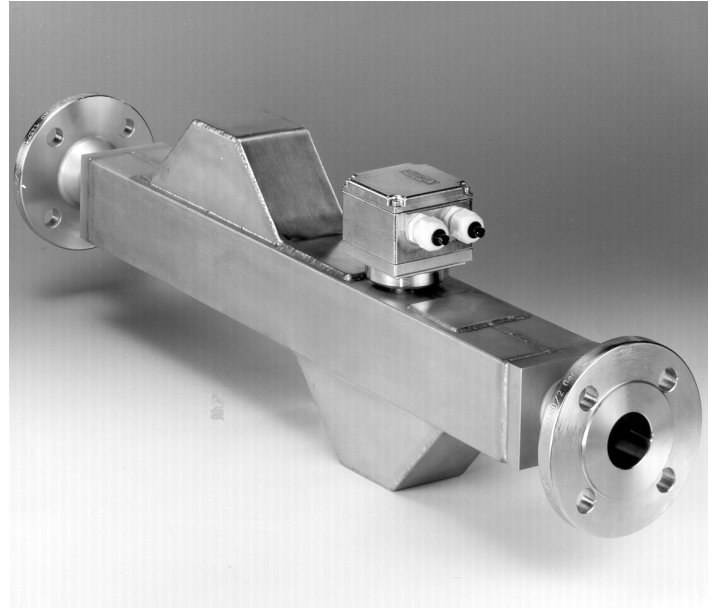


- Classic parallel path dual-tube results in a simple space saving design.
- Center balanced design with a rigid support provides rugged construction with vibration immunity.
- Optimally placed inductive sensors generate large signal amplitudes for efficient and stable operation.
- Flow measurement is independent of fluid conductivity, temperature, density, pressure, and flow profile.
- Self draining in horizontal or vertical pipeline installations.
- Maximum fluid process temperature of 356°F (180°C)
- Maximum cable length between meter primary and converter is 980 ft. (300 m).
- Microprocessor based flow computer with menu-driven software and keypad entry for easy configuration..
- Optional second analog (current) or pulse (active or optocoupled) outputs.
- Optional HART® Protocol or RS232/485 Serial DataLink communications.
- Backlit 2-line LCD dot matrix display.



***Trio-Mass™ Flowmeters  
Series MC1/50MM2000***

## Series MC1/50MM2000 MASS FLOWMETERS

The TRIO-MASS™ Coriolis Mass Flowmeter Model MC1 simultaneously measures mass flowrate, density, and temperature of process liquids. The classic space saving parallel path dual-tube design provides economical and highly accurate in-line flow measurement. Thick walled seamless tubing ensures meter integrity over a wide range of operating pressures. The microprocessor based Model 50MM2000 Flow Computer processes the measured meter signals and provides a variety of useful outputs. A user-friendly menu driven system allows easy setup, configuration, and operation. Optional software for high accuracy density measurement and fast filling and batching applications is also available.

### System Design

The flowmeter primary consists of two one piece meter tubes oriented in parallel as shown in Figure 1. These tubes are contained within a twist and bend resistant mounting structure. This mounting structure is designed to isolate the internal meter tubes from external forces and moments.

The inlet and outlet ends of the meter tubes are welded to junctions inside the mounting structure. You can see the inlets (and outlets) of the tubes as you look down the process connections of the meter.

It is recommended that a minimum of three diameters of straight pipe proceed the meter inlet. This short run of straight pipe ensures an even distribution of fluid through the two internal meter tubes.

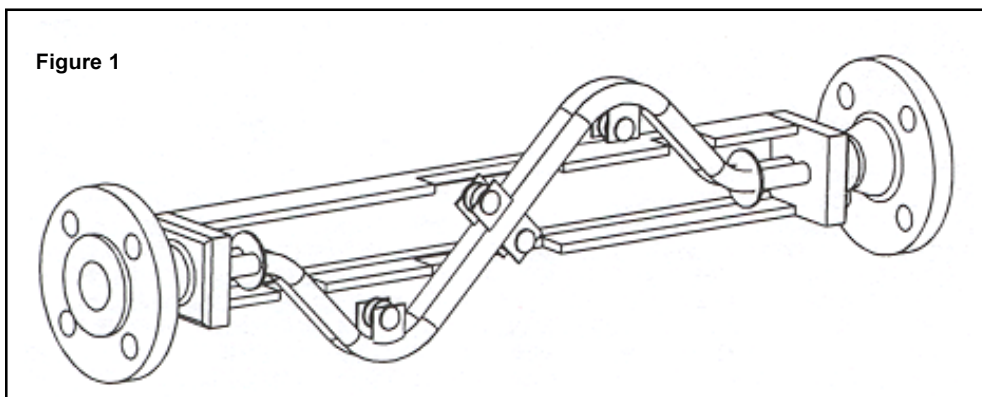
### Supports

The flowmeter should be installed in a rigid pipeline. Two brackets used to support the weight of the meter should be symmetrically installed in close proximity to the process connections as shown in Figure 2.

