INSTRUCTION MANUAL

MAGNETIC FLOWMETERS
10D1475 Design Levels E, P & S

MINI-MAG® MAGNETIC FLOWMETER

PN24456

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

NOTICE

The instructions given herein cover generally the description, installation, operation and maintenance of subject equipment. Fischer & Porter reserves the right to make engineering refinements that may not be reflected in this bulletin. Should any questions arise which may not be answered specifically by these instructions, the questions should be directed to Fischer & Porter for further detailed information and technical assistance. The material in this manual is for informational purposes and is subject to change without notice. Fischer & Porter Company assumes no responsibility for any errors that may appear in this manual.

BAILEY FISCHER & PORTER

SUPPLEMENT TO MAGNETIC FLOWMETER INSTRUCTION BULLETINS 10D1475E,P & S and 10D1476C & P

THIS INFORMATION SUPPLEMENTS INFORMATION CONTAINED IN MAGNETIC FLOWMETER INSTRUCTION BULLETINS 10D1475E,P & S (PN24456) AND 10D1476C & P (PN24453)

1.0 Circuit Description of 10D1475G AND 10D1476G Primaries

Models 10D1475G and 10D1476G wafer flowmeter primaries each have two flux producing coils wired in series and a pair of diametrically opposed electrodes mounted at 90 degrees to the coil flux plane. Meter coils are driven with approximately ±10 volts of pulsed DC. A precision current sensing network is mounted in series with the coils. The current sense network produces what Bailey-Fischer & Porter refers to as a "Reference Voltage", which is typically ±70 millivolts. The reference voltage is directly proportional to the strength of the magnetic field in the measuring tube and must be measured by the signal converter since reference voltage variation also produces a proportional change in electrode signal voltage, assuming a constant flowing velocity.

Flowmeters of the pulsed DC type operate on the principle that unwanted electrode signals occur while the magnetic flux is changing. Accordingly, the signal converters have been designed to sample the electrode voltage only during that portion of the excitation cycle when the magnetic flux is constant. This occurs during the last 25% or 50% of each half cycle, depending on the type of signal converter. Pulsed DC operation of a magmeter system eliminates those variables capable of causing drift of the meter zero point.

The type of signal converter used in the flowmeter system determines the location and configuration of the circuitry used to produce the reference voltage. Further information regarding signal converter operations may be found in their respective instruction bulletins.

2.0 Systems Using The CD-1 Signal Converter

All primaries designed for use with the CD-1 analog signal converter are constructed with a 686B762 connection board beneath the converter module. This connection board serves to interconnect the primary wiring to the converter and also serves to direct converter input/output lines to the customer connection area. A number of configuration jumpers provide selection of certain terminal functions as shown in Table 1.

When used with the CD-1, the current sensing network of the 686B762 is active and produces the converter's reference voltage. The reference network consists of a 0.9 ohm kelvin resistor and a precision adjustable resistive divider network. Adjustment of the divider network changes the magnitude of the reference voltage, thereby forcing the flowmeter system to produce a fixed output for a given size and flow rate (constant meter factor per size).

If the signal converter is integrally mounted, the 686B762 assembly has provisions to bring the 4-20 mA current output, the scaled pulse output, power connections, and zero return inputs to the customer wiring compartment.

If the CD-1 converter is remotely mounted, then a J1 adaptor plug is installed in the ribbon cable connector. Also, the converter power plug is installed in P3. These plugs re-direct coil drive, electrode, and reference voltage signals into the meter's wiring compartment.

TABLE 1. 686B762 BOARD JUMPER FUNCTIONS

JUMPER NUMBER	POSITION	FUNCTION
J1	1-2	ZERO RETURN
J1	3-4	10 KHZ SIGNAL
J1	5-6	REVERSE PULSE SIGNAL
J1	7-8	10 KHZ GROUND, ZERO RETURN
J1	9-10	REVERSE PULSE COMMON
J1	2-4, 8-10	REMOTE CONVERTER
P4	1-2	INTEGRAL CONVERTER
P4	2-3	REMOTE CONVERTER
P5, P6	1-2	M2 MODE
P5, P6	2-3	CD-1, XM1000 MODE

3.0 Systems With M2 Signal Converters

When the flowmeter system is fitted with an integrally mounted M2 microprocessor-based converter, a **686B776** circuit board assembly is installed underneath the converter module. This assembly incorporates the following functional blocks:

- A precision Kelvin current sensing network in series with the coils
- An encapsulated AC coupled buffer preamplifier for each measuring electrode
- An EEPROM for retention of primary span and zero correction factors
- Input/output lines for 4-20 mA current, scaled pulse or data link, contact inputs/outputs (by jumper configuration - Refer to Table 2 and Figure 1)

TABLE 2. 686B776 JUMPER FUNCTIONS

OPTIONAL COMBINATIONS	INPUT/OUTPUT	J1 TERMINALS TO BE CONNECTED
Zero Return / External Totalizer Reset	Input	7-8, 4-6 & 3-5
Alarm / Opto-coupled Scaled Pulse	Output	2-4, 1-3 & 8-10
Forward / Reverse Flow Indication	Output	2-4, 1-3 & 7-9

The resistive divider network which produces a converter reference voltage is similar to the one described previously (see CD-1), but in the case of the M2 converter, the reference voltage is maintained at ±70 mV by the signal converter. This results in approximately 200 mA of constant coil current. The EEPROM is programmed with the mathematical corrections necessary to obtain "constant meter factor per size".

Systems fitted with remotely mounted M2 converters utilize the **686B762** connection board with a remote J1 adaptor. Through use of jumpers P5 and P6, the current sensing network is disconnected from the coils. No reference voltage is produced within this primary type, but rather at the current sense network in inside the remote converter housing (see M2 converter IB). The circuit path to the coils is completed by placing the power connector into P3. Thus, for remote systems using M2 converters, a simplified cabling scheme between primary and secondary consists of a circuit common, a safety ground, two electrode leads, and two coil leads.

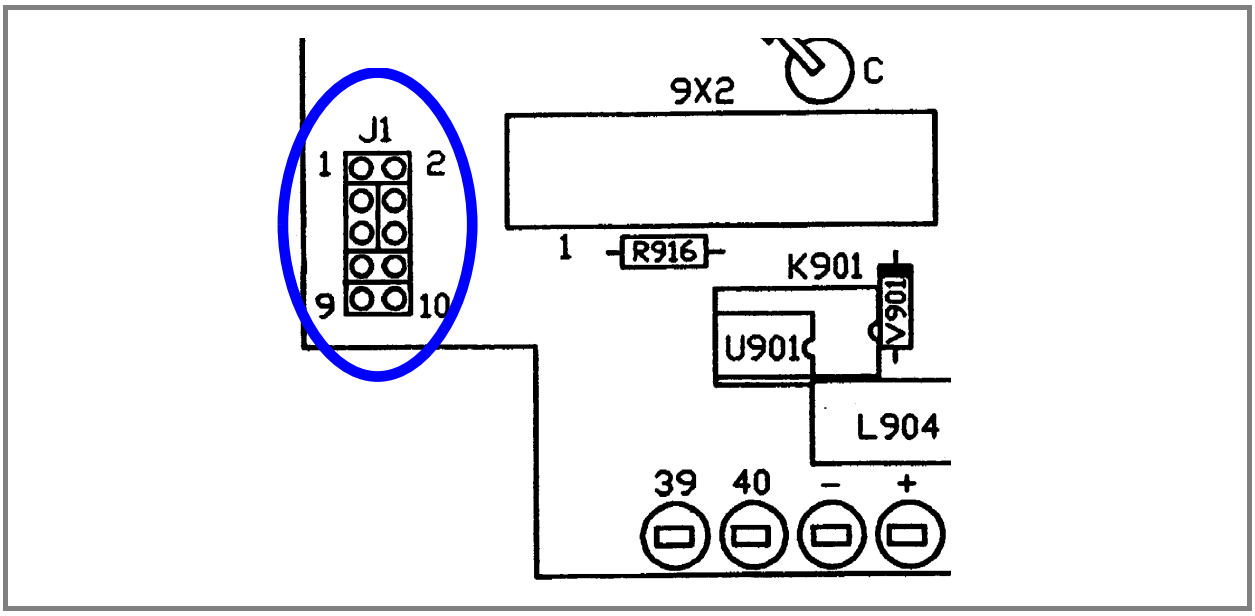

FIGURE 1. JUMPER LOCATIONS FOR 686B776 BOARD

4.0 Coil Resistance Data

Coil winding parameters for size 1-1/2" (1.5") meters differ from those tabulated in the Design Level E Instruction Bulletin. The coil resistance measured between the M1 and MR terminals of the connection board should be 32 ohms, +/-20%.

5.0 Replacement of Primary Printed Circuit Assemblies

The following printed circuit assemblies are **NOT field replaceable**:

- 686B776, used with integral M2
- 686B762*, only the version used with CD-1

The following printed circuit assemblies **may be replaced** without any need for adjustment:

- 686B810, customer connection board
- 686B762, version used with remote mounted M2

* if a constant current source (i.e. Transmation) is available, consult Bailey-Fischer & Porter for detailed replacement instructions.

6.0 Model Numbers

6.1 10D1475G Model Number

10D1475	G	N	__	_	_	2	_	_
Design Level	**G**							
Liner Material								
Tefzel (ETFE)		**N**						
Meter Size - mm (in.)								
3 (1/10)			**01**					
4 (5/32)			**02**					
6 (1/4)			**04**					
10 (3/8			**06**					
15 (1/2)			**07**					
25 (1)			**09**					
40 (1-1/2)			**11**					
50 (2)			**12**					
80 (3)			**14**					
100 (4)			**15**					
Flange Std. / Pressure Rating								
ANSI Class 150				**P**				
ANSI Class 300				**Q**				
BS10 Table D				**S**				
BS10 Table E				**T**				
BS10 Table F				**U**				
DIN PN16				**D**				
DIN PN40				**F**				
Not Required				**X**				
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 SST Tag							**9**	
Safety Classification								
w/o FM Approval, Integral or Remote Converter (General Purpose)								**A**
FM Approved; Primary Flowmeter and remote mounted Signal Converter: Nonincendive for Cl I, Div 2, Gp A, B, C & D: Electrodes Intrinsically Safe for Cl I, Div 1, Gp A, B, C & D:Outdoor Hazardous Locations, NEMA 4X. Integ. Signal Converter enclosure additionally approved: Dust-Ignitionproof Cl II, Div 1, Gp E, F & G: Suitable for Cl III, Div 1; Accidental Submergence, 30 ft H_2O/48 hr (9 m H_2O/48 hr)								**K**

10D1475G Model Number (cont.)

10D1475 G N __ _ _ 2 _ _	–	–	–	–	–	–	–	–	–	–
Power Requirements										
Integral Signal Converter, 220/230/240 VAC, 50/60 Hz	**A**									
110/115/120 VAC, 50/60 Hz	**C**									
48 VAC, 50/60 Hz	**E**									
24 VAC, 50/60 hZ	**F**									
48 VDC	**G**									
24 VDC	**H**									
Remote Converter w/ Separate Model Number	**Y**									
Enclosure Classification										
IEC 529 IP65, NEMA 4X		**1**								
Accidental Submergence, IEC 529 IP67, 30 ft H_2O/48 hr (9 m H_2O/48 hr)		**5**								
Fluid Temperature Range										
Integral Converter to 65°C (149°F)			**1**							
Remote Converter to 121°C (250°F)			**2**							
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**					
Active Scaled Pulse Forward & 10kHz Unscaled Pulse					**7**					
Bailey FSK					**9**					
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**			
Other Frequency (presently not available)							**9**			
Additional Options										
Empty Pipe Detector								**1**		
None								**2**		
HART Protocol & Empty Pipe Detector								**3**		
HART Protocol								**4**		
Mounting Hardware Kit										
Standard Kit: Steel Nuts & Bolts, Centering Device, Klinger Sil C-4401 Gaskets									**C**	
Optional Kit: Steel Nuts & Bolts, Centering Device, Teflon Gaskets									**E**	
Std. Kit Not Required									**X**	
Converter										
Required										**1**
Not Required										**2**

6.2 10D1476G Model Number

10D1476	G	H	__	_	M	2	_	_	_	_	_	_	_	_	_	_	_	_	_
Design Level	**G**																		
Liner Material																			
Ceramic Spool		**H**																	
Meter Size - in. (mm)																			
1 (1/25)			**36**																
2 (1/12)			**37**																
3 (1/10)			**01**																
4 (5/32)			**02**																
6 (1/4)			**04**																
10 (3/8			**06**																
15 (1/2)			**07**																
25 (1)			**09**																
40 (1-1/2)			**11**																
50 (2)			**12**																
80 (3)			**14**																
100 (4)			**15**																
Flange Std./Press. Rating																			
ANSI Class 150				**P**															
ANSI Class 300				**Q**															
BS10 Table D				**S**															
BS10 Table E				**T**															
BS10 Table F				**U**															
DIN PN16				**D**															
DIN PN40				**F**															
Not Required				**X**															
USDA Sanitary Tri-Clamp Fittings				**1**															
Electrode Material																			
Platinum					**M**														
Electrode Type																			
Flush						**2**													
Flange Material																			
Flangeless Design w/ Self-Adhesive Tag							**8**												
Flangeless Design w/ Riveted SST Tag							**9**												
Safety Classification																			
w/o FM Approval, Integral or Remote Converter (General Purpose)								**A**											
FM Approved; Primary Flowmeter and remote mounted Signal Converter: Nonincendive for Cl I, Div 2, Gp A, B, C & D: Electrodes Intrinsically Safe for Cl I, Div 1, Gp A, B, C & D:Outdoor Hazardous Locations, NEMA 4X. Integ. Signal Converter enclosure additionally approved: Dust-Ignitionproof Cl II, Div 1, Gp E, F & G: Suitable for Cl III, Div 1; Accidental Submergence, 30 ft H_2O/48 hr (9 m H_2O/48 hr)								**K**											
USDA Approved Meat & Poultry Equipment								**N**											

10D1476 G H __ _ M 2 _ _	–	–	–	–	–	–	–	–	–	–
Power Requirements										
Integral Signal Converter, 220/230/240 VAC, 50/60 Hz	**A**									
110/115/120 VAC, 50/60 Hz	**C**									
48 VAC, 50/60 Hz	**E**									
24 VAC, 50/60 hZ	**F**									
48 VDC	**G**									
24 VDC	**H**									
Remote Converter w/ Separate Model Number	**Y**									
Enclosure Classification										
IEC 529 IP65, NEMA 4X		**1**								
Accidental Submergence, IEC 529 IP67, 30 ft H_2O/48 hr (9 m H_2O/48 hr)		**5**								
Brewery Design (NEMA 4X)		**8**								
Fluid Temperature Range										
Integral Converter to 65°C (149°F)			**1**							
Remote Converter to 180°C (356°F)			**3**							
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**					
Active Scaled Pulse Forward & 10kHz Unscaled Pulse					**7**					
Bailey FSK					**9**					
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**			
Other Frequency (presently not available)							**9**			
Additional Options										
Empty Pipe Detector								**1**		
None								**2**		
HART Protocol & Empty Pipe Detector								**3**		
HART Protocol								**4**		
Mounting Hardware Kit										
Standard Kit: Steel Nuts & Bolts, Centering Device, Klinger Sil C-4401 Gaskets									**C**	
Optional Kit: Steel Nuts & Bolts, Centering Device, Gylon Style 3500 (Fawn) Gaskets									**D**	
Std. Kit Not Required									**X**	
Converter										
Required										**1**
Not Required										**2**

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READ FIRST

This revision of Instruction Bulletin 10D1475 replaces Pub. No. 24332. The purpose of this revision is to update the grounding information in Section 2.4 and the parts lists in Section 7.0.

