

Multivariable Mass Vortex Flow Meter

FEATURES

- Mass and volumetric flow measurement of gas, liquid, and steam
- Multivariable outputs for five process parameters:
 - mass flow rate
 - volumetric flow rate
 - temperature
 - pressure
 - density
- Single process connection
- In-line (1/2 inch to 8 inch) and insertion (into pipes > 2 inch) configurations
- Field-configurable ranges, alarms, outputs and displays
- Field configurable via six push buttons or magnet through explosion-proof window
- Smart DSP electronics extends low flow range down to a Reynolds number of 5000
- Rangeability up to 30:1
- Temperature -330°F (-200°C) up to 750°F (400°C)
- Cryogenic version measures liquid O₂, N₂, Ar, and CO₂ down to -330°F (-200°C)
- Pressure up to 1500 psig (100 barg)
- High pressure version to 5000 psig (345 barg)
- Ideal for steam applications
- Flow computer integrates AGA-8 equations for natural gas
- Full implementation of HART protocol
- Optional MODBUS protocol
- FMC and ATEX approval



www.sierrainstruments.com

InnovaMass[®] 240 & 241



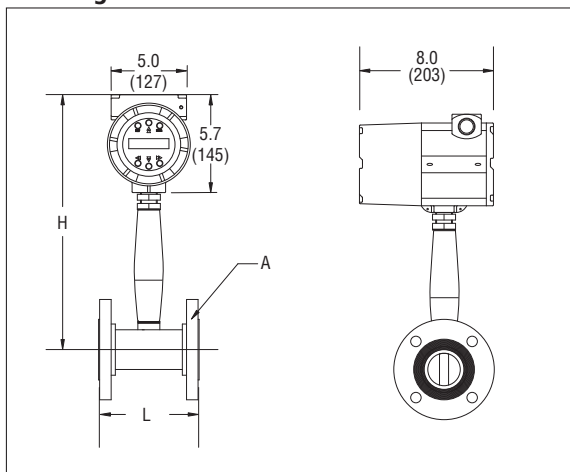
DESCRIPTION

Sierra was the first to introduce a multivariable mass vortex flow meter to the market in the late 1990's. Sierra's multivariable product line features an in-line version, the InnovaMass[®] 240 and a unique insertion version, the InnovaMass[®] 241. The 241 has emerged recently as the proven instrument of choice in geothermal steam applications across the globe. Both the 240 and 241 measure the mass flow rate of any gas or liquid and are ideally suited for saturated or superheated steam. The InnovaMass offers customers one instrument and one process connection, measuring five process parameters simultaneously: mass flow rate, temperature, pressure, volumetric flow rate, and fluid density.

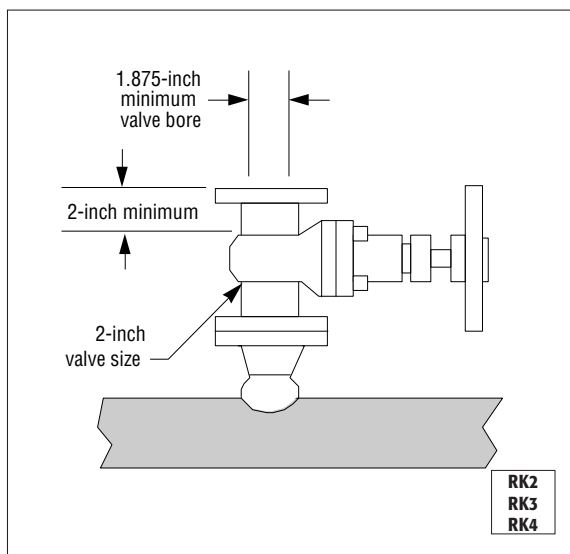
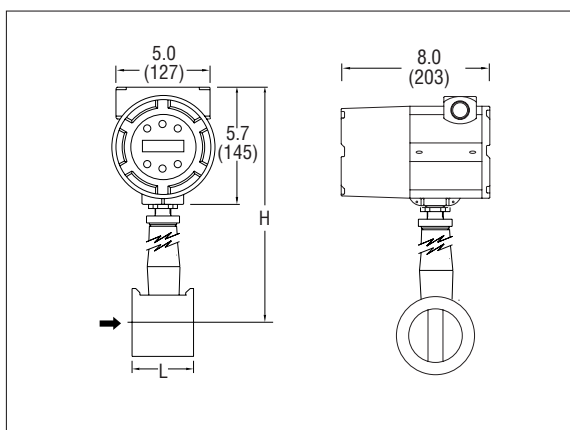
The 241 is available in high-pressure versions capable of mass flow measurement up to 5000 psig (345 barg), and the 240 cryogenic version is widely used for fluids down to -330°F (-200°C). All models are fully field-programmable, configurable and feature RS-485, MODBUS or HART protocols. InnovaMass is a true high performance, rugged, and reliable workhorse in industry.