Elastic pipeline elements should be installed upstream and downstream of the meter in cases of strong pipeline vibration. Multiple flowmeter primaries in the same pipeline or installed in interconnected pipelines should be located far from one another, or, the pipeline must be decoupled to prevent crosstalk.



Figure 2 - Supports near inlet connection of a 6 in. Trio-Mass primary



# ENGINEERING SPECIFICATIONS METER (MODEL MC1)

## MATERIALS OF CONSTRUCTION

### Wetted Parts:

Metering Tube and End Connections:  
316 Ti Stainless Steel

### Non Wetted Parts:

Housing: 304 Stainless Steel  
Connection Terminal Box: 316 Ti Stainless Steel

## OPERATING LIMITS

**Table 1 - Capacity Table\***

Meter Size	Nominal Pipe Size	Flow Range** lbs (kg)/m	Q nom*** lbs (kg)/m	Zero lbs(kg)/m
C	3/8" (D N 10)	0 - 40 (0 - 18)	22 (10)	.008 (.004)
D	1/2" (D N 15)	0 - 100 (0 - 45)	50 (22)	.02 (.009)
E	3/4" (D N 20)	0 - 165 (0 - 75)	100 (45)	.033 (0.15)
F	1" (D N 25)	0 - 275 (0 - 125)	143 (65)	.055 (.025)
G	1-1/2" (D N 40)	0 - 805 (0 - 365)	408 (185)	.16 (.073)
H	2" (D N 50)	0 - 1,565 (0 - 710)	771 (350)	.313 (.142)
I	2-1/2" (D N 65)	0 - 3,195 (0 - 1,450)	1,598 (725)	.64 (.29)
J	3" (D N 80)	0 - 4,165 (0 - 1,890)	2,083 (945)	.883 (.378)
K	4" (D N 100)	0 - 7,050 (0 - 3,200)	3,526 (1,600)	1.41 (.64)
L	6" (D N 150)	0 - 18,700 (0 - 8,500)	9,350 (4,250)	3.75 (1.7)

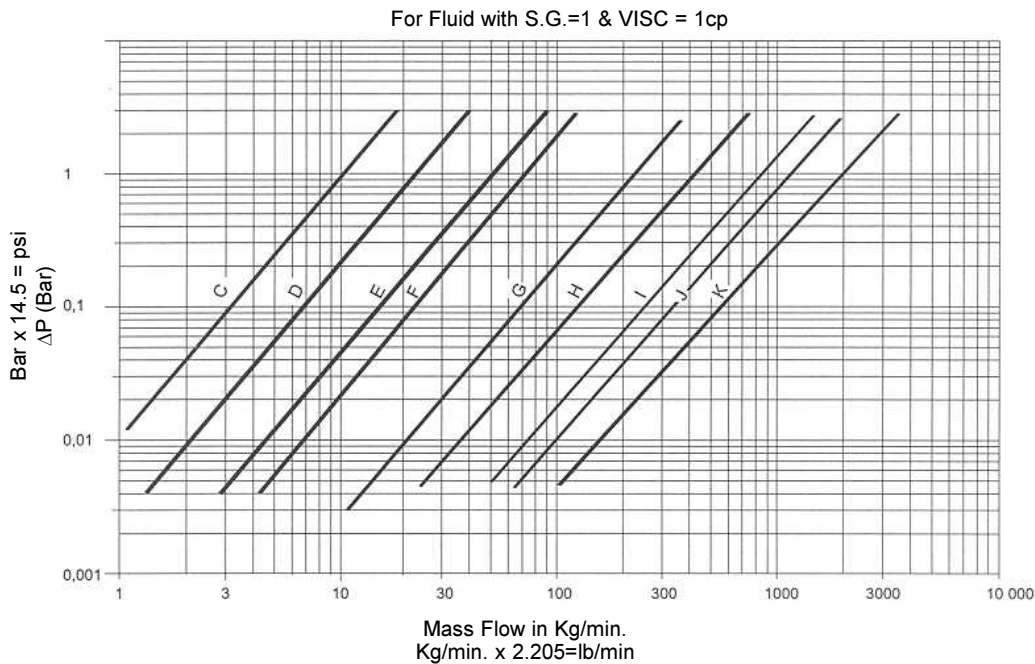
\* Based on Water at 68°F (20°C)

\*\* Maximum capacity based on a maximum permissible pressure drop of 2 bar (29 psi)

\*\*\* Qnom is based on a pressure drop of 0.5 bar (7.3 psi).

