ST-TT-Ø3
ST-TT-Ø4

Custom Alarm and Saturation Levels

Custom factory configuration of alarm and saturation level is available with option code C1. These values can also be configured in the field using a HART Communicator.

Performance

The Model 644 transmitters maintain a specification conformance of at least 3σ.

Accuracy

TABLE A-2. Model 644 Input Options and Accuracy.

Sensor Options	Sensor Reference	Input Ranges		Recommended Min. Span [1]		Digital Accuracy[2]		D/A Accuracy[3]
2-, 3-, 4-Wire RTDs		°C	°F	°C	°F	°C	°F	
Pt 100	IEC 751, 1995 (α = 0.00385)	–200 to 850	–328 to 1562	10	18	± 0.15	± 0.27	±0.03% of span
PT 100	JIS 1604, 1981 (α = 0.003916)	–200 to 645	–328 to 1193	10	18	± 0.15	± 0.27	±0.03% of span
Pt 200	IEC 751, 1995 (α = 0.00385)	–200 to 850	–328 to 1562	10	18	± 0.27	± 0.49	±0.03% of span
Pt 500	IEC 751, 1995 (α = 0.00385)	–200 to 850	–328 to 1562	10	18	± 0.19	± 0.34	±0.03% of span
Pt 1000	IEC 751, 1995 (α = 0.00385)	–200 to 300	–328 to 572	10	18	± 0.19	± 0.34	±0.03% of span
Ni 120	Edison Curve No. 7	–70 to 300	–94 to 572	10	18	± 0.15	± 0.27	±0.03% of span
Cu 10	Edison Copper Winding No. 15	–50 to 250	–58 to 482	10	18	±1.40	± 2.52	±0.03% of span
Thermocouples[4]								
Type B[5]	NIST Monograph 175, IEC 584	100 to 1820	212 to 3308	25	45	± 0.77	± 1.39	±0.03% of span
Type E	NIST Monograph 175, IEC 584	–50 to 1000	–58 to 1832	25	45	± 0.20	± 0.36	±0.03% of span
Type J	NIST Monograph 175, IEC 584	–180 to 760	–292 to 1400	25	45	± 0.35	± 0.63	±0.03% of span
Type K[6]	NIST Monograph 175, IEC 584	–180 to 1372	–292 to 2502	25	45	± 0.50	± 0.90	±0.03% of span
Type N	NIST Monograph 175, IEC 584	–200 to 1300	–328 to 2372	25	45	± 0.50	± 0.90	±0.03% of span
Type R	NIST Monograph 175, IEC 584	0 to 1768	32 to 3214	25	45	± 0.75	± 1.35	±0.03% of span
Type S	NIST Monograph 175, IEC 584	0 to 1768	32 to 3214	25	45	± 0.70	± 1.26	±0.03% of span
Type T	NIST Monograph 175, IEC 584	–200 to 400	–328 to 752	25	45	± 0.35	± 0.63	±0.03% of span
DIN Type L	DIN 43710	–200 to 900	–328 to 1652	25	45	± 0.35	± 0.63	±0.03% of span
DIN Type U	DIN 43710	–200 to 600	–328 to 1112	25	45	± 0.35	± 0.63	±0.03% of span
Type W5Re/W26Re	ASTM E 988–96	0 to 2000	32 to 3632	25	45	± 0.70	± 1.26	±0.03% of span
Millivolt Input		–10 to 100 mV		3 mV		±0.015 mV		±0.03% of span
2-, 3-, 4-Wire Ohm Input		0 to 2000 ohms		20 ohm		±0.45 ohm		±0.03% of span

(1) No minimum or maximum span restrictions within the input ranges. Recommended minimum span will hold noise within accuracy specification with damping at zero seconds.
(2) Digital accuracy: Digital output can be accessed by HART Communicator or Rosemount control system.
(3) Total Analog accuracy is the sum of digital and D/A accuracies.
(4) Total digital accuracy for thermocouple measurement: sum of digital accuracy +0.5 °C
(5) Digital accuracy for NIST Type B T/C is ±3.0 °C from 100 to 300 °C.
(6) Digital accuracy for NIST Type K T/C is ±0.70 °C from –292 to –130 °F (–180 to –90 °C).

Accuracy Example

When using a Pt 100 (α = 0.00385) sensor input with a 0 to 100 °C span: Digital accuracy would be ±0.15 °C, D/A accuracy would be ±0.03% of 100 °C or ±0.03 °C, Total = ±0.18 °C.