WARNING

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

NEMA 4X, Corrosion Resistant Finish

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 Fischer & Porter representative to obtain the correct touch-up paint.

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

1.0 INTRODUCTION

1.1 General

The Fischer & Porter 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.

1/2" (13 mm)
METER SHOWN

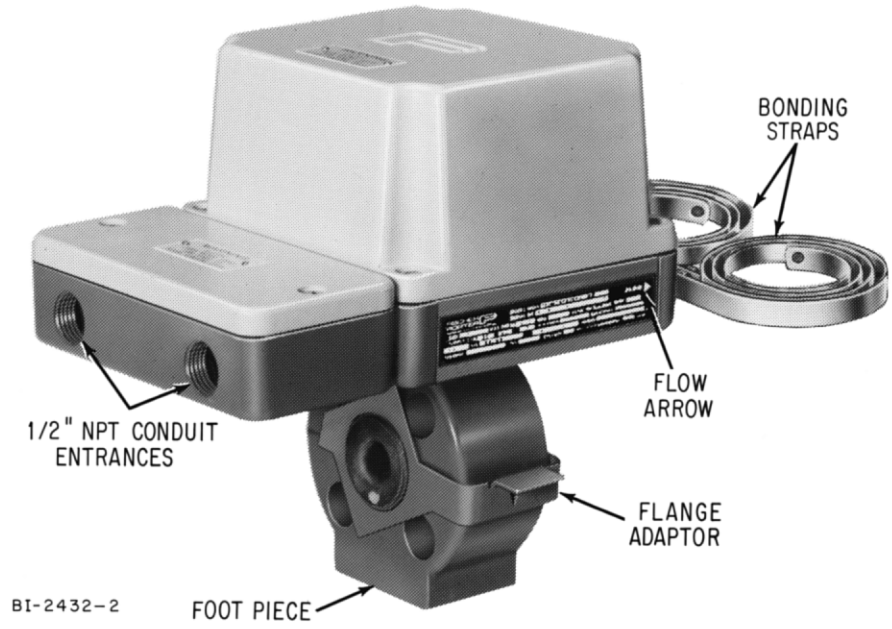


FIGURE 1-1. TYPICAL FLOWMETER

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 either a TEFZEL® (ETFE) or TEFLON® (PFA) 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 and is shown in Figure 1-1.

The associated electronics package is called the Signal Converter and may be either integrally or remotely mounted. A typical MINI-MAG Magnetic Flowmeter is shown in Figure 1-1. Figures 1-2 and 1-3 show the electronic housing with and without the integral Signal Converter. The Flowmeter without the electronic package is used with a remote Signal Converter. A remote mounted Signal Converter is recommended if 1) the vibration specification is exceeded and/or 2) the process liquid temperature exceeds the value given for that ambient temperature listed in the specifications.

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 detail, refer to Section 4.0 Functional Description.

FIGURE 1-2. ELECTRONICS COMPARTMENT WITHOUT SIGNAL CONVERTER

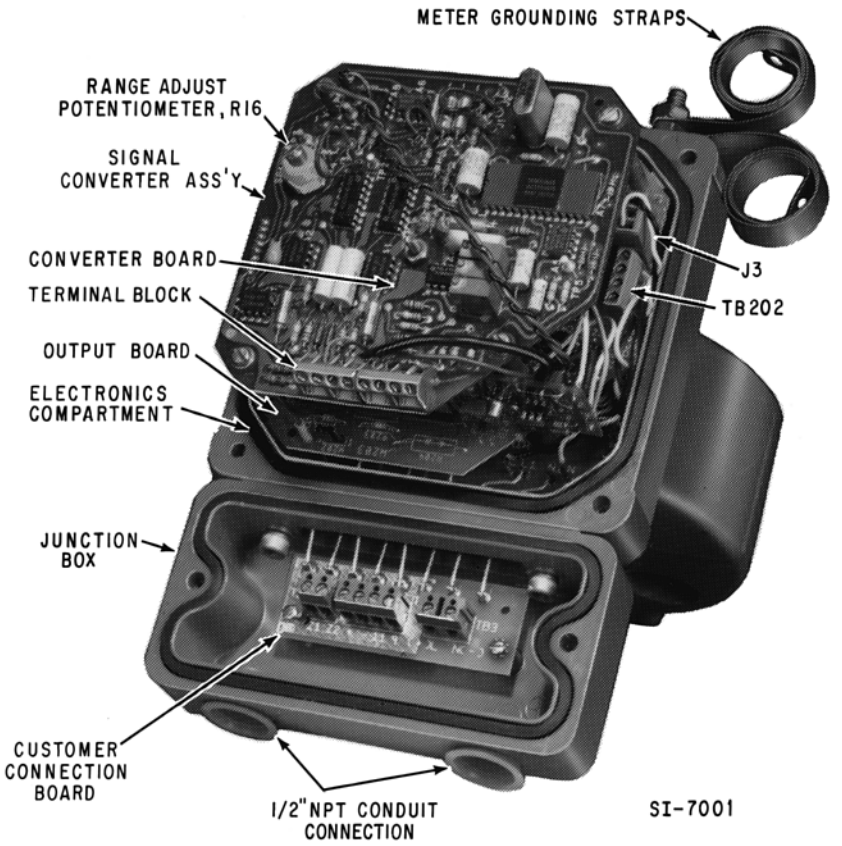
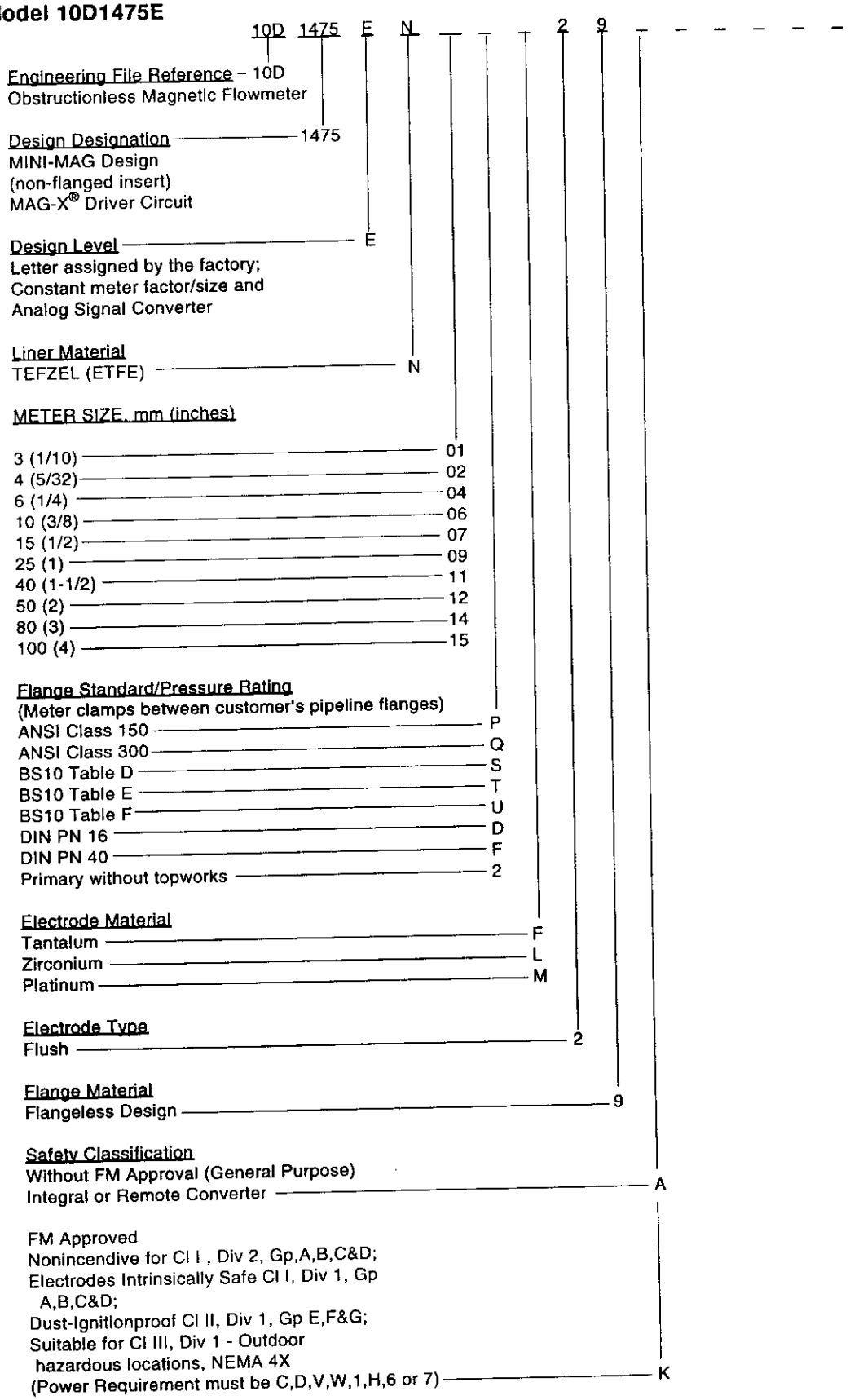


FIGURE 1-3. ELECTRONICS COMPARTMENT WITH ANALOG SIGNAL CONVERTER

1.2 Model Number Breakdown

Refer to the F&P data sheet or the data tag on the equipment for the model number of the instrument furnished. The details of a specific number are as follows:

1.2.1 Model 10D1475E



1.2.1 Model 10D1475E (continued)

10D 1475 E N _ _ _ 2 9

FM Approved -
***Primary:
Suitable for Cl I, Div 1, Gp B,C&D;
Dust-Ignitionproof Cl II, Div 1, Gp E,F&G;
Suitable for Cl III, Div 1
Outdoor Hazardous Location, NEMA 4X;
Signal Converter:
Nonincendive for Cl I, Div 2, Gp A,B,C&D
Dust-Ignitionproof Cl II, Div 1, Gp E,F&G;
Suitable for Cl III, Div 1
Outdoor Hazardous Location, NEMA 4X; — L

FM Approved -
***Primary:
Suitable for Cl I, Div 1, Gp B,C&D;
Dust-Ignitionproof Cl II, Div 1, Gp, E,F&G;
Suitable for Cl III, Div 1
Outdoor Hazardous Location, NEMA 4X;
Signal Converter:
Explosionproof for Cl I, Div 1, Gp C&D;
Dust-Ignitionproof Cl II, Div 1, Gp, E,F&G;
Suitable for Cl III, Div 1
Outdoor Hazardous Location, NEMA 4X; — M

Power Requirement

Signal Converter Integral Mounted		Signal Converter Remote Mounted	
220 V ac, 50 Hz	A	220 V ac, 50 Hz	R
220 V ac, 60 Hz	B	220 V ac, 60 Hz	S
120 V ac, 50 Hz	C	240 V ac, 50 Hz	T
120 V ac, 60 Hz	D	240 V ac, 60 Hz	U
240 V ac, 50 Hz	K	120 V ac, 50 Hz	V
240 V ac, 60 Hz	L	120 V ac, 60 Hz	W
12 V dc	1	12 V dc	6
24 V dc	H	24 V dc	7
Remote Converter with separate Model Number			Y

Enclosure Classification
IEC 529 IP 65, NEMA 4X — 1
Accidental submergence, IEC 529 IP 67
30 ft H_2O/48 h (9 m H_2O/48 h) — 5

Liquid Temperature Range
Integral Converter To 80°C (175°F) — 1
Remote Converter To 121°C (250°F) — 2
NOTE: See Process Limits under 1.3 Specifications for allowable combinations of liquid and ambient temperature at flowmeter.

