FOXBORO®

Instruction

MI 021-412
May 1999

I/A Series Magnetic Flow Transmitter Retrofitting 2800 Series Flanged Flowtubes [Sizes 15 through 900 mm (0.5 through 36 in)] For Use with an IMT96 Transmitter When Previously Connected to an E96 Transmitter

An Invensys company

Contents

Introduction

IMT96 transmitters are designed to replace E96 transmitters used with 2800 Series flowtubes [sizes 15 through 36 mm (0.5 through 36 in)]. To accomplish this replacement, several issues must be addressed. These are:

- Mounting the IMT96 transmitter in place of the E96 transmitter
- Wiring the IMT96 transmitter with the 2800 Series flowtube
- Determining Meter Factor for configuring the IMT96 transmitter

Reference Documents

Table 1. Reference Documents

Document	Description
DP 021-367	IMT96 I/A Series MagEXPERT Flow Transmitter - Dimensions
MI 020-350	Wiring Guidelines for Foxboro Intelligent Transmitters
MI 021-402	IMT96 I/A Series MagEXPERT Flow Transmitter with 2800 Series Flanged Flowtubes - Installation
MI 021-403	IMT96 I/A Series MagEXPERT Flow Transmitter - Local Operation, Configuration, and Calibration
MI 021-404	IMT96 I/A Series MagEXPERT Flow Transmitter - System Maintenance
PL 008-747	IMT96 I/A Series MagEXPERT Flow Transmitter - Parts List
TI 27-71f	Magnetic Flowtubes Material Selection Guide
TI 027-072	Electrical Conductivity of Process Liquids

Mounting the Transmitter

Surface Mount

The IMT96 can accept the E96 surface mounting bracket. Simply attach the E96 surface mounting bracket to the back of the IMT96 housing using the existing flat head screws. Then attach the bracket to the surface securely. The IMT96 can also be surface mounted using the integral flanges at each end of the housing.

Pipe Mount

The IMT96 accepts the E96 pipe mounting bracket and studs allowing attachment to a 2-inch (DN 50) pipe. Use the threaded bosses on the back of the IMT96 enclosure. Fasten the transmitter securely. Alternately, the end flanges of the IMT96 can be used with U-bolts for vertical pipe mounting.

Panel Mount

The IMT96 can be panel mounted in panels up to 9.5 mm (0.38 in) thick. See DP 021-367 for mounting details.

Integral Mount with Flowtube

The IMT96 does **not** integrally mount with a 2800 Series flowtube. The IMT96 can be pipe, panel, or surface mounted. Where existing E96 transmitters are integrally mounted to the flowtube and are to be replaced with IMT96, the E96 transmitter should be removed and the flowtube electrical junction area closed by using 1 blind cover (K0123ES), 1 gasket (K0123EW), 6 O-rings (C0100CK), and 6 screws (K0123EX), all available from Foxboro.

Wiring an IMT96 Transmitter and 2800 Flowtube

Unlike the traditional ac magnetic flowmeter system, the IMT96 transmitter provides the flowtube with coil power.