ST-FT-Ø2

Model 8711 Wafer Flowtube Specifications

SPECIFICATIONS

Functional Specifications

Service
Conductive liquids and slurries

Line Sizes
0.15- through 8-inch (4 through 200 mm)

Interchangeability
Model 8711 Flowtubes are interchangeable with Model 8712C/U, Model 8732, and Model 8742C Transmitters. System accuracy is maintained regardless of line size or optional features. Each flowtube nameplate has a sixteen-digit calibration number that can be entered into a transmitter through the Local Operator Interface (LOI) or the HART Communicator on the Model 8712C/U/H and the Model 8732C. In a FOUNDATION fieldbus environment, the Model 8742C can be configured using the DeltaV fieldbus configuration tool or another FOUNDATION fieldbus configuration device. No further calibration is necessary.

Upper Range Limit
30 ft/s (10 m/s)

Process Temperature Limits

Tefzel (ETFE) Lining

–20 to 300 °F (–29 to 149 °C) for 0.5- through 8-inch (15–200 mm) line sizes

–20 to 200 °F (–29 to 93 °C) for 0.15- and 0.3-inch (4 and 8 mm) line sizes

Teflon (PTFE) Lining

-20 to 350 °F (-29 to 177 °C)

Ambient Temperature Limits
–30 to 150 °F (–34 to 65 °C)

Maximum Safe Working Pressure at 100 °F (38 °C)

Tefzel (ETFE) Lining

Full vacuum to 740 psi (5.1 MPa) for 0.5- through 8-inch (15 through 200 mm) flowtubes

285 psi (1.96 MPa) for 0.15- and 0.30-inch (4 and 8 mm) flowtubes

Teflon (PTFE) Lining

Full vacuum through 4-inch (100 mm) line sizes. Consult factory for vacuum applications with line sizes of 6 inches (150 mm) or larger.

Conductivity Limits
Process liquid must have a conductivity of 5 microsiemens/cm (5 micromhos/cm) or greater for Model 8711. Excludes the effect of interconnecting cable length in remote mount transmitter installations.

Performance Specifications

(System specifications are given using the frequency output and with the unit at referenced conditions.)

Accuracy

Model 8711 with Model 8712C/U, Model 8732C, or Model 8742C Transmitters

±0.5% of rate from 3 to 30 ft/s (1 to 10 m/s)

±0.015 ft/s (0.045 m/s) from low-flow cutoff to 3 ft/s (1 m/s)

Vibration Effect
Meets IEC 770 Pipeline Installation Conditions

Mounting Position Effect
No effect when installed to ensure flowtube remains full

Physical Specifications

Non-Wetted Materials

Flowtube

303 SST (ASTM A-743)

Coil Housing

Investment cast steel (ASTM A-27)

Paint

Polyurethane

Process-Wetted Materials

Lining

Tefzel (ETFE), Teflon (PTFE)

Electrodes

316L SST, Hastelloy C-276, tantalum, 90% platinum—10% iridium, titanium

ST-FE/FT-01

ROSEMOUNT INC.
MASS PROBAR AVERAGING PITOT TUBE ASSEMBLY
CALCULATION DATA SHEET

GENERAL DATA

Customer:	MICHIGAN TECH
Project:	2002 OFFICIAL CALCULATIONS
S. O. No:	1048308
P. O. No:	CREDIT CARD
Calc. Date:	5/31/02
Model No:	MNF+10S007HAMS0S0000FAS23A1A1
Tag No:	ST-FE-01

PRODUCT DESCRIPTION

Product Type:	Mass ProBar + Mass Flowmeter - In Line Flan			Instrument Valve:	Eliminate Instr Conn Assy (Steam)
Sensor Size	10			Valve Material:	150#; WNRF; SS
Wetted Material:				Line Size:	3/4 inch
Mounting Conn. Type:	150#; WNRF; SS			Pipe Sch.:	40S
Mounting Conn. Material:				Pipe Orientation:	
Electronics Mounting:	Integral; 3-Valve MNFLD; HL; SS			Flange Type:	
Max. Allow. Pressure@Temp.:	233.696	psia	280 F	Pipe Wall Thickness:	0.113 inch
Design Pressure/Temperature:	45	psia	280.00 F	Max. Allow. Temp.:	500.00 F