## Operating Pressure - See Table 3

## Pressure Drop - Figure 3



## Fluid Density:

Standard: 0.5 to 3.5 g/cc/31.2 to 218.5 lb/ft<sup>3</sup>

## Fluid Temperature:

Standard: -58 to +356°F (-50 to +180°C)

## Ambient Temperature:

-13 to +140°F (-25 to +60°C)

## Housing:

NEMA-4X (IP 67)

## ACCURACY - Including Electronics

**Mass Flow: % Rate =  $\pm [0.15 + (Zero \times 100)]$**

Where: Zero = Zero Stability Factor (from Table 1)

M = Mass Flowrate (units must be consistent)

## Density:

$\pm 0.005$  g/cc /  $\pm 0.31$  lb/ft<sup>3</sup> (standard calibration)

$\pm 0.001$  g/cc /  $\pm 0.062$  lb/ft<sup>3</sup>

(special density calibration-DENSI-MASS)

$\pm 0.0001$  g/cc /  $\pm 0.0062$  lb/ft<sup>3</sup> (Reproducibility)

## Temperature:

-50 to +180°C < 1.5°C

(-58 to +356°F < 2.7°F)

-20 to +100°C  $\leq$  0.5°C

(-4 to +212°F  $\leq$  0.9°F)

**Table 2 - Available End Connections**

End Connections	Meter Size (Inches)				
	C	D	E	F	G
Flanged ANSI Class 150, 300	3/8	3/8	1/2	3/4	1
	1/2	1/2	3/4	1	1-1/2
		3/4	1	1-1/2	2

End Connections	Meter Size (Inches)				
	H	I	J	K	L
Flanged ANSI Class 150, 300	1-1/2	2	-	3	6
	2	-	3	4	
	-	3	4		

**Table 3 - Pressure Limits psi (bar)\***

End Connections	Meter Size
Flanged:	
ANSI Class 150	275 (19)
ANSI Class 300	725 (50)
DIN PN 40	580 (40)

\* Pressure Rating of flanged connections @ 100°F (37.7°C)  
Pressure rating of tubing is 100 bar (1450 psi)

**ENGINEERING SPECIFICATIONS  
FLOW COMPUTER (MODEL 50MM2000)**

**Materials of Construction (Enclosure):**

Epoxy coated die cast aluminum

**Mounting:**

Wall, Panel or 2" Pipe Mount  
Maximum Cable Length:  
980 ft. (300m) from standard primary  
Optional 19" rack-mount enclosure

**Enclosure:**

NEMA 4X (IP 65) for Field Mount Housing  
(IP 00 for 19" rack-mount unit)

**Outputs**

Only certain combinations of outputs are available. See model configurations.

- Current Output 1  
0/4-20 mA, load ≤ 1 k-ohm  
For mass flowrate, volume flowrate, density, or temperature (software configurable)
- Optional Current Output 2  
0/4-20 mA, load ≤ 500 ohm  
For mass flowrate, volume flowrate, density, or temperature (software configurable). Not available with batch operation

- Optional Scaled Pulse Output  
Max. 5kHz  
Selectable pulse factor (0.001 to 1000)  
Selectable pulse width (64 to 2000 ms)  
Isolated from current output 1  
Active: 24 VDC square wave, 150 ohm min. load  
Relay Passive: Optocoupler, 5 Vdc ≤ V<sub>ce</sub> ≤ 25 Vdc, 5 mA < I<sub>ce</sub> < 30 mA  
Not available with current output 2
- Forward/Reverse Flow Direction  
Relay contact  
≤ 3w, ≤ 250mA, ≤ 28 Vdc  
Also indicated or display by arrows
- Automatic System Self Check with error diagnostics indicated on display and externally via contact outputs.  
Relay Contact Opens: ≤ 3 W, ≤ 250 mA, ≤ 28 Vdc  
Optocoupler: V<sub>ce</sub> ≤ 25 Vdc, I<sub>ce</sub> ≤ 25 mA
- Emulated Pulse Output  
0 to 50 Hz  
Pulse width adjustable between 2 and 10 ms  
Output of pulses is carried out every 100 ms in packages with a max of 5 pulses  
Used when there are two current outputs

