Product Data Sheet
PS-001486, Rev D
May 2017

Micro Motion® Fork Viscosity Meters

High performance multi-variable viscosity meter

Rugged, accurate multi-variable measurement

- Continuous, multi-variable measurement of viscosity, density and temperature
- Accurate measurement of viscosity (±1% of full scale) and density (±1 kg/m^3)
- Optimized design – insensitive to vibration, temperature and pressure variations

Superior multi-variable I/O, meter health, and application capabilities

- Hazardous-area approved, head-mounted transmitter that supports local configuration and display
- Internal diagnostics for fast verification of meter health and installation
- Application-specific factory configurations ensure fit-for-purpose operation

Installation flexibility and compatibility

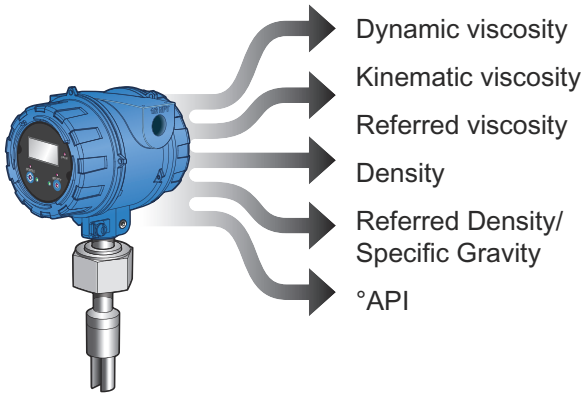
- Direct insertion design for pipeline, bypass loop and tank installations
- Unique direct insertion design in lengths of up to 13 ft (4 m)
- Supports multiple protocols for connection to DCS, PLC, and flow computers
- Optional stainless steel transmitter housing for corrosion resistance in harsh environments

Micro Motion® Fork Viscosity Meters

Micro Motion® Fork Viscosity Meters are accurate multi-variable devices that measure liquid viscosity, density and temperature under demanding conditions. These meters use vibrating fork technology to provide reliable direct insertion measurement. Use these viscosity meters in applications as diverse as product detection, fuel blending and heater combustion control.

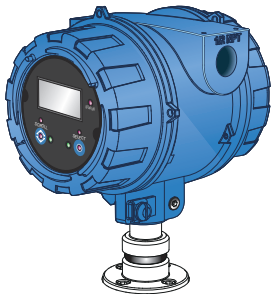
Application configurations

Integral HART I/O direct input of external temperature, pressure, and flow measurements provide enhanced readings.



Integral transmitter

Supports Analog (4-20 mA), HART, WirelessHART®, Modbus RS-485 and FOUNDATION™ fieldbus communications.

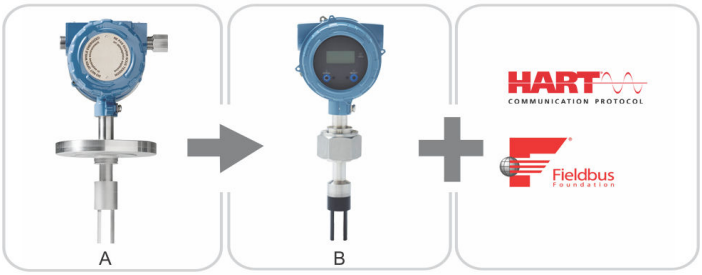


Meter diagnostics

Ensure measurement health through known density verification (KDV) and other meter and installation diagnostic capabilities.