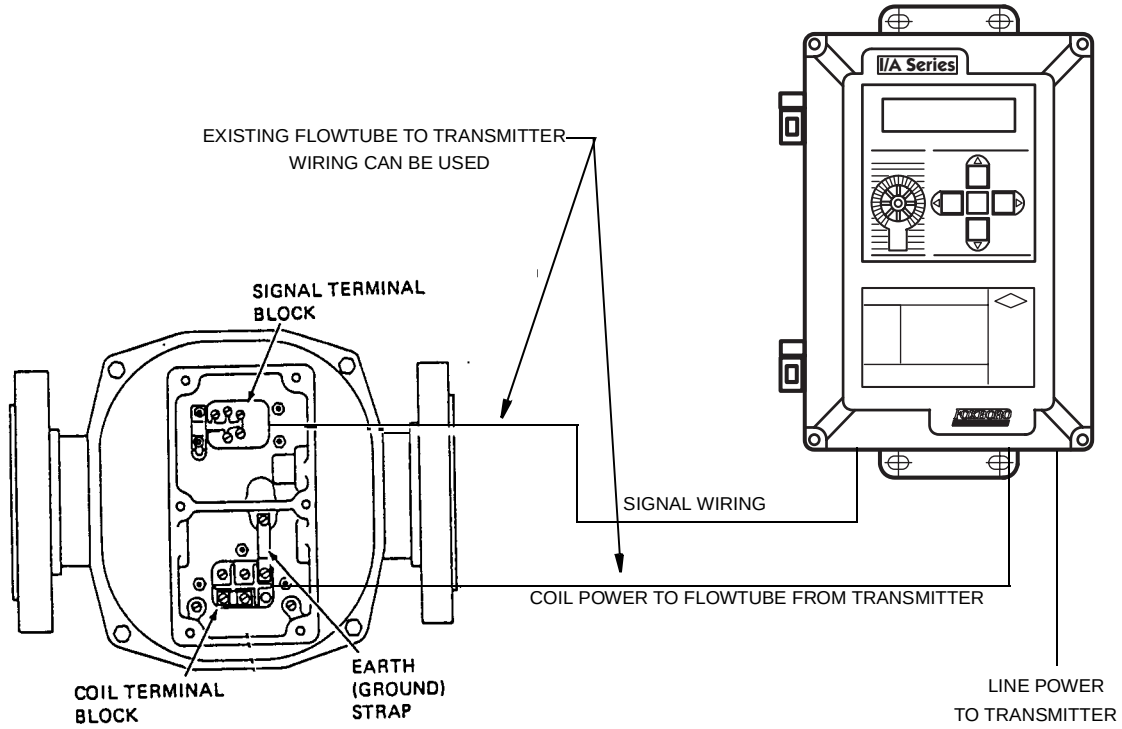
⚠ CAUTION

In wiring an IMT96 transmitter to a 2800 Series flowtube, do **not** supply line power directly to the flowtube coils. Be sure to check that the line power voltage matches that on the transmitter data plate. The transmitter will be damaged if the line power exceeds the transmitter rating.

The coil wiring must be connected as defined in Table 2. To set the coil connection for series or parallel see Figure 3.

In converting from series coil connection to parallel coil connection, a jumper strap must be added to the coil terminal block in the flowtube. A short insulated wire (AWG 14) can be used to create this connection if a jumper strap is not available.

Full details of the wiring requirements can be found in MI 021-402.



⚠ CAUTION

When using an IMT96 transmitter with a 2800 Series flowtube, line power must not be connected to the flowtube terminal block. Power is supplied to the transmitter which generates power pulses to power the flowtube.

Figure 1. Wiring the IMT96 Transmitter to a 2800 Series Flowtube

Full details of the wiring requirements can be found in MI 021-402, Installation.

Determining the Meter Factor

A required parameter in the configuration of an IMT96 transmitter is **Meter Factor**. The value to be used for the meter factor is the **IMT96 Cal Fact** which is stamped on the flowtube data plate when factory calibrated for use with an IMT96 Transmitter. This value does not appear on flowtubes that were manufactured prior to March 1999 or were not calibrated for use with an IMT96 Transmitter. This instruction (MI 021-412) provides information on how to determine the meter factor when the flowtube data plate does not contain the **IMT96 Cal Fact**.

Two methods can be used to calculate this factor. The method selected is dependent on required system accuracy.

- **Calculation Using Measurements Method:** Provides for an expected system accuracy which is 0.5% greater than a flowmeter that has been factory calibrated. It requires an accurate measurement of the coil current and voltage drop to produce a Ref Units Factor.

- **Calculation Using a Nominal Ref Units Factor:** Provides for an expected system accuracy which is 2% greater than a flowmeter that has been factory calibrated. It uses a nominal Ref Units Factor and does not require measurements.

Calculation Using Measurements Method

This is the most accurate method of determining the meter factor. To use this method, accurate simultaneous measurements of the coil current and voltage drop are needed. This provides information about the electrical properties of the flowtube which are combined with the AC Cal Factor.

The procedure is:

1. Check that the coils are wired as shown on the flowtube data plate (S = series or P = parallel). See Figure 3 for jumper positions.
2. Connect your ammeter and voltmeter to the flowtube per Figure 2. Use an ammeter compatible with the **AMPS-MAX.** value stamped on the flowtube data plate.
3. Simultaneously read the voltmeter and ammeter. The accuracy of these readings is important. A 1% error in either of these readings causes a 1% error in the IMT96 Cal Fact calculation.
4. Use the measurements to calculate the Ref Units Factor as follows:

$$\text{Ref Units Factor} = \left(\frac{\text{Current Reading}}{\text{Voltage Reading}}\right) \times \text{Ref Voltage}$$

Where:

Ref Voltage = 115 V for flowtubes with a 120 volt rating
= 230 V for flowtubes with a 220/230/240 volt rating

The IMT96 Meter Factor can now be calculated as explained in “Calculation of Meter Factor” on page 5.