Output Signal
No Output Signal Required — A
0-20 mA dc — B
4-20 mA dc — C
0-1 kHz pulse (not available when Scaler option is specified) — G
+4-20 mA dc with direct reading indicator (3-1/2 digit LCD) — K

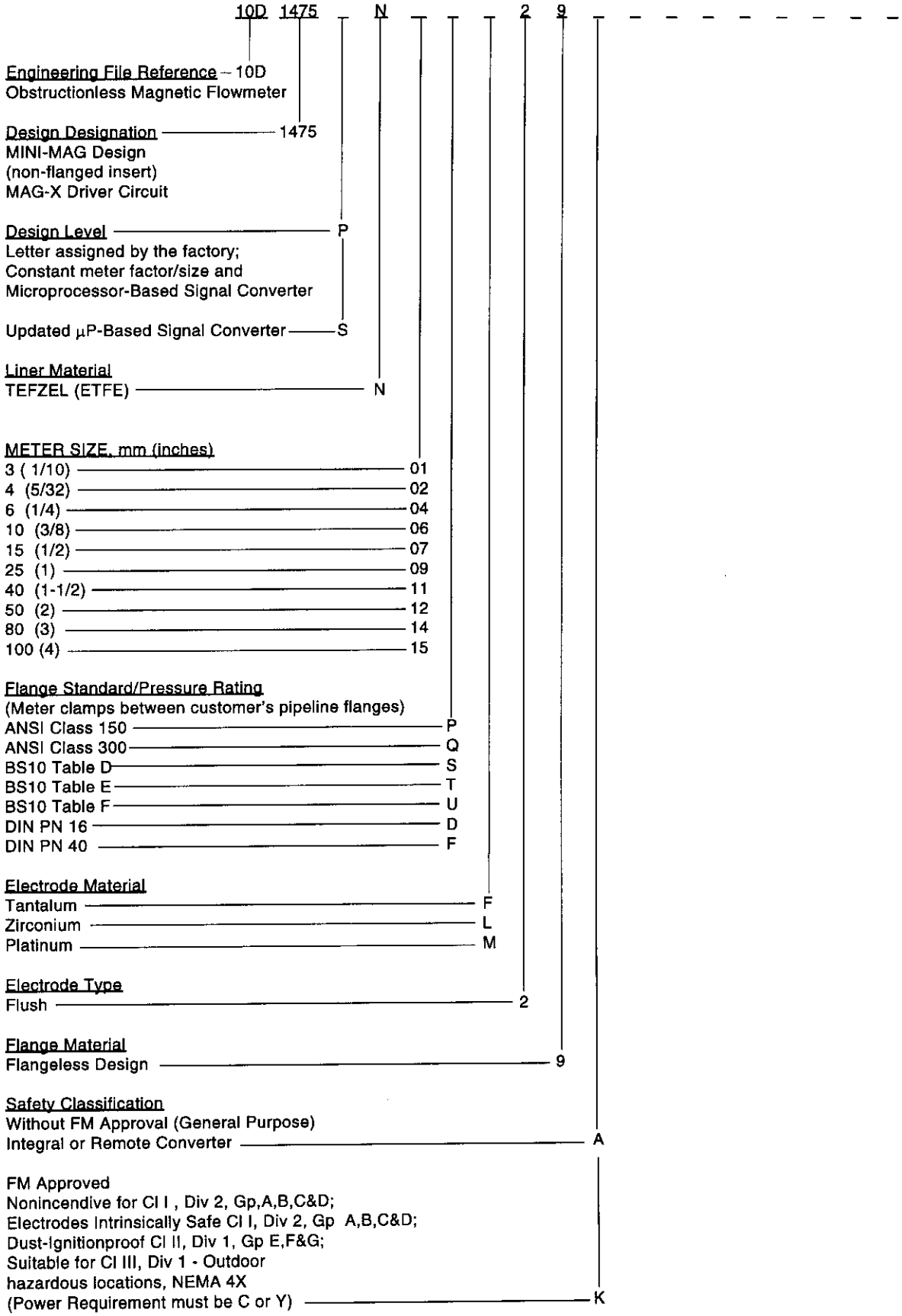
Scaler
No scaled output required — A
Isolated Scaled Freqency Output
50 ms pulse, 10 Hz max, Opto coupled — B
Isolated Scaled Frequency Output
50 µs pulse, 10 kHz max, Opto coupled — C

*** Safety Classification options L and M are not available with constant meter factor/size. These options have individual meter factors determined by calibration.

+ When supplied with integrally mounted Converter, Enclosure Classification must be "1" and Safety Classification must be "A" or "K".

1.2 Model Number (continued)

1.2.2 Model 10D1475P/S



1.2.2 Model 10D1475P/S (continued)

10D 1475 _ N _ _ _ 2 9 _ _ _ _ _ _ _ _

Power Requirement
Signal Converter Integral Mounted
240 V ac, 50/60 Hz — A
220 V ac, 50/60 Hz — B
120 V ac, 50/60 Hz — C
110 V ac, 50/60 Hz — D
24 V dc — H

Remote Converter with separate Model Number — Y

Enclosure Classification
IEC 529 IP 65, NEMA 4X — 1
Accidental submergence, IEC 529 IP 67
30 ft H_2O/48 h (9 m H_2O/48 h) — 5

Liquid Temperature Range
Integral Converter to 65°C (149°F) — 1
Remote Converter to 121°C (250°F) — 2
NOTE; See Process Limits under 1.3 Specifications for allowable combination of liquid and ambient temperature at flowmeter.

Output Current
No Output Signal Required — A
4-20 mA dc — C

Output Options
No Scaled Output Required — 1
#Active Scaled Pulse Forward and Zero Return — 2
#Active Scaled Pulse Forward and Reverse — 4
Data Link RS 232C — 5
Data Link RS 485 — 6
#Active Scaled Pulse Forward and 10 kHz Unscaled Pulse — 7

Communication Mode Over Data Link
Not applicable — 1
ASCII — 2
MICRO-DCI™ Binary — 3
HART® Protocol — 4

Coil Drive Frequency
7-1/2 Hz (60 Hz) — 1
15 Hz (60 Hz) — 2
+DC 15 Hz (@60 Hz Line Frequency) — 3

Additional Options
None — 2
++HART Protocol — 3

4 kHz max pulse configurable from .032 ms to 2000 ms.
+ Must be approved by Product Manager.
++ Communications Mode must be "4", Output Options can be "1", "2","4" or "7".

1.3 Specifications

Power Requirements — See Section 1.2 Model Number Breakdown

Power Consumption — Refer to Signal Converter Instruction Bulletin,
Typically, 10D1475E .....<15 VA
10D1475P/S...< 23 VA

Flowmeter Characteristics

Meter Size/Flow Capacity — See Table 1-1

Span — Factory set at specified range between extremes listed in Table 1-1; can be field adjusted.

Rangeability — 100:1

Minimum Liquid Conductivity — 5 μS/cm

System Accuracy

Model 10D1475E

	Flowrate	Accuracy
Analog Output*	**< 10%**	**± 0.2% fsc**
	≥ 10%	**± 1.0% of rate +0.1% fsc**
Frequency Output*	**< 10%**	**± 0.1% fsc**
	≥ 10%	**± 1.0% of rate**

* For Converters with dc power input add ± 0.03 ft/s (± 0.01m/s) to tabulated accuracy values. This number corresponds to 0.1% of meter calibration factor.

Model 10D1475P/S

	Flowrate	Accuracy
Frequency Output	**< 2% Cal Factor**	**± 0.01% Cal Factor**
	≥ 2% Cal Factor	**± 0.5% of rate**

RFI Protection — **Class 2-abc-0.1% (10 V/m-20 to 1000 MHz) Per SAMA Standard PMC 33.1-1978. Standard with integral Converters; not available with remote Converters.**

Environmental Limits

Enclosure Classification with or without Signal Converter — NEMA 4X, IEC 529 IP65

Accidental Submergence — IEC 529 IP67, 30 feet H_2O/48 h (9 m H_2O /48 h)

Environmental Temperature Limits

	10D1475E	10D1475P/S
Remote Converter	-40 to 150° F (-40 to 65° C)	-40 to 150° F) (-40 to 65° C)
Integral Converter	-40 to 150° F (-40 to 65° C)	14 to 131° F (-10 to 55° C)

PROCESS LIMITS
Temperature Limits, Process Liquid

Model 10D1475E

Ambient Temp		Max Liquid Temp	
° F	° C	° F	° C
32	0	266	130
68	20	230	110
95	35	203	95
113	45	185	85
122	50	176	80
140	60	158	70
149	65	149	65

Model 10D1475P/S

Ambient Temp		Max Liquid Temp	
° F	° C	° F	° C
32	0	250	121
50	10	230	110
68	20	212	100
86	30	194	90
104	40	176	80
122	50	158	70
131	55	149	65

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

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

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 Calibration Factor — specified on Flowmeter data tag (equal to max flow capacity in engineering units). This factor is equivalent to a flow velocity of 33.33 ft/s in the metering tube.

Physical Characteristics

Outline Dimensions Magnetic Flowmeter with or without integral Signal Converter

- 1/10 - 1-1/2 in. (3 - 40 mm) — See Figure 2-1
- 2 - 4 in. (50 - 100 mm) — See Figure 2-2

Remotely Mounted Signal Converter — Refer to Signal Converter Instruction Bulletin

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

Meter Weight

- Magnetic Flowmeter with integral Signal Converter — See Table 1-2
- Remotely Mounted Signal Converter — Refer to Signal Converter Instruction Bulletin

Signal Converter 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:	
1/10 - 4 in. (3 - 100 mm)	TEFZEL (ETFE)
Electrode Assemblies	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	See Section 1.2

TABLE 1-1. CAL FACTOR AND CAPACITY

NOTE
The CAL FACTORS given below can only be used with Model 10D1475-D,E,M,N,P & S. For meters manufactured under design levels A - C, refer to the meter data tag for the appropriate factor.

			Flow Ranges 0 to value tabulated					
Meter Size		CAL FACTOR*	Minimum 10D1475E		Minimum 10D1475M,N,P & S		Maximum	
inch	mm	gpm	gpm	lpm	gpm	lpm	gpm	lpm
1/10	3	1.073	0.096	0.40	0.054	0.20	1.20	4.00
5/32	4	2.147	0.192	0.80	0.108	0.40	2.40	8.00
1/4	6	5.367	0.480	2.00	0.270	1.00	6.00	20.0
3/8	10	12.08	1.08	4.50	0.605	2.25	13.5	45.0
1/2	15	26.84	2.40	10.0	1.35	5.0	30.0	100.
1	25	53.67	4.80	20.0	2.70	10.0	60.0	200.
1 1/2	40	161.0	14.4	60.0	8.10	30.0	180.	600.
				m^3/h		m^3/h		m^3/h
2	50	268.4	24.0	6.0	13.5	3.0	300.	60.
3	80	805.1	72.0	18.0	40.5	9.0	900.	180.
4	100	1073.0	96.0	24.0	53.7	12.0	1200	240.

* Flow Velocity (ft/s) = (Operating GPM x 33.33)/CAL FACTOR

TABLE 1-2. METER WEIGHTS

Meter Size		Weight	
inch	mm	pounds	kilograms
1/10	3	9	4
5/32	4	9	4
1/4	6	9	4
3/8	10	9	4
1/2	15	9	4
1	25	11	5
1 1/2	40	18	8
2	50	13	6
3	80	20	9
4	100	31	14

2.0 INSTALLATION

2.1 Inspection

All F&P 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:

1. Magnetic Flowmeter with integrally mounted Signal Converter and appropriate mounting hardware kit, or,
2. 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 and appropriate flange adaptor components, if specified.

> NOTE
> The centering device (see Figure 2-4) or adaptor sleeves (see Figure 2-5) required for the particular meter installation are supplied by F&P 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 30 feet (of water) depths for up to 48 hours.

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 Flowmeter are given in Figures 2-1 and 2-2. When applicable, provide access for occasional servicing of the integrally mounted Signal Converter. At least 5" overhead clearance is required for cover removal. Observe the various clearances given on the drawing. The cover is removable from the front for servicing of the electronics; provide adequate working space. When a remote mounted Signal Converter is specified, 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 12 or 24 V dc or 120 V ac, 50/60 Hz (220/240 V ac, 50/60 Hz optional) single phase line power. The power source must have an external disconnect and suitable fuse (or circuit breaker), as shown on the interconnection diagram.

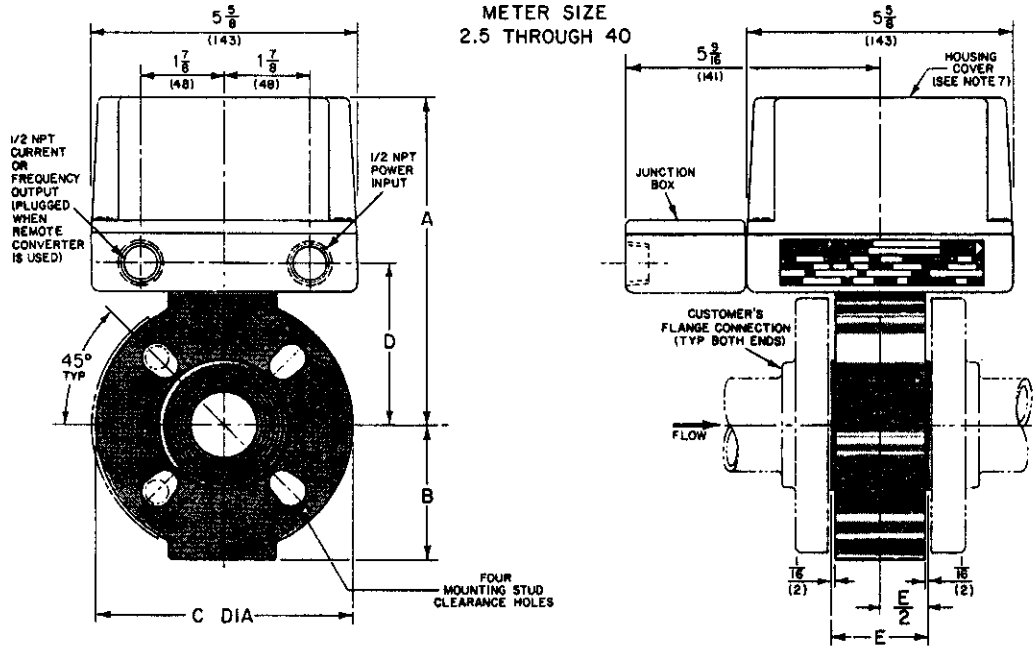


TABLE OF DIMENSIONS

METER SIZE		FLANGE SIZE		CUSTOMER FLANGE TYPE AND RATING	A*		B		C DIA		D		E	
INCH	mm	IN.	mm		INCH	mm	INCH	mm	INCH	mm	INCH	mm	INCH	mm
1/10	3	1/2	15	ANSI 150 300 & 600 BS 10 TBL D,E,F DIN PN 10, 16, 25 & 40	6 1/4	159	2 1/32	52	3 3/4	95	2 9/16	65	2 5/32	55
5/32	4													
1/4	6													
3/8	10													
1/2	15													
1	25	1	25		6 13/16	173	2 19/32	66	4 7/8	124	3 1/8	79	2 5/32	55
1 1/2	40	1 1/2	40		7 1/2	191	3 9/32	83	6 1/8	156	3 13/16	97	2 3/4	70

NOTES

1. DIMENSIONS ARE IN INCHES AND MILLIMETERS (mm).
2. DIMENSIONS PROVIDED FOR REFERENCE ONLY.
3. ALL DIMENSIONS SUBJECT TO MANUFACTURING TOLERANCE OF ± 1/8 INCH (3 mm).
4. METER MUST BE COMPLETELY FILLED WITH LIQUID TO ENSURE ACCURACY.
5. FLOW MUST BE IN SAME DIRECTION AS FLOW ARROW. 1/2 NPT CONDUIT CONNECTION IN METER HOUSING IDENTIFIES "UPSTREAM" FLANGE FACE.
6. METER MOUNTS BETWEEN CUSTOMER'S PIPELINE FLANGES; TYPES AND RATINGS LISTED IN TABLE OF DIMENSIONS.
7. CLEARANCE REQUIRED TO REMOVE COVER IS 5 IN. (127).

