**Product Data Sheet**
PS-001486, Rev B
June 2014

# 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 4 m (13 ft)
- Supports multiple protocols for connection to DCS, PLC, and flow computers



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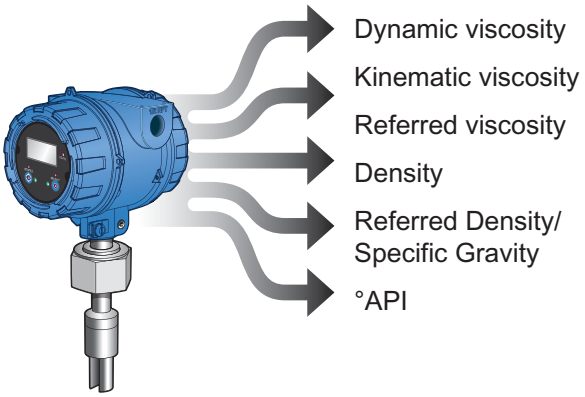
# Micro Motion® Fork Viscosity Meters

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.

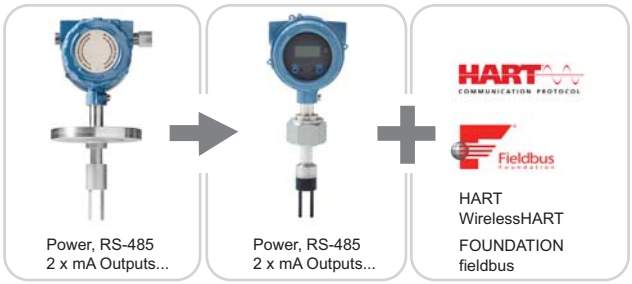
## Application configurations

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



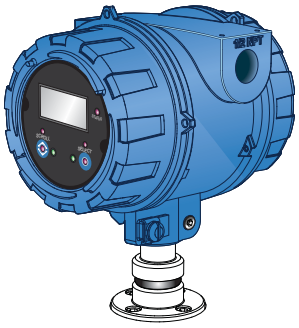

## Retrofit capabilities

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



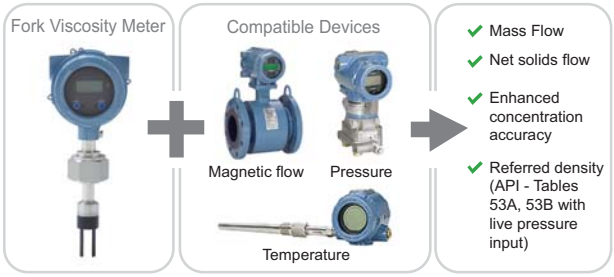

## Integral transmitter

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



## Interconnectivity

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



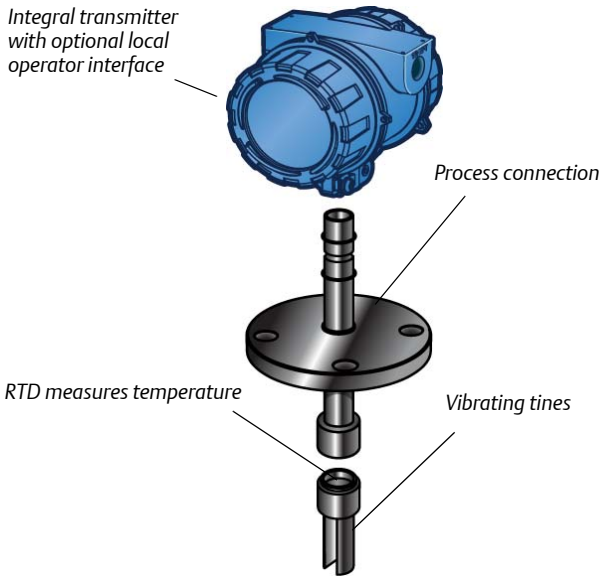

## Meter diagnostics

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


## ProLink® III software

An easy-to-use interface that allows you to view key process variables and diagnostics data.

# Operating principle

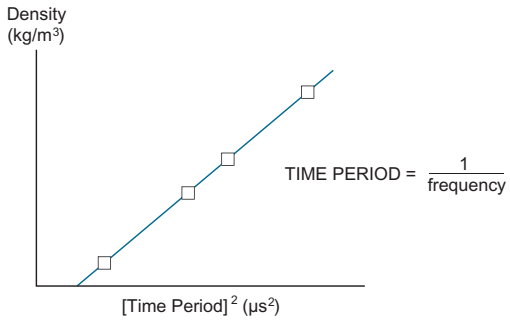



## Fork vibration

- 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.

