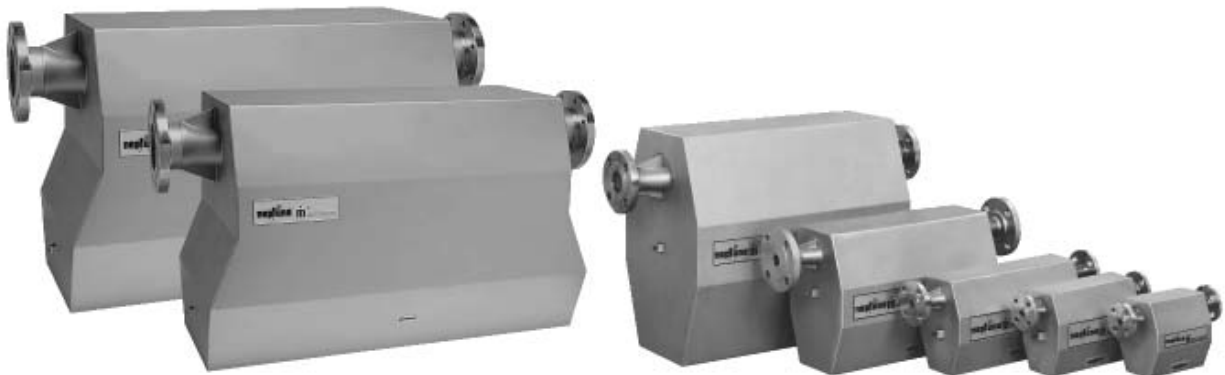


M600
Rev. B
Mass Flow Meter
Installation Guide



\dot{m} [®] Mass Flow Meter Installation Guide



WARNINGS, CAUTIONS, AND NOTES

Throughout this manual you will see WARNINGS, CAUTIONS and NOTES. They are here for your benefit and warrant attention. By paying careful attention to them you can prevent personal injury and possible equipment damage.

Below are examples:

WARNINGS: **INFORM THE READER OF POSSIBLE BODILY INJURY IF PROCEDURES ARE NOT FOLLOWED EXACTLY.**

CAUTION: **Alert the reader to possible equipment damage if procedures are not followed correctly.**

NOTES: *Inform the reader of a general rule for a procedure or of exceptions to such a rule.*

NOTICE

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INTRODUCTION

Actaris would like to thank you for purchasing the Actaris Coriolis Force Flow Meter (CFF). This is the most accurate and reliable flow metering technology for the measurement of mass, volume, density, temperature and % Solids (concentration) available today. This installation guide will assist you in designing a good flow metering system for your CFF.

The Installation Guide is separated into the following sections:

1. Principle of Operation
2. Installation - Mechanical and Electrical
3. Application and System Considerations
4. Special Considerations
5. Reference Table
6. Model Number Designation
7. Performance Specifications
8. Forms for Return of Goods

NOTE: *Make sure that you refer to the Installation - Mechanical and Electrical section and Application/System Considerations for your particular system.*

SECTION 1: PRINCIPLE OF OPERATION

The Coriolis Force Flow Meter measures mass flow directly using the Coriolis Principle. In practice, this means that liquid flow is measured by transferring vibrational energy from the meter tubing to the flowing liquid and back again to the meter. To appreciate this, imagine a vibrating pipe as shown in Figure 1.1. If no liquid is flowing, the drive coil in the middle of the pipe will cause both arms to vibrate in phase.

Now look at Figure 1.2 and consider what will happen when liquid begins to flow. Mass flowing into the flowmeter starts to receive vibrational energy as it enters the first bend. It receives this vibrational energy from the pipe walls. Of course, in doing this, the pipe loses that same amount of energy. The result is the phase of the vibrational cycle lags at the upstream sensor location.

The reverse will happen at the downstream sensor location. The liquid is vibrating as it enters the bend, but transfers this energy to the pipe. The result is that the mass flow advances the vibrational phase at the downstream sensor location.

When combined, these two changes in vibrational phase produce a “twisting” of the flow tubes as shown in Figure 1.3. The amplitude of this twist is directly proportional to the mass flow rate and is virtually independent of the temperature, density, or viscosity of the liquid involved.

The drive coil vibrates the Coriolis Force Flow Meter at its natural frequency. The frequency of vibration of the flow tubes varies with fluid density. This frequency is measured to determine the fluid density and/or the percent solids/concentration.

$$\text{Density: } \rho = K_1 (1/f)^2 - K_2$$

An RTD is used to measure temperature.

Process variables that are calculated:

Gross Volume = Mass / Density

Percent Solids / Concentration

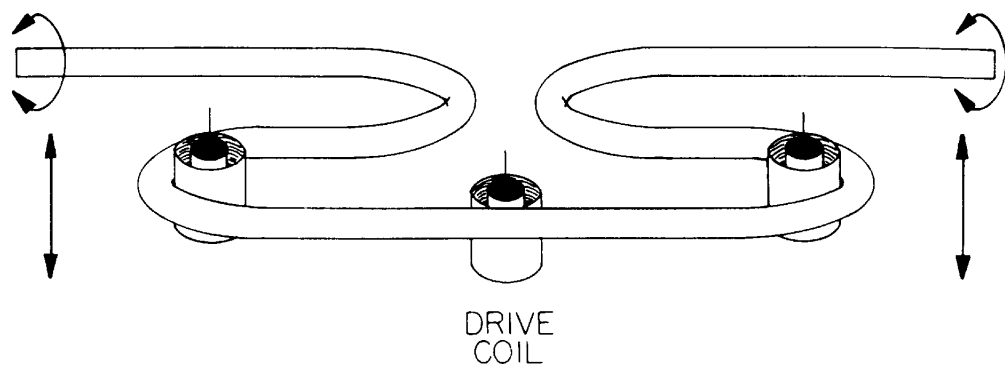


Figure 1.1: Principles of Operation

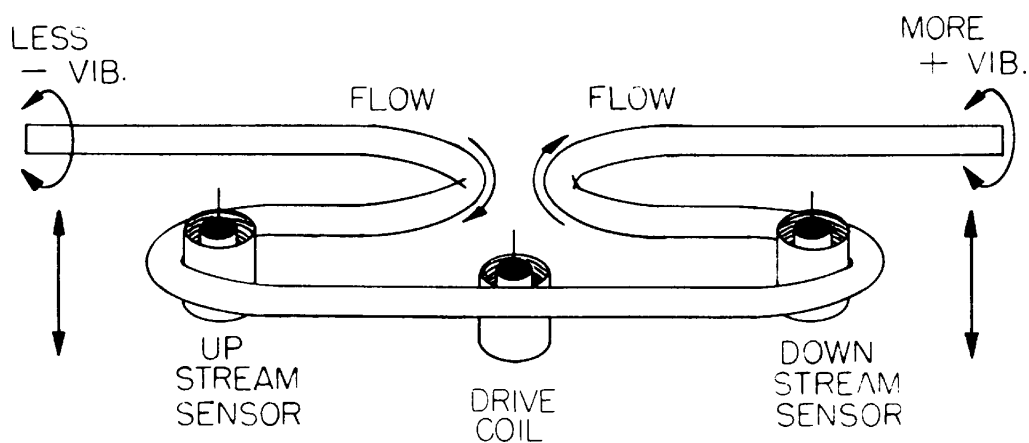


Figure 1.2: Principles of Operation

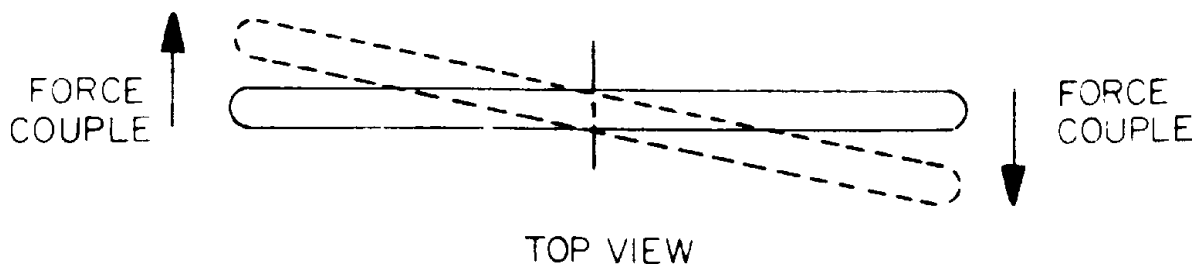


Figure 1.3: Principles of Operation

SECTION 2: INSTALLATION - MECHANICAL AND ELECTRICAL

The principle of operation of a CFF provides a better understanding of how this type of flow meter uses the combination of Coriolis Force, Frequency of Vibration and Temperature to provide direct measurement of mass, density and temperature respectively. Proper installation of a CFF ensures the three (3) measurement characteristics are not affected. The following outlines the piping and structural mounting for a CFF.

2.1 Piping and Structural Mounting

2.1.1 Pipe Supports

Below is a diagram of our recommended piping supports for a CFF.

Pipe Size (in.)	1/8	1/4	3/8	1/2	3/4	1	1 1/2	2	3	4	6	8
D (in.)	5	10	12	13	15	16	20	22	27	31	38	41

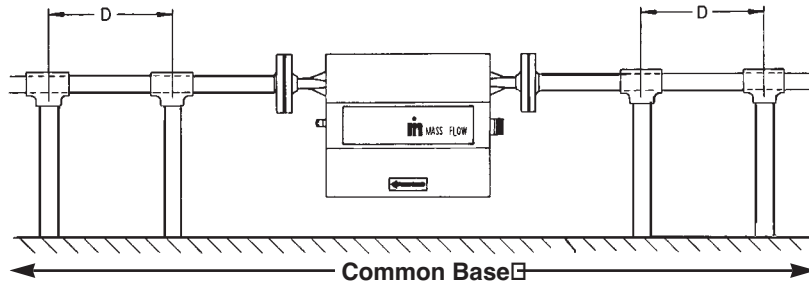


Figure 2.1.1: Transducer Mounting Requirements

- CAUTION:**
- Place pipe supports as close to the process connection as possible
 - Make sure pipe supports are securely clamped or attached to the process line
 - If multiple meters are installed in series or in parallel, piping to each meter must have separate supports. Coriolis Force flowmeters should not share the same pipe supports
 - Do not install a CFF in the highest part of the system. The lowest part of the system is preferred.
 - Do not use wood or any inferior material as a pipe support
 - Do not support the meter or its flanges with piping supports
 - Do not align piping using the meter. Make sure the pipe flanges are aligned with the meter flanges
 - Avoid having two meters mounted to the same superstructure to eliminate the potential of cross talk
 - Make sure the meter is grounded per local agency requirements (See Wiring Section 2.3.2)
 - Some installations require isolation supports that will prevent transfer of excessive vibration in to the sensor. In such situations, install isolation supports such as those manufactured by Stauff, Tel: (201) 444-7800, or Behringer, Tel: (201) 642-0546

2.1.2 Straight Run Requirements

The Actaris Coriolis Mass Flow meter has no straight run pipe diameter requirements for a given installation. Actaris believes that good piping practices should be used in the designing of any flow metering system.

2.1.3 Wall Mounting

A CFF may be mounted or secured to a wall providing that the piping is rigidly secured to the wall (**not the meter**). The wall will be unyielding to any reasonable force and to any vibration. No other vibration inducing device(s) is to be near or on the wall.

There are some disadvantages to wall mounting. For instance, if a vibration inducing device is common to or near a wall from ground or above level, the wall will transmit energy to the CFF affecting the performance and possibly the life of the meter.

NOTE: This configuration is NOT recommended for truck installations.

2.1.4 Common Floor

One of the three measured variables in a CFF is the frequency of vibration. Errors or deviations in this measured variable can result in poor meter performance that is corrected only with considerable changes to the flow metering system. Be sure to take the necessary steps to prevent this occurrence. One of the best methods to guarantee this is by providing a solid common support structure for the pipe supports. Pipe supports on each side of the CFF act as vibration isolators or a mechanical filter to remove unwanted outside vibration frequencies from reaching the meter.

NOTE: This common floor must be free of any type of vibration (e.g. I-beam, cement pad).

If a common floor does not exist, the designed vibration isolators and mechanical filters served by the common floor will be compromised. This will result in an ineffective filter and an uneven torqueing of the meter causing poor meter performance. Meter damage is also a possibility if the limit of mechanical torque on the meter is exceeded in the installation.

NOTE: Soil or dirt surface is not a common floor IF environmental conditions can affect the supports. This also applies if the structure is overhead.

On a truck system, apply the pipe supports to a rigid structure. For installations with excessive vibration use isolation supports.

2.1.5 Ceiling

This is an installation where the pipe supports are mounted to the ceiling or overhead structure above the CFF. If this is the case, ensure the overhead structure is rigid (not wood), and the structure is common to both pipe supports.

2.1.6 Floor Grating

THIS TYPE OF INSTALLATION IS NOT RECOMMENDED. At times, floor grating may be a common floor. However, it is not free from the effects of vibration made by floor movement from people or any vibration inducing device(s).

2.1.7 Valves (Zeroing, Check, Back Pressure, Differential, Air & Flow)

A downstream valve is required to zero the flow meter and to ensure the meter remains full. It can be mounted directly to the meter.

A check valve upstream prevents the drainage of the flow meter in the reverse direction.

On a truck mounted system, always zero the CFF under the actual conditions of a normal delivery (i.e.: engine running, PTO engaged) with the downstream valve or nozzle closed.

CAUTION: Never operate a truck mounted CFF with a different pump(s) than what was used during the original zeroing procedure.

A back pressure valve must be used in conjunction with an air eliminator **on a pumping installation (except gravity feed)**. This ensures that the flow meter will be kept full of product and provides the back pressure for good air elimination.

Differential control valve operation is similar to an air control valve's operation. However, differential control valves are mainly used with liquefied products. For example, LPG, NH₃, and products that have a high vapor pressure, subject to flashing under normal operating conditions.

Air control valves are primarily used in truck systems when multi-compartment deliveries are being made. The control valve provides a constant pressure for the fluid to overcome. This ensures that slugs of air do not pass through the meter. Refined fuel and lube oil truck applications include air control valves as standard equipment in the flow metering system.

Flow Control Valves are utilized in loading rack and custody transfer applications to maintain a constant flow rate through a blending or a preset delivery operation. In applications where the flow control valve is in a control loop, ensure that the control loop is properly tuned to minimize or remove any cycling of the flow rate around the desired flow rate setpoint. Large continuous changes in flow rate around the setpoint could adversely affect the performance of a CFF.

2.1.8 Air Elimination

An air eliminator or an effective means of air elimination is required in a metering system whenever the possibility of air entrainment exists. This is essential for the accurate measurement of product. Air or vapor can enter a system from tanks being pumped dry; leaking valves and fittings; and/or long exposed lines subjected to vaporization. This type of pump and piping arrangement is extremely important in a metering system. Positive displacement and self-priming centrifugal pumps will pump more air, making air elimination more difficult. Piping that pitches downward to feed a pump or has excessive bends and pockets complicates air elimination. Systems that use blind risers contribute to meter indication error due to alternate compression and expansion of air. **On a pumping installation (except gravity feed), a back pressure valve must be used in conjunction with an air eliminator.** This ensures that the flow meter will be kept full of product and provides the back pressure required for good air elimination.

Note: A CFF should be installed in the lowest part of the system. This best ensures that the CFF remains full, free of air entrainment.

2.1.9 Vacuum Breaker

Vacuum (vapor) break is installed at the highest point of the loading arm or towards the end of a filling hose or pipe. It serves to ensure that air does not siphon back into the system. At no flow conditions, the vacuum break ensures that the system is charged with product between itself and the valve downstream of the meter.

2.1.10 Pumps

Large capacity pumps, in particular positive displacement pumps will typically induce vibration into any metering system.

Whenever possible, these types of pumps should be isolated from the CFF and should not share the same floor structure.

In skid systems, isolate large capacity pumps on a separate skid to reduce excessive vibration being transmitted to the CFF through the floor structure.

In applications where multiple (or manifolded) pumps are used, offset the speed of each pump by a minimum of 100 rpm. This will help to minimize the harmonization of the pumps, thereby decreasing the hydraulic noise induced in the process fluid, and reducing the possibility of damage to system components.

CAUTION: Never operate a truck mounted CFF with a different pump than what was used during the original zeroing procedure.

On a truck mounted system, do not use different pumps to off-load multiple products through the same CFF.

2.2 Transducer Orientation

2.2.1 Horizontal (Normal Position)

The normal position of a CFF is in the horizontal configuration. The normal position ensures three (3) measurement characteristics of a CFF are not affected. Horizontal configuration better ensures that the meter will remain full and there is a low percentage of potential air entrainment.

There are some concerns to horizontal configuration of a CFF. For instance, under no flow conditions, solids or precipitates have a tendency to settle unevenly between the lowest areas of the flow tubes. The settling of the solids or precipitates may create the following situations:

- an unstable system zero
- an increase in density
- “tubes not vibrating” or “sensor error” warnings on the electronics display

2.2.2 Vertical

A CFF may be mounted in the vertical position. However, the flow through the meter should be in the upward direction in order to ensure that the meter remains full at all flow rates.

Mounting a CFF in the vertical positions does have its limitations. For instance, applications involving solids or precipitates have a tendency to settle unevenly between the lowest areas of the flow tubes under no flow conditions. The settling of the solids or precipitates may create the following situations:

- an unstable system zero
- an increase in density
- “tubes not vibrating” or “sensor error” warnings on the electronics display

2.2.3 Inverted

The second most popular method of installing a CFF is in the inverted position. The inverted position should be considered in the following applications:

- Food & Beverage and Pharmaceutical Industries require flowmeters to be cleaned in place (CIP) or steamed in place (SIP).

Note: *The Actaris 3A authorized mass flow meter in its horizontal (normal) position is self draining (i.e., the tubes are inverted.)*

- In Solids Content applications as solids or precipitates have a tendency to fall out of solution under no flow conditions
- On truck systems, an Actaris CFF in the inverted position provides for a compact installation inside the truck outer compartment

Listed below are some limitations of the inverted position:

- Higher percentage of air entrainment may require effective air elimination (See section on Special Considerations - Air)
- Inverted position of the meter requires an additional valve upstream of the meter in order to prevent drainage of the meter in the reverse direction under no flow conditions

2.2.4 Side

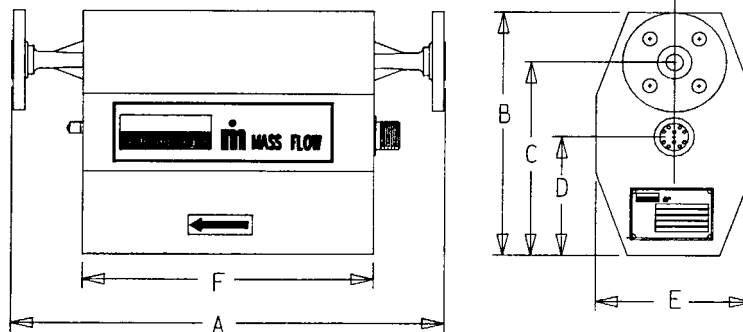
NOTE: *This type of installation is not recommended; however, if your installation requires side mounting configuration, contact an Actaris Representative.*

On a side mounted position, the product flow will have a natural tendency to settle in the lowest flowtube. The likely result is an imbalance and a “tubes not vibrating” or “sensor error” warning on the display of the electronics.

A continuous application may be suitable for this type of mounting configuration.