DIMENSIONAL SPECIFICATIONS

240 Flanged In-line—Side / Outlet View



240 Wafer — Side / Outlet View



IN-LINE TABLE

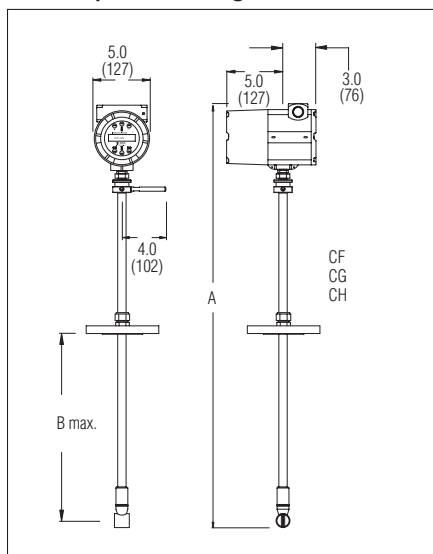
InnovaFlo® 240 Sizes			
Flow Body Size	A	L	H
0.5-inch SCH 80	150 lb flange	4.56 (116)	14.8 (376)
	300 lb flange	4.56 (116)	14.8 (376)
	600 lb flange	4.56 (116)	14.8 (376)
	1.4 flange wafer O.D.	4.56 (116)	14.8 (376)
0.75-inch SCH 80	150 lb flange	4.8 (122)	14.8 (376)
	300 lb flange	4.8 (122)	15.0 (381)
	600 lb flange	4.8 (122)	15.0 (381)
	1.7 flange wafer O.D.	4.8 (122)	15.0 (381)
1-inch SCH 80	150 lb flange	4.94 (125)	15.0 (381)
	300 lb flange	4.94 (125)	15.0 (381)
	600 lb flange	4.94 (125)	15.0 (381)
	2.0 flange wafer O.D.	2.8 (71)	14.8 (376)
1.5-inch SCH 80	150 lb flange	5.5 (140)	15.1 (384)
	300 lb flange	5.5 (140)	15.1 (384)
	600 lb flange	5.5 (140)	15.1 (384)
	2.9 flange wafer O.D.	2.8 (71)	15.1 (384)
2-inch SCH 80	150 lb flange	6.0 (152)	15.3 (389)
	300 lb flange	6.0 (152)	15.3 (389)
	600 lb flange	6.0 (152)	15.3 (389)
	3.7 flange wafer O.D.	3.0 (76)	15.3 (389)
3-inch SCH 80	150 lb flange	6.9 (175)	15.8 (401)
	300 lb flange	6.9 (175)	15.8 (401)
	600 lb flange	6.9 (175)	15.8 (401)
	5.0 flange wafer O.D.	4.0 (102)	15.8 (401)
4-inch SCH 80	150 lb flange	8.0 (203)	16.2 (411)
	300 lb flange	8.0 (203)	16.2 (411)
	600 lb flange	8.0 (203)	16.2 (411)
	6.2 flange wafer O.D.	4.7 (119)	16.2 (411)
6-inch SCH 80	150 lb flange	9.0 (229)	17.3 (439)
	300 lb flange	9.0 (229)	17.3 (439)
	600 lb flange	9.0 (229)	17.3 (439)
8-inch SCH 80	150 lb flange	10.5 (267)	18.2 (462)
	300 lb flange	10.5 (267)	18.2 (462)
	600 lb flange	10.5 (267)	18.2 (462)

All dimensions are inches (+/- .25-inch significant value). Millimeters are in parentheses. Certified drawings are available on request.

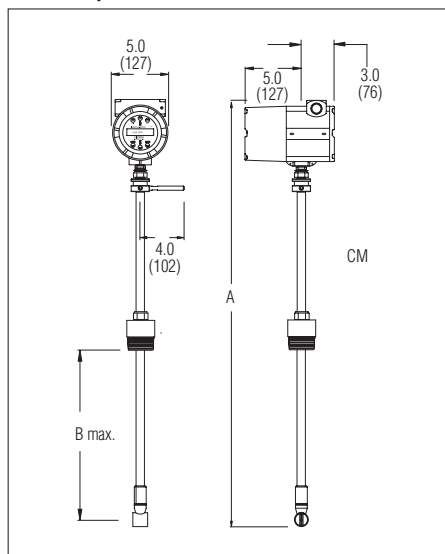
Notes: (1) Can be used with removable retractor.
(2) Retractor is permanently mounted to meter.