**Input Signals:**

- External Zero Return  
All output signals can be turned off (e.g., if pipeline empties).  
Passive (24Vdc) or active (Via external contact closure)
- External Totalizer Reset  
Internal totalizers can be reset  
Passive (24Vdc) or active (Via external contact closure)

**Response Time:** 1 to 99 seconds (programmable)

**Electrical Connections:**

1/2" NPT conduit, screw terminals

**Power Options:** 230 Vac ±10%  
115 Vac ±10%  
24 Vac ±10%  
50/60 Hz ±6%  
17 - 62 Vdc

**Power Consumption:** <22 VA (primary and converter)

**Temperature Limits:** -5 to -122°F (-20 to +50°C)

For general purpose (nonhazardous location) units 10m (33 ft.) of Signal Cable PN 173D022U01 is supplied as standard. Longer lengths up to 300m (930 ft) are available.

## Serial Data Links

### RS485

$V_{ss} = 5\text{ V}$ , Input impedance:  $\geq 12\text{ K}\Omega$   
Max. cable length:  $\leq 1200\text{m}$  (4000 ft.) Shielded twisted pair data transmission line recommended.  
Baud Rate: 110 - 9600 Baud  
Max. of 32 instruments can be connected in parallel on one bus.

## COMMUNICATIONS

### HART® Protocol\*\*\*

Provides communication between process control system, handheld terminal, and field instrument (mass Flowmeter). Digital communication utilizes alternating voltages superimposed on current Output 1 signal which does not affect connected instrument.

#### Transmission Mode:

FSK-modulation on 4-20 mA current output 1 according to Bell 202 standard

**Baud Rate:** 1200 Baud

**Representation:** Logic 1:1200 Hz, Logic 0:2200 Hz

**Cable:** AWG 24 twisted pair

**Maximum Cable Length:** 1500m (4900 ft.)

**Maximum Signal Amplitude:**  $1.2\text{ mA}_{pp}$

**Current Output Load:** Minimum  $>250\Omega$ , Max.  $<750\Omega$

## Display

2 x 16 Chamber LC - Dot Matrix Display with LED background lighting. Both lines can be configured for showing process data. Two variables can be shown alternately on the second line of display in multiplex mode.

## FILL-MASS™

The 50MM2000 can be used for batch operations through utilization of special software and contact outputs. Up to four different batch quantities with pre-set and end contacts can be pre-selected from the keypad. Two stage filling reduces overrun and improves reproducibility. The automatic safety shut-off is also incorporated when the maximum fill time is exceeded.

## DENSI-MASS™

Special density software makes it possible to indicate the concentration of a second component in addition to overall density. Concentration calculations are made using valves from entered data pair of density and concentration. Value pair for two different density vs. concentration curves may be entered. It is also possible to calculate product quality from the mass rate and concentration.