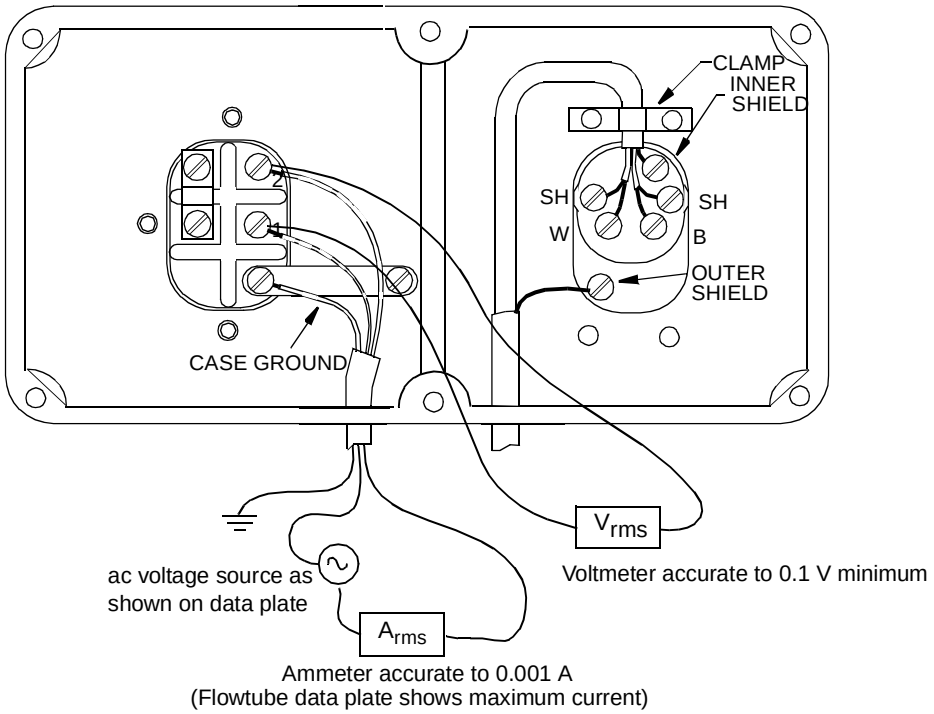


Figure 2. Determining Reference Units Factor for Conversion by Measurements Method

Figure 3. Coil Connection Jumper Position

Calculation of Meter Factor

The equation used to calculate the converted factor is comprised of adjustments for coil connection, a tube size factor, the original AC Cal Factor, and a Ref Units Factor.

$$\text{IMT96 Meter Factor} = \frac{(\text{AC Cal Factor}) \times (\text{S/P K})}{\text{Ref Units Factor}} \times \text{Size Factor}$$

where:

AC Cal Factor Factor is obtained the flowtube data plate (see Figure 4).

NOTE

The AC Cal Factor of the 2800 Series flowtube usually has flow rate units of GPM. If the units are other than GPM, the factor must be converted to GPM to be used in these calculations (see "Meter Factor Calculation Example" on page 8). The factor for the IMT96 is always calculated relative to flowrate in GPM. However, a unit selection parameter is available in the IMT96 Setup menu that allows the transmitter to be ranged and to display measurements in any flow rate units.

Ref Units Factor	Value is determined from the measured coil current and voltage.
S/P K	Value is determined by comparing the original flowtube data plate marking for series or parallel coil connection (S or P) to the coil connection (S or P) needed for excitation with IMT96 as shown in Table 2. Then by retrieving the S/P K value from Table 3.
Size Factor	Factor is obtained from Table 4.