Retrofit capabilities

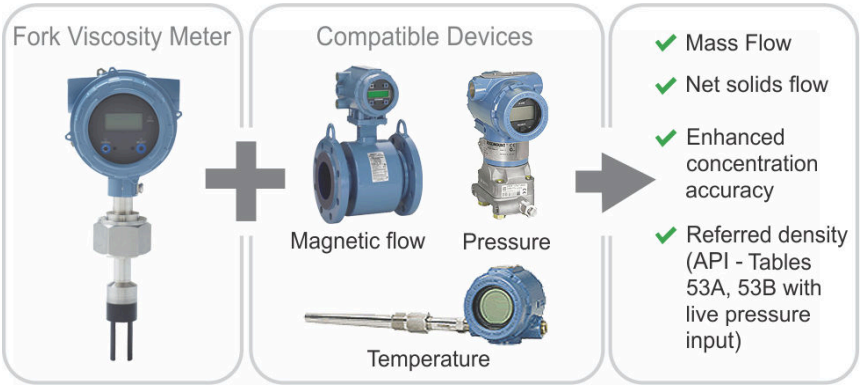
Sensor commonality simplifies the drop-in replacement of the Micro Motion 7827 and 7829 Visconic viscosity meters.



A. Power, RS-485, 2 x mA outputs ...
B. Power, RS-485, 2 x mA outputs ...

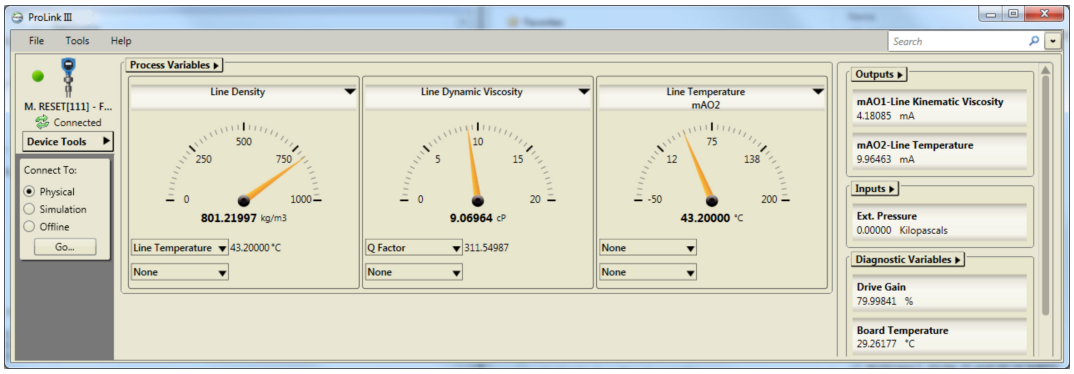
Interconnectivity

Integral HART I/O allows direct input of external temperature, pressure, and flow measurements for enhanced measurements.



ProLink® III software: a configuration and service tool

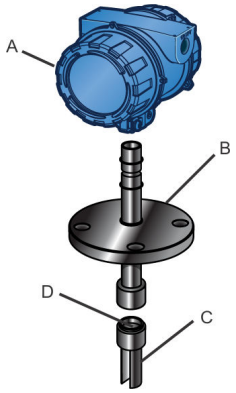
ProLink III software is an easy-to-use interface that allows you to view key process variables and diagnostics data for your meter. For more information on ordering the software, contact your local sales representative or email customer support at *flow.support@emerson.com*.



Operating principle

Fork vibration

- A fully welded fork assembly is mounted directly into the liquid to be measured.
- The fork tines are vibrated piezo-electrically at its natural frequency.



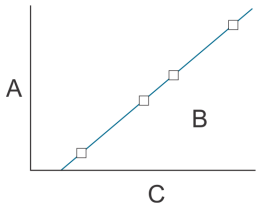
A. Integral transmitter with optional local operator interface
B. Process connection
C. Vibrating tines
D. RTD measures temperature

Temperature measurement

- A class “B” RTD measures the vibrating fork temperature.
- Micro Motion transmitters use this reading to optimize performance over a wide range of process conditions.

Density calibration

- Micro Motion transmitters accurately measure time period.
- Measured time periods are converted into density readings using meter calibration coefficients.
- Minimum of 12 calibration points ensures optimum meter performance.