\*\*\*Not Available with serial port communications

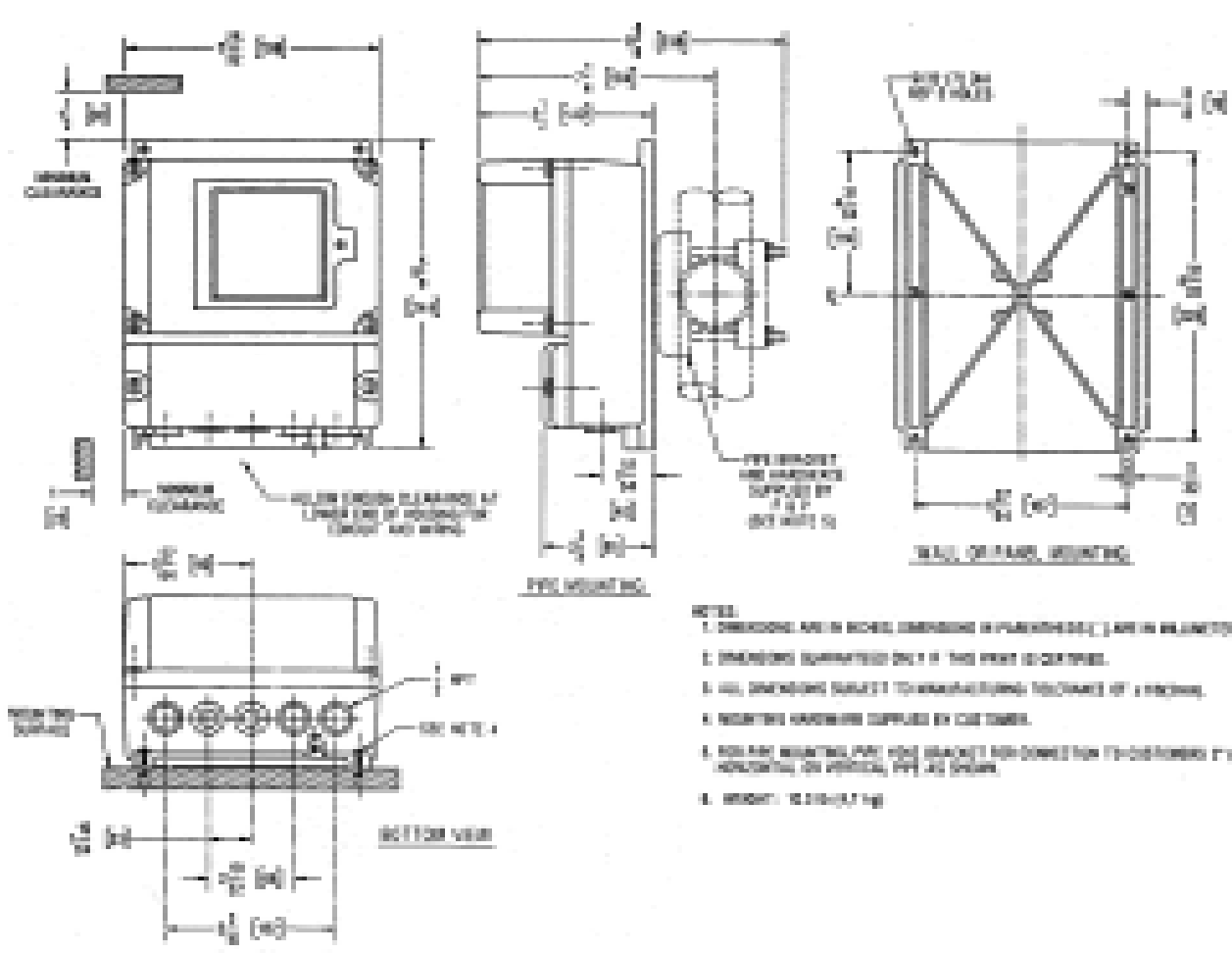


**MODEL NUMBER DESIGNATION  
FLOW COMPUTER**

	50MM2	06	07	08	A	A	11	12	13	14	15	16	2
REMOTE CONVERTER .....	50MM2												
<b>Optional Outputs</b>													
1st Current 4-20 mA only .....		0											
1st & 2nd Current 4-20 mA* .....		1											
1st Current & Active Pulse .....		2											
1st Current & Optocoupler Pulse .....		3											
*2nd current output n/a with batch operation													
<b>Data Link</b>													
None .....		0											
Serial Interface RS485* .....		1											
Profibus .....		3											
<i>*Not available with HART® Protocol</i>													
<b>Certification</b>													
General Purpose .....		0											
<b>Design Level</b> .....					A								
<b>Software Level</b> .....						A							
<b>Enclosure</b>													
Field Mount with Window and Door .....										H			
19" Insert Cassette with Connection Board .....												M	
<b>Operating Mode</b>													
Continuous Flow .....													0
Batch Operation (1) .....													1
Density (% Concentration and Brix) (2) .....													2
<b>Alarm Contact</b>													
Optocoupler .....													1
Relay .....													3
<b>Directional Contact</b>													
Optocoupler .....													1
Relay (Not available with Enclosure Option M) .....													2
<b>Options</b>													
None .....													A
HART® Protocol (Only for Operating Mode O) .....													B
<b>Power Supply</b>													
220 Vac .....													A
115 Vac .....													B
24 Vac .....													D
17 - 62 Vdc .....													F
<b>Nameplate - English</b> .....													2