2.2.5 Physical Dimensions

		Dimensions														
Model	Size	Connection	A1		A2		B		C		D		E		F	
			cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in
m012-1/8"		3/8" VCO	33.60	13.23	33.60	13.23	17.78	7.00	13.46	5.30	3.81	1.50	12.95	5.10	18.80	7.40
		1/2" 150#	30.28	11.92	N/A	N/A										
m025-1/4"		3/8" VCO	42.27	16.64	42.27	16.64	20.07	7.90	15.75	6.20	9.14	3.60	13.21	5.20	26.92	10.60
		1/2" 150#	38.94	15.33												
		1/2" 300#	40.26	15.85												
		1/2" 600#	41.53	16.35												
		DN15 - PN40	37.72	14.85												
m050-1/2"		1" VCO	61.80	24.33	61.80	24.33										
		1/2" 150#	55.88	22.00												
		1/2" 300#	57.20	22.52												
		1/2" 600#	58.47	23.02												
		3/4" 150#	55.88	22.00												
		3/4" 300#	57.84	22.77												
		3/4" 600#	59.10	23.27												
		1" 150#	56.26	22.15												
		1" 300#	58.14	22.89												
		1" 600#	59.41	23.39												
		DN15 - PN 40	56.13	22.10												
		DN25 - PN 40														
M100-1"		1" 150#	68.76	27.07	78.16	30.77	33.78	13.30	27.43	10.80	17.78	7.00	22.35	8.80	48.26	19.00
		1" 300#	70.64	27.81												
		1" 600#	71.91	28.31												
		1 1/2" 150#	69.72	27.45												
		1 1/2" 300#	71.30	28.07												
		1 1/2" 600#	72.87	28.69												
		2" 150#	70.33	27.69												
		2" 300#	71.91	28.31												
		2" 600#	73.84	29.07												
		DN25 - PN 40	68.94	27.14												
		DN50 - PN 40														
		M200-2"		2" 150#												
2" 300#	88.19			34.72												
2" 600#	90.04			35.45												
3" 150#	87.58			34.48												
3" 300#	90.12			35.48												
3" 600#	91.92			36.19												
4" 150#	88.19			34.72												
4" 300#	91.08			35.86												
4" 600#	93.48			36.81												
DN50 - PN 40																
DN80 - PN 40	86.11			33.90												
DN100 - PN 40																



Notes: A1. 316L SS Wetted Part
A2. Hastelloy C-22
Wetted parts -
Lap-Joint Flanges.

Figure 2.2.5.1: Dimensional Diagram Standard (except m300 and m400)

Dimensions																	
Type	Model-Size	Connection Size	Eccentric Reducer Size	A'		A		B		C		D		E		F	
				cm	in	cm	in	cm	in	cm	in	cm	in	cm	in	cm	in
Sanitary	m012-1/8"	1 1/2"	1 1/2"x1/2"	23.5	9.2	41.2	16.2	17.8	7.0	13.5	5.3	3.8	1.5	12.7	5.0	5.0	2.0
	m025-1/4"	1 1/2"	1 1/2"x1/2"	31.8	12.5	49.6	19.5	20.1	7.9	15.7	6.2	9.1	3.6	13.2	5.2	5.0	2.0
	m050-1/2"	2"	2"x1"	45.5	17.9	70.9	27.9	22.4	8.8	17.8	7.0	10.2	4.0	15.0	5.9	6.4	2.5
	m100-1"	2.5"	2 1/2"x1 1/2"	53.6	21.1	79.0	31.1	33.8	13.3	27.4	10.8	17.8	7.0	22.4	8.8	7.7	3.1
	m200-2"	4"	4"x3"	69.2	27.3	95.3	37.5	55.6	21.9	44.5	17.5	26.7	10.5	37.6	14.8	11.8	4.7
Industrial	m025-1/4"	1 1/2"	1 1/2"x1/2"	38.2	15.0	56.0	22.0	20.1	7.9	15.7	6.2	9.1	3.6	13.2	5.2	5.0	2.0
	m050-1/2"	2"	2"x1"	55.1	21.7	72.9	28.7	22.4	8.8	17.8	7.0	10.2	4.0	15.0	5.9	5.0	2.0
	m100-1"	2.5"	2 1/2"x1 1/2"	68.3	26.9	93.7	36.9	33.8	13.3	27.4	10.8	17.8	7.0	22.4	8.8	6.4	2.5
	m200-2"	4"	4"x3"	85.0	33.5	111.1	43.7	55.6	21.9	44.5	17.5	26.7	10.5	37.6	14.8	11.9	4.7

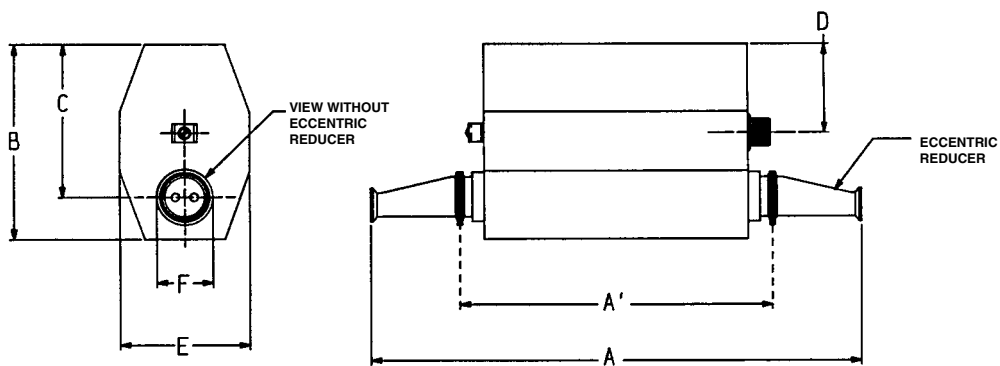
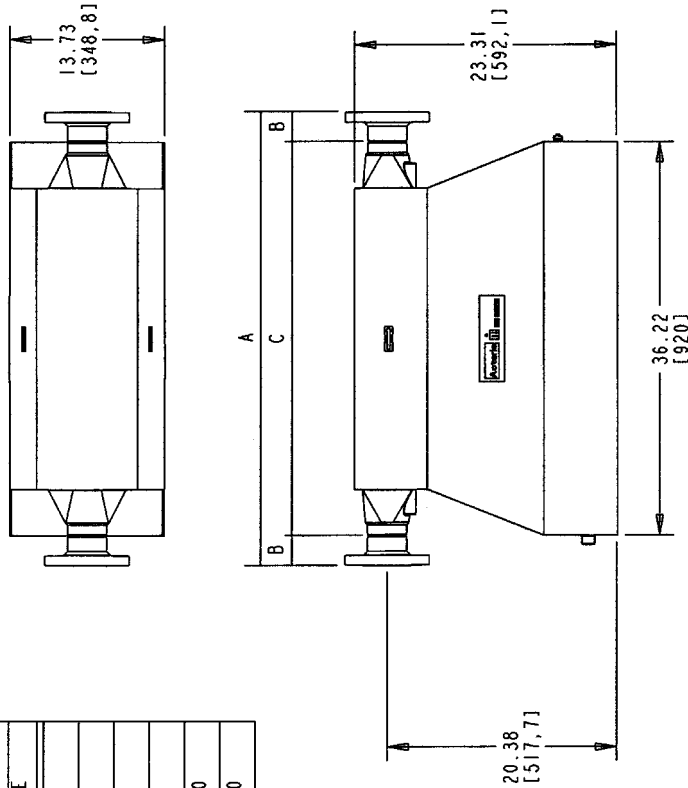


Figure 2.2.5.2: Dimensional Diagram (3A-Sanitary Tri Clamp®)

LTR	REVISION	DATE	AUTH	BY	APPD
A	INITIAL RELEASE	6/29/99	N30856	MT	SHERPA
B	REDESIGNED HOUSING	7/26/00	N44114	MT	SHERPA
C	REDESIGNED HOUSING	9/24/02	00080208	RC	MFGPRO

METERS WITH "DIN" FLANGE CONNECTIONS			
A (mm)	B (mm)	C (mm)	FLANGE SIZE
1037	58	921	PN40-DN80
1051	65	921	PN40-DN100
1071	75	921	PN40-DN150
1077	78	921	PN100-DN80
1101	90	921	PN100-DN100
1151	115	921	PN100-DN150

METERS WITH "ANSI" FLANGE CONNECTIONS			
A (in)	B (in)	C (in)	FLANGE SIZE
41.75	2.75	36.25	3"-150#
42.50	3.12	36.25	3"-300#
42.75	3.25	36.25	3"-600#
44.25	4.00	36.25	3"-900#
42.25	3.00	36.25	4"-150#
43.00	3.38	36.25	4"-300#
44.25	4.00	36.25	4"-600#
45.25	4.50	36.25	4"-900#
43.25	3.50	36.25	6"-150#
44.00	3.88	36.25	6"-300#
45.50	4.62	36.25	6"-600#
47.25	5.50	36.25	6"-900#



SCALE 0:1

UNLESS OTHERWISE SPECIFIED		MATERIAL		DWG. TITLE		REV.	
BREAK EDGES .0057.015		HEAT TREAT		SHEET 1-1		M300 DIMENSIONAL DATA	
SURFACE FINISH $\sqrt{}$		FINISH SPECIFICATION		SCALE NOTED		NO. D001065	
DECIMALS	2 PL .01					GREENWOOD, SOUTH CAROLINA	
FRACTIONS	3 PL .005					C	
ANGLES	$\pm 1^\circ$						
DO NOT SCALE DRAWING							

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Figure 2.2.5.3: Dimensional Diagram Standard (m300)

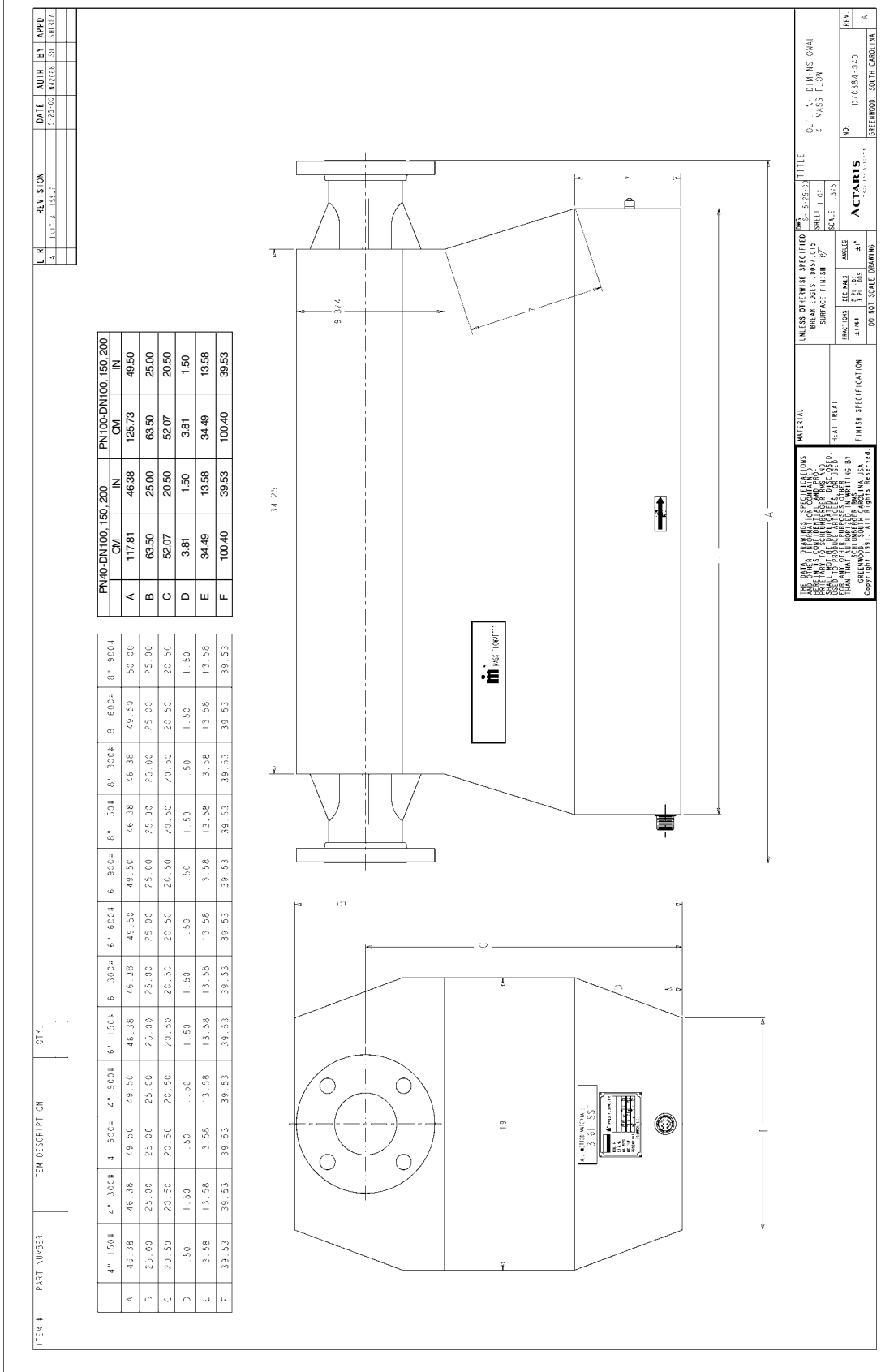


Figure 2.2.5.4: Dimensional Diagram Standard (m400)

2.3 Transmitter (Electronics) Installation

2.3.1 General Considerations

When unpacking a Actaris Coriolis Force Flow Meter, the Belden interconnect cable located between the flow meter and its electronics is included (if ordered). This cable is of prime importance to the operation of the meter. Therefore, make sure you run this cable correctly.

The interconnect cable is an 8 conductor Belden 89892. It consists of 4 shielded twisted pairs and a separate shield.

WARNING: DO NOT SPLICE THIS CABLE FOR ANY REASON.

If the cable is too short, order a replacement cable that is manufactured to the correct length.

DO NOT MOUNT THE CFF ELECTRONICS OR THE TRANSDUCER NEAR RADIO FREQUENCY OR ELECTROMAGNETIC INTERFERENCE SOURCES SUCH AS VARIABLE-FREQUENCY MOTORS, RADIO TRANSMITTERS, LARGE SWITCH GEAR, OR HIGH VOLTAGE CABLES.

When running the cable, **DO NOT RUN THE CABLE IN THE SAME CABLE TRAY OR SAME CONDUIT AS HIGH VOLTAGE POWER CABLES AND/OR SOURCES OF EMI/RFI NOISE.** These can cause interference with the signals from the meter.

THE FLOW METER AND ITS CALIBRATED ELECTRONICS ARE IDENTICALLY MATCHED BY SERIAL NUMBER FOUND ON THE NAMETAG OR ON THE SIDE OF THE ORIGINAL BOX.

If the transducer is purchased as a replacement or a spare without a set of electronics, refer to Section III.2 to III.6 of the Datamate 2100 O&M Manual (M610).

If power to the CFF electronics is not clean, **INSTALL POWER LINE CONDITIONERS.**

SEAL OFF UNUSED CABLE ENTRIES.

On truck systems, the CFF electronics (except the NexGen SFT100) is normally powered using marine inverters that convert 12VDC to 110VAC. Typically 250 Watt marine inverters are used. The input power to the CFF electronics is supplied through a power line conditioner with a 35VA minimum rating.

WARNING: THE CFF ELECTRONICS USES A DEDICATED MARINE INVERTER. A SECONDARY MARINE INVERTER SHOULD BE USED FOR AUXILLIARY EQUIPMENT, TO PREVENT ELECTRICAL INTERFERENCE WITH THE CFF ELECTRONICS POWER SUPPLY.

2.3.2 Hazardous Area Approvals

Agency	Components	Method	Class	Div./Zone	Group	Temp. Class	Ambient Temp.
FM	Transducer	Intrinsic Safety	I,II,III	1	C,D,E,F,G	T5*	2
				2	A,B,C,D	T5*	2
	Datamate	Non-incendive	I	2	A,B,C,D	T5	4
				NexGen	Explosion-Proof	I,II, III	1
2	A,B,C,D	T4	4				
CSA	Transducer	Intrinsic Safety	I,II,III	1	C,D,E,F,G		2
				2	C,D,E,F,G		2
	Datamate	Non-incendive	I,II,III	2	C,D	T4A	4
				NexGen	Explosion Proof	I,II,III	1
	2	A,B,C,D,E,F,G	T4				4

*M300 rated at T6

Ambient temperature limits:

- 2 -20°C to 40°C (-4 to 104°F)
- 3 -20°C to 60°C (-4 to 140°F)

2.3.3 Wiring

NOTE: *If the CFF Electronics Form C batching relays are used, it is recommended that a snubber circuit is installed across the batching relay contacts TB1 and TB2 respectively to protect against power surges from the solenoid.*

A snubber circuit is typically comprised of the following placed in series:

1. Capacitor (0.1 μ f, non-polarized, 250V)
2. Resistor (100 ohm, 1/4 watt resistor)

CAUTION: The CFF Electronics power circuit should not be used as the power circuit for the batch control devices (e.g., motors, relays, solenoids, etc.) If this is not possible, a power line conditioner should be installed to isolate the CFF electronics from the voltage transients that may be created by them.