IN-LINE DIMENSIONAL SPECIFICATIONS

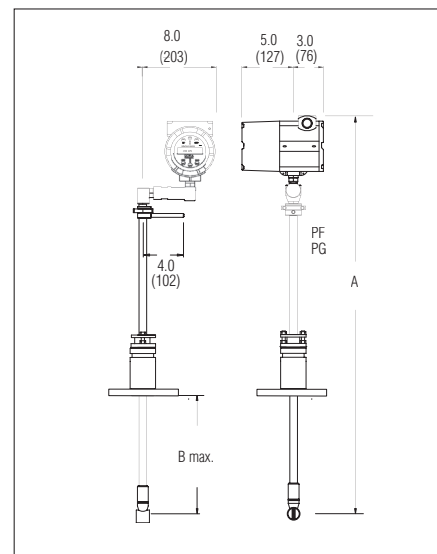
241 Compression, Flange



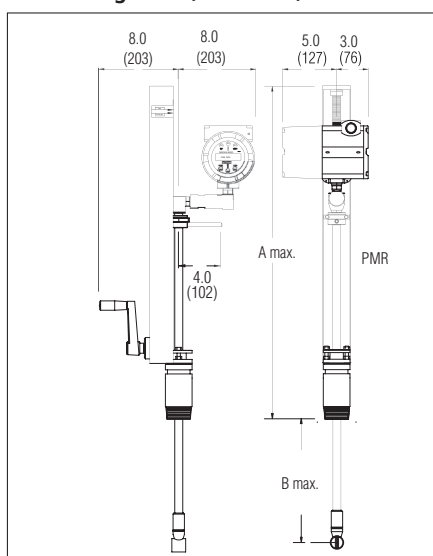
241 Compression, Male NPT



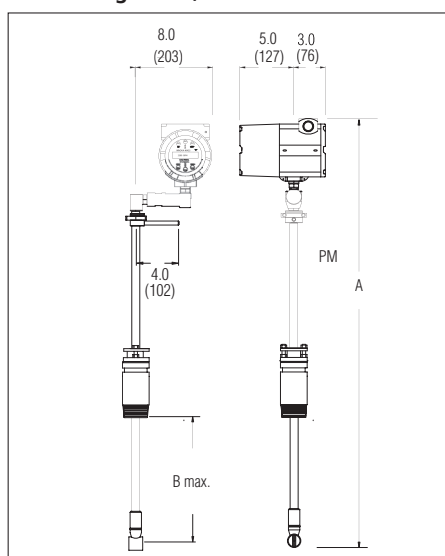
241 Packing Gland, Flange



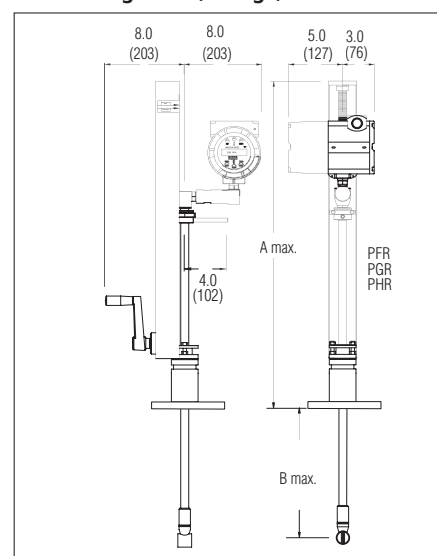
241 Packing Gland, Male NPT, Retractor



241 Packing Gland, Male NPT



241 Packing Gland, Flange, Retractor

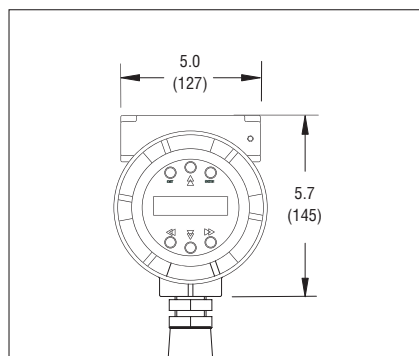


InnovaMass® 241 Sizes

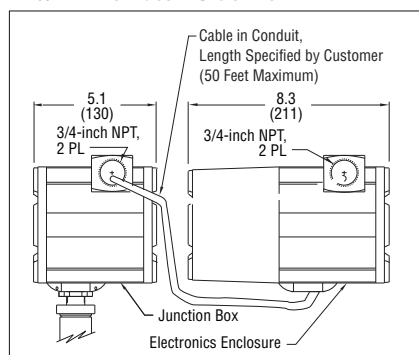
Model Code / Probe Seal / Process Connection	Standard Probe		Compact Probe		Extended Probe	
	A	B	A	B	A	B
CM / Compression / 2-in Male NPT	41.0 (1041)	26.2 (665)	24.6 (625)	9.8 (249)	53.0 (1346)	38.2 (970)
CF / Compression / 150 lb Flange	41.0 (1041)	27.3 (693)	24.6 (625)	10.9 (277)	53.0 (1346)	39.3 (998)
CG / Compression / 300 lb Flange	41.0 (1041)	27.2 (691)	24.6 (625)	10.8 (274)	53.0 (1346)	39.2 (996)
CH / Compression / 600 lb Flange	41.0 (1041)	26.8 (681)	24.6 (625)	10.4 (264)	53.0 (1346)	38.8 (986)
PM / Packing Gland / 2-in Male NPT	40.5 (1029)	21.5 (546)	N/A	N/A	53.0 (1346)	33.5 (851)
PMR / Packing Gland / 2-in Male NPT with Retractor	40.5 (1029)	21.5 (546)	N/A	N/A	53.0 (1346)	33.5 (851)
PF / Packing Gland / 150 lb Flange	40.5 (1029)	21.1 (536)	N/A	N/A	53.0 (1346)	33.1 (841)
PFR / Packing Gland / 150 lb Flange with Retractor	40.5 (1029)	21.1 (536)	N/A	N/A	53.0 (1346)	33.1 (841)
PG / Packing Gland / 300 lb Flange	40.5 (1029)	21.1 (536)	N/A	N/A	53.0 (1346)	33.1 (841)
PGR / Packing Gland / 300 lb Flange w/ Retractor	40.5 (1029)	21.1 (536)	N/A	N/A	53.0 (1346)	33.1 (841)
PHR / Packing Gland / 600 lb flange w/ Retractor	40.5 (1029)	21.1 (536)	N/A	N/A	53.0 (1346)	33.1 (841)