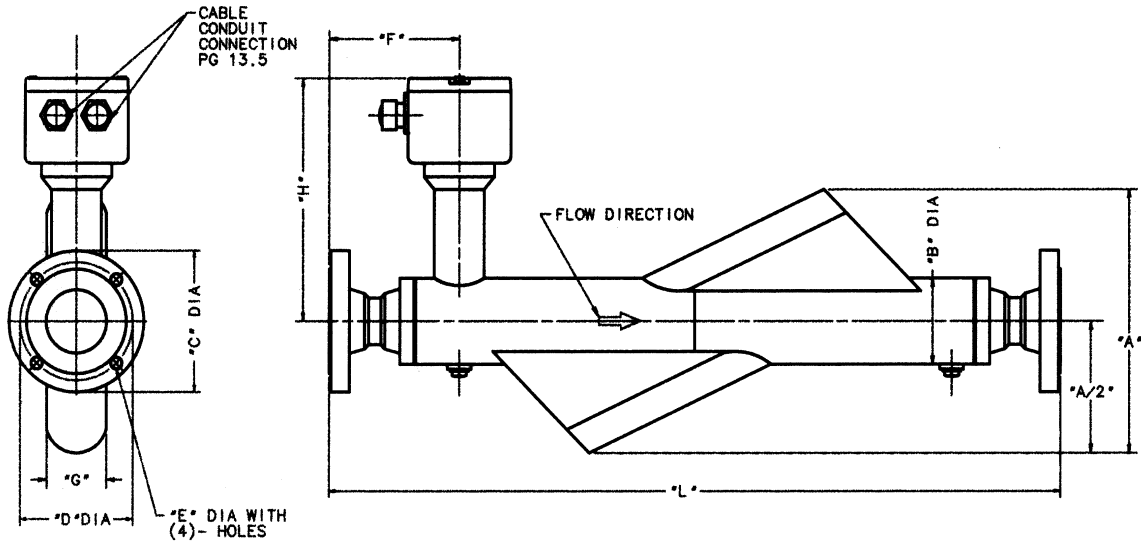
(1) No serial link, Hart or Current Output 2  
 (2) No serial link or Hart