* ADD 1/4" (6 mm) TO DIMENSION "A" WHEN HOUSING COVER WITH WINDOW IS SUPPLIED.

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FIGURE 2-1. OUTLINE DIMENSIONS OF 3-40 mm (1/10 - 1-1/2") FLOWMETER WITH OR WITHOUT SIGNAL CONVERTER

2.3 Mounting

2.3.1 Meter Orientation

The F&P 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.

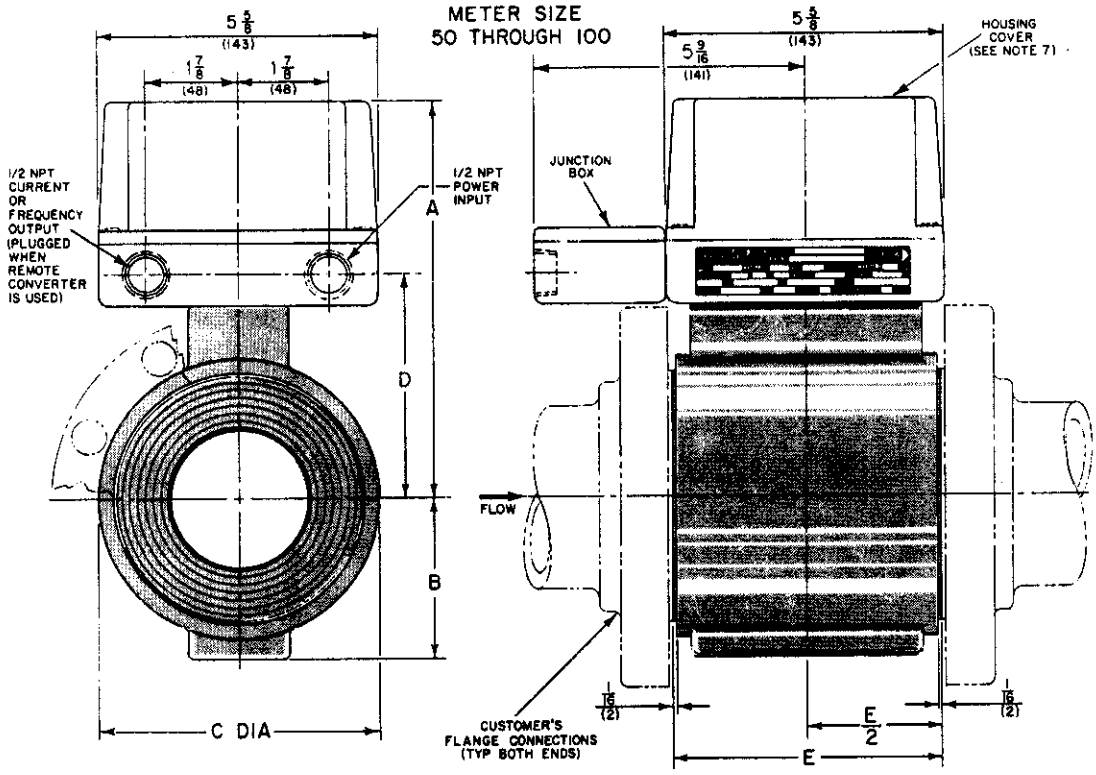


TABLE OF DIMENSIONS

METER AND FLANGE SIZES		CUSTOMER FLANGE TYPE AND RATING	A‡		B		C DIA		D		E	
INCH	mm		INCH	mm	INCH	mm	INCH	mm	INCH	mm	INCH	mm
2	50	ANSI 150 ANSI 300 BS 10 TBL D,E,F DIN PN 10, 16, 25, & 40	8	203	2 7/16	62	3 7/8	98	4 5/16	110	3 11/32	85
3	80		8 11/16	221	3 3/16	81	5 1/8	130	4 31/32	126	4 23/32	120
4	100		9 3/8	238	3 11/16	94	6 3/8	162	5 11/16	144	5 29/32	150

NOTES

1. DIMENSIONS ARE IN INCHES AND MILLIMETERS (mm).
2. DIMENSIONS PROVIDED FOR REFERENCE ONLY.
3. ALL DIMENSIONS SUBJECT TO MANUFACTURING TOLERANCE OF ±1/8 INCH (3mm).
4. METER MUST BE COMPLETELY FILLED WITH LIQUID TO ENSURE ACCURACY.
5. FLOW MUST BE IN SAME DIRECTION AS FLOW ARROW. 1/2 NPT CONDUIT CONNECTION IN METER HOUSING IDENTIFIES "UPSTREAM" FLANGE FACE.
6. METER MOUNTS BETWEEN CUSTOMER'S PIPELINE FLANGES; TYPES AND RATINGS LISTED IN TABLE OF DIMENSIONS.
7. CLEARANCE REQUIRED TO REMOVE COVER IS 5 IN. (127).

‡ ADD 1/4" (6 mm) TO DIMENSION "A" WHEN HOUSING COVER WITH WINDOW IS SUPPLIED.

812357-3

FIGURE 2-2. OUTLINE DIMENSIONS OF 50-100 mm (2-4") FLOWMETER WITH OR WITHOUT SIGNAL CONVERTER

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 .5 g, 14-200 Hz. 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 2-3. For higher accuracy requirements, use twice the number of pipe diameters referenced. See Figure 2-3 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. During shipment, the TEFLON liner of the 1/2 through 4 inch (15-100 mm)size meters is protected by liner protector plates that cover the meter ends. Remove the liner protector plates at the time of installation. Do not pass any rope or wire sling through the meter liner.

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 included with the meter.

The Magnetic Flowmeter is supplied in one of two basic body designs, depending upon meter size. For example, 1/10 - 1-1/2 inch (3 - 40 mm) size meters have clearance holes provided in the meter body for through-bolt mounting, while 2 - 4 inch (50 - 100 mm) size meter bodies mount in a cradle formed by the mounting studs (and adaptor sleeves, if required) used for that particular 4-bolt or 8-bolt flange pattern. Typical mounting arrangements are illustrated in Figures 2-4 and 2-5. 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 incre-

ments around the flange surface. It is recommended that an open end wrench with a handle length no greater than 8 inches be used for tightening the nuts; i.e., torque should be limited to that which will produce a positive seal without damage to the face of the meter lining.

The flange gaskets supplied with the meter are the proper size for the flange 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.

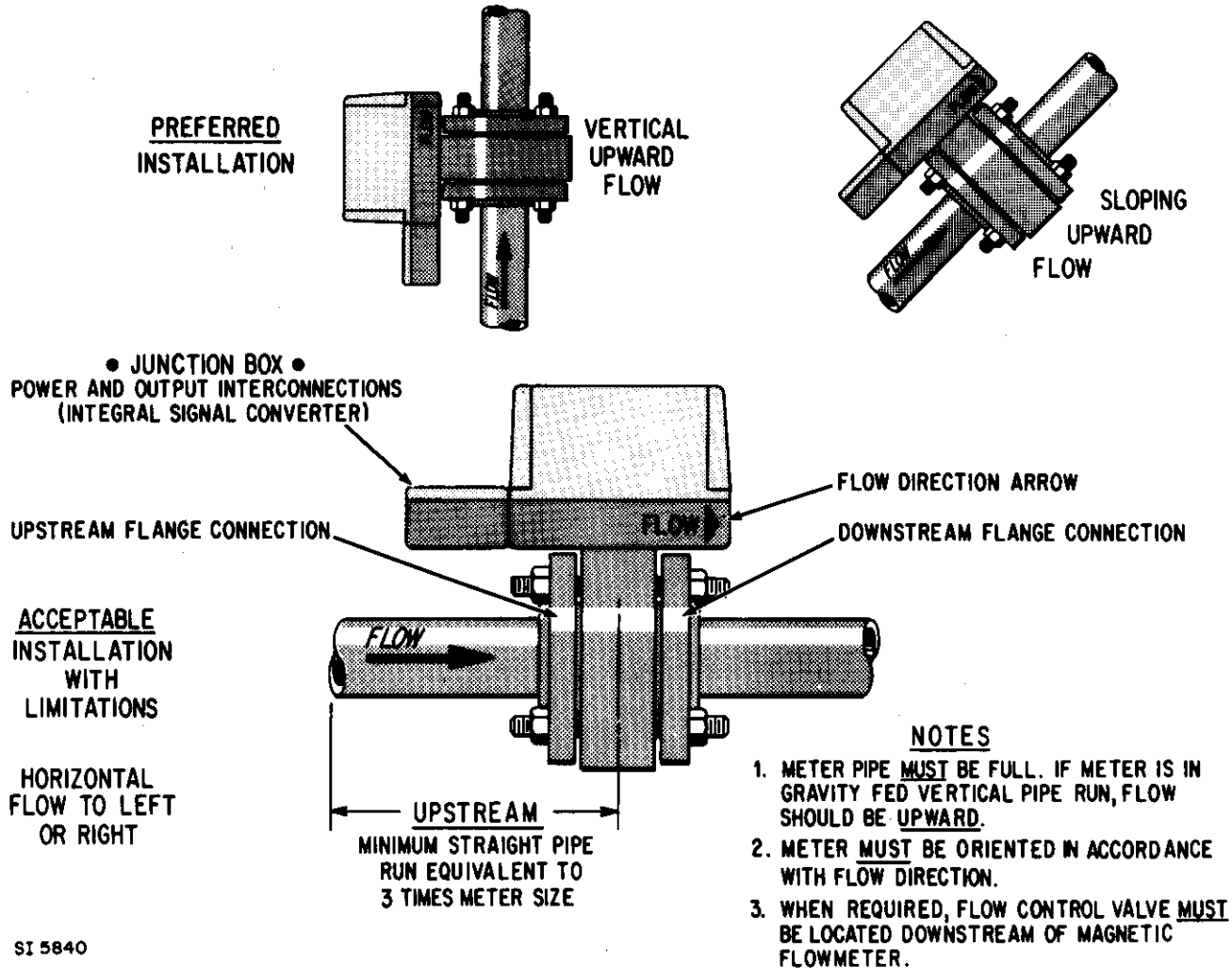


FIGURE 2-3. RECOMMENDED PIPING ARRANGEMENT

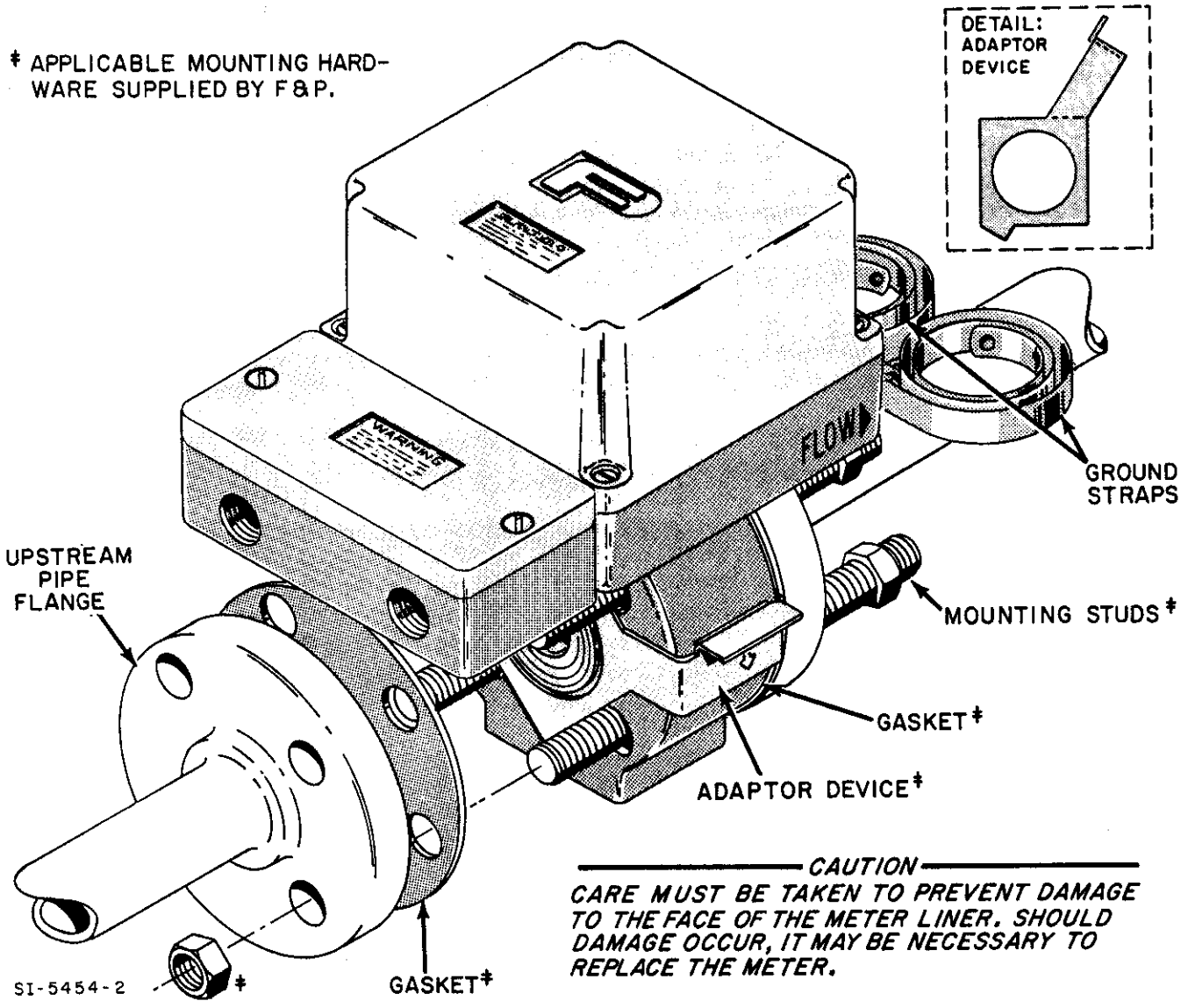


FIGURE 2-4. MOUNTING DIAGRAM FOR 3 - 40 mm (1/10 - 1-1/2") SIZES

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

2.3.4 Basic Mounting Procedure

Select the procedure below that is applicable for the size meter supplied.

1/10 - 1-1/2 inch (3 - 40 mm) Meter Sizes

Refer to Figures 2-1 and 2-4 to supplement the following procedure.

1. Remove the liner protector plates from the meter inlet and outlet ends.

2. Install flange adaptor on meter as shown in Figure 2-4. Align the flange adaptor device (supplied with meter) so that the mounting stud clearance holes in the meter body are not obstructed.

3. Place one of the flange gaskets next to the upstream (typical) pipe flange; so that the gasket will be between the pipe flange and the meter body.