ORDERING SPECIFICATIONS

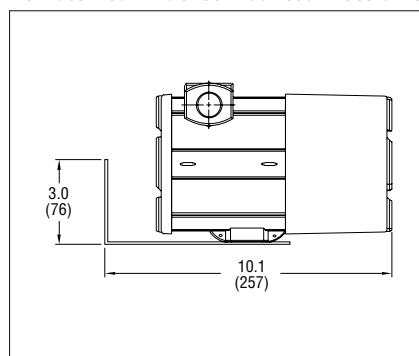
240/241 Remote—Front View



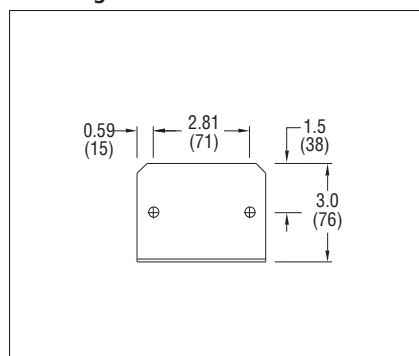
240/241 Remote—Side View



Remote Rear Bracket Mounted Electronics



Mounting Holes for Remote Rear Bracket



Straight Pipe Length Requirements (in number of internal diameters, D)

	Upstream	Downstream
One 90° elbow before meter	10 D	5 D
Two 90° elbows before meter	15 D	5 D
Two 90° elbows before meter out of plane (If three 90° bends present, double recommend length)	25 D	10 D
Reduction before meter	10 D	5 D
Expansion before meter	20 D	5 D
Regulator or valve partially closed before meter (If valve wide open, base length requirements on fitting directly preceding it.)	25 D	10 D

Weight

Connection Size	240 In-Line Meter					
	ANSI 150 lb		ANSI 300 lb		ANSI 600 lb	
	lb	kg	lb	kg	lb	kg
0.5-inch Flange	12.0	5.5	12.5	5.7	13	5.9
0.75-inch Flange	13.0	5.9	14	6.4	14.5	6.6
1-inch Flange	13.5	6.1	16.4	7.4	16.4	7.4
1.5-inch Flange	14.6	6.6	22.7	10.3	24.8	11.2
2-inch Flange	19.5	8.8	26.9	12.2	33.2	15.1
3-inch Flange	27.5	12.5	39.5	17.9	56.3	25.5
4-inch Flange	43.5	19.7	60.5	27.4	96.2	43.6
6-inch Flange	48.4	22.0	96.2	43.6	178	80.8
8-inch Flange	71.0	32.2	149	67.4	300	136
1-inch Wafer	—	—	—	—	10.1	4.6
1.5-inch Wafer	—	—	—	—	11.8	5.4
2-inch Wafer	—	—	—	—	14.2	6.4
3-inch Flange	—	—	—	—	22.7	10.3
4-inch Flange	—	—	—	—	33.0	15.0

241 Insertion Meter

Connection Size	lb	kg
Compression Fitting, Male NPT	13.8	6.2
Compression Fitting, 150 lb Flange	16.3	7.3
Compression Fitting, 300 lb Flange	18.3	8.3
Compression Fitting, 600 lb Flange	19.3	8.7
Packing Gland, Male NPT	15.8	7.1
Packing Gland, Male NPT with Reactor	25.3	11.5
Packing Gland, 150 lb Flange	20.8	9.4
Packing Gland, 150 lb Flange with Reactor	30.3	13.7
Packing Gland, 300 lb Flange	24.8	11.3
Packing Gland, 300 lb Flange with Reactor	34.3	15.5
Packing Gland, 600 lb Flange with Reactor	35.3	16.0

All dimensions are inches (+/- .25-inch significant value). Millimeters are in parentheses. Certified drawings are available on request.

OPERATING SPECIFICATIONS

Flow Rates

Typical mass flow ranges are given in the following table. Precise flow ranges depend on the fluid and pipe size. 241 insertion meters are applicable to pipe sizes from 2 inches and greater. Consult factory for sizing program.