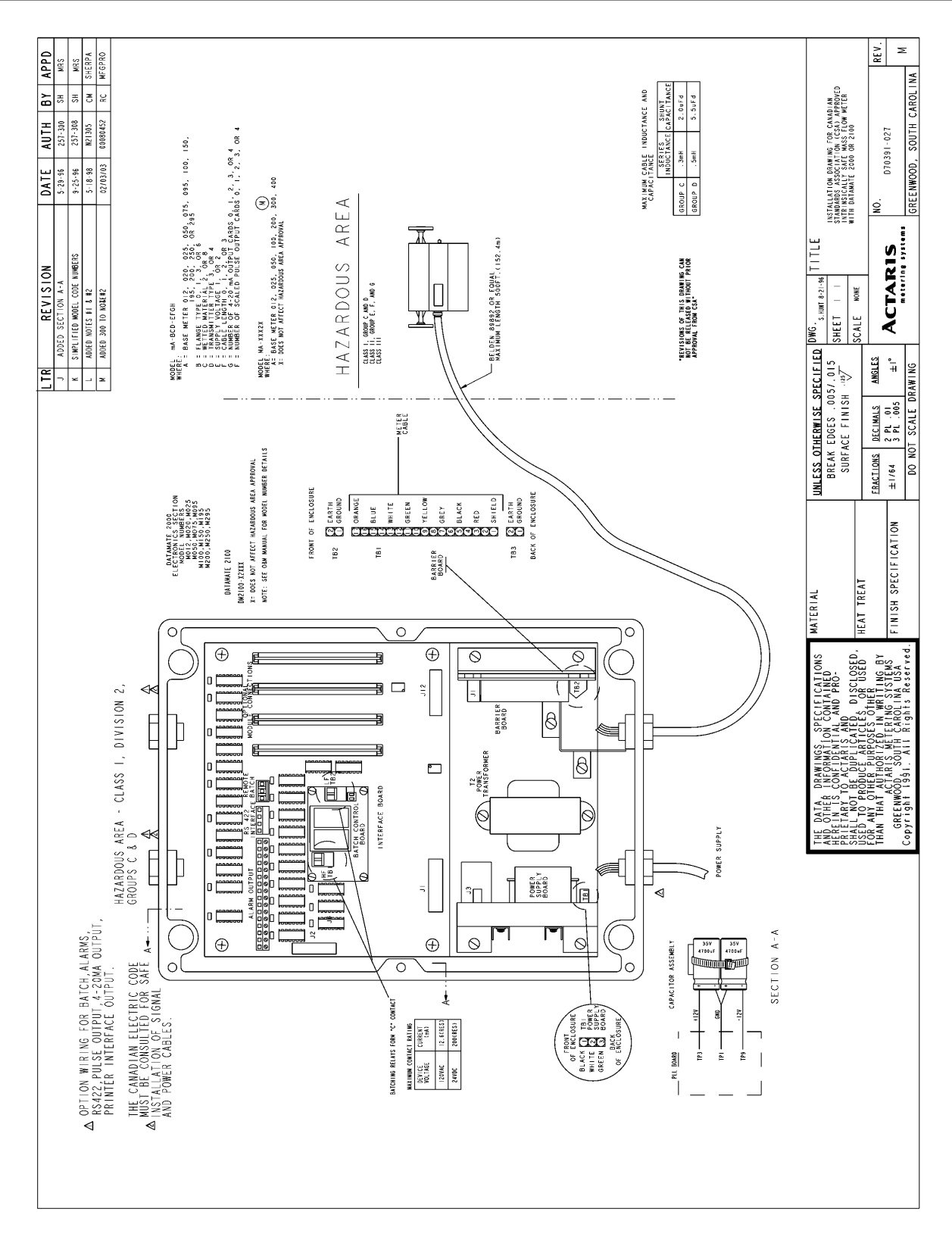


Figure 2.3.3.2: Installation Drawing, CSA I.S. Meters with Non-Incendive Datamate 2100 (except m300)

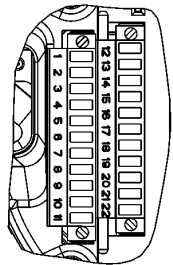
NONHAZARDOUS OR HAZARDOUS AREA

NEXGEN[®] CORIOLIS FLOW TRANSMITTER SFT100

J2

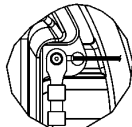
1	START BATCH PB IN
2	PB RETURN
3	STOP BATCH PB IN
4	HART OUT
5	HART IN
6	12V RETURN (-)
7	RS485 A
8	RS485 B
9	ALARM1 OUT
10	ALARM RETURN
11	ALARM2 OUT
12	CURRENT1 OUT (+)
13	CURRENT1 RETURN (-)
14	CURRENT2 OUT (+)
15	CURRENT2 RETURN
16	12V SUPPLY (+)
17	PULSE OUT
18	PULSE/QUAD RETURN
19	QUADATURE OUT
20	BATCH1 OUT
21	BATCH RETURN
22	BATCH2 OUT

PROCESS CONTROL I/O
DETAIL A



CLASS I, DIVISION 1, GROUPS C & D
CLASS II, DIVISION 1, GROUPS E, F & G
CLASS III, DIVISION 1
CLASS I, DIVISION 2, GROUPS A, B, C, & D

PROVIDES INTRINSICALLY SAFE CONNECTIONS TO ACTARIS
MODEL M CORIOLIS MASS FLOWMETERS LOCATED:
CLASS I, DIVISION 1, GROUPS C & D
CLASS II, DIVISION 1, GROUPS E, F, & G
CLASS III, DIVISION 1

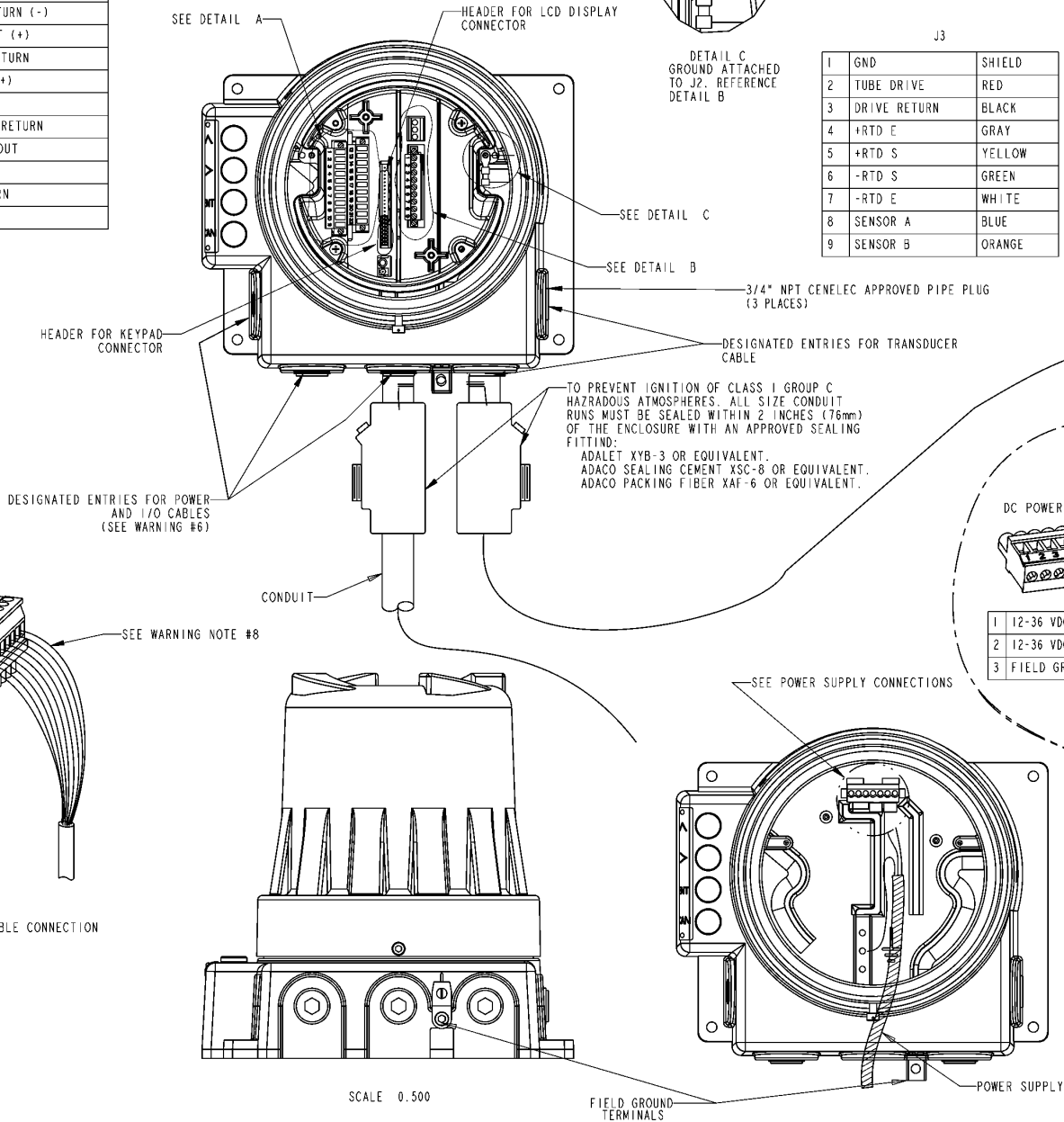


J2

1	IS
2	IS
3	IS

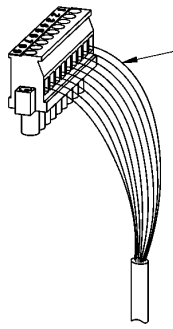
J3

		SHIELD
1	GND	
2	TUBE DRIVE	RED
3	DRIVE RETURN	BLACK
4	+RTD E	GRAY
5	+RTD S	YELLOW
6	-RTD S	GREEN
7	-RTD E	WHITE
8	SENSOR A	BLUE
9	SENSOR B	ORANGE

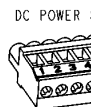


DESIGNATED ENTRIES FOR POWER AND I/O CABLES (SEE WARNING #6)

TO PREVENT IGNITION OF CLASS I GROUP C HAZARDOUS ATMOSPHERES. ALL SIZE CONDUIT RUNS MUST BE SEALED WITHIN 2 INCHES (76mm) OF THE ENCLOSURE WITH AN APPROVED SEALING FITTING:
ADALET XYB-3 OR EQUIVALENT.
ADACO SEALING CEMENT XSC-8 OR EQUIVALENT.
ADACO PACKING FIBER XAF-6 OR EQUIVALENT.



TRANSDUCER CABLE CONNECTION



DC POWER

1	12-36 VDC
2	12-36 VDC
3	FIELD GRO

SCALE 0.500

FIELD GROUND TERMINALS

POWER SUPPLY

Figure 2.3.3.3: Installation Drawing, CSA I.S. Meter with Explosion proof NexGen SFT100

LTR	REVISION	DATE	AUTH	BY	APPD
D	ADDED NOTE #10	10/16/98	N25278	TAS	SHERPA
E	ADDED M300 TO NOTE	1/31/03	00080452	RC	MFGPRO

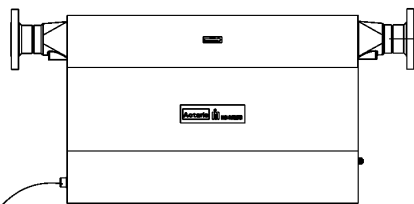
HAZARDOUS AREA

CLASS I, II, III, DIVISION I, GROUPS C, D, E, F, G

MODEL mA - XXX2X

WHERE:

A = BASE METER 012, 025, 050, 100, 200, 300, 400
 X = DOES NOT AFFECT HAZARDOUS AREA APPROVAL.

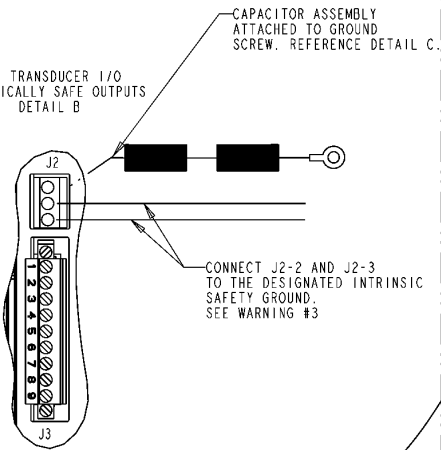


Model M CORIOLIS MASS FLOWMETER
 Model M012, M025, M050, M100, M200, M300, M400

MAXIMUM FLOWMETER CABLE INDUCTANCE & CAPACITANCE

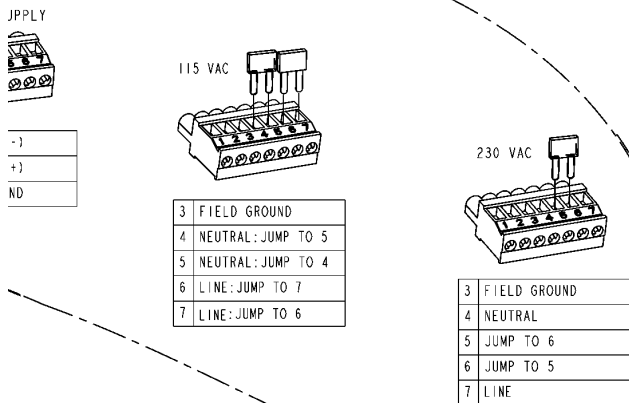
GROUP	C CABLE (uF)	L CABLE (mH) OR L/R CABLE (uH/Ω)
A, B (DIV 2)	9.3	25
C, E (DIV 1)	10.3	2.48 287
D, F, G (DIV 1)	41.0	17.4 574

⑥



BELDEN #89892 or EQUAL (4) PAIR CABLE

POWER SUPPLY INPUT CONNECTIONS



WARNING:

- SUBSTITUTION OF NEXGEN COMPONENTS MAY IMPAIR INTRINSIC SAFETY OF TRANSDUCER.
- NEXGEN COVER MUST BE CLOSED WHILE CIRCUITS ARE ALIVE.
- RESISTANCE BETWEEN INT. SAFE GND. AND EARTH GROUND MUST BE LESS THAN 1 OHM.
- CONTROL EQUIPMENT CONNECTED TO NEXGEN MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc.
- NO REVISION TO THIS DRAWING WITHOUT PRIOR CSA APPROVAL.
- TO PREVENT IGNITION OF CLASS I GROUP C HAZARDOUS ATMOSPHERES. ALL SIZE CONDUIT RUNS MUST BE SEALED WITHIN 2 INCHES (50 mm) OF ENCLOSURE WITH CERTIFIED SEALING FITTING. ALL NON-INTRINSICALLY SAFE CABLING MUST BE RUN THROUGH CONDUIT WITH CERTIFIED SEALING FITTINGS.
- INSTALLATION OF INTRINSICALLY SAFE SYSTEMS FOR HAZARDOUS (CLASSIFIED) LOCATIONS SHOULD BE IN ACCORDANCE WITH CCEC PT. 1, SEC. 18, APPENDIX F.
- TRANSDUCER CABLE TO BE STRIPPED NO MORE THAN 6.0".
- GROUND THE NEXGEN'S ENCLOSURE USING THE MECHANICAL GROUND LUG LOCATED BETWEEN THE 3/4" CONDUIT ENTRIES ON THE BOTTOM OF THE ENCLOSURE. USE A 14 AWG COPPER CONDUCTOR FOR THIS GROUND.
- AN INTRINSIC SAFETY GROUND IS PROVIDED FROM TERMINAL NUMBER 3 ON THE BARRIER BOARD CONNECTOR THROUGH THE BLACK CONDUCTOR TO PIN "J" ON THE TRANSDUCER CONNECTOR. AN EXTERNAL INTRINSIC SAFETY GROUND IS NOT REQUIRED.

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MATERIAL	UNLESS OTHERWISE SPECIFIED		DWG. RC	TITLE INSTALLATION DRAWING FOR CANADIAN STANDARDS ASSOCIATION (CSA) APPROVED INTRINSICALLY SAFE MODEL M CORIOLIS MASS FLOWMETER WITH EXPLOSION PROOF NEXGEN ASSEMBLY	
HEAT TREAT	BREAK EDGES .005/.015 SURFACE FINISH $\sqrt{125}$		SHEET 1/1		
FINISH SPECIFICATION	FRACTIONS $\pm 1/64$	DECIMALS 2 PL .01 3 PL .005	SCALE NTS	NO. D70500-007	REV. E
	DO NOT SCALE DRAWING		ACTARIS		GREENWOOD, SOUTH CAROLINA

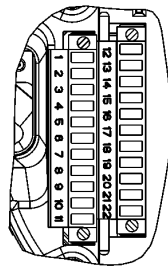
NONHAZARDOUS OR HAZARDOUS AREA

NEXGEN[®] CORIOLIS FLOW TRANSMITTER SFT100

J2

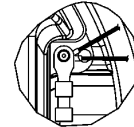
1	START BATCH PB IN
2	PB RETURN
3	STOP BATCH PB IN
4	HART OUT
5	HART IN
6	12V RETURN (-)
7	RS485 A
8	RS485 B
9	ALARM1 OUT
10	ALARM RETURN
11	ALARM2 OUT
12	CURRENT1 OUT (+)
13	CURRENT1 RETURN (-)
14	CURRENT2 OUT (+)
15	CURRENT2 RETURN
16	12V SUPPLY (+)
17	PULSE OUT
18	PULSE/QUAD RETURN
19	QUADATURE OUT
20	BATCH1 OUT
21	BATCH RETURN
22	BATCH2 OUT

PROCESS CONTROL I/O
DETAIL A



EXPLOSIONPROOF: CLASS I, DIVISION I, GROUPS C & D
DUST/IGNITIONPROOF: CLASS II, III, DIVISION I, GROUPS E, F & G
CLASS III

PROVIDES INTRINSICALLY SAFE CONNECTIONS TO ACTARIS
MODEL M CORIOLIS MASS FLOWMETERS LOCATED:
CLASS I, DIVISION I, GROUPS C & D
CLASS II, DIVISION I, GROUPS E, F, & G
CLASS III, DIVISION I



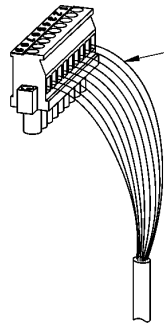
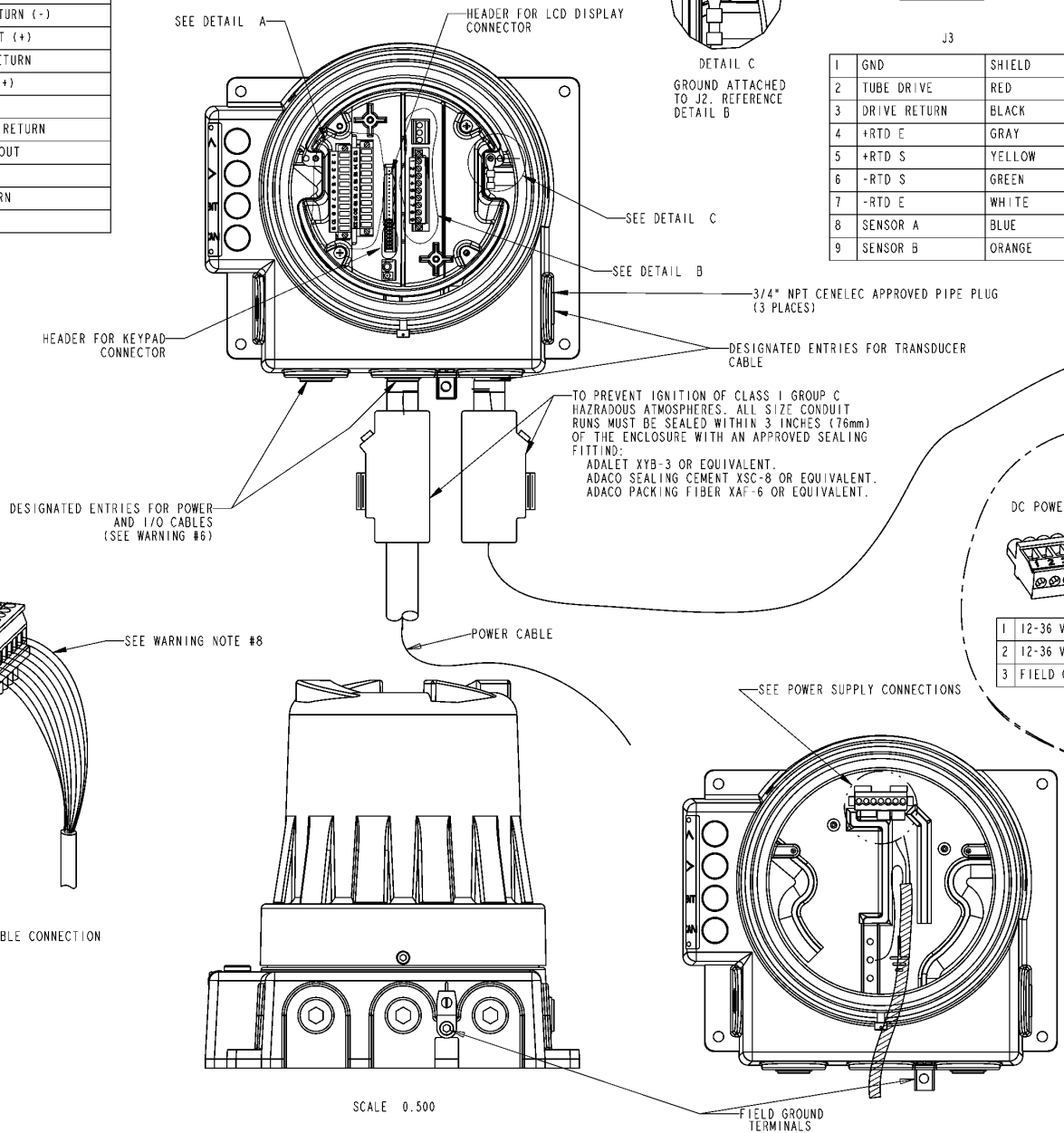
DETAIL C
GROUND ATTACHED
TO J2. REFERENCE
DETAIL B