4. Insert meter in pipeline in accordance with the flow direction arrow. Next, while supporting the meter, insert one, or more, of the mounting studs through the clearance holes in the upstream pipe flange and gasket, so that these studs enter the holes in the meter body. This will help support the meter.

5. Insert the other (downstream) gasket between the meter outlet and the downstream pipe flange. The mounting studs can then be guided through the clearance holes in the downstream gasket and pipe flange. Similarly, insert the remaining mounting studs through the clearance holes provided.

6. Thread nuts on both ends of the four mounting studs, finger-tight.

7. To center the Magnetic Flowmeter with the longitudinal axis of the pipeline, press down firmly on the flange adaptor. This will force-spread the mounting studs, thereby centering the meter body (and gasket). Press down until nuts have been sufficiently tightened to prevent movement of meter relative to the flanges.

8. Tighten the stud nuts in even increments to produce even pressure distribution around the respective flanges. Bolt torque should be limited to that which is sufficient to produce a positive seal for the application.

2 - 4 inch (50 - 100 mm) Meter Sizes

Refer to Figures 2-2 and 2-5 to supplement the following procedure.

1. Remove the liner protector plates from the meter inlet and outlet ends.

2. Insert both of the two lower mounting studs (see Figure 2-5, Detail "I" 4-Bolt Flange, or Detail "II" 8-Bolt Flange, as applicable) 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 type BS 10 - Table D or E flanges in 50 - 100 mm sizes, or for DIN PN 10/16 in 100 mm size.

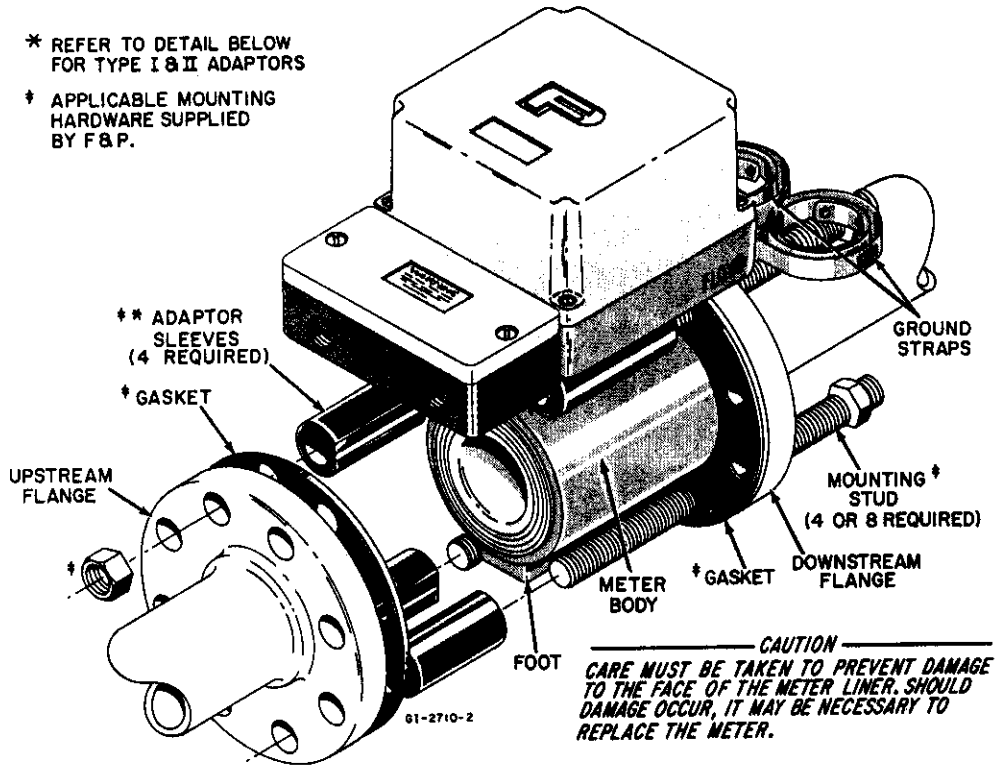
5. Place the MINI-MAG Magnetic Flowmeter between the two flange gaskets, with the meter body foot piece (opposite the neck) being seated between the two adaptor sleeves. The meter must be oriented in accordance with the flow direction arrow.

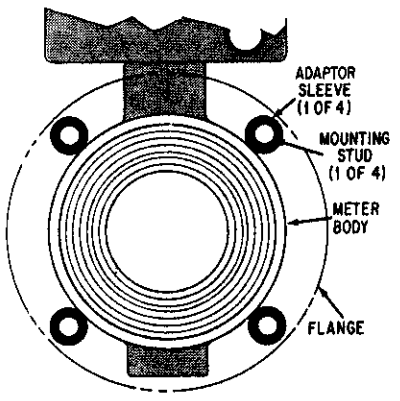
Note
In pipelines with 8-bolt flange patterns (Figure 2-5, Detail "II") the adaptor sleeves required (Type II) have a "flat" machined surface with a color strip. This flat surface must face the flat part of the meter body to permit the meter to be seated properly. Refer to figure 2-5..

6. Install the two upper mounting studs and adaptor sleeves as shown in Figure 2-5. 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.

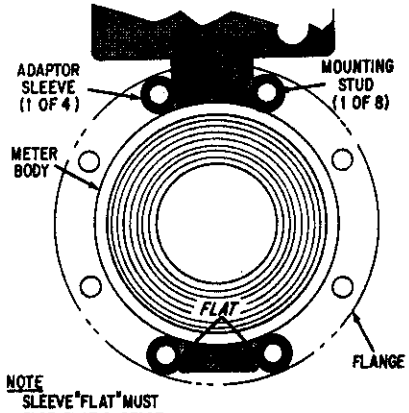
7. Thread nuts on both ends of the 4 (or 8) mounting studs, finger-tight.

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 an alternate pattern (e.g., 1-3, 2-4) and in even increments; to produce an even pressure distribution around the flange faces. Bolt torque should be limited to that sufficient to produce a positive seal for the application.





4-BOLT FLANGE PATTERN
(ADAPTOR SLEEVE, TYPE I)



NOTE
SLEEVE "FLAT" MUST FACE FLAT SURFACE ON METER BODY

8-BOLT FLANGE PATTERN
(ADAPTOR SLEEVE, TYPE II)

DETAIL - TYPE I SLEEVE

GI-2711-1

DETAIL - TYPE II SLEEVE

TYPE I ADAPTOR SLEEVES

METER SIZE	FLANGE RATING	COLOR CODE	†P/N
2-INCH (50mm)	ANSI CLASS 150	BLUE	U01
3-INCH (80mm)	ANSI CLASS 150	BLUE	U02
2-INCH (50mm)	BS 10"F" & DIN 10-40	GREEN	U03
TYPE II ADAPTOR SLEEVES			
2-INCH (50mm)	ANSI CLASS 300	YELLOW	U04
3-INCH (80mm)	DIN 10-40	YELLOW	U05
4-INCH (100mm)	ANSI 150 & BS 10 "F"	YELLOW	U06
3-INCH (80mm)	ANSI 300 & BS 10 "F"	RED	U07
4-INCH (100mm)	ANSI 300	RED	U08
4-INCH (100mm)	DIN 25-40	WHITE	U09

†F&P PART No. 430E013___ (ADD U0_ FROM TABLE TO COMPLETE PART No.

NOTE: ADAPTOR SLEEVES ARE NOT REQUIRED FOR BS 10 TABLES D & E, 2", 3" AND 4" SIZES; OR FOR DIN 100 PN 10/16

FIGURE 2-5. MOUNTING DIAGRAM FOR 50 - 100 mm (2 - 4") SIZES

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 Paragraphs 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 2-6 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 2-6 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.)

2.4.3 Non-Conductive or Insulated Pipeline

For the F&P 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 2-7 and 2-8 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 7-1 and 7-2. 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 F&P).

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.

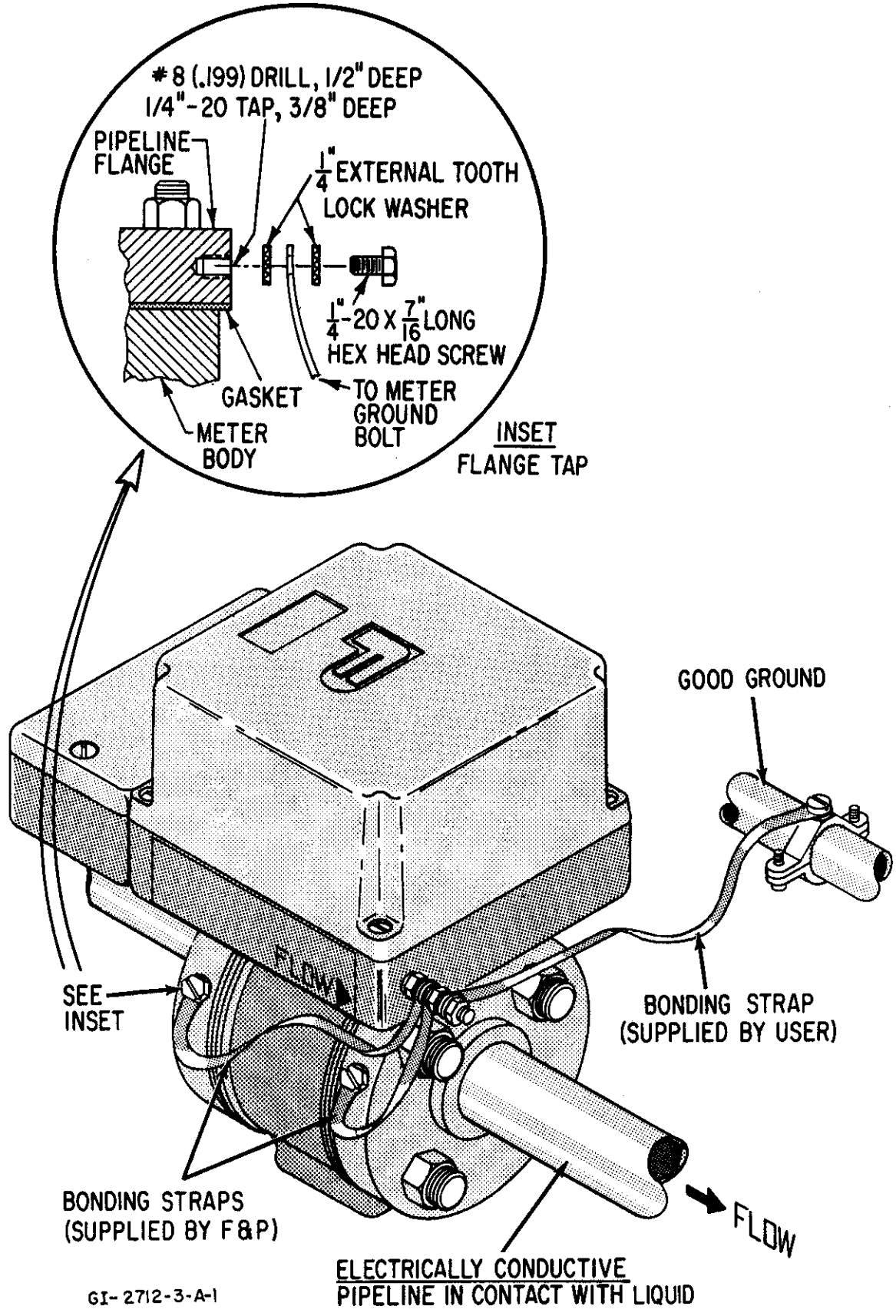
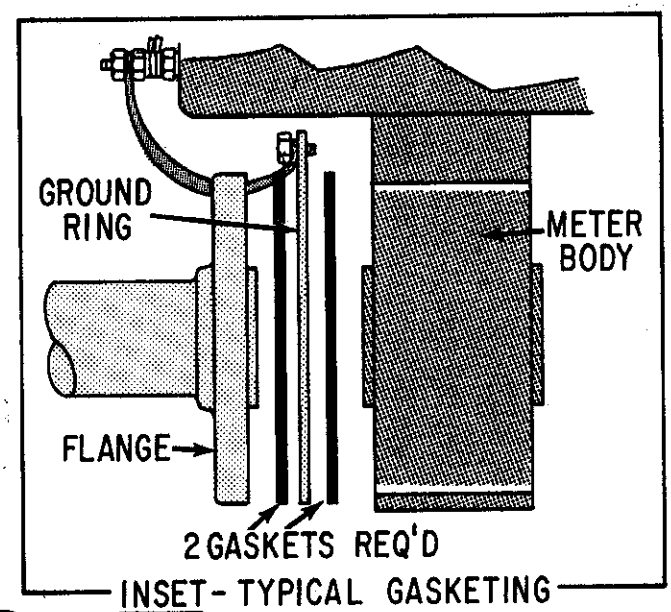


FIGURE 2-6. GROUNDING PROCEDURE, CONDUCTIVE PIPE

NOTE:
METAL RING IN CONTACT WITH LIQUID (SUPPLIED BY USER). A QUANTITY OF 4 GASKETS ARE NEEDED FOR PROPER INSTALLATION OF THE 2 GROUNDING RINGS REQUIRED (SEE INSET). WHEN THE GROUNDING RINGS ARE PURCHASED FROM F&P, GASKETS ARE SUPPLIED.