Water Minimum and Maximum Flow Rates									
Pressure	0.5-inch	0.75-inch	1-inch	1.5-inch	2-inch	3-inch	4-inch	6-inch	8-inch
gpm	0.9	1.4	2.2	5.5	9.2	21	36	81	142
	22	40	67	166	276	618	1076	2437	4270
m ³ /hr	0.2	0.3	0.5	1.3	2.1	4.7	8.1	18	32
	5	9	15	38	63	140	244	554	970

Air Minimum and Maximum Flow Rates (scfm) ⁽¹⁾									
Pressure	0.5-inch	0.75-inch	1-inch	1.5-inch	2-inch	3-inch	4-inch	6-inch	8-inch
0 psig	1.8	3	5	13	22	50	87	198	347
	18	41	90	221	369	826	1437	3258	5708
100 psig	5	9	15	38	63	141	245	555	972
	138	325	704	1730	2890	6466	11254	25515	44698
200 psig	7	13	21	52	86	193	335	761	1332
	258	609	1322	3248	5427	12140	21131	47911	83931
300 psig	8	15	25	63	104	234	407	922	1615
	380	896	1944	4775	7978	17847	31064	70431	123375
400 psig	10	18	29	72	120	269	467	1060	1857
	502	1183	2568	6309	10542	23580	41043	93057	163000
500 psig	11	20	33	80	134	300	521	1182	2071
	624	1472	3195	7849	13115	28034	51063	115775	203000

Note: (1) Standard conditions are 70° F and 1 atmosphere.

Saturated Steam Minimum and Maximum Flow Rates (lb/hr)									
Pressure	0.5-inch	0.75-inch	1-inch	1.5-inch	2-inch	3-inch	4-inch	6-inch	8-inch
5 psig	6.5	12	20	49	82	183	318	722	1264
	52	122	265	650	1087	2431	4231	9594	16806
100 psig	15	27	46	112	187	419	728	1652	2893
	271	639	1386	3405	5690	12729	22156	50233	87998
200 psig	20	37	62	151	253	565	983	2229	3905
	493	1163	2525	6203	10365	23184	40354	91494	160279
300 psig	24	45	74	182	304	680	1184	2685	4704
	716	1688	3664	9000	15040	33642	58556	132763	232575
400 psig	28	51	85	209	349	780	1358	3079	5393
	941	2220	4816	11831	19770	44222	76971	174516	305717
500 psig	31	57	95	233	389	870	1514	3433	6014
	1170	2760	5988	14711	24582	54987	95710	17001	380148

OPERATING SPECIFICATIONS

Process Fluid Pressure

240 Pressure Ratings				
Probe Seal	Process Connection	Material	Rating	Ordering Code
Compression Fitting	2-inch male NPT	316L SS	ANSI 600 lb	CM
	2-inch 150 lb flange	316L SS	ANSI 150 lb	CF
	2-inch 300 lb flange	316L SS	ANSI 300 lb	CG
	2-inch 600 lb flange	316L SS	ANSI 600 lb	CH
Packing Gland	2-inch male NPT	316L SS	50 psig	PM
	2-inch 150 lb flange	316L SS	50 psig	PF
	2-inch 300 lb flange	316L SS	50 psig	PG
Packing Gland w/ Removable Retractor	2-inch male NPT	316L SS	ANSI 300 lb	PM, RR
	2-inch 150 lb flange	316L SS	ANSI 150 lb	PF, RR
	2-inch 300 lb flange	316L SS	ANSI 300 lb	PG, RR
Packing Gland w/ Permanent Retractor	2-inch male NPT	316L SS	ANSI 600 lb	PMR
	2-inch 150 lb flange	316L SS	ANSI 150 lb	PFR
	2-inch 300 lb flange	316L SS	ANSI 300 lb	PGR
	2-inch 600 lb flange	316L SS	ANSI 600 lb	PHR

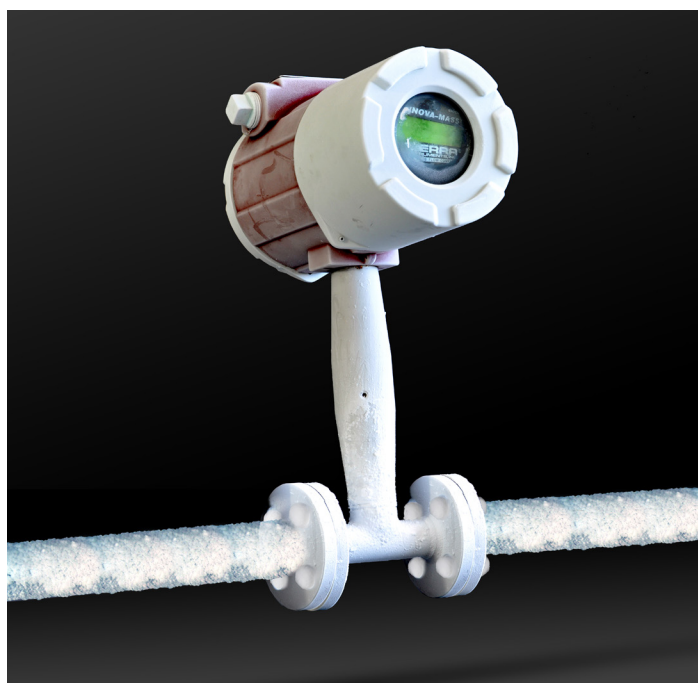
Process Fluid Pressure

240 Pressure Ratings		
Process Connection	Material	Rating
Flanged	316L SS, A105 carbon steel, C276 Hastalloy®	150, 300, 600 lb
Wafer	316L SS, A105 carbon steel, C276 Hastalloy®	600 lb