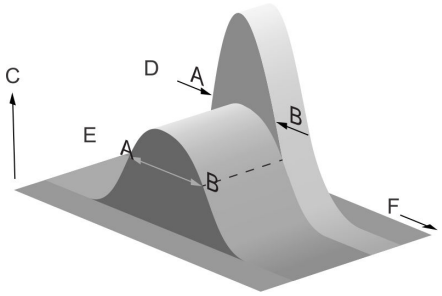


A. Density (kg/m^3)
B. Time period = 1 / frequency
C. $[\text{Time period}]^2$ (μs^2)

Viscosity calibration

- The bandwidth of the tines’ natural frequency changes with the viscosity of the surrounding liquid.
- Micro Motion transmitters accurately measure bandwidth.

- Bandwidth measurements are converted into viscosity readings using meter calibration coefficients.



A. Point A
B. Point B
C. Response amplitude
D. Product 1 = low viscosity
E. Product 2 = high viscosity
F. Frequency (Hz)

Note

- Bandwidth = point B - point A
- Resonant frequency = (point A + point B) / 2
- Quality factor = resonant frequency / bandwidth

Performance specifications

Viscosity measurement

Specification	Value	
Calibration range and accuracy	Calibration range	Accuracy
	0.5to 10 cP	±0.2 cP
	10 to 100 cP	±1% of calibration range maximum
	100 to 1000 cP	±1% of calibration range maximum
	1000 to 12500 cP	±1% of calibration range maximum
Multiple calibration range options(1)	■ 0.5 to 100 cP ■ 0.5 to 1000 cP ■ 10 to 1000 cP ■ 0.5 to 12500 cP ■ 10 to 12500 cP ■ 100 to 12500 cP	
Operating viscosity range	0.5 to 20,000 cP	
Repeatability	±0.5% of reading	

(1) Accuracies depend upon which calibration range is applicable for the measured viscosity.

Density measurement

Specification	Value	
Accuracy	±1 kg/m^3	±0.001 g/cm^3
Operating density range	0 to 3000 kg/m^3	0 to 3.0 g/cm^3

Specification	Value	
Calibration range	600 to 1250 kg/m^3	0.6 to 1.25 g/cm^3
Repeatability	±0.1 kg/m^3	±0.0001 g/cm^3
Process temperature effect (corrected)	±0.1 kg/m^3 per °C	±0.0001 g/cm^3 per °C
Process pressure effect (corrected)	None	

Temperature measurement

Specification	Value	
Operating temperature range – short stem	–50 °C to +200 °C	–58 °F to +392 °F
Operating temperature range – long stem	–40 °C to +150 °C	–40 °F to +302 °F
Integral temperature measurement	■ Technology: 100 Ω RTD ■ Accuracy: BS1904 Class, DIN 43760 Class B	

Pressure ratings

Actual maximum operating pressures are limited by the process connection rating.

Specification	Value	
Maximum operating pressure – short stem(1)	207 bar	3000 psi
Maximum operating pressure – long stem	100 bar	1450 psi
Test pressure	Tested to 1.5 times the maximum operating pressure	
PED compliance	Not applicable	

(1) For short-stem meters with a cone seat fitting, the maximum operating pressure is 100 bar (1450 psi).

Transmitter specifications

Available transmitter versions

Typical application	Transmitter version(1)	Output channels		
		A	B	C
■ General purpose measurement ■ DCS/PLC connection	Analog	4–20 mA + HART (passive)	4–20 mA (passive)	Modbus/RS-485
	Processor for remote-mount 2700 FOUNDATION fieldbus transmitter	Disabled	Disabled	Modbus/RS-485

Typical application	Transmitter version[1]	Output channels		
		A	B	C
■ General purpose measurement with output switch ■ DCS/PLC connection	Discrete	4–20 mA + HART (passive)	Discrete output	Modbus/RS-485

(1) For more information on the transmitter outputs and ordering codes, see the product ordering information.

Local display

Design	Features
Physical	■ Segmented two-line LCD screen. ■ Can be rotated on transmitter, in 90-degree increments, for ease of viewing. ■ Suitable for hazardous area operation. ■ Optical switch controls for hazardous area configuration and display. ■ Glass lens. ■ Three-color LED indicates meter and alert status.
Functions	■ View process variables. ■ View and acknowledge alerts. ■ Configure mA and RS-485 outputs. ■ Supports Known Density Verification (KDV). ■ Supports multiple languages.