J2

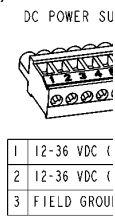
1	IS
2	1S
3	GROUNDS

J3

1	GND	SHIELD
2	TUBE DRIVE	RED
3	DRIVE RETURN	BLACK
4	+RTD E	GRAY
5	+RTD S	YELLOW
6	-RTD S	GREEN
7	-RTD E	WHITE
8	SENSOR A	BLUE
9	SENSOR B	ORANGE



TRANSDUCER CABLE CONNECTION



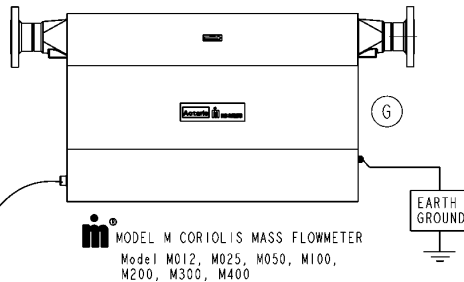
1	12-36 VDC (
2	12-36 VDC (
3	FIELD GROU

Figure 2.3.3.4: Installation Drawing, FM I.S. Meter with Explosion Proof NexGen SFT100

LTR	REVISION	DATE	AUTH	BY	APPD
F	SPECIFIED METER MODEL SIZES	2-4-00	N25278	SH	SHERPA
G	ADDED CHART, CHANGED M300 VIEW	1/31/03	00080451	RC	MFGPRO

HAZARDOUS AREA

INTRINSICALLY SAFE:
 CLASS I, II, III, DIVISION 1, GROUPS C, D, E, F, G
 NONINCENDIVE:
 CLASS I, DIVISION 2, GROUPS A, B, C, D



MAXIMUM CABLE INDUCTANCE & CAPACITANCE

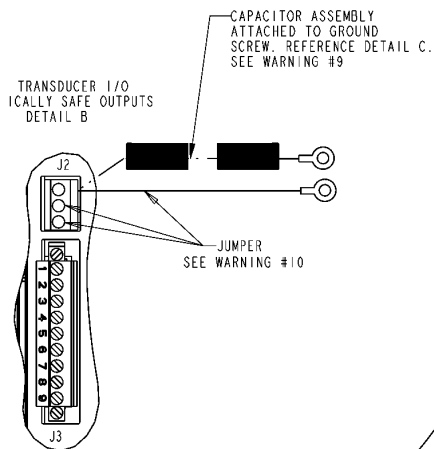
GROUP	C CABLE (uF)	L CABLE (mH) OR L/R CABLE (uH/Ω)
A, B (DIV 2)	9.3	25
C, E (DIV 1)	10.3	2.48
D, F, G (DIV 1)	41.0	17.4

MAXIMUM CABLE INDUCTANCE & CAPACITANCE M300 ONLY

	SERIES INDUCTANCE	SHUNT CAPACITANCE
GROUP A (DIVISION 2 ONLY)	.3mH	0.5 uFd
GROUP B (DIVISION 2 ONLY)	.3mH	0.5 uFd
GROUP C, E	.3mH	0.5 uFd
GROUP D, F, G	0.5mH	1.7 uFd

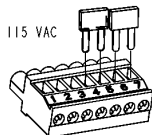
WARNING:

- SUBSTITUTION OF NEXGEN COMPONENTS MAY IMPAIR INTRINSIC SAFETY OF TRANSDUCER.
- NEXGEN COVER MUST BE CLOSED WHILE CIRCUITS ARE ALIVE.
- RESISTANCE BETWEEN INT. SAFE GND. AND EARTH GROUND MUST BE LESS THAN 1 OHM.
- CONTROL EQUIPMENT CONNECTED TO NEXGEN MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc.
- NO REVISION TO THIS DRAWING WITHOUT PRIOR FM APPROVAL.
- TO PREVENT IGNITION OF CLASS I GROUP C HAZARDOUS ATMOSPHERES. ALL SIZE CONDUIT RUNS MUST BE SEALED WITHIN 3 INCHES (50 mm) OF ENCLOSURE WITH CERTIFIED SEALING FITTING. ALL NON-INTRINSICALLY SAFE CABLING MUST BE RUN THROUGH CONDUIT WITH CERTIFIED SEALING FITTINGS.
- INSTALLATION SHOULD BE IN ACCORDANCE WITH ANSI/ISA RP12.6. INSTALLATION OF INTRINSICALLY SAFE SYSTEMS FOR HAZARDOUS (CLASSIFIED) LOCATIONS AND THE NATIONAL ELECTRIC CODE (ANSI/NFPA 70).
- TRANSDUCER CABLE TO BE STRIPPED NO MORE THAN 6.0".
- REMOVE CAPACITOR ASSEMBLY IF INSTALLATION HAS AN EQUIPOTENTIAL GROUND SYSTEM.
- REMOVE JUMPER IF INSTALLATION DOES NOT HAVE AN EQUIPOTENTIAL GROUND SYSTEM.
- GROUND THE NEXGEN'S ENCLOSURE USING THE MECHANICAL GROUND LUG. LOCATED BETWEEN THE 3/4" CONDUIT ENTRIES ON THE BOTTOM OF THE ENCLOSURE. USE A 14 AWG COPPER CONDUCTOR FOR THIS GROUNDING.

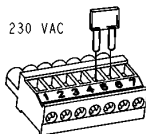


BELDEN #89892 or EQUAL
(4) PAIR CABLE

POWER SUPPLY INPUT CONNECTIONS



3	FIELD GROUND
4	NEUTRAL: JUMP TO 5
5	NEUTRAL: JUMP TO 4
6	LINE: JUMP TO 7
7	LINE: JUMP TO 6



3	FIELD GROUND
4	NEUTRAL
5	JUMP TO 6
6	JUMP TO 5
7	LINE

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MATERIAL	UNLESS OTHERWISE SPECIFIED BREAK EDGES .005/.015 SURFACE FINISH $\sqrt{125}$	DWG. RC	TITLE
HEAT TREAT		SHEET	INSTALLATION DRAWING FOR FACTORY MUTUAL (FM) APPROVED INTRINSICALLY SAFE MODEL M MASS FLOWMETER WITH EXPLOSION PROOF NEXGEN ASSEMBLY
FINISH SPECIFICATION	FRACTIONS DECIMALS ANGLES $\pm 1/64$ 2 PL .01 3 PL .005 $\pm 1^\circ$	SCALE	NO. D70500-008
	DO NOT SCALE DRAWING		REV. G
		ACTARIS GREENWOOD, SOUTH CAROLINA	

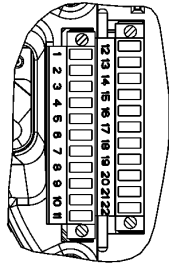
NONHAZARDOUS OR HAZARDOUS AREA

NEXGEN[®] CORIOLIS FLOW TRANSMITTER SFT100

J2

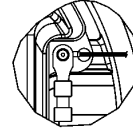
1	START BATCH PB IN
2	PB RETURN
3	STOP BATCH PB IN
4	HART OUT
5	HART IN
6	12V RETURN (-)
7	RS485 A
8	RS485 B
9	ALARM1 OUT
10	ALARM RETURN
11	ALARM2 OUT
12	CURRENT1 OUT (+)
13	CURRENT1 RETURN (-)
14	CURRENT2 OUT (+)
15	CURRENT2 RETURN
16	12V SUPPLY (+)
17	PULSE OUT
18	PULSE/QUAD RETURN
19	QUADATURE OUT
20	BATCH1 OUT
21	BATCH RETURN
22	BATCH2 OUT

PROCESS CONTROL I/O
DETAIL A



CLASS I, DIVISION 2, GROUPS A, B, C, & D

PROVIDES INTRINSICALLY SAFE CONNECTIONS TO ACTARIS
MODEL M CORIOLIS MASS FLOWMETERS LOCATED:
CLASS I, DIVISION 1, GROUPS C & D
CLASS II, DIVISION 1, GROUPS E, F, & G
CLASS III, DIVISION 1



DETAIL C
GROUND ATTACHED
TO J2. REFERENCE
DETAIL B

J2

1	IS
2	GROUNDS
3	

J3

1	GND	SHIELD
2	TUBE DRIVE	RED
3	DRIVE RETURN	BLACK
4	+RTD E	GRAY
5	+RTD S	YELLOW
6	-RTD S	GREEN
7	-RTD E	WHITE
8	SENSOR A	BLUE
9	SENSOR B	ORANGE

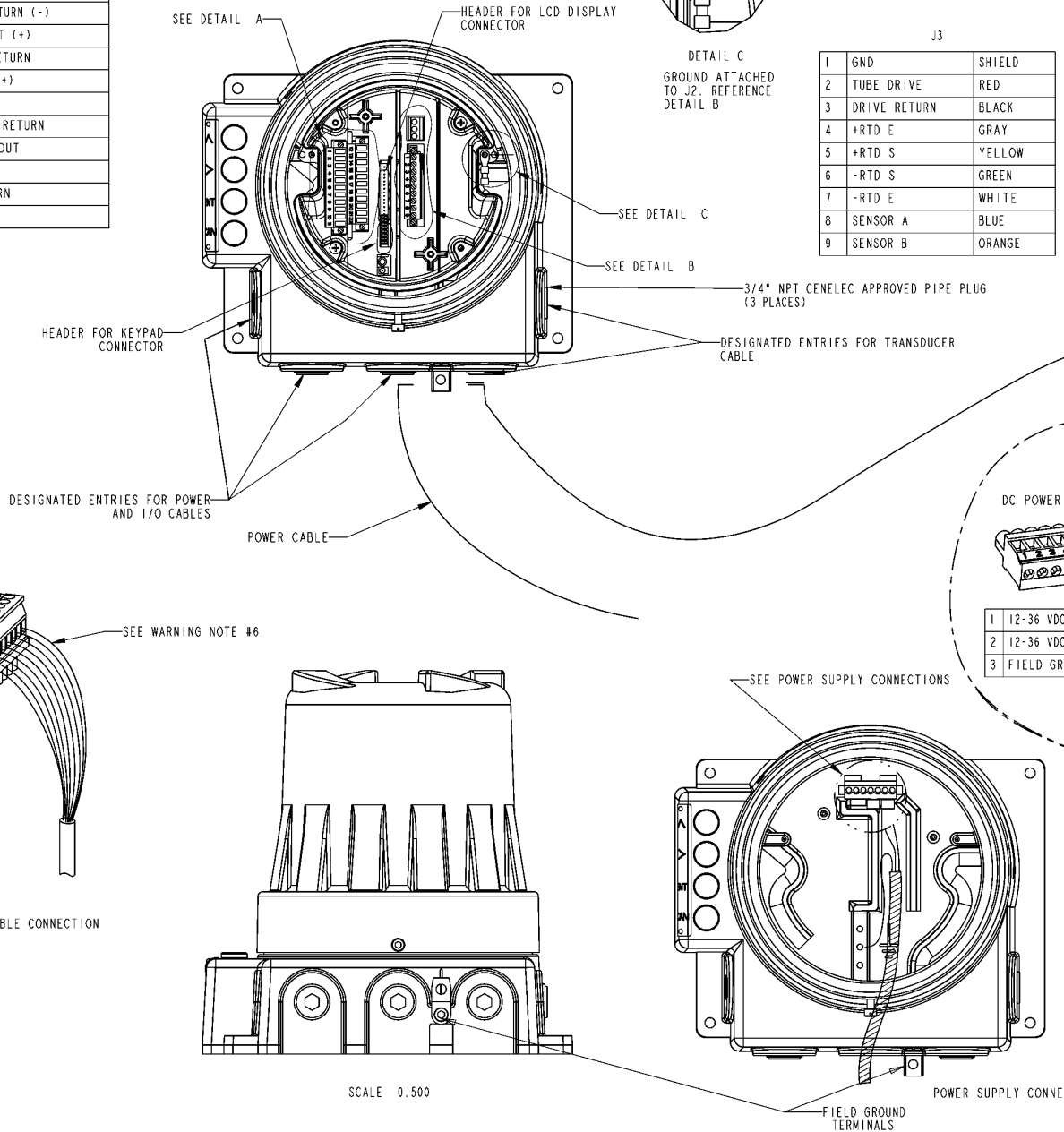
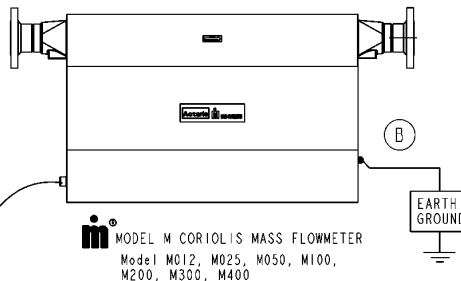
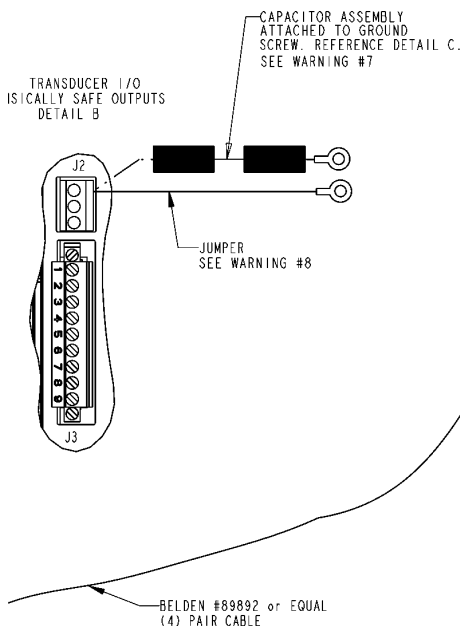


Figure 2.3.3.5: Installation Drawing, FM I.S. Meter (m300) with NexGen SFT100

LTR	REVISION	DATE	AUTH	BY	APPD
A	RELEASE	10/7/98	N24940	JD	SHERPA
B	ADDED CHART, CHANGED M300 VIEW	1/31/03	00080451	RC	MFGPRO

HAZARDOUS AREA

INTRINSICALLY SAFE:
 CLASS I, II, III, DIVISION 1, GROUPS C, D, E, F, G
 NONINCENDIVE:
 CLASS I, DIVISION 2, GROUPS A, B, C, D



MAXIMUM FLOWMETER CABLE INDUCTANCE & CAPACITANCE

GROUP	C CABLE (uF)	L CABLE (mH) OR L/R CABLE (uH/Ω)
A, B (DIV 2)	9.3	25
C, E (DIV 1)	10.3	2.48
D, F, G (DIV 1)	41.0	17.4

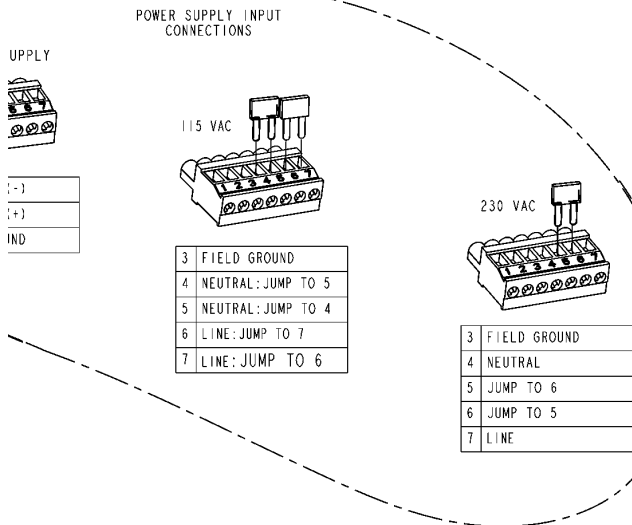
(B)

M300 ONLY
 MAXIMUM CABLE INDUCTANCE & CAPACITANCE

	SERIES INDUCTANCE	SHUNT CAPACITANCE
GROUP A (DIVISION 2 ONLY)	.3mH	0.5 uFd
GROUP B (DIVISION 2 ONLY)	.3mH	0.5 uFd
GROUP C, E	.3mH	0.5 uFd
GROUP D, F, G	0.5mH	1.7 uFd

WARNING:

- SUBSTITUTION OF NEXGEN COMPONENTS MAY IMPAIR INTRINSIC SAFETY OF TRANSDUCER.
- RESISTANCE BETWEEN INT. SAFE GND. AND EARTH GROUND MUST BE LESS THAN 1 OHM.
- CONTROL EQUIPMENT CONNECTED TO NEXGEN MUST NOT USE OR GENERATE MORE THAN 250 Vrms OR Vdc.
- NO REVISION TO THIS DRAWING WITHOUT PRIOR FM APPROVAL.
- INSTALLATION SHOULD BE IN ACCORDANCE WITH ANSI/ISA RP12.6. INSTALLATION OF INTRINSICALLY SAFE SYSTEMS FOR HAZARDOUS (CLASSIFIED) LOCATIONS AND THE NATIONAL ELECTRIC CODE (ANSI/NFPA 70).
- TRANSDUCER CABLE TO BE STRIPPED NO MORE THAN 6.0".
- REMOVE CAPACITOR ASSEMBLY IF INSTALLATION HAS AN EQUIPOTENTIAL GROUND SYSTEM.
- REMOVE JUMPER IF INSTALLATION DOES NOT HAVE AN EQUIPOTENTIAL GROUND SYSTEM.



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MATERIAL	UNLESS OTHERWISE SPECIFIED BREAK EDGES .005/.015 SURFACE FINISH $\sqrt{16}$	DWG T. SWEENEY	TITLE INSTALLATION DRAWING FOR FACTORY MUTUAL (FM) APPROVED INTRINSICALLY SAFE MODEL M MASS FLOWMETER WITH NEXGEN ASSEMBLY
HEAT TREAT	FRACTIONS DECIMALS ANGLES $\pm 1/64$ 2 PL .01 3 PL .005 $\pm 1^\circ$	SHEET	NO. D001029
FINISH SPECIFICATION	DO NOT SCALE DRAWING	SCALE	REV. B

ACTARIS

GREENWOOD, SOUTH CAROLINA

2.4 Troubleshooting

2.4.1 Transducer Resistances Nominal Value

Note: In older m300 model transducers cable connections are made directly to a PCB terminal board contained within a conduit connection box located on the side of the transducer body. More recent models use the standard screw tape connection method.

Figure 2.4.1 lists terminal designations for Actaris transducers using the screw type cable connector.

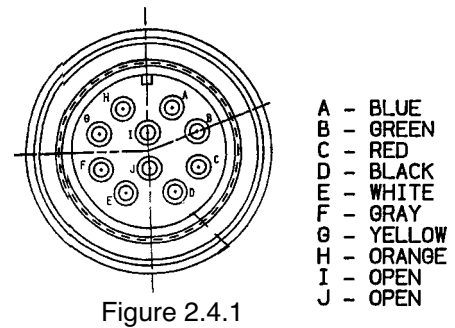


Figure 2.4.1

Figure 2.4.2 displays the m300 connector board terminals. This should be used if the m300 has the conduit box style connector.