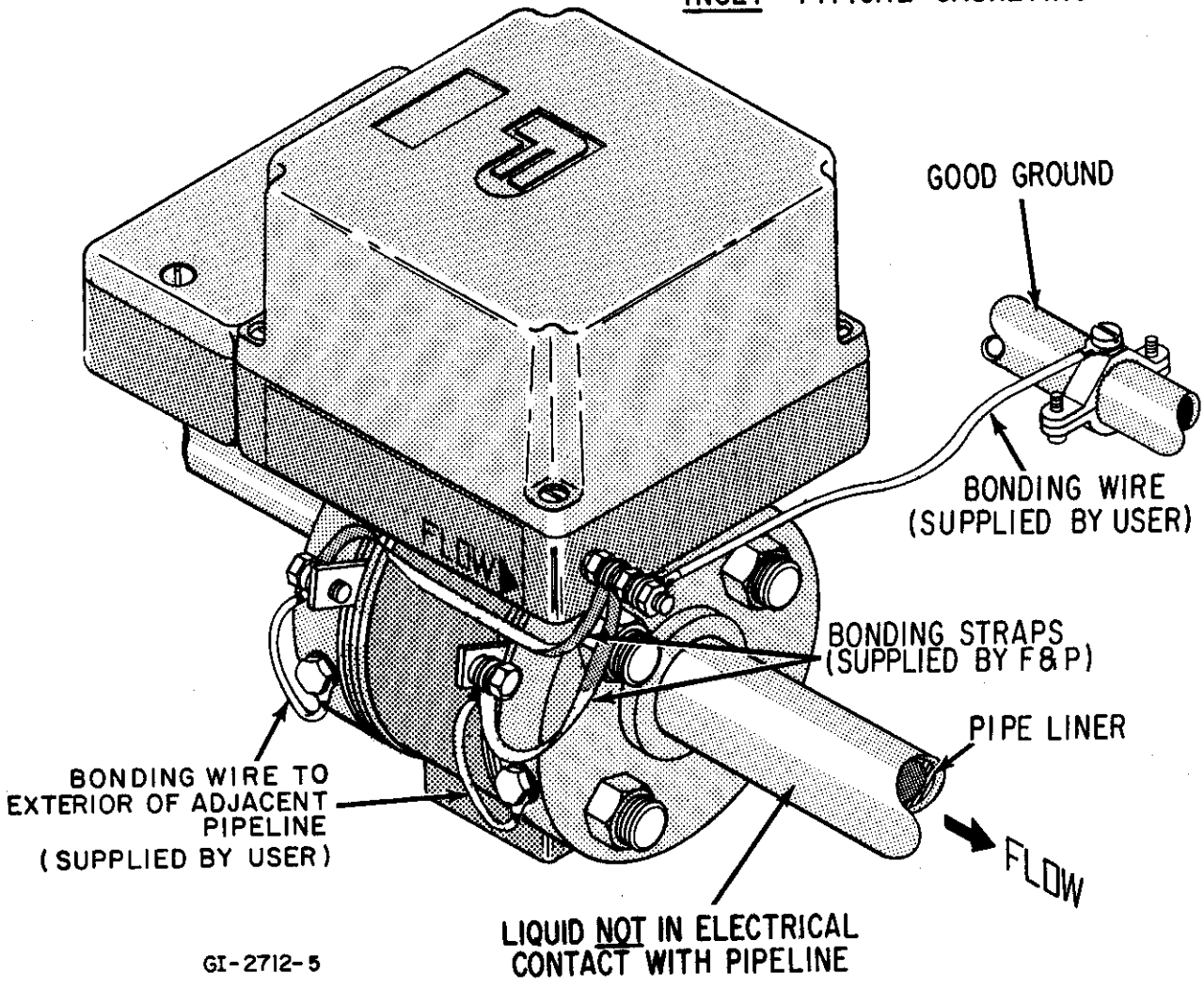


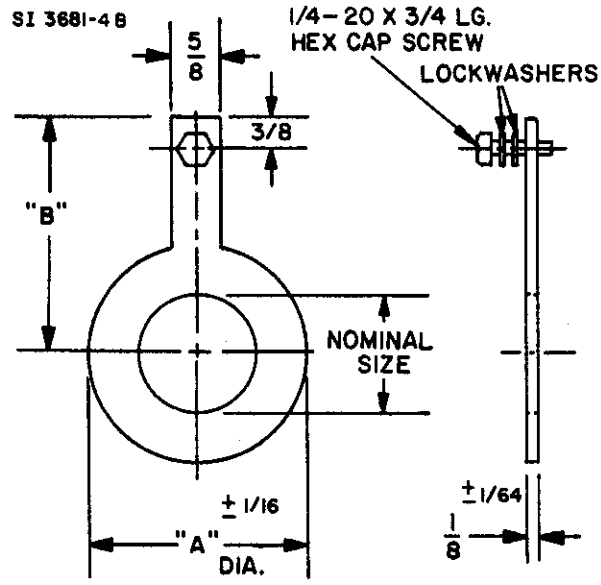
FIGURE 2-7. GROUNDING PROCEDURE, NON-CONDUCTIVE OR INSULATED PIPE

2.5 Electrical Interconnection

The Series 10D1475 MINI-MAG Magnetic Flowmeter may be furnished with either an integral or remote mounted Signal Converter. Interconnection wiring is arranged differently for the two systems. Interconnection details are provided in the Instruction Bulletin supplied with the Signal Converter.

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

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



NOMINAL SIZE		ANSI CLASS 150	
mm	(inch)	"A"	"B"
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: OD-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 F&P.

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 fluid 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** will prevent the process fluid from entering the electrical conduit system. This seal consists of a conduit entry cable seal on the meter junction box. It is the user's responsibility to 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 2-9.

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.

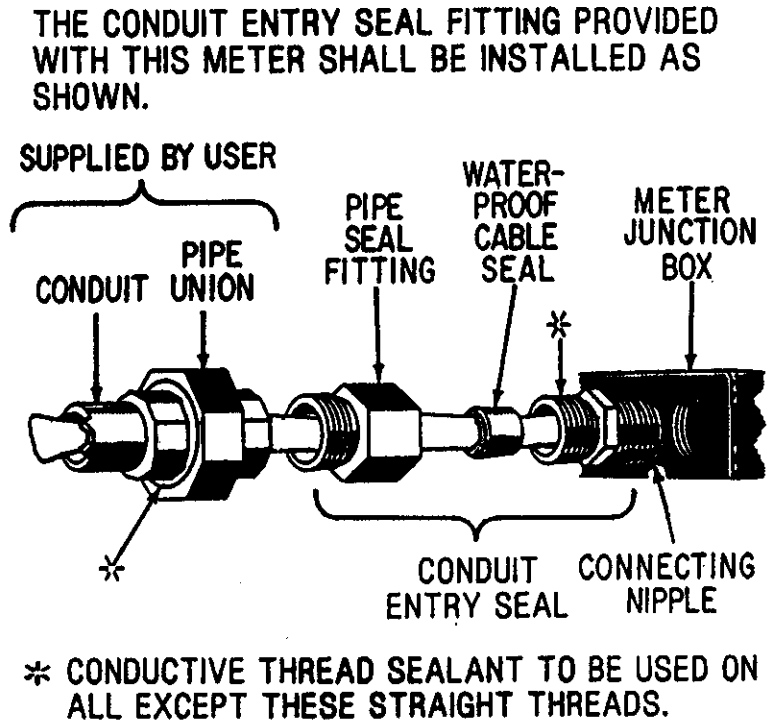


FIGURE 2-9. CONDUIT ENTRY SEAL INSTALLATION

3.0 START-UP and OPERATION

The F&P 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 some nominal maximum flow rate and for a 4-20 mA current output span. In either case, the calibration data is noted on the instrument data tag as shown in Figure 3-1. The basic primary mounted electronic components are identified in Figure 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 Bulletin supplied with the Signal Converter. If no change is required, the equipment is ready for operation as received.

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

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

Apply system power to the 10D1475 Magnetic Flowmeter by closing the external switch or circuit breaker; there are no switches inside of the equipment. Also energize any auxiliary equipment associated with the flow metering system; such as remote analog recorders, controllers or rate indicators.

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

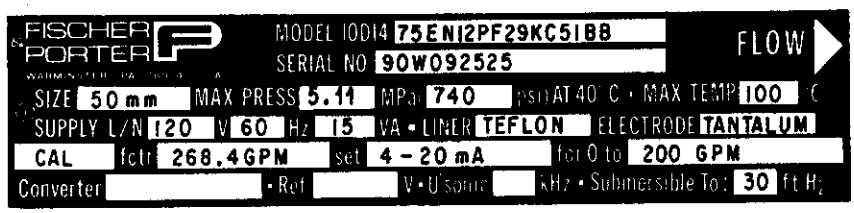


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FIGURE 3-1. TYPICAL INSTRUMENT TAG

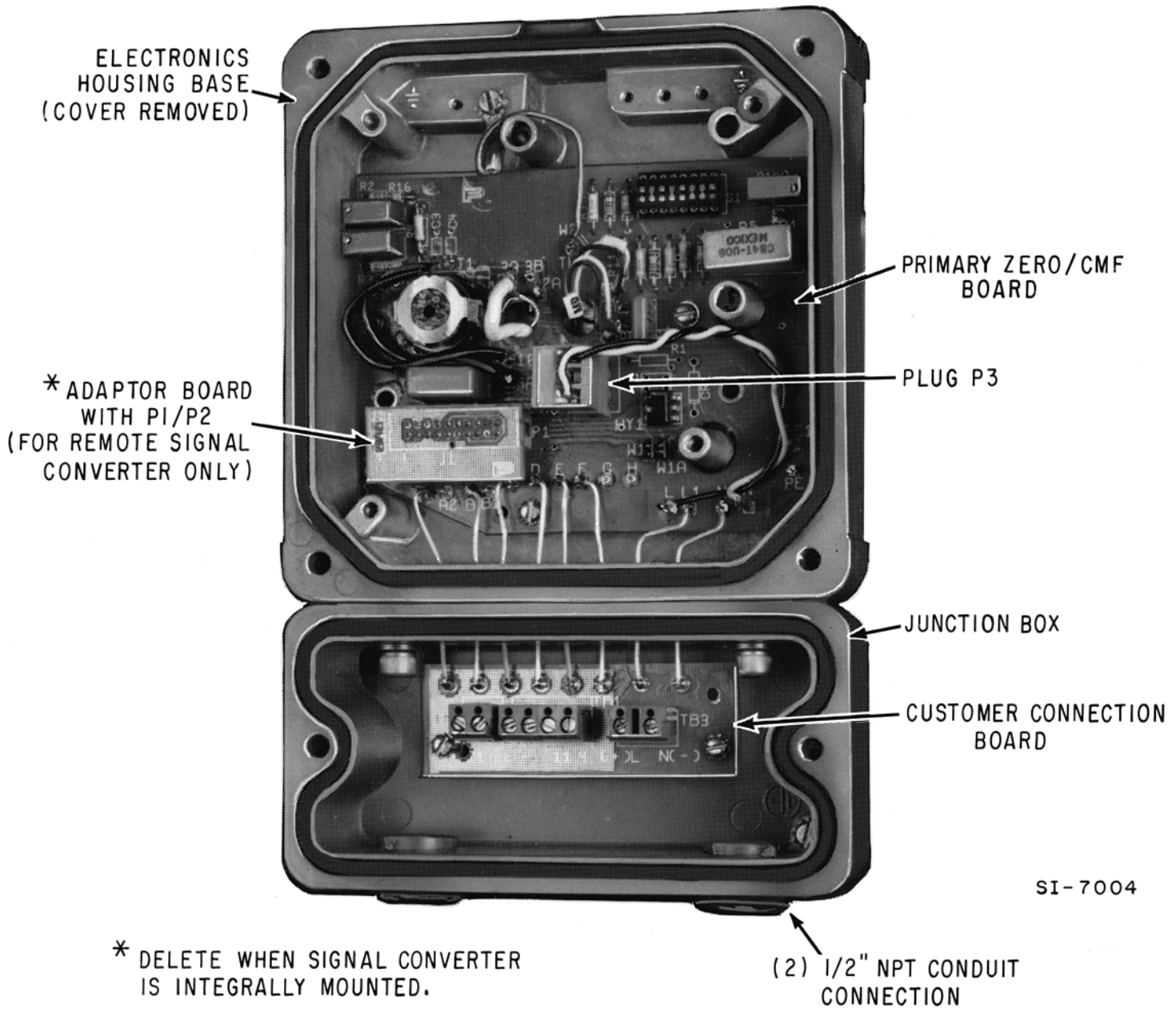


FIGURE 3-2. PRIMARY MOUNTED PC ASSEMBLIES

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 primary 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 Fischer & Porter 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 F&P Magnetic Flowmeter constitutes a modified form of a generator.

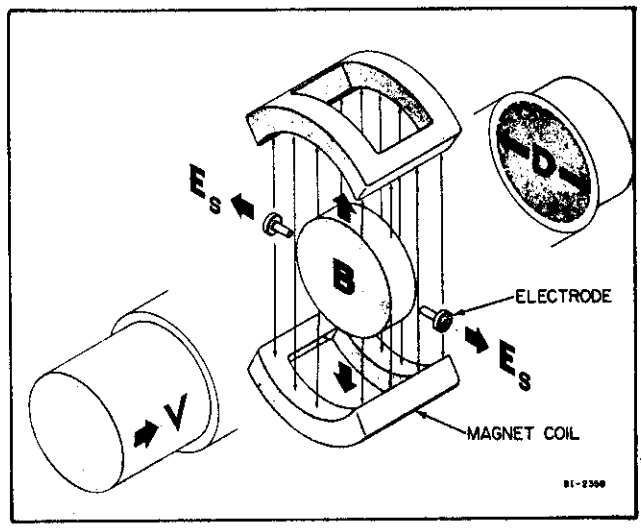


FIGURE 4-1. BASIC OPERATING PRINCIPLE

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

(Equation #2)

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

Substituting for V in equation #1

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

and solving for Q:

$$\therefore Q = \frac{\pi \alpha D^2}{4} \cdot \frac{E_S}{B}$$

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 F&P 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 F&P 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. F&P 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 F&P 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.

5.0 CIRCUIT DESCRIPTION

5.1 Primary Signals

The Magnetic Flowmeter body houses two signal electrodes and the flux producing magnet coils, as shown schematically in Figures 5-1 and 5-2. All primary intraconnection wiring is terminated at the Primary pc board located in the base of the meter housing.

The primary provides two output signals to the associated Signal Converter; one, an electrode signal that contains the flow rate information, and two, 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.

The (gated) magnet driver operates at a frequency that permits magnetic flux in the primary to reach a steady state level during the last 50% 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.