Process measurement variables

Variables	Value
Standard	■ Dynamic viscosity ■ Kinematic viscosity ■ Density ■ Temperature ■ External temperature (when external device connected)
Derived	The derived output variables vary, depending on the application configuration of the meter. ■ Referred kinematic viscosity (ASTM D341-03) ■ Referred density ■ Referred density (API) ■ User-defined calculation output
Derived (when external device connected)	■ Mass flow ■ Net solids flow ■ Enhanced concentration accuracy ■ Referred density (API tables with live pressure input)

Additional communication options

The following communications accessories are purchased separately from the meter.

Type	Description
WirelessHART®	WirelessHART is available via the THUM adapter
FOUNDATION™ fieldbus	Remote-mount Model 2700 transmitter with FOUNDATION fieldbus ■ One FOUNDATION fieldbus H1 connection provided
HART® Tri-Loop	Three additional 4-20 mA outputs are available via connection to a HART Tri-Loop

Hazardous area approvals

Ambient and process temperature limits are defined by temperature graphs for each meter and electronics interface option. Refer to the detailed approval specifications, including temperature graphs for all meter configurations, and safety instructions. See the product page at *www.emerson.com*.

ATEX, CSA, and IECEx approvals

ATEX		
Zone 1 Flameproof	Without display (all transmitters) CE 0575 Ex	■ II 1/2G Ex db IIC T6 Ga/Gb
	With display (Analog, TPS, Discrete versions with stainless steel transmitter housing material only) CE 0575 Ex	■ II 1/2G Ex db IIC T6 Ga/Gb
	Remote connection to 2700 FOUNDATION™ fieldbus transmitters CE 0575 Ex	■ II 1/2G Ex db [ib] IIC T6 Ga/Gb
Zone 2	Without display (all transmitter versions) CE Ex	■ II 3G Ex nA IIC T6 Gc
	With display (Analog, TPS, Discrete versions with stainless steel transmitter housing material only) CE Ex	■ II 3G Ex nA IIC T4 Gc

CSA	
Explosion proof	With display (Analog, TPS, Discrete versions with stainless steel transmitter housing material only) or without display (all transmitter versions) ■ Class I, Division 1, Groups C & D ■ Class I, Division 2, Groups A, B, C & D ■ Class II, Division 1, Groups E, F & G

CSA	
Non-incendive	With display (Analog, TPS, Discrete versions) or without display (all transmitter versions) ■ Class I, Division 2, Groups A, B, C & D

IECEx	
Zone 1 Flameproof	Without display (all transmitters) ■ Ex db IIC T6 Ga/Gb
	With display (Analog, TPS, Discrete versions with stainless steel transmitter housing material only) ■ Ex db IIC T6 Ga/Gb
	Remote connection to 2700 FOUNDATION fieldbus transmitters: ■ Ex db [ib] IIC T6 Ga/Gb
Zone 2	Without display (all transmitter versions) ■ Ex nA IIC T6 Gc
	With display (Analog, TPS, Discrete versions with aluminum housing only) ■ Ex nA IIC T4 Gc
	With display (Analog, TPS, Discrete versions with stainless steel transmitter housing material only) ■ Ex nA IIC T4 Gc

Environmental specifications

Type	Rating	
Electromagnetic compatibility	All versions conform to the latest international standards for EMC, and are certified compliant with EN 61326	
Humidity limits	5 to 95% relative humidity, non-condensing at 140 ° F (60 °C)	
Ambient temperature	–40 °C to +65 °C	–40 °F to +149 °F
Ingress protection rating	■ IP66/67, NEMA4 aluminum housing ■ NEMA4X stainless steel housing	

Power requirements

Type	Description
DC Power requirements	■ 24 VDC, 0.65 W typical, 1.1 W maximum ■ Minimum recommended voltage: 21.6 VDC with 1000 ft of 24 AWG (300 m of 0.20 mm2) power-supply cable ■ At startup, power source must provide a minimum of 0.5 A of short-term current with a minimum of 19.6 V at the power input terminals.