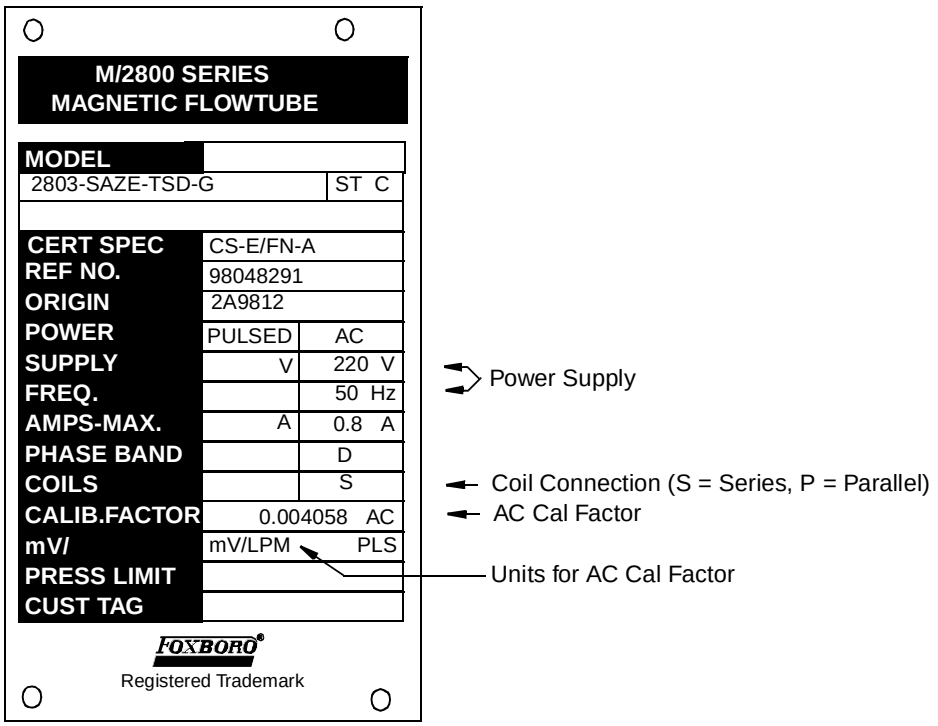


Figure 4. Data Plate

Table 2. Determining the 2800 Flowtube Coil Connection

Flowtube Voltage and Frequency (From Flowtube Data Plate)	Required Coil Connection for IMT96 Use
120 V, 60 Hz	Series only
240 V, 60 Hz	Series only
120 V, 50 Hz	Series only
220 V, 50 Hz	Parallel for 15 through 200 mm (½ through 8 in), Series for 250 mm (10 in) and larger
240 V, 50 Hz	Parallel for 15 through 200 mm (½ through 8 in), Series for 250 mm (10 in) and larger

NOTE

The voltage and frequency rating of the flowtube does not dictate the voltage rating of the IMT96 transmitter. The IMT96 transmitter used for any of the above flowtubes could be either the 120 or 230 Volt model code selection. The power the IMT96 transmitter generates to energize the flowtube is the same with either supply voltage. It is also true that the meter factor calculations and system accuracy are unaffected by the transmitter supply voltage selection.

Table 3. Determining S/P K Factor

S/P K Factor	Coil Connection
0.5	If the data plate value is S and the IMT96 requires P
1	If the coil connection method is not changed from the flowtube data plate
2	If the data plate value is P and the IMT96 requires S

Table 4. Size Factor

Flowtube Size		Power Line Frequency	
mm	in	60 Hz	50 Hz
15	0.5	1000	1000
25	1	1000	1000
40	1.5	1000	1000
50	2	1001	1000
80	3	1008	1006
100	4	1001	1000
150	6	1010	1000
200	8	1012	1000
250	10	1025	1025
300	12	1025	1025

Table 4. Size Factor (Continued)

Flowtube Size		Power Line Frequency	
mm	**in**	**60 Hz**	**50 Hz**
350	14	1035	1035
400	16	1031	1031
450	18	1040	1040
500 through 900	20 through 36	Consult Foxboro	

Meter Factor Calculation Example

An existing flowtube used with an E96 transmitter is to be retrofitted for use with an IMT96 transmitter. The flowtube data plate shows the following data:

- Model 2803 (3-inch) flowtube
- Series (S) connected coils
- 220 V ac, 50 Hz power
- AC Cal Factor is 0.004058 mV/LPM.

The current and voltage readings taken at the flowtube using Figure 2 as a guide are:

- 0.6290 A
- 232.3 V.

The Ref Units Factor is calculated as follows:

$$\text{Ref Units Factor} = \left(\frac{\text{Ampere Reading}}{\text{Voltage Reading}}\right) \times \text{Ref Voltage}$$

In this example:

$$\text{Ref Units Factor} = \left(\frac{0.6290\ \text{A}}{232.3\ \text{V}}\right) \times 230 = 0.6228$$

Since this flowtube was originally built with the coils for 220 V, 50 Hz power, the IMT96 requires that the coils be connected in parallel (P) according to Table 2. Table 3 indicates that for this flowtube the S/P K factor is 0.5 [the coil connection had to be changed from (S) to (P)].

Table 4 provides a Size Factor for the 3-inch flowtube as 1006 (50 Hz column).

The AC Cal Factor must be converted to mV/GPM to be used in the following calculations.

— NOTE

The IMT96 transmitter to be used with the flowtube in this example could be either the 120 or 230 V Model Code selection. The power the IMT96 transmitter generates to energize the flowtube is the same with either supply voltage. The meter factor calculations are also unaffected by the transmitter supply voltage selection.