5.2 Primary PC Assembly (686B623)

The Primary PC Assembly provides several functions. These include:

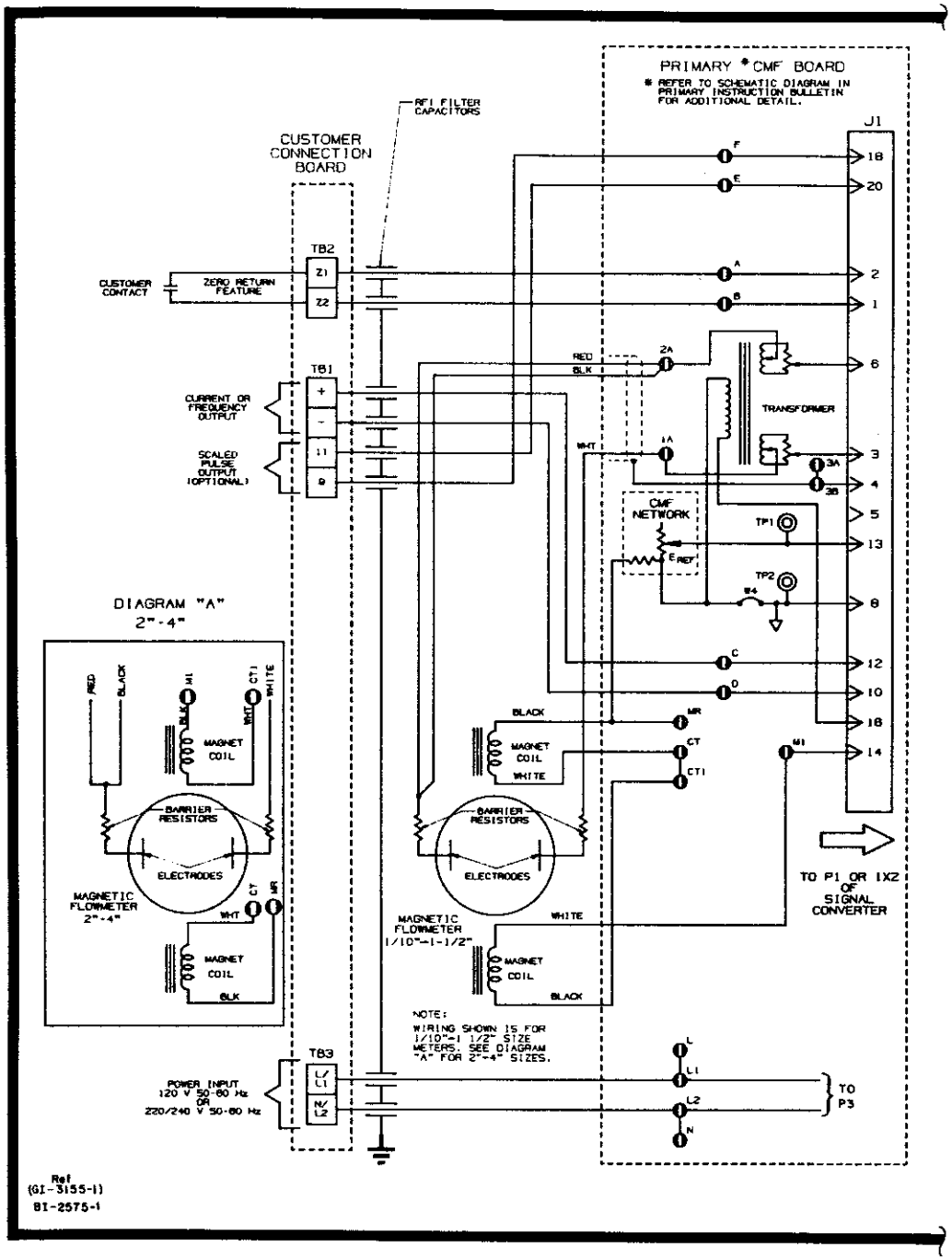
1. Establishing interconnections between the primary internal wiring and the Signal Converter.

2. Permitting adjustment of meter calibration factors to a fixed value for each nominal size primary.

3. Permitting adjustment of primary zero.

4. Establishing proper wiring connections for integrally or remotely mounted Converters.

A circuit schematic of the primary Primary Board is shown in Figure 5-3. The meter calibration factor is established by a voltage division off the R5 current sensing resistor, first by a coarse network consisting of R6 through R12, and then by a fine adjustment via potentiometer R14. These values may only be re-established by noting the open positions of shunt S1 and measuring (out of circuit) the values of R14 (each end to wiper) and R15.



SIGNAL CONVERTER ASSEMBLY

NOTE:
REFER TO SCHEMATIC DIAGRAM(S) PROVIDED IN EITHER THE SERVICE MANUAL OR INSTRUCTION BULLETIN SUPPLIED FOR THE SIGNAL CONVERTER SPECIFIED.

FIGURE 5-1. SCHEMATIC for PRIMARY WIRING WHEN USING INTEGRAL CONVERTER

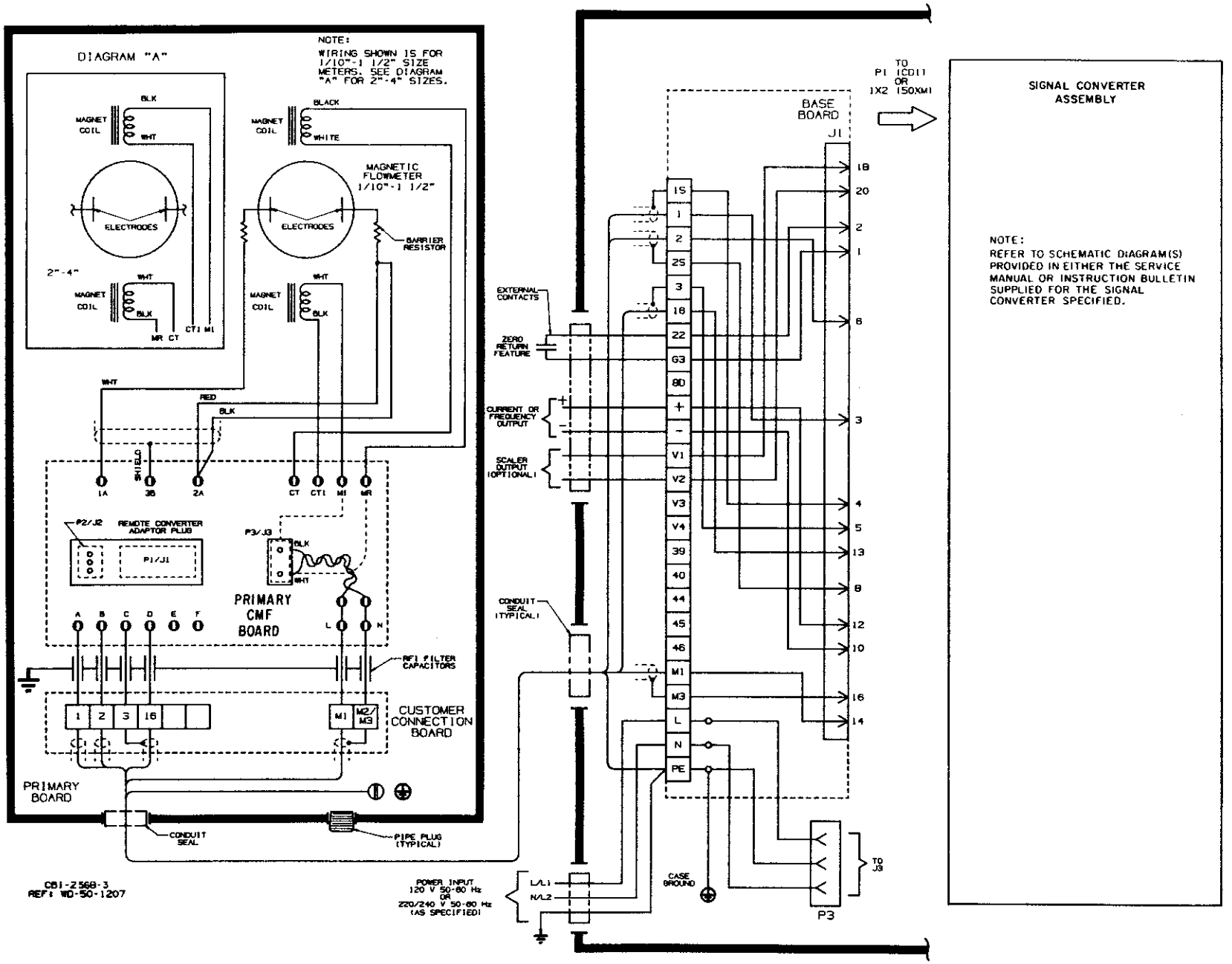


FIGURE 5-2. SCHEMATIC for PRIMARY WIRING WHEN USING REMOTE CONVERTER

System zero is established with the aid of transformer T1, through whose primary winding the magnet coil current flows. The center tap connection of the respective secondary windings of T1 are connected in series with each electrode signal.

One secondary winding removes from electrode signal 2 the voltage impulse which occurs as a result of coil voltage reversal. This signal is factory adjusted to a minimum, using an oscilloscope connected to the input amplifying system of the Converter. The adjustment is very sensitive and thus extreme care must be exercised when setting potentiometer R3.

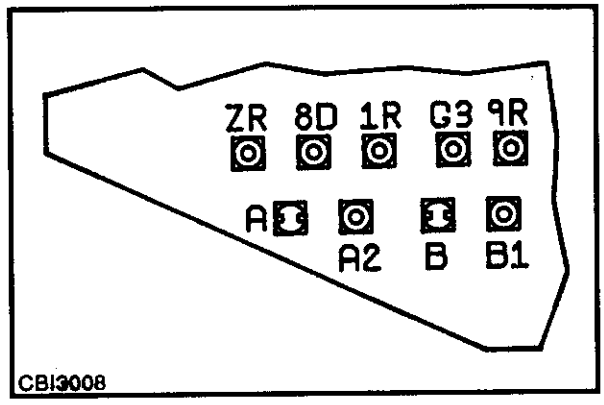
Electrode circuit 1 receives a signal from the other secondary winding, and is integrated via capacitor C2 and potentiometer R2 so as to produce a square wave. This adjustment removes residual offset not corrected by the previous adjustment.

Connections to the Converter are established by one of two means. For integral Converters, power is applied to receptacle P3 and signals pass through connector J1 to the Converter assembly as shown in Figure 5-1. For remotely mounted Converters, the magnet coils are driven (see inset) via the connection of J3 to P3, while the 686B630 Adaptor Board routes the reference and electrode signals to the proper positions of J1, J2, and their corresponding RFI filters. Typical wiring is shown in Figure 5-2. Refer to the Instruction Bulletin provided with the Signal Converter for interconnection wiring.

For integrally mounted Converters, zero return and options 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 primary board. The following table and diagram correlates the zero return and options with the jumper connections.

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

*XM Converter only



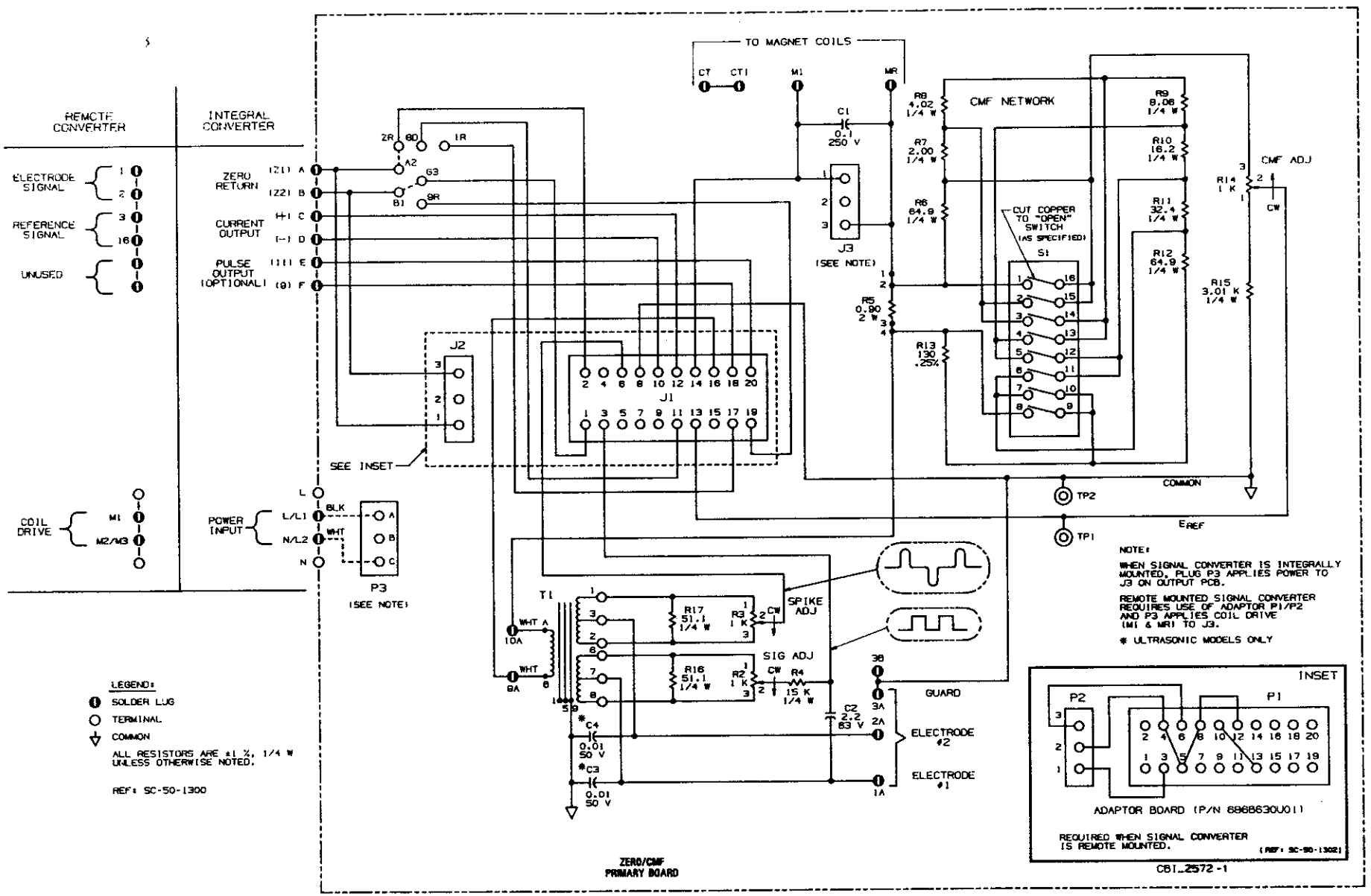


FIGURE 5-3. SCHEMATIC for PRIMARY BOARD

6.0 MAINTENANCE

6.1 General

Except for an occasional performance verification check, there is no required routine maintenance for the Model 10D1475. 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.

F&P 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 F&P (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 F&P 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 inadvertent damage to the integral solid state circuitry.

WARNING

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

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

When communicating with F&P 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.

6.2 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:

- Section 5.0 Circuit Description
- the applicable Signal Converter Instruction Bulletin

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 meter operation is suspect, 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 options available for use with the Magnetic Flowmeter include:

- integrally or remotely mounted Analog Signal Converter (50CD)
- integrally or remotely mounted Microprocessor-Based Signal Converter (50XM)

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

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

6.3 Static Test

If improper operation of the Magnetic Flowmeter is suspected, the following resistance measurements can be made to establish whether an electrical malfunction has occurred. A standard multimeter is suitable for making the resistance checks. These measurements can be made at the primary 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.