Pressure Transducer Ranges

Pressure Sensor Ranges ⁽¹⁾ psia (bara)			
Full Scale Operating Pressure		Maximum Over-Range Pressure	
psia	(bara)	psia	(bara)
30	2	60	4
100	7	200	14
300	20	600	41
500	34	1000	69
1500	100	1500	100

Note: (1) To maximize accuracy, specify the lowest full scale operating pressure range for the application. To avoid damage, the flow meter must never be subjected to pressure above the over-range pressure shown above.



OPERATING SPECIFICATIONS (continued)

Power Requirements

12 to 36 VDC, 100 mA (add 20mA per output up to 60mA)
100 to 240 VAC, 50/60 Hz, 25 watts

Display

Alphanumeric 2x16 LCD digital display
Six push buttons switches (up, down, right, left, enter, exit) operable through the display glass of the explosion-proof enclosure viewing at 90° mounting intervals

Process Fluid & Ambient Temperature

Process Fluid Cryogenic Temperature Sensor:
-330°F to -40°F (-200°C to -40°C)
Standard Temperature Sensor:
-40°F to 500°F (-40°C to 260°C)
High Temperature Sensor:
-40°F to 750°F (40°C to 400°C)
Ambient Operating:
-5°F to 140°F (-20° to 60°C)
Storage:
-40°F to 150°F (-40° to 65°C)
0-98% relative humidity, non-condensing conditions

Output Signals⁽¹⁾

Analog One to three field rangeable, simultaneous linear 4-20 mA output signals (1000 ohms maximum loop resistance) selected by user from the five parameters—mass flow rate, volumetric flow rate, temperature, pressure and density
Pulse Pulse output for totalization is a 50-millisecond duration pulse operating a solid-state relay capable of switching 40 VDC, 40 mA maximum HART standard, optional MODBUS RTU

Note: (1) All outputs are optically isolated and require external power for operation.

Alarms

Up to three programmable solid-state relays for high, low or window alarms capable of switching to 40 VDC, 40 mA maximum

Totalizer

Based on user-determined flow units, nine full digits, with rollover at 4, 294, 967, 295; total stored in non-volatile memory.

PERFORMANCE SPECIFICATIONS

Wetted Materials

240. 316L stainless steel standard
C276 Hastalloy® or A105 carbon steel optional
Teflon-based thread sealant on pressure transducer
241. 316L stainless steel
Teflon® packing gland below 500°F (260°C)
Graphite packing gland above 500°F (260°C)
Teflon-based thread sealant on pressure transducer

Enclosure

NEMA 4x/7 (IP65) cast enclosure

Electrical Ports

Two 3/4-inch female NPT ports

Mounting Connections

240. Wafer or 150, 300, 600 lb ANSI flange
241. Permanent Installation:
Two-inch male NPT; 150, 300, 600 lb ANSI flange with compression fitting probe seal
Hot Tap⁽¹⁾ Installation:
Two-inch male NPT; 150, 300, 600 lb ANSI flange; and optional retractor with packing gland probe seal

Note: (1) Removable under line pressure.

Mounting Position

240. No effect
241. Meter must be perpendicular within +/- 5° of the pipe centerline

FMC Approval

Explosion proof for Class I, Division 1, Groups B, C & D.
Dust-ignition proof for Class II/III, Division 1, Groups E, F & G.
NEMA Type 4x/7 and IP66
T6 at Tamb=60°C