# OUTLINE DIMENSIONS





# TRIO-MASS - 3/8" THRU 1"

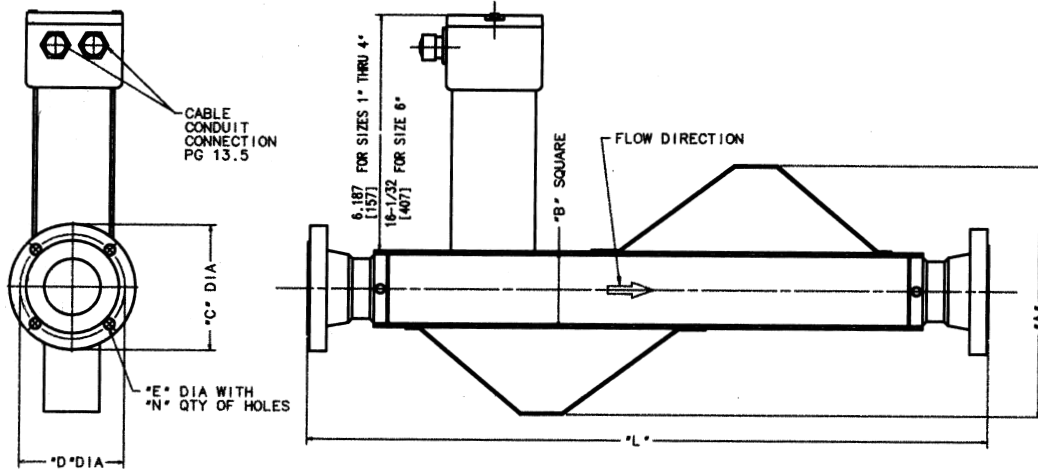


METER SIZE	PROCESS FLANGE CONN.	*L*	*A*	*B*	*C*-DIA	*D*-DIA	*E*- DIA	*F*	*G*	*H*	WEIGHT	
											Kg	Lbs
*C* (3/8")	1/2" ANSI CL-150	[595] 23-137/16	[164] 6-15/32	[60] 2-3/8	[88.9] 3-1/2	[60.5] 2-3/8	[15.7] 5/8	[152] 6	[35] 1-3/8	[202] 7-31/32	7	15.4
	1/2" ANSI CL-300	[605] 23-15/16			[95.2] 3-3/4	[66.5] 2-5/8	[15.7] 5/8	[157] 6-3/16			7	15.4
*D* (1/2")	1/2" ANSI CL-150	[595] 23-7/16	[200] 7-7/8	[76] 3	[88.9] 3-1/2	[60.5] 2-3/8	[15.7] 5/8	[118] 4-21/32	[45] 1-25/32	[210] 8-9/32	9	19.8
	1/2" ANSI CL-300	[605] 23-13/16			[95.2] 3-3/4	[66.5] 2-5/8	[15.7] 5/8	[123] 4-27/32			9	19.8
	3/4" ANSI CL-150	[705] 27-3/4			[98.6] 3-7/8	[69.9] 2-3/4	[15.7] 5/8	[173] 6-13/16			9	19.8
	3/4" ANSI CL-300	[715] 28-5/32			[117.3] 4-5/8	[82.5] 3-1/4	[19] 3/4	[178] 7			10	22
*E* (3/4")	1/2" ANSI CL-150	[710] 27-15/16	[240] 9-7/16	[89] 3-1/2	[88.9] 3-1/2	[60.5] 2-3/8	[15.7] 5/8	[167] 6-9/16	[60] 2-3/8	[216] 8-1/2	12	26.4
	1/2" ANSI CL-300	[720] 28-11/32			[95.2] 3-3/4	[66.5] 2-5/8	[15.7] 5/8	[172] 6-25/32			13	28.6
	3/4" ANSI CL-150	[620] 24-13/32			[98.6] 3-7/8	[69.9] 2-3/4	[15.7] 5/8	[122] 4-13/16			12	28.4
	3/4" ANSI CL-300	[630] 24-13/16			[117.3] 4-5/8	[82.5] 3-1/4	[19] 3/4	[127] 5			13	28.6
	1" ANSI CL-150	[730] 28-3/4			[108] 4-1/4	[79.2] 3-1/8	[15.7] 5/8	[177] 6-31/32			13	28.6
	1" ANSI CL-300	[740] 29-5/32			[123.9] 4-7/8	[88.9] 3-1/2	[19] 3/4	[182] 7-5/32			14	30.8
*F* (1")	3/4" ANSI CL-150	[780] 30-23/32	[240] 9-7/16	[89] 3-1/2	[98.6] 3-7/8	[69.9] 2-3/4	[15.7] 5/8	[182] 7-5/32	[60] 2-3/8	[216] 8-1/2	13	28.6
	3/4" ANSI CL-300	[790] 31-1/8			[117.3] 4-5/8	[82.5] 3-1/4	[19] 3/4	[187] 7-3/8			14	30.8
	1" ANSI CL-150	[690] 27-5/32			[108] 4-1/4	[79.2] 3-1/8	[15.7] 5/8	[137] 5-13/32			13	28.6
	1" ANSI CL-300	[700] 27-3/16			[123.9] 4-7/8	[88.9] 3-1/2	[19] 3/4	[142] 5-19/32			14	30.8
	1-1/2" ANSI CL-150	[840] 33-1/16			[127] 5	[98.4] 3-7/8	[15.7] 5/8	[212] 8-11/32			15	33
	1-1/2" ANSI CL-300	[855] 34-27/32			[155.6] 6-1/8	[114.3] 4-1/2	[22.3] 7/8	[220] 8-21/32			17	37.4

NOTE: ALL DIMENSIONS IN BRACKETS [ ] ARE IN MILLIMETERS [mm]