6.3.1 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 CT1" and "CT and MR" on the Primary board in the meter electronics base. (Note that terminals CT and CT1 are internally connected via printed circuit path.) Figures 5-1 and 5-2 show the actual connection method.

Before making resistance measurements, verify that the system power service has been de-energized. Remove the electronics housing cover to obtain access to the Primary 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 Primary 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 CT1 on the Primary board. The value displayed should correspond to 1/2 of the value (±20%) indicated in Table 6-1.

3) Connect the Ohmmeter test leads to terminal lugs CT and MR. The value displayed should correspond to that obtained in Step 2 and 1/2 of the value indicated in Table 6-1 within ±20%.

If proper coil resistance is measured, it can be assumed that the magnet coils are functional. If the measurement indicates that either or both coils are "open" (infinite resistance), or shorted (zero resistance), the Magnetic Flowmeter must be replaced.

4) Carefully unsolder the four coil wires from the terminal lugs on the Primary pc board. Identify each wire to enable its proper reconnection.

5) Set the Ohmmeter to its highest range (R x 10,000) and measure from wire lead M1 or MR to the meter body (case ground). The resistance reading should be infinite. If this measurement is less than 100 K ohms, the meter is defective and must be replaced.

When all measurements appear normal, the coil wires can be reconnected and the meter can be returned to service. As applicable, re-install the integrally mounted Signal Converter and/or replace meter housing cover.

TABLE 6-1. PRIMARY COIL RESISTANCE

Meter Size		Coil Resistance, M1 to MR
inch	mm	Ohms (nominal)
1/10	3	18
5/32	4	18
1/4	6	18
3/8	10	18
1/2	15	18
1	25	41
1 1/2	40	60
2	50	16
3	80	19
4	100	21

6.3.2 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 5-1 and 5-2, 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 indicate 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.

6.3.3 Flowmeter Board

The Flowmeter board is located in the base of the electronics housing as shown in Figure 6-1. This pc board includes the constant meter factor/size network. The constant meter factor/size network is utilized to standardize the particular flowmeter; i.e., provide a meter CAL FACTOR 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.

Replacement of the Flowmeter board in the field is not recommended. Should board replacement become necessary, the following steps must be followed:

1. De-energize the Signal Converter power source (this will remove power from the Flowmeter). If applicable, remove the integrally mounted Signal Converter as discussed in 6.3.2.

2. Before removing the board, it will be necessary to unsolder the eight leads from the RFI capacitors (see Figure 5-1), plus the three leads from the meter electrodes, and the four wires from the magnet coils. Use care to identify all leads to ensure proper reconnection. Also, disconnect the two (lugged) ground wires.

3. When primary connections to the board have been disconnected, remove the three # 4-40 board mounting screws. The board can now be removed from the meter base.

The following procedure is required to maintain the accuracy of the meter Cal Factor.

4. Potentiometer R14 and resistor R15 must be carefully removed from the old circuit assembly (note the orientation of potentiometer R14). If they are in usable condition, place them into the new assembly (observe R14 orientation). If they cannot be used, then measure and record the resistance of the following components to an accuracy of 0.1%:

R15, R14 pin 1-2, R14 pin 3-2 ("2" is the wiper)

Calculate the following:

K = (R15 + R14 pin 1-2) / (R15 + R14 pin 1-2 + R14 pin 3-2)

5. Remove R14 and R15 from the replacement assembly. Measure R15 and adjust R14 to obtain the same "K" as calculated in step 4. Place R14 and R15 back into the circuit board, noting the proper orientation of R14.

6. Note which positions of shunt S1 were opened in the old Primary board. Open the identical shunt positions of S1 in the replacement board.

7. Replace the Primary Board in the meter base and restore intraconnection wiring. As applicable, install the Adapter board (for remote mounted Signal Converter) or replace integral Converter assembly. The jumpers on the Primary board; e.g., "A2 to ZR" and "B1 to G3" (see Figure 5-3) must be configured accordingly.

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 primary 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.

8. A zero flow, full pipe condition in the primary must now be established and the system powered. An oscilloscope must be connected to TP5 (TP1 com.) of a 50CD Converter or TP103 (TP101 com.) of the 50XM Converter. 50CD Converters must be set to a 1 ft/sec range and placed into self-test (elevated). R3 of the Primary assembly must be adjusted for a peak to peak waveform value of less than 2 volts (50CD) or 0.2 volts (50XM). For integrally mounted Converters, it will be necessary to place an insulator under the Converter and set it on the lip of the meter housing to permit access for adjustment of the Primary Board.

9. After R3 has been adjusted, R2 is to be set so that the Converter output is zero. For 50CD Converters, the Converter must be elevated on a 1 ft/sec span and R2 then set to obtain 74.3% output (+/- 0.2%). For microprocessor-based Converters, the Converter must be placed in the bidirectional mode, low flow cutoff set to zero, and R2 set so that indication on the rate display toggles between forward and reverse.

10. Following completion of steps 4 through 9, the system may now be returned to normal operation.

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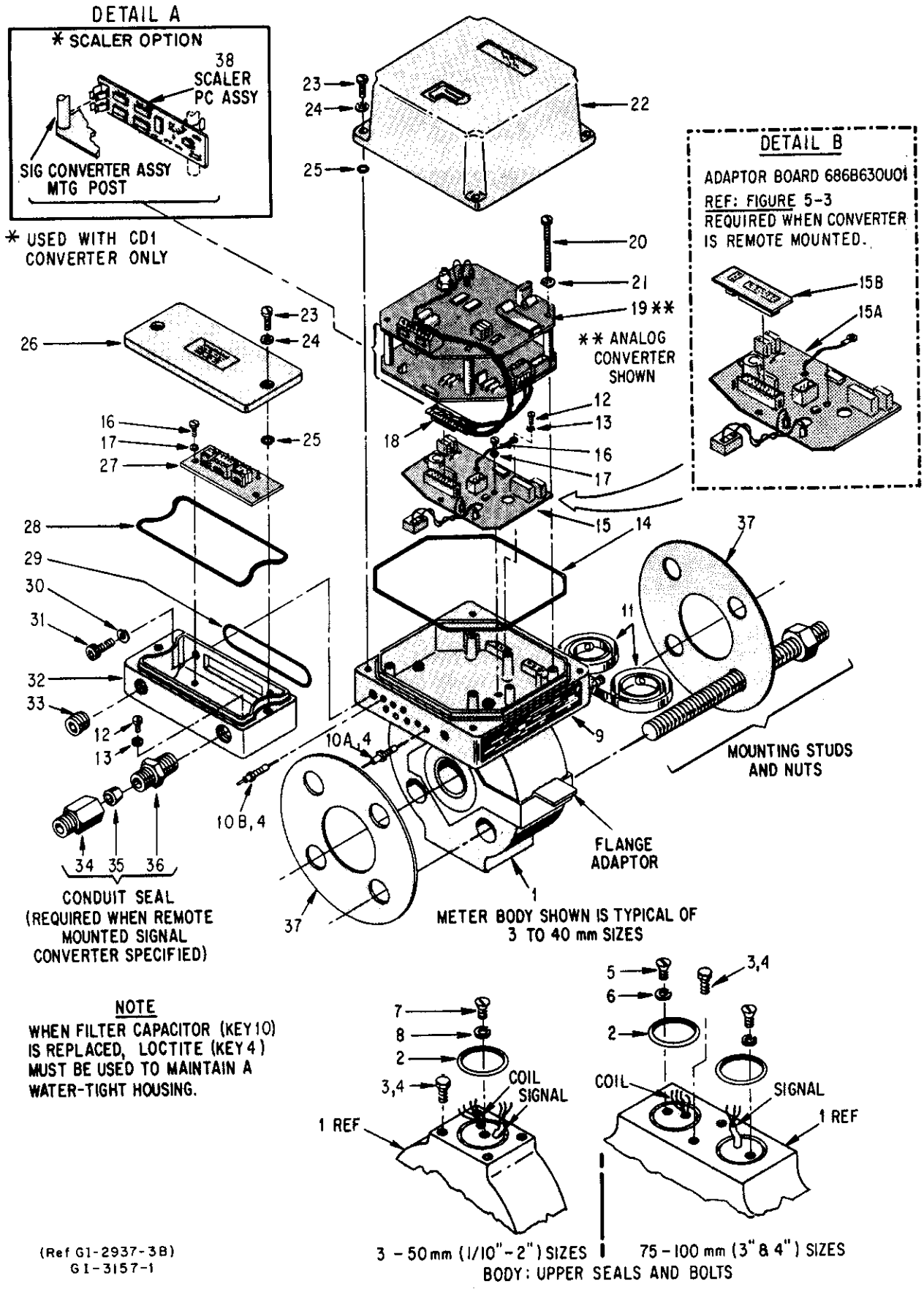

FIGURE 6-1. EXPLODED VIEW, BASIC FLOWMETER PARTS

7.0 PARTS LIST

TABLE 7-1. BASIC METER PARTS (REF: FIGURE 6-1)

KEY	QTY	DESCRIPTION	SIZE, mm	PART NUMBER
1	1	METER BODY: SEE NOTE 1		N/A
2	1	O-RING: Converter Base Seal	3 - 25	101A927U01
	1		40 - 50	101A937U01
	2		80	101A922U01
	2		100	101A927U01
3	2/4	BOLT, Self Sealing		091B022U01
4	-	LOCTITE, Type 271		145A016U02
5	2	SCREW, Flat Hd: 1/4-20 x 1/2"		032B008T10
6	2	WASHER, Csk: M6		85G027KU05
7	1	SCREW, Flat Hd: #8-32 x 1/4"	3 - 25	002K004T10
		#10-32 x 5/16"	40 - 50	002L005T10
8	1	LOCKWASHER, Csk, Ext. Tooth #8	3 - 25	085M008V11
		#10	40 - 50	085M010V11
9	1	BASE, Converter	3 - 25	610B249U03
			40 - 50	610B249U04
			80	610B249U05
			100	610B249U06
10A	2	FILTER CAPACITOR ASSY (RFI), 100 pF, 120 V ac		C160C102U01
10B	6	FILTER CAPACITOR ASSY (RFU), 1000 pF, 500 V dc		160C055U01
11	2	GROUND STRAP		355A422U01
12	2	SCREW, Pan Hd: #6-32 x 1/4"		006H004T10
13	2	LOCKWASHER, Ext. Tooth: #6		085H006V11
14	1	SEAL RING, Cover		101A834U01
15A	1	PRIMARY BOARD, Converter Base (CMF) (See NOTE 5)		686B623U01
15B	1	ADAPTOR BOARD (for remote Converter)		686B630U01
16	5	SCREW, Pan Hd: #4-40 x 1/4"		006F004T10
17	5	LOCKWASHER, Ext. Tooth: #4		085H004V11
18	1	CABLE ASSEMBLY: CD1 Converter*		686B631U01
19	1	SIGNAL CONVERTER ASSY: SEE NOTE 2		
20	4	SCREW, Pan Hd: #6-32 x 2-1/4"		006H228T10
21	4	LOCKWASHER, Int Tooth: #6		085F006V11
22	1	COVER, Converter Base: w/o Window		379D358U01
		with Window		D612A083U01
23	6	SCREW, Pan Hd: #10-32 x 3/4"		006L012T10
24	6	LOCKWASHER, Ext Tooth: #10		085D010T10
25	6	O-RING, Screw Retainer		333C596U01
26	1	COVER, Customer Connection Box		C379D371U01
27	1	PC BOARD, Customer Connection Box		C686B624U01
28	1	SEAL RING, Customer Connection Box		101A825U01
29	1	O-RING, Connection Box to Converter Base		101A001U08
30	2	LOCKWASHER, Ext Tooth: 1/4"		085H416T10
31	2	SCREW, Hex Soc Hd: 1/4-20 x 7/8"		038B014T10
32	1	CUSTOMER CONNECTION BOX:		C323D416U02
33	1	PIPE PLUG: 1/2" NPT SEE NOTE 3		112A352U22
34	1	FITTING, Pipe SEE NOTE 3		364D297U01
35	1	GROMMET SEE NOTE 3		368B071U01
36	1	FITTING, Pipe SEE NOTE 3		364D257U01
37	2	GASKET, See TABLE 7-4		
38	1	SCALER BOARD: (Option)**		
		10 Hz max range		686B518U02
		10 kHz max range		686B518U03

NOTES:

1. Meter body (Key 1) is a welded assembly and is not a repairable item. F&P maintains a repair/exchange program so that the entire meter or the Signal Converter alone, can be replaced with a minimum of down time; contact your local F&P field office for details. To order specify either a new or repair/exchange Meter or Signal Converter, as required. All correspondence should reference the complete instrument model number and serial number.
2. The same Signal Converter is used for integral or remote mounting. Refer to the Instruction Bulletin supplied for the Signal Converter model specified for the applicable replacement part number. F&P maintains a repair/exchange program for this assembly; simply add "RE" to the part number given in the IB. For example: 50CD9001 - PN 6988076U65RE.
3. Pipe plug (Key 33) and conduit seal (Keys 34, 35 & 36) are not used when Signal Converter is integrally mounted. Parts are supplied with signal cable, when specified.
4. Mounting hardware and gaskets (supplied by F&P) are selected according to meter size.
5. The Primary CMF Board is not interchangeable, see procedure 6.3.3 in MAINTENANCE section. It is suggested that the user return the Magnetic Flowmeter to the factory for repair and calibration, or consult an F&P service representative for assistance.

* Included with replacement Converter.
** Used with CD1 Converter only. See I850CD9001

7.0 PARTS LIST (continued)

TABLE 7-2. ANSI CLASS 150 GROUNDING RINGS

Meter Size		F&P Part	Part Number Suffix (Material)			
mm	inch	Number*	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.

TABLE 7-3. GASKETS FOR ANSI CLASS 150 GROUNDING RINGS (2 Required)

KLINGER SIL C-4401————Part Number 333J089U__*
TEFLON————————————-Part Number 333J092U__*

	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 nuumber, 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 F&P.

7.0 PARTS LIST (continued)

TABLE 7-4. GASKETS FOR METER BODY (2 required)

KLINGER SIL C-4401————Part Number 333J089U__*
TEFLON————————————Part Number 333J092U__*

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
BS 10 TABLE D	U02	U02	U12	U15	U20	U23	U24
BS 10 TABLE E	U02	U02	U12	U15	U20	U23	U31
BS 10 TABLE F	U02	U02	U13	U17	U21	U27	U29
DIN PN 10/16	U03	U03	U14	U18	U21	U28	U32
DIN PN 25/40	U03	U03	U14	U18	U21	U28	U33

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

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