ATEX Approval

II 2 G Ex d II B + H2 T6
II 2 D Ex t D A 21 IP66 T6
KEMA 08 ATEX 0143

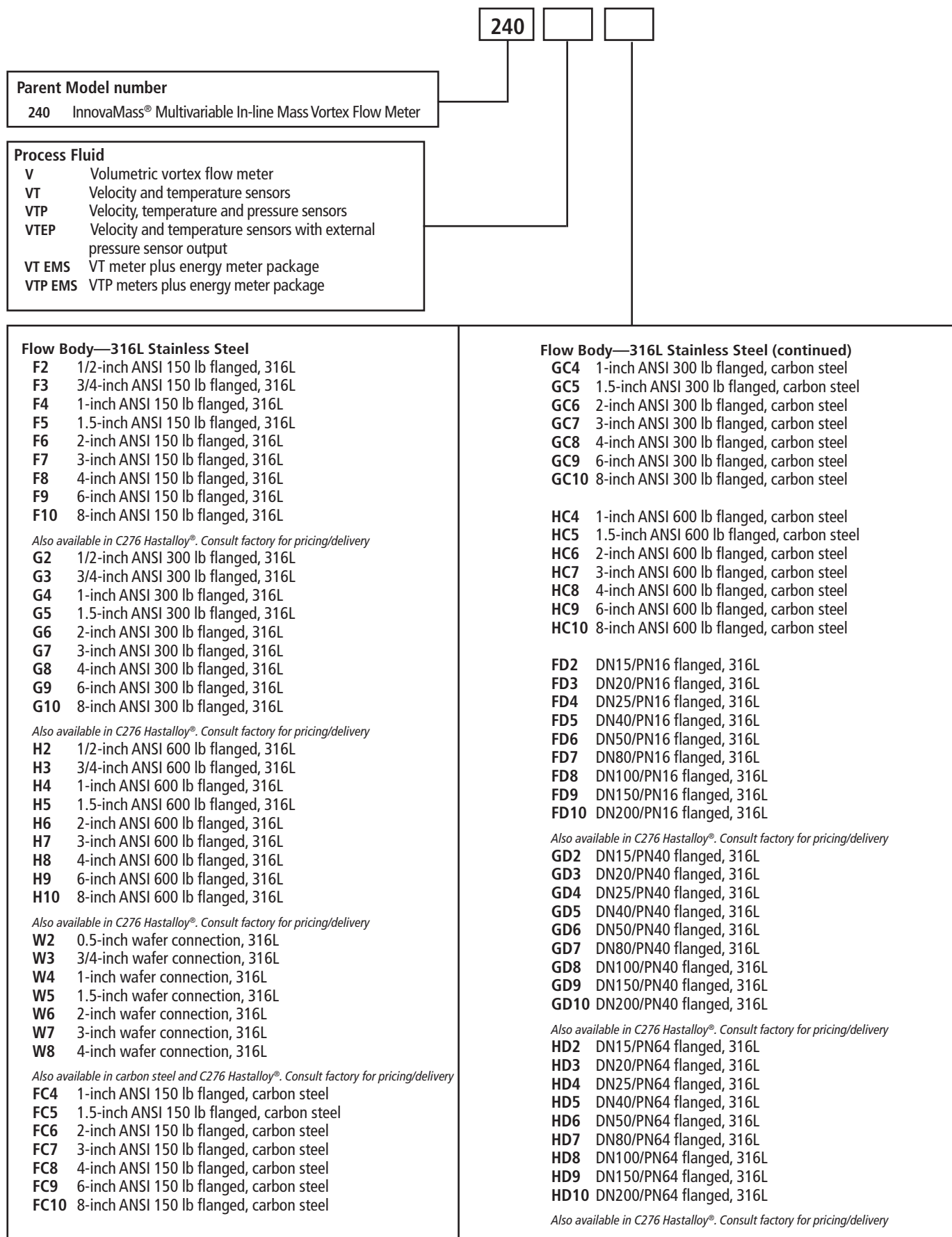
CE Approval

0344

Optional Certifications

Construction and inspection (ANSI/ASME B31.3)
Materials (NACE MR-01-75(90))

ORDERING THE 240 IN-LINE



ORDERING the 240 In-Line (Continued)

240

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Electronics Enclosure

- E2** NEMA 4x enclosure mounted on probe
- E4()** Remote electronics NEMA 4x includes NEMA 4x on probe
Specify cable length in parentheses, maximum 50 feet

Display Option

- DD** Digital display
- NR** No display

Input Power

- PV1L** 12-36 VDC loop powered (available only with V4LH)
- PV1** 12-36 VDC
- PS** 100-240 VAC, 50/60 Hz line power, 25 watts

Output

- V4LH** One analog output (4-20 mA), one pulse, HART. Loop powered
- V4H** One analog output (4-20 mA), one alarm, one pulse and HART
Communication. Not loop powered
- V4M** One analog output (4-20 mA), one alarm, one pulse, and MODBUS.
- V6H** Three analog outputs (4-20 mA), three alarms, one pulse, HART
protocol communication
- V6M** Three analog outputs (4-20 mA), three alarms, one pulse, MODBUS

Process Temperature

- CT** Cryogenic temperature (CT only available with V or VT versions)
Process temperature -330°F to -40°F (-200°C to -40°C)
Not available in carbon steel
- ST** Standard temperature
Process temperature -40°F to 500°F (40°C to 260°C)
- HT** High Temperature
Process temperature -40°F to 750°F (-40°C to 400°C)

Process Pressure

- MP0** No pressure sensor used with VT process fluid
- MP1** Maximum 30 psia (2 bara), proof 60 psia (4 bara)
- MP2** Maximum 100 psia (7 bara), proof 200 psia (14 bara)
- MP3** Maximum 300 psia (20 bara), proof 600 psia (41 bara)
- MP4** Maximum 500 psia (34 bara), proof 1000 psia (64 bara)
- MP5** Maximum 1500 psia (100 bara), proof 2500 psia (175 bara)

Option: Oxygen Cleaning

- O2C** Cleaned for O₂ service (includes certification). Meter
Must include (oxygen cleaning) if meter to be used for
oxygen service.