To check integrity of wiring circuits, perform the following:

1. Disconnect the transmitters power supply.
2. Disconnect the transducer wiring from the transmitter's intrinsically safe terminal block in the transducer wiring area.
3. Use a digital multimeter (DMM) to measure resistance between wire pairs, as indicated in Table 2.4.1.1.
4. Use Table 2.4.1.2. to verify correct wiring at the NexGen transmitter terminals.
5. If the transmitter is remotely mounted from the transducer, repeat the measurements at the transducer cable connector on the transducer to distinguish cable failure. If the m300 has the conduit box type connection, it may be tested at the proper terminals on the terminal PCB.

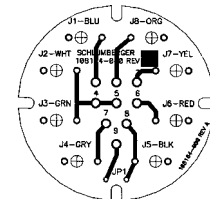


Figure 2.4.2 *

Allowable Transducer Resistances by Circuit and Transducer Size (ins.)									
Conductor Color	Transducer Pin-pairs	Circuit	m012 (1/8)	m025 (1/4)	m050 (1/2)	m100 (1)	m200 (2)	m300 (3)	m400 (4)
Red-Black	C-D	Drive	72-88	80-96	74-90	46-55	46-55	33-39	33-39
White-Blue	E-A	Sensor A	128-144	80-96	10-12	10-12	10-12	78-94	78-96
White-Orange	E-H	Sensor B	128-144	80-96	10-12	10-12	10-12	78-94	80-96
Green -Yellow	B-G	RTD Sense + to -	RTD - About 108 ohms at room temperature - all transducer sizes						
Black - CASE	J-CASE	Drive Return to transducer case	Less than 1 ohm - all transducer sizes						
	Any other combination		Over 100 megohms - all transducer sizes						
			From NexGen			At Transducer			
Gray - Yellow	F-G	RTD Excite to Sense +	Less than 1 ohm - all transducer sizes			Over 100 megohms - all transducer sizes			
White- Green	E-B	RTD Excite to Sense -							

Table 2.4.1.1: NexGen Allowable Transducer Resistances

Terminal Block	Pin Number	Label	Conductor Color	Transducer Connector Pin	m300 Terminal *	Function
J2	1	SHLD	Bare	None	None	Shield
J2	2	RED	Red	C	J6	Tube Drive
J2	3	BLK	Black	D	J5	Drive Common
J2	4	GRY	Gray	F	J4	RTD Excite +
J2	5	YEL	Yellow	G	J7	RTD Sense +
J2	6	GRN	Green	B	J3	RTD Sense -
J2	7	WHT	White	E	J2	RTD Excite -/ Sensor Common
J2	8	BLU	Blue	A	J1	Sensor A
J2	9	ORG	Orange	H	J8	Sensor B

Table 2.4.1.2: Connector Board Cable Connection Table

		Transducer Model (ins.)						
		m012	m025	m050	m100	m200	m300	m400
Cable Color	Pin Pairs	1/8	1/4	1/2	1	2	3	4
RED-BLK	C - D	72-88	80 - 96	74 - 90	46 - 55	46 - 55	33 - 39	33 - 39
WHT-BLU	E - A	28 - 144	80 - 96	10 - 12	10 - 12	10 - 12	78 - 94	80 - 96
WHT-ORG	E - H	128 - 144	80 - 96	10 - 12	10 - 12	10 - 12	78 - 94	80 - 96
GRY-YEL	F - G	Less than 0.1 ohms for all transducers sizes						
WHT-GRN	E - B	Less than 0.1 ohms for all transducers sizes						
GRN-YEL	B - G	RTD - 108 ohms @ 75° F for all transducer sizes						
		J - CaseLess than 1.0 ohm all sizes						
		Any other - CaseOver 100 Mohms for all transducer sizes						

Table 2.4.1.3: Datamate Allowable Transducer Resistances
 (Configuration of Datamate 2100™ Transducer Configuration
 when test with or without the transducer cable

Terminal Block	Pin Number	Label	Conductor Color	Transducer Connector Pin	M300 * Connector Terminal	Function
TB1	1	SHLD	Bare	None	None	Ground
TB1	2		No Connect			Ground
TB1	3	RED	Red	C	J6	Tube Drive
TB1	4		No Connect.			Ground
TB1	5	BLK	Black	D	J5	Drive Return
TB1	6		No Connect.			Ground
TB1	7	GRY	Gray	F	J4	RTD Excite +
TB1	8		No Connect.			Ground
TB1	9	YEL	Yellow	G	J7	RTD Sense +
TB1	10		No Connect.			Ground
TB1	11	GRN	Green	B	J3	RTD Sense -
TB1	12		No Connect.			Ground
TB1	13	WHT	White	E	J2	RTD Excite -/ Sensor Common
TB1	14		No Connect.			Ground
TB1	15	BLU	Blue	A	J1	Sensor A
TB1	16		No Connect.			Ground
TB1	17	ORG	Orange	H	J8	Sensor B

Table 2.4.1.4: Datamate Connector Board Cable Connections

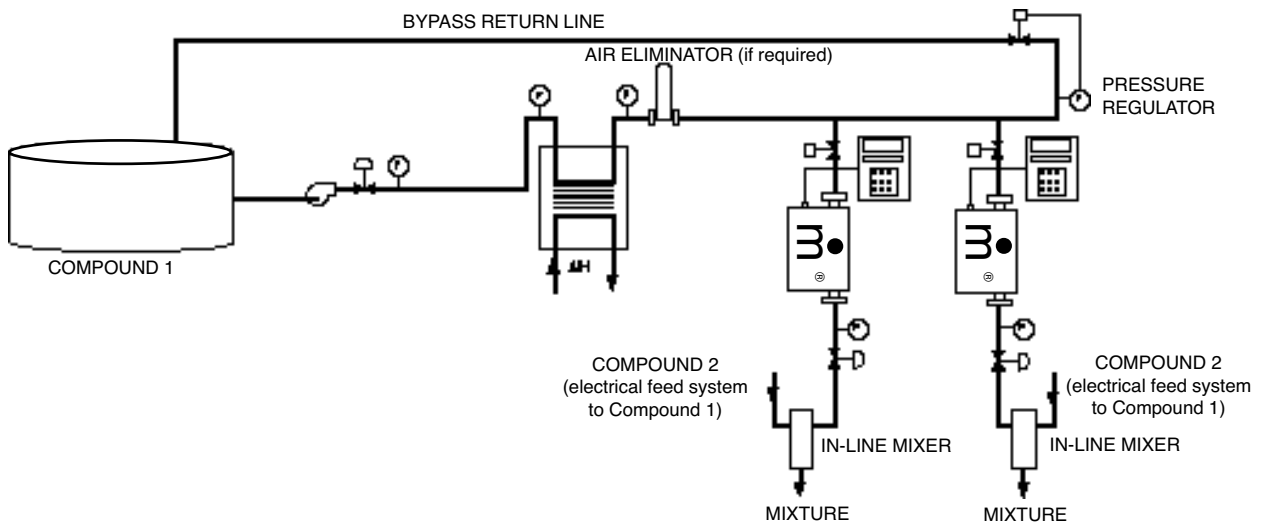
* NOTE: Use this column if m300 has conduit box connector.

SECTION 3: APPLICATION AND SYSTEM CONSIDERATIONS

3.1 Continuous

A continuous process operates on a constant basis for extended periods of time (usually 8 hours or more). A typical example of a continuous application is shown below.

The key requirements for a continuous application are as follows:

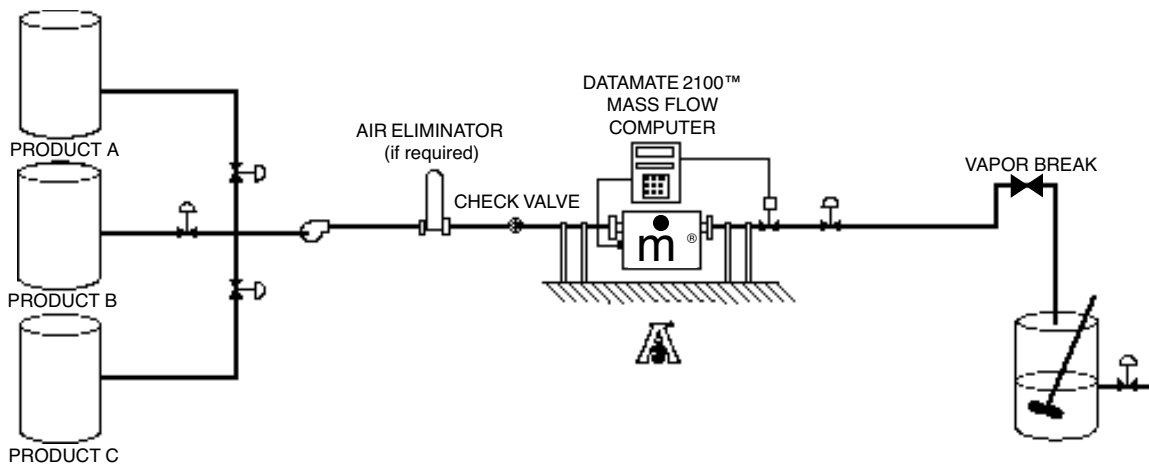


1. Air eliminator or an effective means of air elimination. An air eliminator removes all presence of air or vapor that is present prior to the meter.
2. A back pressure valve must be used in conjunction with an air eliminator **on a pumping installation (except gravity feed)**. This ensures the flow meter is kept full of product and provides the back pressure required for good air elimination.
3. A downstream valve is required to zero the flow meter and to ensure the meter remains full at all times.

NOTE: *For critical applications, a second Coriolis Force Flow meter or other backup flow meter technology should be considered. If a problem exists with the primary meter, a second coriolis force flow meter or other flow meter on the bypass line will permit the continuous operation of the process while attention is given to the primary meter.*

3.2. Batching

A batching system is best described as an application where the CFF is used to deliver a preset quantity of fluid for the filling of containers, vessels, vats, tanks, or trucks.



Key elements of a batching system are as follows:

1. An air eliminator or an effective means of air elimination. An air eliminator removes all presence of air or vapor that is present upstream of the meter.
2. A back pressure valve must be used in conjunction with an air eliminator **on a pumping installation (except gravity feed)**. This ensures the flow meter is kept full of product and provides the back pressure required for good air elimination.
3. A check valve upstream to prevent the drainage of the flow meter in the reverse direction.
4. A 3A approved mass flow meter (self draining) in its normal position the flowtubes are inverted for self-draining.
5. A downstream valve is required to zero the flow meter and to ensure the meter remains full.
6. Differential control valve (LPG, NH₃ or other products with high vapor pressures).
7. A vacuum (vapor) break is installed at the highest point of a loading arm or towards the end of the filling hose or pipe. It serves to ensure that air does not siphon back into the system, and at no flow conditions that the system is charged with product between the vacuum (vapor) break and the valve downstream of the meter.

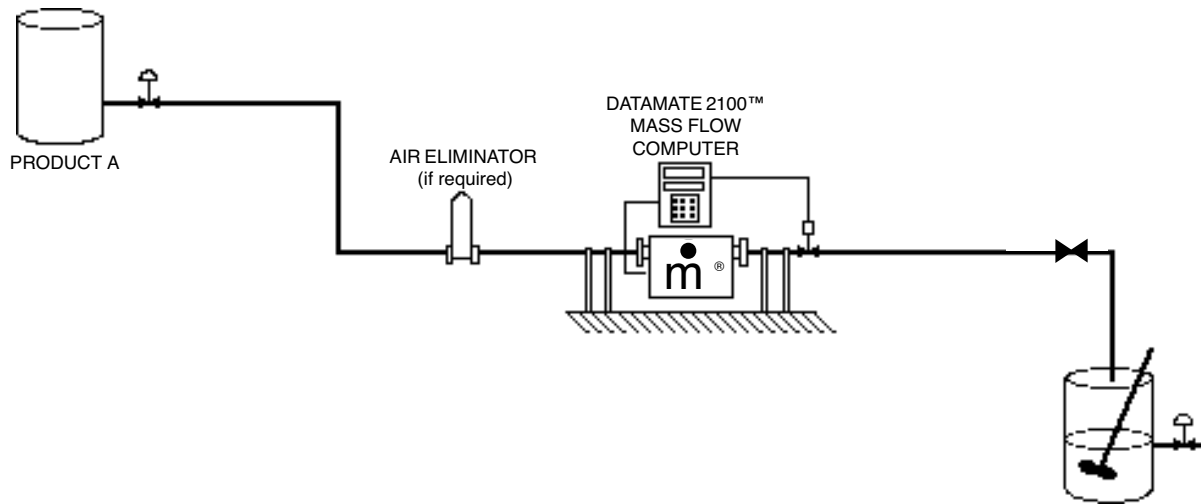
In a batching application, a good system is designed to keep the meter full at all times. For empty to empty batching (i.e., where the meter is blown dry with air, nitrogen or steam), it may be beneficial to install the meter in the inverted position. This position allows the meter to empty after the batch has been completed. Otherwise, the residual product left over in the meter will result in an unbalanced meter and a “tubes not vibrating” or “sensor error” indication may result.

NOTE: *In a custody transfer application, the flow meter must remain full and the system completely charged with product between the downstream valve and the vacuum (vapor) break after the meter.*

3.3. Gravity Feed

A gravity feed system is designed to flow product through the system by the force of gravity usually from above ground storage tanks. Some hybrid variations of gravity feed systems incorporate small pumps into the system to assist in increasing the pressure and flow rate of the liquid.

Key requirements for a gravity feed system are as follows:



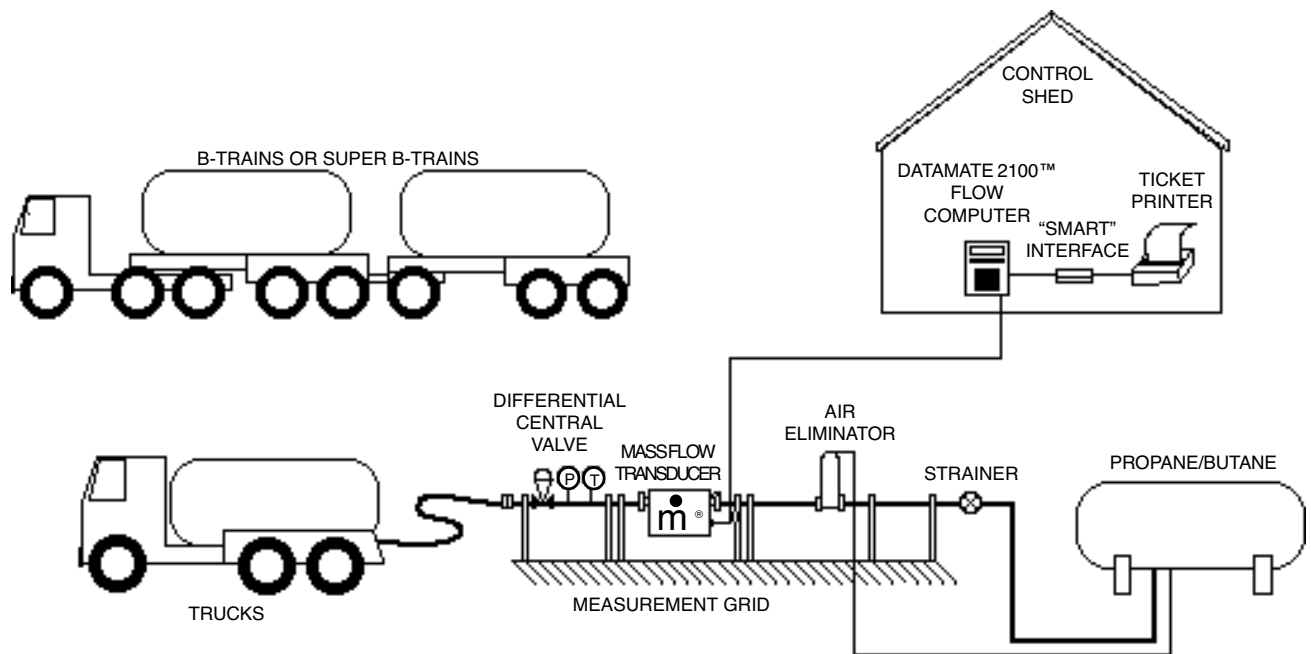
1. An air eliminator or an effective means of air elimination to remove all presence of air or vapor that is present prior to the meter.
2. A downstream valve is required to zero the flow meter and to ensure the meter remains full.
3. A vacuum (vapor) break is installed at the highest point of a loading arm or towards the end of the filling hose or pipe. It serves to ensure that air does not siphon back into the system, and at no flow conditions that the system is charged with product between the vacuum (vapor) break and the valve downstream of the meter.

In a gravity feed system, air elimination is especially important if the tank level at any time is lower than the system outlet. If this occurs, slugs of air will be present. If the tank level is higher than the system outlet, the tank will try to drain product towards the outlet of the system. A check valve upstream of the flow meter is required to prevent draining of the product towards the outlet of the system.

3.4 Loading Rack

A loading rack system is usually located at a company distribution facility. It is comprised of an island of flowmeters that are used for the bulk filling (ON-LOADING), or bulk unloading (OFF-LOADING) of trucks, and/or railcars. A loading rack facility may house underground or above ground storage tanks that are filled either by a pipeline, or the OFF-LOADING of trucks and/or railcars that come into the facility.

Key elements of a loading rack system are as follows:



1. An air eliminator or an effective means of air elimination to remove all presence of air or vapor that is present prior to the meter.
2. A back pressure valve must be used in conjunction with an air eliminator **on a pumping installation (except gravity feed)**. This ensures the flow meter is kept full of product and provides the back pressure required for good air elimination.
3. A downstream valve is required to zero the flow meter and to ensure the meter remains full.
4. Differential control valve (LPG, NH₃ or other products with high vapor pressures)
5. A vacuum (vapor) break is installed at the highest point of a loading arm or towards the end of the filling hose or pipe. It serves to ensure that air does not siphon back into the system, and at no flow conditions that the system is charged with product between the vacuum (vapor) break and the valve downstream of the meter.