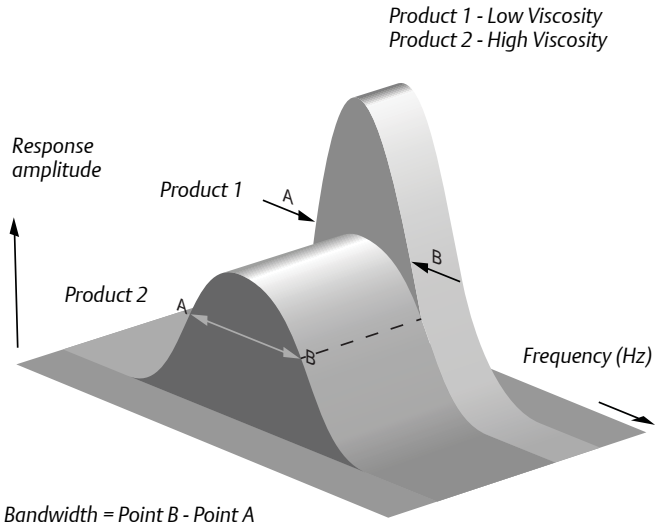
## Temperature measurement

- An integral 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

- The tines' natural frequency changes with the density of the surrounding liquid.
- Micro Motion transmitters accurately measure time period (1/frequency).
- Measured time periods are converted into density readings using meter calibration coefficients.




*Bandwidth = Point B - Point A*
*Resonant frequency = (Point A + Point B) / 2*
*Quality factor = Resonant frequency / bandwidth*

## 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.

# 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<br>■ 0.5 to 1000 cP<br>■ 10 to 1000 cP<br>■ 0.5 to 12500 cP<br>■ 10 to 12500 cP<br>■ 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$^3$ |
| 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<br>■ 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<br>■ 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 |
| ■ General purpose measurement with output switch<br>■ 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.<br>■ Can be rotated on transmitter, in 90-degree increments, for ease of viewing.<br>■ Suitable for hazardous area operation.<br>■ Optical switch controls for hazardous area configuration and display.<br>■ Glass lens.<br>■ Three-color LED indicates meter and alert status. |
| Functions | ■ View process variables.<br>■ View and acknowledge alerts.<br>■ Configure mA and RS-485 outputs.<br>■ Supports Known Density Verification (KDV).<br>■ Supports multiple languages. |

## Process measurement variables

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

## Additional communication options

The following communications accessories are purchased separately from the meter.

| Type | Description |
|---|---|
| FOUNDATION fieldbus™ | Micro Motion® remote-mount Model 2700 transmitter with FOUNDATION fieldbus<br>■ One Foundation fieldbus H1 connection provided. |
| WirelessHART® | Wireless HART is available via the THUM adapter |
| 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 that can be found on the product page at the Micro Motion web site (at *www.micromotion.com*).

| | |
|---|---|
| **ATEX** | |
| Zone 1 Flameproof | **Without display (Analog, Discrete versions only)**<br>CE 0575 Ex ■ II 1/2G Ex d IIC T6 Ga/Gb |
| | **Remote connection to 2700 FOUNDATION fieldbus transmitters:**<br>CE 0575 Ex ■ II 1/2G Ex d [ib] IIC T6 Ga/Gb |
| Zone 2 | **Without display (All transmitter versions)**<br>CE Ex ■ II 3G Ex nA IIC T6 Gc |
| | **With display (Analog, Discrete versions only)**<br>CE Ex ■ II 3G Ex nA IIC T4 Gc |
| **CSA** | |
| Explosion proof | **Without display (all transmitter versions)**<br>■ Class I, Division 1, Groups C & D<br>■ Class I, Division 2, Groups A, B, C & D<br>■ Class II, Division 1, Groups E, F & G |
| | **With display (Analog, Discrete versions only)**<br>■ Class I, Division 2, Groups A, B, C & D |
| **IECEx** | |
| Zone 1 Flameproof | **Without display (Analog, Discrete versions only)**<br>■ Ex d IIC T6 Ga/Gb |
| | **Remote connection to 2700 FOUNDATION fieldbus transmitters:**<br>■ Ex d [ib] IIC T6 Ga/Gb |
| Zone 2 | **Without display (All transmitter versions)**<br>■ Ex nA IIC T6 Gc |
| | **With display (Analog, Discrete versions only)**<br>■ 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 | |
| Ambient temperature | –40 °C to +65 °C | –40 °F to +149 °F |
| Ingress protection rating | IP66/67, CSA Type 4 | |