ORDERING THE 241 INSERTION

241

Parent Model Number**241** InnovaMass® Insertion Mass Vortex Flow Meter**Process Fluid**

V Vortex flow meter
VT Velocity and temperature sensors
VTP Velocity, temperature and pressure sensors
VTEP Velocity and temperature sensors with external pressure sensor output
VT EMS VT meter plus energy meter package
VTP EMS VTP meters plus energy meter package

Probe Length

LS Standard probe
LC Compact probe (available only for compressions fitting connections CM, CF, CG and CH)
LE Extended probe (consult factory if for PMR, PFR, PGR or PHR)

Electronics Enclosure

E2 NEMA 4x7/7 enclosure. Mounted on probe
E4 () Remote electronics NEMA 4x7/7 (IP65) includes NEMA 4x7/7 (IP65) on probe
 Specify cable length in parentheses, maximum 50ft (17m)

Display Option

DD Digital display
NR No display

Input power

PV1L 12-36 VDC loop powered (available only with V4LH).
PV1 12-36 VDC
PS 100-240 VAC, 50/60 Hz line power, 25 Watts

Output Power

V4LH One analog output (4-20mA), one pulse, HART, loop powered
V4H One analog output (4-20 mA), one alarm, one pulse HART communication, not loop powered
V4M One analog output (4-20 mA), one alarm, one pulse and MODBUS
V6M Three analog outputs (4-20 mA), three alarms, one pulse and MODBUS
V6H Three analog outputs (4-20 mA), three alarms, one pulse and HART protocol communication

Process Temperature

ST Standard temperature. Process temperature -330° to 500°F (-200° to 260°C)
HT High temperature. Process temperature -40° to 750°F (-40° to 400°C)

Process Pressure

MP0 No pressure sensor used with VT process fluid
MP1 Maximum 30 psia (2 bara), proof 60 psia (4 bara)
MP2 Maximum 100 psia (7 bara), proof 200 psia (14 bara)
MP3 Maximum 300 psia (20 bara), proof 600 psia (41 bara)
MP4 Maximum 500 psia (34 bara), proof 1000 psia (64 bara)
MP5 Maximum 1500 psia (100 bara), proof 1500 psia (100 bara)

Option: Oxygen Cleaning

O2C Cleaned for O2 service (includes certification). Meter
 Must include (oxygen cleaning) if meter to be used for oxygen service.

ORDERING THE 241 INSERTION (Continued)

241	*	*	*	*	*	*	*	
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Process Connection ANSI		Process Connection DN	
CM	Compression fitting 2-inch male NPT, 600 lb pressure rating	CFD	Compression fitting DN50/PN16 flange
CF	Compression fitting 2-inch 150 lb flange	CGD	Compression fitting DN50/PN40 flange
CG	Compression fitting 2-inch 300 lb flange	CHD	Compression fitting DN50/PN64 flange
CH	Compression fitting 2-inch 600 lb flange	PFD	Packing gland DN50/PN16 flange, 50 psig (3.5 barg) maximum process pressure
PM	Packing gland 2-inch male NPT, 50 psig (3.5 barg) maximum process pressure without removable retractor	PFDR	Packing gland DN50/PN16 flange, with retractor
PMR	Packing gland 2-inch male NPT with retractor, 600 lb pressure rating	PFDR-LE	Packing gland DN50/PN16 flange, with retractor For use with extended probe length (see LE option)
PMR-LE	Packing gland 2-inch male NPT with retractor, 600 lb pressure rating (for LE)	PGD	Packing gland DN50/PN40 flange, 50 psig (3.5 barg) maximum process pressure
PF	Packing gland 2-inch 150 lb flange, 50 psig (3.5 barg) maximum process pressure without removable retractor	PGDR	Packing gland DN50/PN40 flange, with retractor
PFR	Packing gland 2-inch 150 lb flange with retractor	PGDR-LE	Packing gland DN50/PN40 flange, with retractor For use with extended probe length (see LE option)
PFR-LE	Packing gland 2-inch 150 lb flange with retractor For use with extended probe length (see LE option)	PHDR	Packing gland DN50/PN64 flange, with retractor
PG	Packing gland 2-inch 300 lb flange, 50 psig (3.5 barg) maximum process pressure without removable retractor	PHDR-LE	Packing gland DN50/PN64 flange, with retractor For use with extended probe length (see LE option)
PGR	Packing gland 2-inch 300 lb flange with retractor		
PGR-LE	Packing gland 2-inch 300 lb flange with retractor For use with extended probe length (see LE option)		
PHR	Packing gland 2-inch 600 lb flange with retractor		
PHR-LE	Packing gland 2-inch 600 lb flange with retractor For use with extended probe length (see LE option)		



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