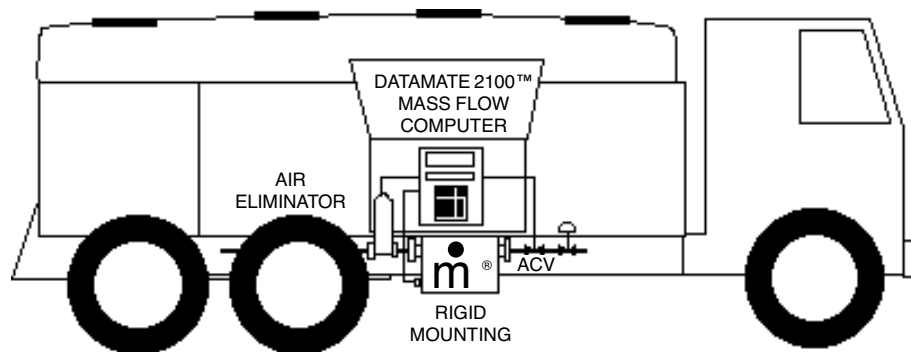
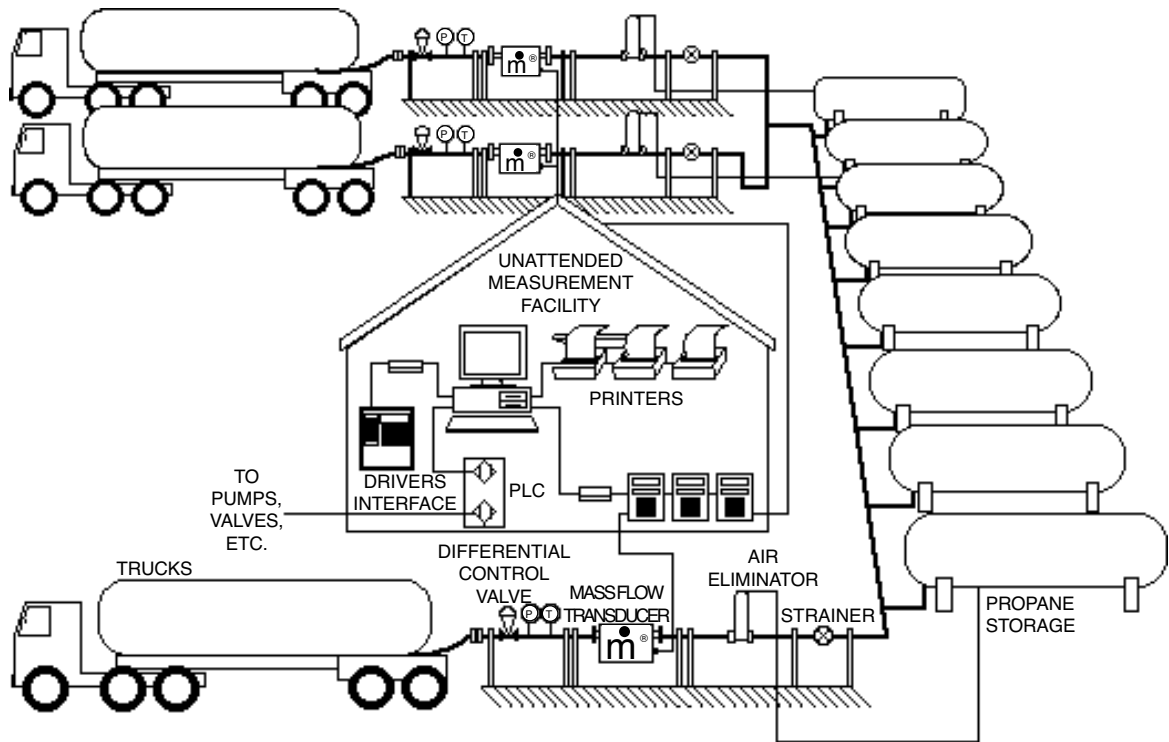
NOTE: In applications where multiple (or manifolded) pumps are used, offset the speed of each pump by a minimum of 100 rpm. This will help to minimize the harmonization of the pumps, thereby decreasing the hydraulic noise induced in the process fluid, and reducing the possibility of damage to system components.

3.5 Custody Transfer

A custody transfer system is best described as being the same as any of the previous systems listed with the difference that the registration of the CFF electronics display unit will be certified by the local authorities for sale of the measured product to the general public or industry.

If your application requires custody transfer approval, all equipment listed in the previous systems are required in order to comply with custody transfer rules and regulations. It guarantees the best performance of the CFF in your system.

Key requirements for a custody transfer system are as follows:



1. An air eliminator or an effective means of air elimination to remove all presence of air or vapor that is present prior to the meter.
2. A back pressure valve must be used in conjunction with an air eliminator **on a pumping installation (except gravity feed)**. This ensures that the flow meter is kept full of product and provides the back pressure required for good air elimination.
3. A check valve (upstream) to prevent the drainage of the flow meter in the reverse direction.
4. A downstream valve is required to zero the flow meter and to ensure the meter remains full.
5. Differential control valve (LPG, NH₃ or other products with high vapor pressures).
6. Air control valve (truck applications only).
7. A vacuum (vapor) break is installed at the highest point of a loading arm or towards the end of the filling hose or pipe. It serves to ensure that air does not siphon back into the system, and at no flow conditions that the system is charged with product between the vacuum (vapor) break and the valve downstream of the meter.

CAUTION: Never operate a truck mounted CFF with a different pump than what was used during the original zeroing procedure.

NOTE: *In applications where multiple (or manifolded) pumps are used, offset the speed of each pump by a minimum of 100 rpm. This will help to minimize harmonization of the pumps, thereby decreasing the hydraulic noise induced in the process fluid, and reducing the possibility of damage to system components.*

On a truck mounted system, do not use different pumps to off-load multiple products through the same CFF.

Good piping practices should be standard on all CFF systems, especially custody transfer systems.

3.6 System Drawings

The following drawings highlight the typical metering installation system for a CFF on a stationary and truck mounted system.

DATE	REVISION	DATE	BY	APP'D

DATE	REVISION	DATE	BY	APP'D

DATE	REVISION	DATE	BY	APP'D

DATE	REVISION	DATE	BY	APP'D

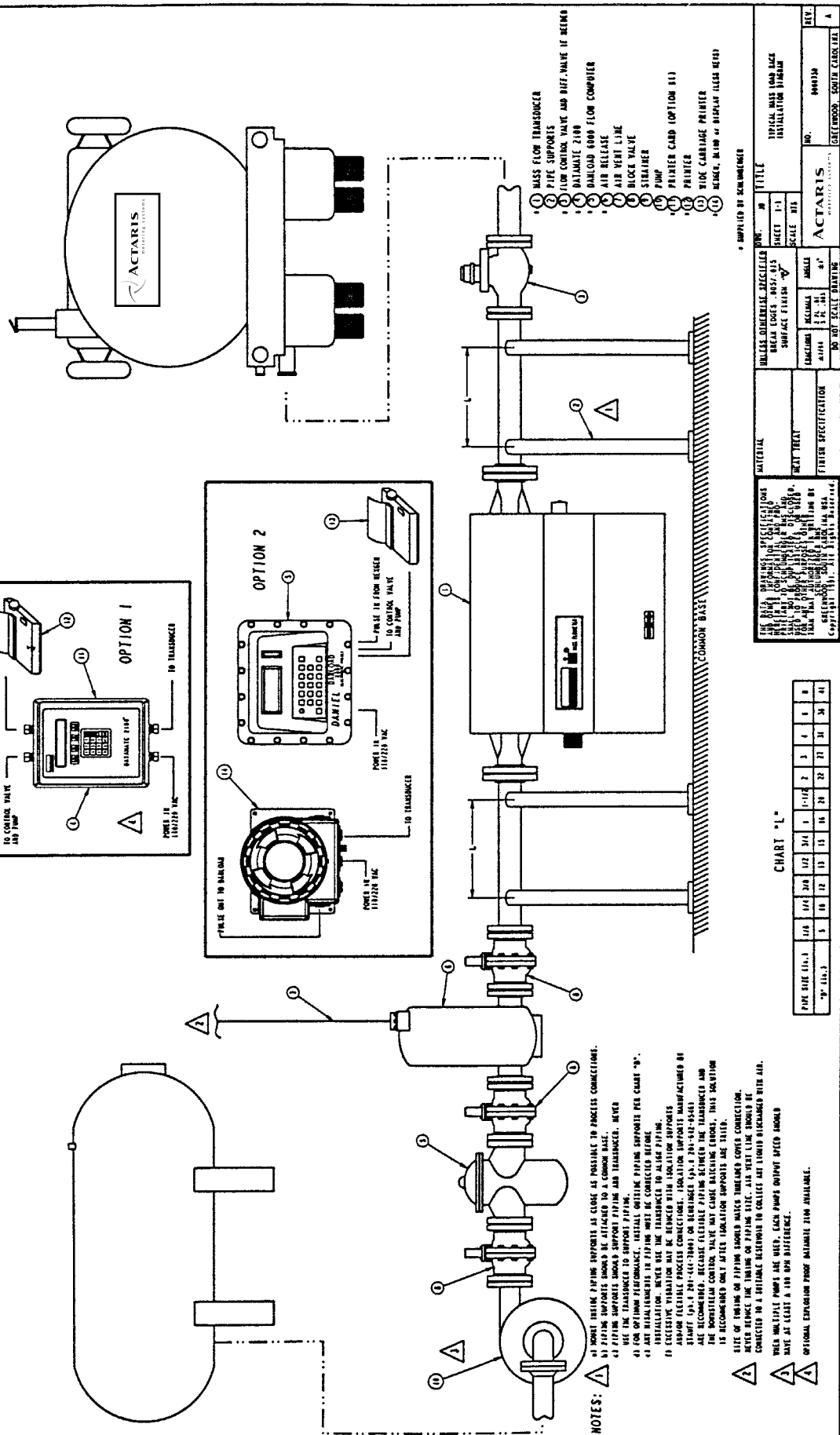
DATE	REVISION	DATE	BY	APP'D

DATE	REVISION	DATE	BY	APP'D

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DATE	REVISION	DATE	BY	APP'D



NOTES:

- 1. VERIFY THE FLOW SUPPORTS ARE CORRECT AS INDICATED IN THE CONNECTIONS.
- 2. PUMP SUPPORTS SHOULD BE ATTACHED TO THE TRANSDUCER.
- 3. FLOW SUPPORTS SHOULD SUPPORT PIPING AND TRANSDUCER, NEVER USE THE TRANSDUCER TO SUPPORT PIPING.
- 4. FOR OPTIMUM PERFORMANCE, INSTALL OUTSIDE PIPING SUPPORTS PER CHART "9".
- 5. ALL INSTALLATIONS IN PIPING MUST BE CONNECTED BEFORE INSTALLATION. NEVER USE THE TRANSDUCER TO SUPPORT PIPING.
- 6. PIPING SHOULD BE CONNECTED WITH ISOLATION VALVES.
- 7. ISOLATION VALVES SHOULD BE CONNECTED TO THE TRANSDUCER BEFORE START (20-1-201-110-700) OR BEHIND (20-1-201-110-850) AND ARE RECOMMENDED, BECAUSE CLEARABLE PIPING BETWEEN THE TRANSDUCER AND THE DOWNSTREAM CONTROL VALVE MAY CAUSE BACKING FLOW. THIS SOLUTION IS RECOMMENDED ONLY AFTER ISOLATION SUPPORTS ARE TESTED.
- 8. SIZE OF TUBING OR PIPING SHOULD MATCH THE LARGEST LOWER CONNECTION. NEVER REDUCE THE TUBING OR PIPING SIZE. AIR VENT LINE SHOULD BE CONNECTED TO A SUITABLE RECEIVER TO COLLECT AIR LIQUID DISCHARGED WITH AIR.
- 9. WHEN MULTIPLE PUMPS ARE USED, EACH PUMP OUTPUT SPEED SHOULD HAVE AT LEAST A 100 RPM DIFFERENCE.
- 10. OPTIONAL EXPLOSION PROOF METER IS AVAILABLE.

ITEM #	PART NUMBER	ITEM DESCRIPTION	QTY.

DATE	REVISION	DATE	BY	APP'D

DATE	REVISION	DATE	BY	APP'D

DATE	REVISION	DATE	BY	APP'D

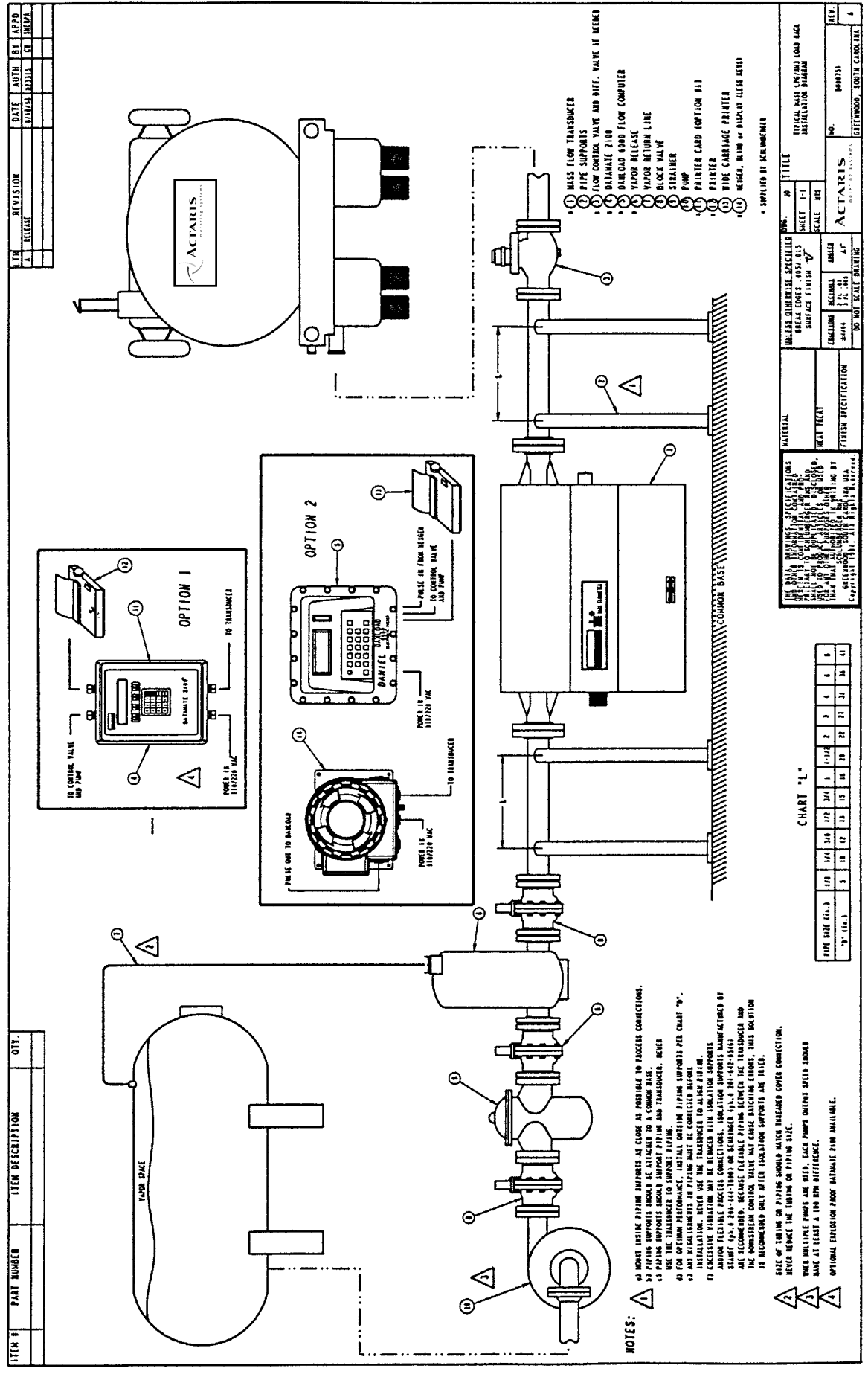
DATE	REVISION	DATE	BY	APP'D

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DATE	REVISION	DATE	BY	APP'D

DATE	REVISION	DATE	BY	APP'D



REVISIONS	DATE	BY	APPROVED
1			
2			
3			
4			

PART NUMBER		DESCRIPTION	
1	110	1	110
2	110	2	110
3	110	3	110
4	110	4	110
5	110	5	110
6	110	6	110
7	110	7	110
8	110	8	110
9	110	9	110
10	110	10	110
11	110	11	110
12	110	12	110

CHART		DESCRIPTION	
1	110	1	110
2	110	2	110
3	110	3	110
4	110	4	110
5	110	5	110
6	110	6	110
7	110	7	110
8	110	8	110
9	110	9	110
10	110	10	110
11	110	11	110
12	110	12	110

SECTION 4: SPECIAL CONSIDERATIONS

4.1. Heat Tracing/Insulating

The function of an insulating jacket is to insulate the meter in order to prevent the loss of heat from the measured product.

NOTE: *If the piping around the flow meter is insulated, the flow meter should be insulated.*

Some applications operate at high temperatures in order to get the product to flow (e.g., asphalt, coal tar pitch, molasses, and syrup). These applications are easily identified because **a small change in temperature results in a large change in viscosity**. In addition to an insulating jacket, these applications require heat tracing in order to maintain the product temperature of the process. The combination of an insulating jacket and heat tracing keeps the viscosity constant. This prevents against the saturating of the energy required to vibrate the flow tubes of the CFF.

NOTE: *If the product being measured experiences a large change in viscosity resulting from a small change in temperature, the CFF is to be insulated and heat traced to the MAXIMUM OPERATING TEMPERATURE of the process.*

The following information is needed when selecting the correct insulating jacket:

1. Meter size
2. Temperature to maintain
3. Lowest ambient temperature
4. Area classification
5. Power supply
6. Agency approval (i.e., UL, FM, or CSA)

4.2 Air

An air eliminator removes all presence of air or vapor that is present prior to the metering. The air eliminator uses a float assembly that is directly connected to a valve via linkage at the top of the tank. During operation the tank is completely full of liquid. When air enters the tank, the float assembly lowers because of the sudden lowering of the tank level; thus, the valve opens and allows air to escape.

Actaris offers a wide selection of air/vapor eliminators for liquids including liquefied compressed gas applications ranging from 2" to 8" in size. The information required is as follows:

1. Fluid
2. Line Size
3. Maximum flow rate
4. Flange Rating
5. Maximum Pressure and Temperature

In any type of flow metering system air elimination is especially important if the storage tank level at any time is lower than the height of the system outlet. If this occurs, slugs of air are likely to be present. If the storage tank level is lower than the system outlet, the system outlet will have a tendency to drain product towards the storage tank. A check valve upstream of the flow meter is required to prevent draining of the product towards the storage tank.

NOTE: A CFF should be installed in the lowest part of the system. This best ensures that the CFF remains full, free of air entrainment.

4.3 Gases/Vapor Pressure

CONSULT ACTARIS IF YOU ARE CONSIDERING A GAS APPLICATION.

If your application has the potential to flash under normal operating conditions, typically evident with liquefied products, alcohols, and/or other fluids operating at high temperatures (>100°F), ensure that adequate back-pressure is provided by the use of a downstream valve. Refer to the Expert Selection Program (ESP™) for back-pressure requirements.

4.4 Special Connections

On CFF sizes (1/8" through 1/2"), an optional Swagelok® CAJON VCO® female connection can be supplied. The mating fitting can be obtained from Swagelok®, Tel: 216-349-5800.

4.5 Special Tagging

The flow meter is NOT a table, chair or footstool. If the installation location of the CFF invites this type of use, we recommend placing a label(s) on the appropriate side(s) of the flow meter to prevent this occurrence.