# Power requirements

| Type | Description |
|---|---|
| DC Power requirements | ■ 24 VDC, 0.65 W typical, 1.1 W maximum<br>■ Minimum recommended voltage: 21.6 VDC with 1000 ft of 24 AWG (300 m of 0.20 mm2) power-supply cable<br>■ At startup, power source must provide a minimum of 0.5 A of short-term current at 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, PFA coated, DLC (Diamond-Like Carbon) coated, or electro-polished(1) |
| Transmitter housing | Polyurethane-painted aluminum |

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

## Weight

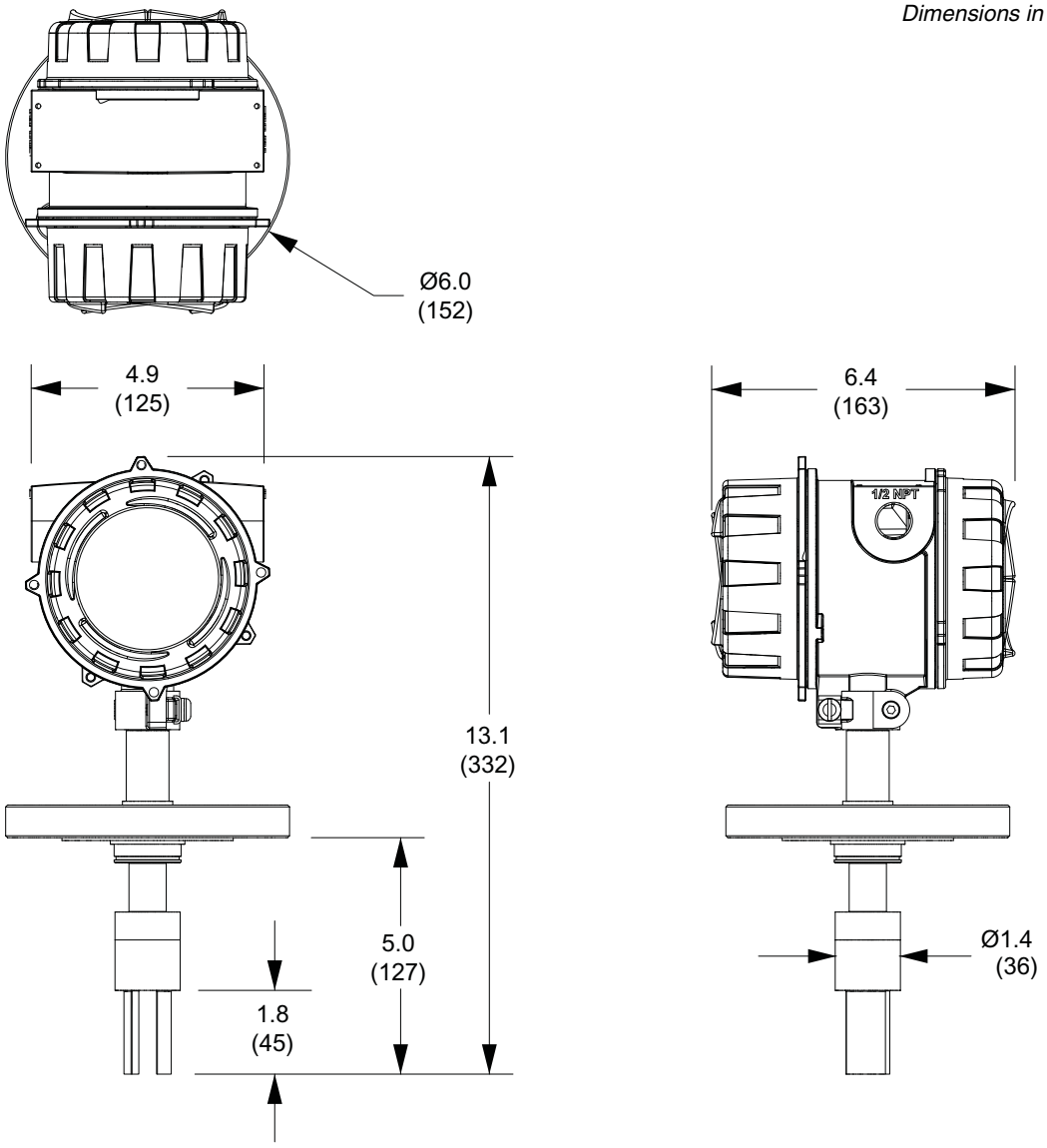
| Specification | Value | |
|---|---|---|
| Weight – short stem (typical) | 6.7 kg | 15 lbs |
| Weight – long stem | Dependent on stem length (contact Micro Motion) | |