Physical specifications

Materials of construction

Component	Material
Wetted parts	316L stainless steel
Tine finish	Standard, DLC (Diamond-Like Carbon)(1) coated, or electro-polished
Transmitter housing	Polyurethane-painted aluminum or 316L stainless steel

(1) DLC coating is applied only to the tines for anti-stick properties, not for corrosion protection.

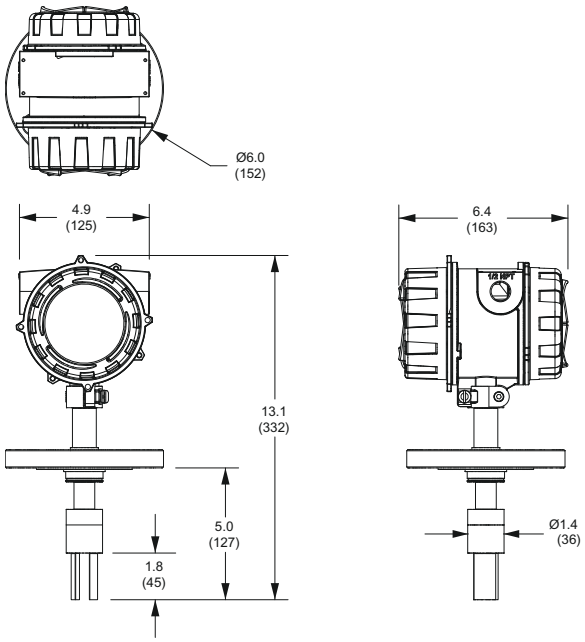
Weight

Specification	Weight with aluminum housing	Weight with stainless steel housing
Weight – short stem (typical)	Approximately 15 lbs (7 kg)	Approximately 21 lbs (10 kg)
Weight – long stem	Dependent on stem length (contact Micro Motion)	

Dimensions

These dimensional drawings are intended to provide a basic guideline for sizing and planning. Complete and detailed dimensional drawings can be found through the product drawings link in our online store at *www.emerson.com*.

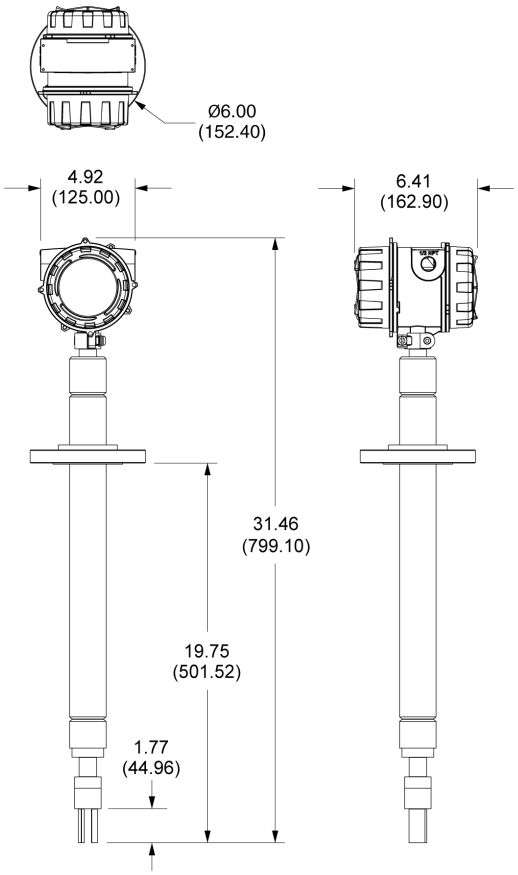
Figure 1: Short-stem meter



Note

Dimensions are shown in inches (mm).

Figure 2: Long-stem meter



Note

Dimensions are shown in inches (mm). Stem length can be from 19.7 inches (500 mm) to 13 feet (4 m).