SECTION 5: REFERENCE TABLE

FIXED OR TRUCK MOUNTING CONFIGURATION											
SYSTEM	2.2.1	2.2.2	2.2.3	2.2.4	2.1.3	2.1.4	2.1.5	2.1.6	2.1.2	2.1.1	2.3.2
Guide Reference											
TYPE	HORIZ	VERTICAL	INVERTED	SIDE	WALL	COM/FLR	FLR GRT	SUPPORTS	STR RUN	FLANGES	ELEC CONN
LOADING RACK (Fixed or Truck)	X(1)	X(2)	X(1)	O	O	X	O	X(6)	(4)	(6),(12)	(5)
BATCHING (Fixed or Truck)	X(1)	X(2)	X(1)	O	(3)	X	O	X(6)	(4)	(6),(12)	(5)
CONTINUOUS (Fixed Only)	X	X(2)	X	X	(3)	X	X	X(6)	(4)	(6),(12)	(5)
GRAVITY FEED (Fixed Only)	X	X(2)	X	O	O	X	O	X(6)	(4)	(6),(12)	(5)
CUSTODY TRANSFER (Fixed or Truck) ***	X(1)	X(2)	X(1)	O	O	X	O	X(6)	(4)	(6),(12)	(5)

FIXED OR TRUCK SYSTEM REQUIREMENTS				
SYSTEM	2.1.8	2.1.7	2.1.7	2.1.9
Guide Reference	-			
TYPE	A/E	DIFF CV	DWN VAL	CHK VAL VAP BRK
LOADING RACK	X	X(8)	X	X(9)
BATCHING	X(7)	X(8)	X	X(10)
CONTINUOUS	X(7)	X(8)	X	N/A
GRAVITY FEED	X	X(8)	X	X(10)
CUSTODY TRANSFER ***	X	X(8)	X	X(10)

***if you have a custody transfer application, the mounting configuration and system requirements precedes all recommendations in the above chart

***if you have a custody transfer application, the mounting configuration and system requirements precedes all recommendations in the above chart

1. An Actaris 3A Mass Flowmeter tubes are inverted in the horizontal(normal) mounting configuration
2. Flow is to be upwards through the meter.
3. Fixed installations only. Refer to section in guide
4. There are no straight run requirements for an Actaris mass flowmeter. We do however recommend good piping practices in all installations
5. Do Not Splice Belden Interconnect Cable. Do not run cable next to high voltage and/or communication lines
6. Do not support meter or its flanges with piping supports
7. Effective means of air elimination is to be met by system design, or use of an air eliminator
8. For LPG, NH3, Alcohols, and similar liquids that have high vapor pressures or high operating temperatures. Air Control Valve is recommended on trucks with split compartments
9. Necessary to be installed upstream of meter if installed in the vertical or inverted position
10. On-loading applications requires a vapor break. Off-loading applications require a dry break
11. The meter and its calibrated electronics are identically matched by serial number found on nameplate or the original box
12. Ensure pipe flanges are aligned with meter flanges. DO NOT ALIGN PIPING USING THE METER
13. If product viscosity significantly changes (>300cP) with small changes in temperature (< 5 deg F), a heat jacket with heat kit is required
14. A bypass around the meter is recommended on continuous applications. A second meter is recommended but optional for the bypass line.

FOR MORE DETAILED INFORMATION PLEASE REFER TO THE INSTALLATION GUIDE

SECTION 6: MODEL NUMBER DESIGNATION

Table 6.1: m[®] MASS FLOW METER Model Numbers

MODEL NUMBER						DESCRIPTION
M012	X	X	X	X	X	
	2					TYPE TRANSDUCER 1/8" HASTELLOY® C-22 *
	8					TRANSDUCER 1/8" SST *
	S					TRANSDUCER 1/8" SST SANITARY TRI CLAMP *
		000				FLANGE 1 1/2" 3A SST SANITARY TRI CLAMP
		212				1/2" 150 LB ANSI RF HASTELLOY C-22
		213				1/2" 300 LB ANSI RF HASTELLOY® C-22
		801				3/8" CAJON VCO **
		812				1/2" 150 LB ANSI RF SST
		813				1/2" 300 LB ANSI RF SST
		XXX				SPECIAL - CONTACT FACTORY
			0			APPROVALS GENERAL PURPOSE
			1			FM
			2			CSA
				000		CABLE NO CABLE
				101		ASM CBL KIT 10 FT. ***
				102		ASM CBL KIT 20 FT. ***
				103		ASM CBL KIT 30 FT. ***
				105		ASM CBL KIT 50 FT. ***
				110		ASM CBL KIT 100 FT. ***
					0	ELECTRONICS NO ELECTRONICS
					D	FOR USE WITH DATAMATE
					N	FOR USE WITH NEXGEN

* Wetted materials and connection materials must be the same.

** Only available as 3/8" female CAJON VCO® connections. Requires male CAJON VCO 8-VCO by SWAGELOCK®.

*** For a complete list of available cable lengths, consult your local Actaris distributor.

MODEL NUMBER							DESCRIPTION
M025	X	X	X	X	X	X	
	2						TYPE TRANSDUCER 1/4" HASTELLOY® C-22 *
	8						TRANSDUCER 1/4" SST *
	S						TRANSDUCER 1/4" SST SANITARY TRI CLAMP *
		000					FLANGE 1 1/2" 3A SST SANITARY TRI CLAMP ***
		212					1/2" 150 LB ANSI RF HASTELLOY® C-22
		213					1/2" 300 LB ANSI RF HASTELLOY® C-22
		801					3/8" CAJON VCO **
		812					1/2" 150 LB ANSI RF SST
		813					1/2" 300 LB ANSI RF SST
		814					1/2" 600 LB ANSI RF SST
		846					1 1/2" SST INDUSTRIAL TRI CLAMP ***
		8BE					DN15 PN40 SST
		XXX					SPECIAL - CONTACT FACTORY
			0				APPROVALS GENERAL PURPOSE
			1				FM
			2				CSA
				0			W & M NONE
				W			CUSTODY TRANSFER (WEIGHTS & MEASURES)
					000		CABLE NO CABLE
					101		ASM CBL KIT 10 FT. ****
					102		ASM CBL KIT 20 FT. ****
					103		ASM CBL KIT 30 FT. ****
					105		ASM CBL KIT 50 FT. ****
					110		ASM CBL KIT 100 FT. ****
						0	ELECTRONICS NO ELECTRONICS
						D	FOR USE WITH DATAMATE
						N	FOR USE WITH NEXGEN

* Wetted materials and connection materials must be the same.

** Only available as 3/8" female CAJON VCO® connections. Requires male CAJON VCO 8-VCO by SWAGELOCK®.

*** The 1-1/2" Industrial and 3A tri-clamp connections are available in 316L SS wetted materials only.

**** For a complete list of available cable lengths, consult your local Actaris distributor.

Table 6.2: m® MASS FLOW METER Model Numbers (cont.)

MODEL NUMBER						DESCRIPTION
M050	X	X	X	X	X	
	2		•			TYPE TRANSDUCER 1/2" HASTELLOY® C-22 *
	8					TRANSDUCER 1/2" SST *
	S					TRANSDUCER 1/2" SST SANITARY TRI CLAMP *
		000				FLANGE 2" 3A SST SANITARY TRI CLAMP ***
		232				1" 150 LB ANSI RF HASTELLOY® C-22
		233				1" 300 LB ANSI RF HASTELLOY® C-22
		811				NUT VCO CAJON SST **
		812				1/2" 150 LB ANSI RF SST
		813				1/2" 300 LB ANSI RF SST
		822				3/4" 150 LB ANSI RF
		823				3/4" 300 LB ANSI RF SST
		832				1" 150 LB ANSI RF SST
		833				1" 300 LB ANSI RF SST
		846				1 1/2" SST INDUSTRIAL TRI CLAMP ***
		8BE				DN15 PN40 SST
		XXX				SPECIAL - CONTACT FACTORY ****
			0			APPROVALS GENERAL PURPOSE
			1			FM
			2			CSA
				0		W & M NONE
				W		CUSTODY TRANSFER (WEIGHTS & MEASURES)
					000	CABLE NO CABLE
					101	ASM CBL KIT 10 FT. ****
					102	ASM CBL KIT 20 FT. ****
					103	ASM CBL KIT 30 FT. ****
					105	ASM CBL KIT 50 FT. ****
					110	ASM CBL KIT 100 FT. ****
						ELECTRONICS
					0	NO ELECTRONICS
					D	FOR USE WITH DATAMATE
					N	FOR USE WITH NEXGEN

* Wetted materials and connection materials must be the same.

** Only available as 1" female CAJON VCO® connections. Requires male CAJON VCO 16 -VCO by SWAGELOCK®.

*** The 1-1/2" Industrial and 2" 3A tri-clamp connections are available in 316L SS wetted materials only.

**** The special 2" mating flanges to the MT truck accessories are no charge (N/C).

***** For a complete list of available cable lengths, consult your local Actaris distributor.

MODEL NUMBER						DESCRIPTION
M100	X	X	X	X	X	
	2					TYPE TRANSDUCER 1" HASTELLOY® C-22 *
	8					TRANSDUCER 1" SST *
	S					TRANSDUCER 1" SST SANITARY TRI CLAMP *
		000				FLANGE 2 1/2" 3A SST SANITARY TRI CLAMP **
		252				2" 150 LB ANSI RF HASTELLOY® C-22
		253				2" 300 LB ANSI RF HASTELLOY® C-22
		832				1" 150 LB ANSI RF SST
		833				1" 300 LB ANSI RF SST
		842				1 1/2" 150 LB ANSI RF SST
		852				2" 150 LB ANSI RF SST
		853				2" 300 LB ANSI RF SST
		856				2" SST INDUSTRIAL TRI CLAMP **
		8DE				DN25 PN40 SST
		8FE				DN50 PN40 SST
		XXX				SPECIAL - CONTACT FACTORY ***
			0			APPROVALS GENERAL PURPOSE
			1			FM
			2			CSA
				0		W & M NONE
				W		CUSTODY TRANSFER (WEIGHTS & MEASURES)
					000	CABLE NO CABLE
					101	ASM CBL KIT 10 FT. ****
					102	ASM CBL KIT 20 FT. ****
					103	ASM CBL KIT 30 FT. ****
					105	ASM CBL KIT 50 FT. ****
					110	ASM CBL KIT 100 FT. ****
						ELECTRONICS
					0	NO ELECTRONICS
					D	FOR USE WITH DATAMATE
					N	FOR USE WITH NEXGEN

* Wetted materials and connection materials must be the same.

** The 2" Industrial and 2-1/2" 3A tri-clamp connections are available in 316L SS wetted materials only.

*** The special 2" mating flanges to the MT truck accessories are no charge (N/C).

**** For a complete list of available cable lengths, consult your local Actaris distributor.

Table 6.3: m® MASS FLOW METER Model Numbers (cont.)

MODEL NUMBER						DESCRIPTION
M200	X	X	X	X	X	
	2					TYPE TRANSDUCER 2" HASTELLOY® C-22 *
	8					TRANSDUCER 2" SST *
	S		•			TRANSDUCER 2" SST SANITARY TRI CLAMP *
		000				FLANGE 4" 3A SST SANITARY TRI CLAMP **
		252				2" 150 LB ANSI RF HASTELLOY® C-22
		272				4" 150 LB ANSI RF HASTELLOY® C-22
		273				4" 300 LB ANSI RF HASTELLOY® C-22
		852				2" 150 LB ANSI RF SST
		853				2" 300 LB ANSI RF SST
		862				3" 150 LB ANSI RF SST
		863				3" 300 LB ANSI RF SST
		866				3" SST INDUSTRIAL TRI CLAMP **
		872				4" 150 LB ANSI RF SST
		873				4" 300 LB ANSI RF SST
		8FE				DN50 PN40 SST
		8GE				DN80 PN40 SST
		XXX				SPECIAL - CONTACT FACTORY ***
			0			APPROVALS GENERAL PURPOSE
			1			FM
			2			CSA
				0		W & M NONE
				W		CUSTODY TRANSFER (WEIGHTS & MEASURES)
					000	CABLE NO CABLE
					101	ASM CBL KIT 10 FT. ****
					102	ASM CBL KIT 20 FT. ****
					103	ASM CBL KIT 30 FT. ****
					105	ASM CBL KIT 50 FT. ****
					110	ASM CBL KIT 100 FT. ****
					0	ELECTRONICS NO ELECTRONICS
					D	FOR USE WITH DATAMATE
					N	FOR USE WITH NEXGEN

* Wetted materials and connection materials must be the same.

** The 3" or 4" Industrial and 4" 3A tri-clamp connections are available in 316L SS wetted materials only.

*** The special 2" mating flanges to the MT truck accessories are no charge (N/C)

**** For a complete list of available cable lengths, consult your local Actaris distributor.

MODEL NUMBER						DESCRIPTION
M300	X	X	X	X	X	
	8					TYPE TRANSDUCER 3" SST
		862				FLANGE 3" 150 LB ANSI RF
		863				3" 300 LB ANSI RF
		872				4" 150 LB ANSI RF
		873				4" 300 LB ANSI RF
		882				6" 150 LB ANSI RF
		887				6" 900 LB ANSI RF
		8GE				DN80 PN40 SST
		8HE				DN100 PN40 SST
		XXX				SPECIAL - CONTACT FACTORY
			0			APPROVALS GENERAL PURPOSE
			1			FM
			2			CSA
				0		W & M NONE
				W		CUSTODY TRANSFER (WEIGHTS & MEASURES)
					000	CABLE NO CABLE
					101	ASM CBL KIT 10 FT. *
					102	ASM CBL KIT 20 FT. *
					103	ASM CBL KIT 30 FT. *
					105	ASM CBL KIT 50 FT. *
					110	ASM CBL KIT 100 FT. *
					0	ELECTRONICS NO ELECTRONICS
					D	FOR USE WITH DATAMATE
					N	FOR USE WITH NEXGEN

* For a complete list of available cable lengths, consult your local Actaris distributor.

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Table 6.3: \dot{m} ® MASS FLOW METER Model Numbers (cont.)

MODEL NUMBER						DESCRIPTION
M400	X	X	X	X	X	X
	8					TYPE TRANSDUCER 4" SST 150/300 LB *
	9					TRANSDUCER 4" SST 600/900 LB *
	872					FLANGE 4" 150 LB ANSI RF
	882					6" 150 LB ANSI RF
	892					8" 150 LB ANSI RF
	893					8" 300 LB ANSI RF
	897					8" 900 LB ANSI RF
	8HE					DN100 PN40 SST
	8IE					DN150 PN40 SST
	XXX					SPECIAL - CONTACT FACTORY
			0			APPROVALS GENERAL PURPOSE
			1			FM
			2			CSA
			0			W & M NONE
			W			CUSTODY TRANSFER (WEIGHTS & MEASURES)
					000	CABLE NO CABLE
					101	ASM CBL KIT 10 FT. **
					102	ASM CBL KIT 20 FT. **
					103	ASM CBL KIT 30 FT. **
					105	ASM CBL KIT 50 FT. **
					110	ASM CBL KIT 100 FT. **
					0	ELECTRONICS NO ELECTRONICS
					D	FOR USE WITH DATAMATE
					N	FOR USE WITH NEXGEN

* Wetted materials and connection materials must be the same.

** For a complete list of available cable lengths, consult your local Actaris distributor.

Table 6.4: \dot{m} ® OLD MASS FLOW METER Model Numbers For Reference Only

MODEL NUMBER		DESCRIPTION
M	-	-
0 1 2		1/8" flowmeter w/3/8" female VCO fittings ① ② (1 1/2" Nominal)
0 2 0		1/4" flowmeter w/3/8" female VCO fittings
0 2 5		1/4" flowmeter w/1/2" connections ① ② (1 1/2" Nominal)
0 5 0		1/2" flowmeter w/1/2" connections
0 7 5		1/2" flowmeter w/3/4" connections
0 9 5		1/2" flowmeter w/1" connections ① ② (1 1/2" Nominal)
1 0 0		1" flowmeter w/1" connections
1 5 0		1" flowmeter w/1 1/2" connections ①
1 9 5		1" flowmeter w/2" connections ① ② (2" Nominal)
2 0 0		2" flowmeter w/2" connections
2 5 0		2" flowmeter w/3" connections ①
2 9 5		2" flowmeter w/4" connections ② (4" Nominal)
	0 8	VCO fittings (m012 and m020 only)
	1 8	ANSI 150# RF flanges
	2 8	Industrial grade sanitary clamp connection – See Note ②
	3 8	ANSI 300# RF flanges
	4 8	3-A authorized sanitary clamp w/2 tube access – See Note ①
	6 8	ANSI 600# RF flanges
	2	DATAMATE 2000™ electronics, no I.S. option
	4	DATAMATE 2000™ electronics, FM I.S. option
	5	DATAMATE 2000™ electronics, CSA I.S. option
	1	115 volts AC power required, 50/60 Hz
	2	230 volts AC power required, 50/60 Hz
	0	Connector only (I.S. approved only when ordered factory assembled with P/N 300064-002 below)
	1	10 ft. (3 m) Belden cable supplied
	2	30 ft. (9 m) Belden cable supplied
	3	50 ft. (15 m) Belden cable supplied (for lengths above 50 ft. – see below)
	0	No 4-20 output*
	1	One 4-20 output*
	2	Two 4-20 outputs*
	3	Three 4-20 outputs*
	4	Four 4-20 outputs*
	0	No pulse outputs*
	1	One pulse output*
	2	Two pulse outputs*
	3	Three pulse outputs*
	4	Four pulse outputs
Part No. 300064-002		Connector cable for lengths greater than 50 ft. (must be ordered with flowmeter).

- ① When ordering the 3-A authorized version, only those connection sizes with a ① can be selected.
 ② When ordering the industrial grade Tri-Clamp® connection, only those connections with a ② can be selected.

Note: The nominal Tri-Clamp connector sizes (in parenthesis) differs from standard.

* Maximum total of four (4) outputs in the DATAMATE 2000.

N/C = No Charge

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SECTION 7: PERFORMANCE SPECIFICATIONS

Table 7.1: m012 - 1/8" m[®] MASS FLOW METER

METERING ELEMENT	
Connections: Connection type	Swagelok [®] CAJON VCO [®] : 3/8" female ANSI: 1/2"; 150#, 300#RF Flange 3A-Authorized: 1-1/2" Tri-Clamp [®]
Tube material Tube shape Nominal element bore Minimum tube ID Housing Hazardous area classification (option) Mass accuracy (Datamate) Mass accuracy (NexGen) Mass repeatability Mass zero stability Turndown ratio Density range (Datamate) Density range (NexGen) Density accuracy Density repeatability Temperature measurement Temperature accuracy Signal output Weight	316L SST or HASTELLOY [®] C-22 optional Twin Omega tubes 3 mm (1/8") 2.95 mm (0.116") 304L SST Transducer is intrinsically safe when connected to an approved mass flow computer. See Table 2.3.2.1 (page 14) for ratings. ±0.15% of rate ±zero stability ¹ ±0.10% of rate ±zero stability ¹ ±0.10% of rate ±0.0012 kg/min (±0.0027 lb/min) 100:1 0.4 to 2.0 gm/cc 0 to 3.0 gm/cc ±0.005 gm/cc ±0.0005 gm/cc 100 ohm platinum resistance sensor ±0.56°C (±1°F) 8-conductor cable, 4 shielded twisted-pairs 4.6 kg (10 lb)
Fluid: Flow rate Max. temperature Min. temperature Max. operating pressure	0.09 to 9.0 kg/min (0.2 to 20 lb/min) 204°C (400°F) -45°C (-50°F) 137 bar (2,000 psi); limited by flange/connection rating
ASSOCIATED INSTRUMENT	
Max. length of signal cable Electrical connections Manufacturer Meter model number Instrument model number	Datamate: 150m (500 ft); NexGen: 300m (1000 ft) Belden 89892, 8 conductor, 4 shielded twisted pairs Screw terminal Actaris m012-XXXXX (refer to Model Number Designation) Refer to Model Number Designation
¹ Calibrations are traceable to N.I.S.T.	

Actaris U. S. Liquid Measurement Inc. pursues a policy of continuous development and product improvement. The specifications above may therefore be changed without notice.