## 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 (*www.micromotion.com/onlinestore)*.

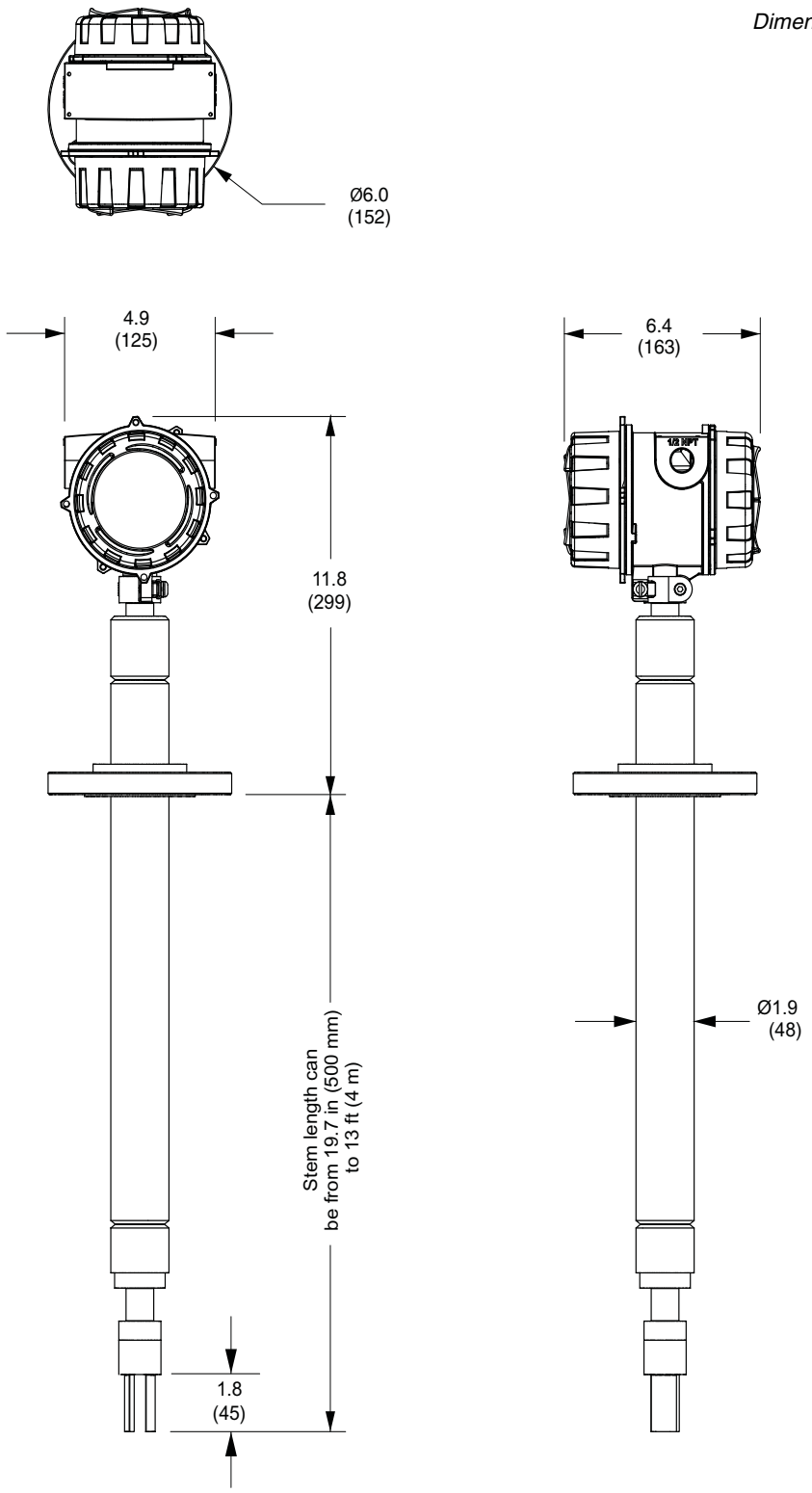
### Short-stem meter

*Dimensions in inches (mm)*



## Long-stem meter

*Dimensions in inches (mm)*



# 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 [tine length: 45 mm (1.8 in)], density accuracy ±1 kg/m$^3$ (±0.001 g/cm$^3$) |
| **Code** | **Stem Length** |
| 1 | 0 mm: no stem extension and with standard spigot |
| 2 | 500 mm (19.7 in) with removable transit cover |
| X[1] | Special order (ETO) stem length — available up to 4 m (13 ft) |
| **Code** | **Materials of Wetted Parts (including process connection)** |
| A | 316L stainless steel, standard finish tines |
| C | 316L stainless steel, electro-polished tines |
| F | 316L stainless steel, PFA laminated tines |
| L | 316L stainless steel, DLC (Diamond-like carbon) coated tines |
| X[1] | Special order (ETO) Material of wetted parts |
| **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 only with 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 only with stem length code 2 or X** | |
| 730[2] | No connections (for open tanks) |
| **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 |
| **Code** | **Transmitter Housing Option** |
| A | Integral, Aluminum alloy |
| **Code** | **Transmitter Outputs Option** |
| A[3] [4] | Integral processor for remote mount 2700 FOUNDATION fieldbus™ transmitter (Channels A & B inactive) |
| C | Integral transmitter, Channel B = mA output, Channel A = mA + HART, Channel C = Modbus/RS-485 |
| D | Integral transmitter, Channel B = Discrete output, Channel A = mA + HART, Channel C = Modbus/RS-485 |

| Code | Display Option |
|---|---|
| **Available with approvals codes M, 2, V and 3 only** | |
| 2 | Two-line display (non-backlit) |
| **Available with all approvals codes** | |
| 3 | No display |
| **Code** | **Approvals** |
| M | Micro Motion standard (no approval) |
| 2 | CSA Class 1, Div 2 (US and Canada) |
| V | ATEX - Equipment category 3 (Zone 2) |
| 3 | IECEx - Zone 2 |
| A | CSA (US and Canada) - Explosion-proof |
| F | ATEX - Zone 1 IIC flameproof |
| I[4] | IECEx - Zone 1 IIC flameproof |
| T | TIIS - IIC sensor (not available for quotes outside of Japan) |
| **Code** | **Application Configuration[5]** |