Ordering information

Model	Description
FVM	Insertion Fork Viscosity Meter

Code	Sensor calibration range and performance
1	Viscosity accuracy ±0.2 cP (0-10 cP range) then ±1% of FS of calibrated range, viscosity limit 20, 000 cP

Code	Stem length
1	0 mm: no stem extension and with standard spigot
2	19.7 in (500 mm) with removable transit cover
X(1)	Special order (ETO) stem length — available up to 13 ft (4 m)

(1) Requires factory option X.

Code	Materials of wetted parts (including process connection)
A	316L stainless steel, standard finish tines

Code	Materials of wetted parts (including process connection)
C	316L stainless steel, electro-polished tines
L	316L stainless steel, DLC (Diamond-Like Carbon) coated tines
X(1)	Special order (ETO) Material of wetted parts

(1) Requires factory option X.

Code	Process connections
Available with all stem length codes	
720	2-inch, CL150, ASME B16.5, blind flange, raised face
721	2-inch, CL300, ASME B16.5, blind flange, raised face
722	2-inch, CL600, ASME B16.5, blind flange, raised face
723	DN50, PN16, EN 1092-1, blind flange, Type B1
724	DN50, PN40, EN 1092-1, blind flange, Type B1
999(1)	Special order (ETO) process connection
Available with only stem length code 1	
726	2-inch, CL900, ASME B16.5, blind flange, raised face
727	2-inch, CL1500, ASME B16.5, blind flange, raised face
729	1-1/2 inch, cone-seat compression fitting, 316/316L
Available with only stem length code 2 or X	
730(2)	No connections for open tanks

(1) Requires factory option X.

(2) Available with approvals code M only. Note that maximum pressure rating is 100 bar maximum.

Code	Sensor calibration types
A	Free stream
B	2-inch schedule 40 boundary [viscosity limits = 200 cSt (T-piece), 1000 cSt (782791 flow through chamber)]
D	2-inch schedule 80 boundary [viscosity limit = 200 cSt (T-piece)]
E	3-inch schedule 80 boundary [viscosity limit = 1000 cSt (782791 flow through chamber)]
H	2-1/2 inch schedule 40 boundary [viscosity limit = 200 cSt (T piece)]
X(1)	Special order (ETO) calibration type

(1) Requires factory option X.

Code	Transmitter housing option
A	Integral, aluminum alloy
B	Integral, stainless steel

Code	Transmitter outputs option
A(1)(2)(3)	Integral processor for remote mount 2700 FOUNDATION™ fieldbus transmitter (Channels A and B inactive)
C	Integral transmitter, Channel B = mA output, Channel A = mA + HART, Channel C = Modbus/RS-485

Code	Transmitter outputs option
D	Integral transmitter, Channel B = Discrete output, Channel A = mA + HART, Channel C = Modbus/RS-485

(1) Requires Model 2700 transmitter with mounting option H - 4 wire connection option (power and communications).

(2) With Transmitter Output Options code A, all signal outputs on the integrally mounted transmitter are disabled, except for the Modbus/RS-485 communications which is used for communication to the Model 2700 transmitter.

(3) Available with only application configuration code P.

Code	Display option (available with all approval codes)
2(1)(2)	Two-line display (non-backlit)
3	No display

(1) For transmitter housing option code A, available with only approval codes M, 2, V and 3.

(2) Not available with transmitter output option code A.

Code	Approvals
M	Safe area - no hazardous area approval
2(1)	CSA Class 1 Div. 2 (US and Canada)
V	ATEX - Equipment category 3 (zone 2)
3	IECEx Zone 2
A (1)	CSA (US and Canada) – Explosion-proof
F(2)	ATEX - Zone 1 IIC flameproof
I(2)	IECEx - Zone 1 IIC flameproof
G	Country-specific approval. Requires an R1 or R2 selection from the *Special tests and certificates, tests, calibrations and services (optional)* table.