Table 7.2: m025 - 1/4" m[®] MASS FLOW METER

METERING ELEMENT	
Connections: Connection type	Swagelok [®] CAJON VCO [®] : 3/8" female ANSI: 1/2"; 150#, 300#, 600# RF Flange DIN: DN15; PN40, PN100 3A-Authorized: 1-1/2" Tri-Clamp [®] Industrial Tri-Clamp [®] : 1-1/2"
Tube material Tube shape Nominal element bore Minimum tube ID Housing Hazardous area classification (option) Mass accuracy (Datamate) Mass accuracy (NexGen) Mass repeatability Mass zero stability (Datamate) Mass zero stability (NexGen) Turndown ratio Density range (Datamate) Density range (NexGen) Density accuracy Density repeatability Temperature measurement Temperature accuracy Signal output Weight	316L SST or HASTELLOY [®] C-22 optional Twin Omega tubes 6.4 mm (1/4") 6.50 mm (0.256") 304L SST Transducer is intrinsically safe when connected to an approved mass flow computer. See Table 2.3.2.1 (page 14) for ratings. 0.15% of rate zero stability ¹ 0.10% of rate zero stability ¹ 0.10% of rate 0.0064 kg/min (0.014 lb/min) 0.004 kg/min (0.0087 lb/min) 100:1 0.4 to 2.0 gm/cc 0 to 3.0 gm/cc 0.002 gm/cc 0.0005 gm/cc 100 ohm platinum resistance sensor 0.56 C (1 F) 8-conductor cable, 4 shielded twisted-pairs 6.8 kg (15 lb)
Fluid: Flow rate Max. temperature Min. temperature Max. operating pressure	0.36 to 36.0 kg/min (0.8 to 80 lb/min) 204 C (400 F) -45 C (-50 F) 250 bar (3,600 psi); limited by flange/connection rating
ASSOCIATED INSTRUMENT	
Max. length of signal cable Electrical connections Manufacturer Meter model number Instrument model number	Datamate: 150m (500 ft); NexGen: 300m (1000 ft) Belden 89892, 8 conductor, 4 shielded twisted pairs Screw terminal Actaris m025-XXXXX (refer to Model Number Designation) Refer to Model Number Designation
² Calibrations are traceable to N.I.S.T.	

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Table 7.3: m050 - 1/2" m[®] MASS FLOW METER

	METERING ELEMENT
Connections: Connection type	Swagelok [®] CAJON VCO [®] : 1" female ANSI: 1/2", 3/4", 1"; 150#, 300#, 600# RF Flange DIN: DN15, DN25; PN40, PN100 3A-Authorized: 2" Tri-Clamp [®] Industrial Tri-Clamp [®] : 1-1/2"
Tube material Tube shape Nominal element bore Minimum tube ID Housing Hazardous area classification (option) Mass accuracy (Datamate) Mass accuracy (NexGen) Mass repeatability Mass zero stability (Datamate) Mass zero stability (NexGen) Turndown ratio Density range (Datamate) Density range (NexGen) Density accuracy Density repeatability Temperature measurement Temperature accuracy Signal output Weight	316L SST or HASTELLOY [®] C-22 optional Twin Omega tubes 12.7 mm (1/2") 11.9 mm (0.470") 304L SST Transducer is intrinsically safe when connected to an approved mass flow computer. See Table 2.3.2.1. (page 14) for ratings. 0.15% of rate zero stability ¹ 0.10% of rate zero stability ¹ 0.10% of rate 0.0168 kg/min (0.037 lb/min) 0.014 kg/min (0.029 lb/min) 100:1 0.4 to 2.0 gm/cc 0 to 3.0 gm/cc 0.002 gm/cc 0.0005 gm/cc 100 ohm platinum resistance sensor 0.56 C (1 F) 8-conductor cable, 4 shielded twisted-pairs 11.3 kg (25 lb)
Fluid: Flow rate Max. temperature Min. temperature Max. operating pressure	1.36 to 136 kg/min (3 to 300 lb/min) 204 C (400 F) -45 C (-50 F) 250 bar (3,600 psi); limited by flange/connection rating
	ASSOCIATED INSTRUMENT
Max. length of signal cable Electrical connections Manufacturer Meter model number Instrument model number	Datamate: 150m (500 ft); NexGen: 300m (1000 ft) Belden 89892, 8 conductor, 4 shielded twisted pairs Screw terminal Actaris m050-XXXXX (refer to Model Number Designation) Refer to Model Number Designation
¹ Calibrations are traceable to N.I.S.T.	

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Table 7.4: m100 - 1" \dot{m} ® MASS FLOW METER

METERING ELEMENT	
Connections: Connection type	ANSI: 1", 1-1/2", 2"; 150#, 300#, 600# RF Flange DIN: DN25, DN50; PN40, PN100 3A-Authorized: 2-1/2" Tri-Clamp® Industrial Tri-Clamp®: 2"
Tube material Tube shape Nominal element bore Minimum tube ID Housing Hazardous area classification (option) Mass accuracy (Datamate) Mass accuracy (NexGen) Mass repeatability Mass zero stability (Datamate) Mass zero stability (NexGen) Turndown ratio Density range (Datamate) Density range (NexGen) Density accuracy Density repeatability Temperature measurement Temperature accuracy Signal output Weight	316L SST or HASTELLOY® C-22 optional Twin Omega tubes 25.4 mm (1.0") 18.9 mm (0.745") 304L SST Transducer is intrinsically safe when connected to an approved mass flow computer. See Table 2.3.2.1 (page 14) for ratings. 0.15% of rate zero stability1 0.10% of rate zero stability1 0.10% of rate 0.0612 kg/min (0.135 lb/min) 0.0246 kg/min (0.0543 lb/min) 100:1 0.4 to 2.0 gm/cc 0 to 3.0 gm/cc 0.001 gm/cc 0.0005 gm/cc 100 ohm platinum resistance sensor 0.56 C (1 F) 8-conductor cable, 4 shielded twisted-pairs 26.4 kg (58 lb)
Fluid: Flow rate Max. temperature Min. temperature Max. operating pressure	5.0 to 500 kg/min (11 to 1,100 lb/min) 204 C (400 F) -45 C (-50 F) 83 bar (1,200 psi); limited by flange/connection rating
ASSOCIATED INSTRUMENT	
Max. length of signal cable Electrical connections Manufacturer Meter model number Instrument model number	Datamate: 150m (500 ft); NexGen: 300m (1000 ft) Belden 89892, 8 conductor, 4 shielded twisted pairs Screw terminal Actaris m100-XXXXX (refer to Model Number Designation) Refer to Model Number Designation
Calibrations are traceable to N.I.S.T.	

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Table 7.5: m200 - 2" m[®] MASS FLOW METER

METERING ELEMENT	
Connections: Connection type	ANSI: 2", 3", 4"; 150#, 300#, 600# RF DIN: DN50, DN80; PN40, PN100 3A-Authorized: 4" Tri-Clamp [®] Industrial Tri-Clamp [®] : 4"
Tube material Tube shape Nominal element bore Minimum tube ID Housing Hazardous area classification (option) Mass accuracy (Datamate) Mass accuracy (NexGen) Mass repeatability Mass zero stability (Datamate) Mass zero stability (NexGen) Turndown ratio Density range (Datamate) Density range (NexGen) Density accuracy Density repeatability Temperature measurement Temperature accuracy Signal output Weight	316L SST or HASTELLOY [®] C-22 optional Twin Omega tubes 51 mm (2.0") 33.3 mm (1.31") 304L SST Transducer is intrinsically safe when connected to an approved mass flow computer. See Table 2.3.2.1 (page 14) for ratings. 0.15% of rate zero stability ¹ 0.10% of rate zero stability ¹ 0.10% of rate 0.1901 kg/min (0.419 lb/min) 0.05 kg/min (0.123 lb/min) 100:1 0.4 to 2.0 gm/cc 0 to 3.0 gm/cc 0.001 gm/cc 0.0005 gm/cc 100 ohm platinum resistance sensor 0.56 C (1 F) 8-conductor cable, 4 shielded twisted-pairs 58.9 kg (130 lb)
Fluid: Flow rate Max. temperature Min. temperature Max. operating pressure	14.5 to 1,450 kg/min (32 to 3,200 lb/min) 204 C (400 F) -45 C (-50 F) 68 bar (1,000 psi); limited by flange/connection rating
ASSOCIATED INSTRUMENT	
Max. length of signal cable Electrical connections Manufacturer Meter model number Instrument model number	Datamate: 150m (500 ft); NexGen: 300m (1000 ft) Belden 89892, 8 conductor, 4 shielded twisted pairs Screw terminal Actaris m200-XXXXX (refer to Model Number Designation) Refer to Model Number Designation
¹ Calibrations are traceable to N.I.S.T.	

Actaris U. S. Liquid Measurement Inc. pursues a policy of continuous development and product improvement. The specifications above may therefore be changed without notice.

Table 7.6: m300 - 3" m[®] MASS FLOW METER

METERING ELEMENT	
Connections: Connection type	ANSI: 3", 4", 6"; 150#, 300#, 600#, 900# RF DIN: DN80, DN100, DN150; PN40, PN100
Tube material Tube shape Nominal element bore Minimum tube ID Housing Hazardous area classification (option) Mass accuracy (Datamate) Mass accuracy (NexGen) Mass repeatability Mass zero stability (Datamate) Mass zero stability (NexGen) Turndown ratio Density range (Datamate) Density range (NexGen) Density accuracy Density repeatability Temperature measurement Temperature accuracy Signal output Weight	316L SST Twin Omega tubes 76.2 mm (3.0") 57.4 mm (2.26") 304L SST Transducer is intrinsically safe when connected to an approved mass flow computer. See Table 1 (page 3) for ratings. 0.15% of rate zero stability ¹ 0.10% of rate zero stability ¹ 0.05% of rate 0.4536 kg/min (1.0 lb/min) 0.3628 kg/min (0.8 lb/min) 100:1 0.4 to 2.0 gm/cc 0 to 3.0 gm/cc 0.001 gm/cc 0.0002 gm/cc 100 ohm platinum resistance sensor 0.56 C (1 F) 8-conductor cable, 4 shielded twisted-pairs 163 kg (360 lb)
Fluid: Flow rate Max. temperature Min. temperature Max. operating pressure	41 to 4,082 kg/min (90 to 9,000 lb/min) 204 C (400 F) -45 C (-50 F) 103 bar (1,500 psi); limited by flange/connection rating
ASSOCIATED INSTRUMENT	
Max. length of signal cable Electrical connections Manufacturer Meter model number Instrument model number	Datamate: 150m (500 ft); NexGen: 300m (1000 ft) Belden 89892, 8 conductor, 4 shielded twisted pairs Screw terminal Actaris m300-XXXXX (refer to Model Number Designation) Refer to Model Number Designation
¹ Calibrations are traceable to N.I.S.T.	

Actaris U. S. Liquid Measurement Inc. pursues a policy of continuous development and product improvement. The specifications above may therefore be changed without notice.

Table 7.7: m400 - 4" m[®] MASS FLOW METER

METERING ELEMENT	
Connections: Connection type	ANSI: 4", 6", 8"; 150#, 300#, 600#, 900# RF DIN: DN100, DN150, DN200; PN40, PN100
Tube material Tube shape Nominal element bore Minimum tube ID Housing Hazardous area classification (option) Mass accuracy (Datamate) Mass accuracy (NexGen) Mass repeatability Mass zero stability (Datamate) Mass zero stability (NexGen) Turndown ratio Density range (Datamate) Density range (NexGen) Density accuracy Density repeatability Temperature measurement Temperature accuracy Signal output Weight	316L SST Twin Omega tubes 102 mm (4.0") 67.0 mm (2.64") 304L SST Transducer is intrinsically safe when connected to an approved mass flow computer. See Table 2.3.2.1 (page 14) for ratings. 0.15% of rate zero stability ¹ 0.10% of rate zero stability ¹ 0.05% of rate 0.9072 kg/min (2.0 lb/min) 0.751 kg/min (1.657 lb/min) 100:1 0.4 to 2.0 gm/cc 0 to 3.0 gm/cc 0.0008 gm/cc 0.0002 gm/cc 100 ohm platinum resistance sensor 0.56 C (1 F) 8-conductor cable, 4 shielded twisted-pairs 163 kg (360 lb)
Fluid: Flow rate Max. temperature Min. temperature Max. operating pressure	68 to 6,800 kg/min (150 to 15,000 lb/min) 204 C (400 F) -45 C (-50 F) 103 bar (1,500 psi); limited by flange/connection rating
ASSOCIATED INSTRUMENT	
Max. length of signal cable Electrical connections Manufacturer Meter model number Instrument model number	Datamate: 150m (500 ft); NexGen: 300m (1000 ft) Belden 89892, 8 conductor, 4 shielded twisted pairs Screw terminal Actaris m400-XXXXX (refer to Model Number Designation) Refer to Model Number Designation
¹ Calibrations are traceable to N.I.S.T.	

Actaris U. S. Liquid Measurement Inc. pursues a policy of continuous development and product improvement. The specifications above may therefore be changed without notice.

SECTION 8: FORMS FOR RETURN OF GOODS



RETURN MATERIAL AUTHORIZATION

Please complete Form and Fax to 1-800-833-6971

Section A

An Incomplete Form May Delay Processing of this RMA.

Dist/Rep Name and Address:

Account # _____

Contact Person: _____

Phone #: _____

Fax #: _____

SECTION C: Please Mark All Applicable Boxes with an "X"

1. Register Repair
2. Defective Flow Meter/Part
3. Defective Replacement Part
4. Reimburse Labor Hours
5. Shipped Incorrect Part Number

Section B

Return number: _____ RMA

Certification sheet or MSDS is Required

**SHIP TO: Actaris Metering Systems
US Liquid Measurement Inc.
1310 Emerald Road
Greenwood, S. C. 29646**

No Material to be Returned. Credit # _____

Parts to be returned for repair and replacement.

Restocking fee to apply of _____ %

6. Ordered Wrong Part Number
7. Non-Warranty (Evaluate/Repair)
8. Stock Return (On approval)
9. Order Entered Incorrectly

SECTION D: Please Complete the Following Information

Actaris Order No. _____

Distributor P.O. #: _____

Date of Installation: _____

Flow Meter Serial # _____

Order Date: _____

P.O. # Date: _____

Size & Type of Meter: _____

Register Serial #: _____

Customer Name: _____

Address: _____

1) Describe Problem in Detail – (Attach Additional Sheet if Necessary)

2) Service Performed to Correct Problem – (Attach Additional Sheet if Necessary)

3) Location Where Service was Performed _____ 4) Labor Hrs. to Perform Service: _____
(Travel Time Not Included)

SECTION E: Please List the Material Involved in Your Claim: (Ship Material Pre-Paid Only)

QTY	PART NUMBER	DESCRIPTION	REPLACEMENT ORDER

Figure 8.1: Return Material Authorization (RMA) Form



ACTARIS metering systems 1310 Emerald Road Greenwood, SC 29646		RMA Certification Transmittal Form	Ph: (864) 223-1212 Fax: (864) 223-0341
MSDS INCLUDED:	YES NO	Date: _____	RMA Number: _____
Company:	_____		
Returned Materials:	_____		
Model #:	_____	Serial #:	_____
Fluid Identification:	_____		

POLICY AND PROCEDURES FOR RETURNED MATERIALS

To ensure the safety of personnel and to prevent improper handling and disposal of materials including those listed in OSHA 1910, Subpart Z (Toxic and Hazardous Substance List), Actaris has adopted the following policy and procedure for the return of goods to be evaluated or repaired.

POLICY

It is the policy of Actaris that no returned materials would be accepted from any end user without a Return Material Authorization (RMA) number clearly visible on the exterior of the shipping container. Returned materials using the RMA number constitutes an agreement to comply with this policy and procedure. Goods received that are not in compliance will be returned to the end user and any cost incurred will be invoiced to the end user.

PROCEDURE

1. Prior to shipping, the end user will contact Actaris to request a RMA number. The request will identify the material(s) to be reviewed, and either state that the device(s) are empty and free of all process and cleaning substances or provide Material Safety Data Sheets (MSDS) for the substances in the device(s), unless Actaris agrees that a MSDS is not necessary for the process fluid.
2. The end user will contact Actaris for instructions on opening any closed cavity if a leak into the closed cavity is suspected.
3. Actaris will not accept any goods wetted with process or other fluid unless the MSDS has been submitted in advance for review and written approval.
4. The returned material(s) must be:
 - (a) fully and accurately described by the proper shipping name;
 - (b) properly classified, packed, marked and labeled, and;
 - (c) in proper condition for transport by highway according to applicable international and national government regulations, the laws and regulations of the State of South Carolina and all other applicable laws and regulations.

END USER CERTIFICATION

I certify that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete.

I am aware that violation of the policies and procedures of Actaris will result in return of material(s) to the end user; and are subject to the possibility of penalties from the applicable international and national government regulations and the laws of the State of South Carolina; and agree to indemnify Actaris for any loss or expense resulting from violation in the policies of Actaris.

Upon compliance with the above steps, the shipper will place a signed copy of this form with the Actaris address and RMA number visible along with all appropriate MSDS and additional information requested.

Signature: _____ **Date:** _____

Print Name: _____

Figure 8.2: RMA Certification Transmittal Form

Introduction	Principles of Operation	Installation	Application & System Considerations	Special Considerations	Reference Table	Model Number Designation	Performance Specifications	Forms for Return of Goods
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Warranties and Limitations of Damages and Remedies

Seller warrants that at the time of delivery, products delivered or services to be performed hereunder will conform to applicable drawings and specifications and will be free from defects of materials and workmanship for a period of eighteen (18) months from the date of delivery to Customer, or twelve (12) months from the date of installation of products or the completion of services by Seller, whichever occurs first. Upon prompt notice by Customer of any nonconformity or defect, which notice must be given within thirty (30) days from date such nonconformity or defect is first discovered, Seller's obligation under this warranty is limited, and at its option, to replacing at its plant, with transportation charges prepaid by Customer, the product or component part thereof that is proved to be other than as herein warranted or, in the case of services, to promptly performing all reasonable repairs or replacement of defective or improperly installed products or components at Buyer's site where such defective or improperly installed components are located. This warranty does not extend to any of Seller's products which have been subject to misuse, abnormal use, accident, improper installation by Customer or improper storage, improper maintenance or application or unusual environmental conditions, nor does it extend to products which have been repaired or altered outside of Seller's plant unless authorized in writing by Seller or unless such installation, repair or alteration is performed by Seller, nor does this warranty extend to any labor charges for removal and/or replacement of the nonconforming or defective product or part thereof unless such product was originally installed by Seller.

THIS WARRANTY IS IN LIEU OF AND EXCLUDES ALL OTHER EXPRESS OR IMPLIED WARRANTIES ARISING BY OPERATION OF LAW OR OTHERWISE, INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT WILL SELLER BE LIABLE FOR INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES SUFFERED BY PURCHASER OR ITS CUSTOMERS INCLUDING LOST PROFITS OR REVENUE.

Seller's liability for any claim arising hereunder shall not exceed the price of the product or service which gives rise to the claim or the cost by Seller to repair or replace defective products or installation, whichever is less. Customer assumes all other risk and liability for any loss, damage or injury to persons or property arising out of, connected with, or resulting from the use of Seller's products, either alone or in combination with other products.

Introduction

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Special Considerations

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Model Number Designation

Performance Specifications

Forms for Return of Goods



U.S.A./International
1310 Emerald Road
Greenwood, SC 29646-9558
Tel.: Toll-Free (800) 833-3357
(864) 223-1212
Fax: (864) 223-0341

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Specifications subject to change without prior notification.