TRIO-MASS 3/8 THRU 1

# TRIO-MASS - 1-1/2" THRU 6"



METER SIZE	PROCESS FLANGE CONN.	*L*	*A*	*B*	*C*-DIA	*D*-DIA	*E*- DIA	*N*-HOLES	WEIGHT	
									Kg	Lbs
*G* (1-1/2")	1" ANSI CL-150	[910] 35-13/16	[258] 10-5/32	[90] 3-17/32	[108] 4-1/4	[79.2] 3-1/8	[15.7] 5/8	4	20	44
	1" ANSI CL-300	[922] 36-3/32			[123.9] 4-7/8	[88.9] 3-1/2	[19] 3/4	4	21	46
	1-1/2" ANSI CL-150	[810] 31-7/8			[127] 5	[98.6] 3-7/8	[15.7] 5/8	4	21	46
	1-1/2" ANSI CL-300	[825] 32-15/32			[155.4] 6-1/8	[114.3] 4-1/2	[22.3] 7/8	4	23	51
	2" ANSI CL-150	[970] 38-3/16			[152.4] 6	[120.7] 4-3/4	[19] 3/4	4	23	51
	2" ANSI CL-300	[980] 38-19/32			[165.1] 6-1/2	[127] 5	[19] 3/4	8	25	55
*H* (2")	1-1/2" ANSI CL-150	[1075] 42-5/16	[296] 11-21/32	[110] 4-11/32	[127] 5	[98.6] 3-7/8	[15.7] 5/8	4	30	66
	1-1/2" ANSI CL-300	[1080] 42-29/32			[155.4] 6-1/8	[114.3] 4-1/2	[22.3] 7/8	4	33	72.6
	2" ANSI CL-150	[970] 38-3/16			[152.4] 6	[120.7] 4-3/4	[19] 3/4	4	32	70.4
	2" ANSI CL-300	[980] 38-19/32			[165.1] 6-1/2	[127] 5	[19] 3/4	8	34	74.8
	2-1/2" ANSI CL-150	[1135] 44-11/16			[177.8] 7	[139.7] 5-1/2	[19] 3/4	4	36	79.2
	2-1/2" ANSI CL-300	[1145] 45-1/16			[190.5] 7-1/2	[149.3] 5-7/8	[22.3] 7/8	8	38	83.6
*I* (2-1/2")	2" ANSI CL-150	[1250] 49-7/32	[328] 12-29/32	[130] 5-1/8	[152.4] 6-1/8	[120.7] 4-3/4	[19] 3/4	4	42	92.4
	2" ANSI CL-300	[1260] 49-5/8			[185.1] 7-1/2	[127] 5	[22.3] 7/8	8	44	96.8
	2-1/2" ANSI CL-150	[1135] 44-11/16			[177.8] 7	[139.7] 5-1/2	[19] 3/4	4	45	99
	2-1/2" ANSI CL-300	[1145] 45-1/16			[190.5] 7-1/2	[149.3] 5-7/8	[22.3] 7/8	8	47	103.4
	3" ANSI CL-150	[1240] 48-13/16			[190.5] 7-1/2	[152.4] 6	[19] 3/4	4	47	103.4
	3" ANSI CL-300	[1260] 49-5/8			[209.5] 8-1/4	[168.1] 6-5/8	[22.3] 7/8	8	50	110
*J* (3")	2-1/2" ANSI CL-150	[1365] 53-3/4	[372] 14-5/8	[140] 5-1/2	[177.8] 7	[139.7] 5-1/2	[19] 3/4	4	53	116.6
	2-1/2" ANSI CL-300	[1375] 54-1/8			[190.5] 7-1/2	[149.3] 5-7/8	[22.3] 7/8	8	56	123.2
	3" ANSI CL-150	[1240] 48-13/16			[190.5] 7-1/2	[152.4] 6	[19] 3/4	4	54	118.8
	3" ANSI CL-300	[1260] 49-5/8			[209.5] 8-1/4	[168.1] 6-5/8	[22.3] 7/8	8	58	127.6
	4" ANSI CL-150	[1500] 59-1/16			[228.6] 9	[190.5] 7-1/2	[19] 3/4	8	60	132
	4" ANSI CL-300	[1520] 59-27/32			[254] 10	[200.1] 7-7/8	[22.3] 7/8	8	69	151.8
*K* (4")	3" ANSI CL-150	[1660] 65-11/32	[430] 16-15/16	[170] 6-11/16	[190.5] 7-1/2	[152.4] 6	[19] 3/4	4	80	176
	3" ANSI CL-300	[1680] 66-1/8			[209.5] 8-1/4	[168.1] 6-5/8	[22.3] 7/8	8	84	184.8
	4" ANSI CL-150	[1500] 59-1/16			[228.6] 9	[190.5] 7-1/2	[19] 3/4	8	82	180.4
	4" ANSI CL-300	[1520] 59-27/32			[254] 10	[200.1] 7-7/8	[22.3] 7/8	8	91	200.2
*L* (6")	6" ANSI CL-150	[2070] 81-1/2	[570] 22-7/16	[250] 9-27/32	[279.4] 11	[241] 9-1/2	[22.3] 7/8	8	170	374
	6" ANSI CL-300	[2090] 82-9/32			[317.5] 12-1/2	[269.8] 10-5/8	[22.3] 7/8	12	190	418

NOTE: ALL DIMENSIONS IN BRACKETS [ ] ARE IN MILLIMETERS [mm]

TRIO-MASS 1-1/2 THRU 6



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