(1) For transmitter output options code A, CSA approvals code A (C1D1) is valid only for groups C and D.

(2) For transmitter output options code A, approvals codes F and I will indicate Exd [ib], not Exd.

Code	Application configuration(1)(2)
Available with all calibration type codes	
H	Line viscosity (4mA = 0cSt, 20mA = 25cSt)
J	Line viscosity (4mA = 0cSt, 20mA = 50cSt)
E	Line viscosity (4mA = 0cSt, 20mA = 100cSt)
M	Line viscosity (4mA = 0cSt, 20mA = 200cSt)
P	None
X(3)	ETO analog output configuration (customer data required)
Available with only calibration type codes A, B, E, H, J and X	
K	Line viscosity (4mA = 0cSt, 20mA = 500cSt)
F	Line viscosity (4mA = 0cSt, 20mA = 1000cSt)
Available with only calibration type codes A and X	
D	Line viscosity (4mA = 0cSt, 20mA = 12500cSt)
N	Line viscosity (4mA = 10cSt, 20mA = 12500cSt)

Code	Application configuration[1][2]
G	Line viscosity (4mA = 100cSt, 20mA = 12500cSt)

(1) When transmitter output options code is C or D, the chosen application configuration code 4mA and 20mA are programmed as the Channel A mA output 4mA and 20mA points.

(2) For transmitter output options code A, CSA approvals code A (C1D1) is valid only for groups C and D.

(3) Requires factory option X.

Code	Calibration range
Available with only application configuration codes H, J, E, or P.	
B	0.5 to 100cP
Available with only application configuration codes M, K, F, or P.	
C	0.5 to 1000cP
F	10 to 1000cP
Available with only application configuration codes D, N, or G.	
D	0.5 to 12,500cP
E	10 to 12,500cP
G	100 to 12,500cP
Available with all calibration type codes	
X[1]	ETO calibration range

(1) Requires factory option X.

Code	Language (manual and software)
Transmitter display language English	
E	English installation manual and English configuration manual
I	Italian quick installation manual and English configuration manual
M	Chinese quick installation manual and English configuration manual
R	Russian quick installation manual and English configuration manual
Transmitter display language French	
F	French quick installation manual and English configuration manual
Transmitter display language German	
G	German quick installation manual and English configuration manual
Transmitter display language Spanish	
S	Spanish quick installation manual and English configuration manual

Code	Future option 1
Z	Reserved for future use

Code	Conduit connections
Z	Standard 1/2-inch NPT fittings (no adapters)
B	M20 stainless steel adapters

Code	Factory options
Z	Standard product
X	Special order (ETO) product

Code	Special tests and certificates, tests, calibrations and services (optional)(1)
Material quality examination tests and certificates	
MC	Material Inspection Certificate 3.1 (Supplier Lot Traceability per EN 10204)
NC	NACE Certificate 2.1 (MR0175 and MR0103)
Pressure testing	
HT	Hydrostatic Test Certificate 3.1
Dye penetrant examination	
D1	Dye Penetrant Test Package 3.1 (Sensor only; Liquid Dye Penetration NDE Qualification)
Weld examination	
WP	Weld Procedure Package (Weld Map, Weld Procedure Specification, Weld Procedure Qualification Record, Welder Performance Qualification)
Positive material testing (select only one from this group)	
PM	Positive Material Test Certificate 3.1 (without carbon content)
PC	Positive Material Test Certificate 3.1 (including carbon content)
Sensor completion options	
WG	Witness General
SP	Special Packaging
Instrument tagging	
TG	Instrument Tagging - customer information required (max. 24 characters)
Country-specific approvals (select only one when Approvals option G is selected)	
R1(2) (3)	EAC Zone 1 - Hazardous area approval - intrinsically safe
R2 (1) (2)	EAC Zone 1 - Hazardous area approval - flameproof terminal compartment

(1) Multiple test or certificate options may be selected.

(2) Available only with approval G

(3) Not available with Transmitter Output Options code F or Transmitter Housing Option B

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