INPUT DATA

Fluid Type:	Steam			
Fluid Description:				
Pipe I.D:	0.824	inch		
Pressure:	39.700	psia	Base Pressure:	14.696 psia
Temperature at Flow:	266.80	F	Base Temperature:	59.00 F
Absolute Viscosity:	0.01332	cP		
Isentropic Exponent:	1.31994			
Compressibility at Flow:			Base Compressibility:	
Density at Flow:	0.094599	lb/ft3	Base Density:	lb/ft3
Flow Rates				
Minimum:	0	lb/hr		
Normal:	300	lb/hr		
Maximum:	350	lb/hr		
Full Scale:	350	lb/hr		

CALCULATED DATA

(Calculation Performed at Normal Conditions. DP in inH2O@68F)

DP at Min Flow:	0.000 inH2O@68F	Flow Coefficient:	0.5074
DP at Normal Flow:	62.145 inH2O@68F	Thermal Expansion Factor:	1.0038
DP at Max Flow:	84.782 inH2O@68F	Rod Reynolds Number (Normal):	36257
DP at Full Scale Flow:	84.782 inH2O@68F	Pipe Reynolds Number (Normal):	172694
Structural Limit (DP):	1500.000 inH2O@68F	Gas Expansion Factor:	0.9968
Structural Limit (Flow):	1472.18022 lb/hr	Permanent Pressure Loss:	
N Factor:		at Normal Flow:	16.613 inH2O@68F
Minimum Accurate Flow:	53.98 lb/hr	at Maximum Flow:	22.664 inH2O@68F
		Velocity at Max Flow:	277.521 ft/sec

NOTES

Low Reynolds Number Notice at Minimum Flow

Calculation by MLS.

Version: 3.0 (Build97F) **Printed On:** 9-Jul-02

PERFORMANCE SPECIFICATIONS

Combined System Accuracy (Including Linearity, Hysteresis, Repeatability)

±1.3% of mass flow rate.

Flow Turndown

8:1 flow turndown.

Differential Pressure Ambient Temperature Effect Per 50 °F (28 °C)

±0.025% of URL + 0.175% of span.
Spans from 1:1 to 30:1.

±0.035% of URL – 0.125% of span.
Spans from 30:1 to 100:1.

Static Pressure Effects

Zero error= ±0.10% of URL per 1,000 psi (6894 kPa).

Span error= ±0.20% of reading per 1,000 psi (6894 kPa).

Stability

±0.1% of URL for 12 months.

Absolute/Gage Pressure Ambient Temperature Effect Per 50 °F (28° C)

±0.05% of URL + 0.175% of span.

Spans from 1:1 to 30:1.

±0.06% of URL-0.125% of span.

Spans from 30:1 to 100:1.

Stability

±0.1% of URL for 12 months.

Process Temperature Ambient Temperature Effect Per 50 °F (28 °C)

0.36 °F (0.20 °C) for process temperatures from –40 °F to 185°F (–40 °C to 85 °C).

±(0.64 °F (0.36 °C) + 0.16% of reading) for process temperatures from 185 °F (85 °C) to 400 °F (204 °C).

Straight Run Requirements

See page 2-3.

Mass ProBar Operating Limitations

Model	Minimum Reynold's Number (Re_{rod})
10	2000
15/16	5000
25/26	10000
35/36	15000
45/46	25000

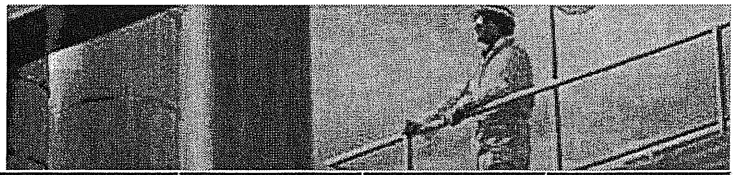
Where:

$$Re_{rod} = \frac{dV\rho}{\mu}$$

ρ = fluid density in lb/ft^3
d = probe width in feet
V = velocity of fluid in ft/sec
μ = fluid viscosity in lbm/ft-sec

See DS-7300 for detailed information.

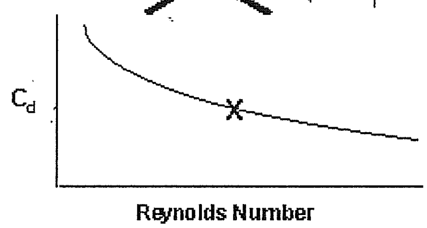
ST-FT-Ø1



Model 3095MV™
Why Fully Compensated DP Flow?