The AC Cal Factor was in mV/LPM. It must be converted to mV/GPM. Since a flow rate of 1 GPM is equal to a flow rate of 3.7854 LPM, the factor must be increased by that ratio.

Thus, the AC Cal Factor 0.004058 mV/LPM * 3.7854 = 0.01536 mV/GPM

The IMT96 meter factor can now be calculated as follows:

$$\text{IMT96 Meter Factor} = \frac{(\text{AC Cal Factor}) \times (\text{S/P K})}{\text{Ref Units Factor}} \times \text{Size Factor}$$

$$= \frac{(0.01536) \times (0.5)}{0.6228} \times 1006 = 12.405^*$$

*As a check of this calculation, compare to the average meter factor shown in Table 6.

Calculation Using Nominal Ref Units Factor

If you prefer not to make accurate measurements of coil current and voltage drop to calculate the Ref Units Factor, you can obtain a nominal Ref Units Factor from Table 5. Calculate the Meter Factor as shown in the previous method except use the Ref Units Factor from Table 5 instead of the Ref Units Factor determined from measurements.

Table 5. Nominal Ref Units Factor

Flowtube Size		Power Supply and Coil Connection (from flowtube data plate)									
		120 V, 60 Hz		240 V, 60 Hz		120 V, 50 Hz		220 V, 50 Hz		240 V, 50 Hz	
mm	in	S	P	S	P	S	P	S	P	S	P
15	0.5	2.42	9.68	4.84	N/A	1.96	7.84	1.12	4.46	1.12	N/A
25	1	1.59	6.36	3.18	N/A	1.23	4.92	0.73	2.94	0.73	N/A
40	1.5	1.41	5.64	2.82	N/A	1.18	4.72	0.65	2.62	0.65	N/A
50	2	1.30	5.20	2.60	N/A	1.09	4.36	0.60	2.40	0.60	N/A
80	3	1.27	5.08	2.54	N/A	1.06	4.24	0.62	2.46	0.62	N/A
100	4	1.23	4.92	2.46	N/A	1.03	4.12	0.56	2.26	0.56	N/A
150	6	1.94	7.76	3.88	N/A	1.62	6.48	0.90	3.60	0.90	N/A
200	8	2.35	9.40	4.70	N/A	1.96	7.84	1.09	4.34	1.09	N/A
250	10	N/A	3.70	1.85	7.40	2.81	11.2	1.62	6.50	1.62	N/A
300	12	N/A	4.32	2.16	8.64	3.58	14.3	2.07	8.28	2.07	N/A
350	14	N/A	4.37	2.17	8.74	N/A	5.24	2.60	10.4	2.60	N/A
400	16	N/A	5.84	2.95	11.68	N/A	7.01	3.54	14.2	3.54	N/A
450	18	N/A	5.54	2.77	11.08	N/A	6.65	3.32	13.3	3.32	N/A
500 through 900	20 through 36	Consult Foxboro									

For the 3-inch flowtube in the previous example, the Nominal Ref Units Factor from Table 5 is 0.62.

$$\text{IMT96 Meter Factor} = \frac{(\text{AC Cal Factor}) \times (\text{S/P K})}{\text{Nominal Ref Units Factor}} \times \text{Size Factor}$$

$$= \frac{(0.01536) \times (0.5)}{0.62} \times 1006 = 12.461^*$$

*As a check of this calculation, compare to the average meter factor shown in Table 6.

Table 6. Average Meter Factor

Flowtube Size		Flowtube Supply and Frequency Rating From Data Plate and Coil Connection for IMT96 Use			
mm	in	120 or 240 V 60 Hz Series (S)	120 V 50 Hz Series (S)	220 or 240 V 50 Hz Series (S)	220 or 240 V 50 Hz Parallel (P)
15	0.5	185	222	Use parallel coil connection	207
25	1	84.0	101		94
40	1.5	37.6	45.1		42.1
50	2	25.0	30.0		28.0
80	3	11.3	13.6		12.6
100	4	6.21	7.45		6.95
150	6	1.75	2.10		1.96
200	8	0.817	0.98		0.914
250	10	0.712	0.449	0.833	Use serial coil connection
300	12	0.417	0.251	0.467	
350	14	0.319	0.319	0.319	
400	16	0.190	0.190	0.190	
450	18	0.143	0.143	0.143	
500	20	0.094	0.094	0.094	
600 through 900	24 through 36	Consult Foxboro			

Values for 350 through 900 mm (14 through 36 in) sizes are not valid for flowtubes with steel housings.

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