Traditionally, DP flow has been calculated in a DCS or flow computer using a simplified mass flow equation. In simplified DP mass flow measurements, a constant is used to represent many of the terms in the flow calculation:

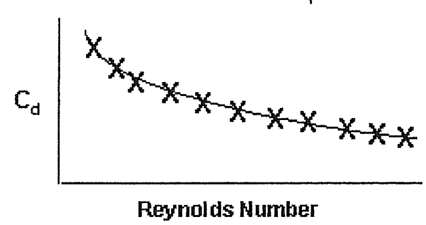
$$Q_{mass} = constant(k) \sqrt{DP \frac{P}{T}}$$



The constant combines unit conversion factor, velocity of approach factor, gas expansion factor, and discharge coefficient.

Compensating flow is the process of combining the dynamic fluid condition values with the flow signal to calculate true flow. The Model 3095MV uses a fully compensated equation from mass flow through any differential producer:

$$Q_{mass} = N\, C_d\, E\, Y_1\, d^2 \sqrt{DP(\rho)}$$



N = units conversion factor
C_d = discharge coefficient
E = velocity of approach factor
Y_1 = gas expansion factor
d^2 = bore of differential producer
p = density

In fact, only the units conversion factor is constant. The other terms (discharge coefficient, velocity of approach factor, and gas expansion factor) are functions of the process variables. The simplified flow equation cannot compensate for changes in these terms, resulting in unrecorded errors in the calculated flow rate.

The Model 3095MV provides the greatest DP flow accuracy over the widest operating range by dynamically calculating all flow equation coefficients real time, including discharge coefficients, velocity of approach factor, thermal expansion effects, and density. This fully compensated flow equation reduces the sources of traditional DP flow uncertainty, thereby providing a more accurate flow calculation.

How Does the 3095MV Calculate Mass Flow?

Using the EA Software the user enters the process fluid (EA database already knows molecular weight, isentropic exponent, and constants), primary element type

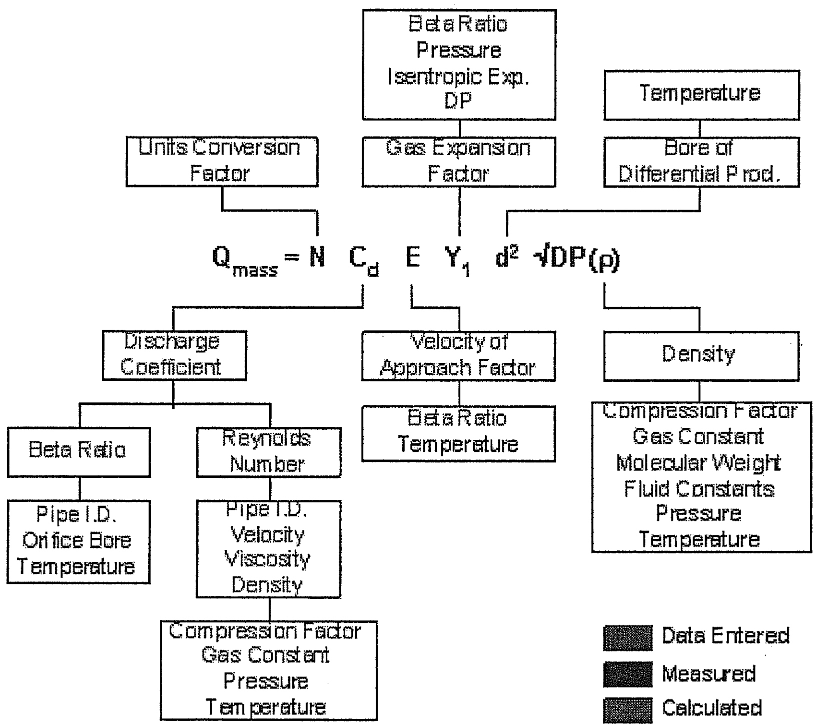
ST-FT-Ø1

and size, and pressure and temperature operating conditions.

The Model 3095MV measures the static pressure, differential pressure, and process temperature.

The internal flow computer dynamically calculates all flow equation coefficients in real time including: discharge coefficient, velocity of approach factor, thermal expansion effects, and density

Result is the Model 3095MV provides the greatest DP flow accuracy over the widest operating range!



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