| **Available with all calibration type codes** | |
| H | Line viscosity (4 mA = 0 cSt, 20 mA = 25 cSt) |
| J | Line viscosity (4 mA = 0 cSt, 20 mA = 50 cSt) |
| E | Line viscosity (4 mA = 0 cSt, 20 mA = 100 cSt) |
| M | Line viscosity (4 mA = 0 cSt, 20 mA = 200 cSt) |
| P | None |
| X[1] | Special order (ETO) analog output configuration (customer data required) |
| **Available with calibration type codes A, B, E, H and X only** | |
| K | Line viscosity (4 mA = 0 cSt, 20 mA = 500 cSt) |
| F | Line viscosity (4 mA = 0 cSt, 20 mA = 1000 cSt) |
| **Available with calibration type codes A or X only** | |
| D | Line viscosity (4 mA = 0 cSt, 20 mA = 12500 cSt) |
| N | Line viscosity (4 mA = 10 cSt, 20 mA = 12500 cSt) |
| G | Line viscosity (4 mA = 100 cSt, 20 mA = 12500 cSt) |
| **Code** | **Calibration Range** |
| **Available with application configuration codes H, J, E or P only** | |
| B | 0.5 to 100 cP |
| **Available with application configuration codes M, K, F or P only** | |
| C | 0.5 to 1000 cP |
| F | 10 to 1000 cP |
| **Available with application configuration codes D, N or G only** | |
| D | 0.5 to 12500 cP |
| E | 10 to 12500 cP |
| G | 100 to 12500 cP |
| **Available with all calibration type codes** | |
| X[1] | Special order (ETO) calibration range |
| **Code** | **Language (Manual and Software)** |
| **Transmitter display language English** | |
| E | English installation manual and English configuration manual |
| I | Italian installation manual and English configuration manual |
| M | Chinese installation manual and English configuration manual |

| Code | Language (Manual and Software) *(continued)* |
|---|---|
| R | Russian installation manual and English configuration manual |
| **Transmitter display language French** | |
| F | French installation manual and English configuration manual |
| **Transmitter display language German** | |
| G | German installation manual and English configuration manual |
| **Transmitter display language Spanish** | |
| S | Spanish 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)(6)** |
| **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 (Pressure retaining parts only) |
| **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) |

*(1) Requires Factory Option X.*
*(2) Available with Approvals code M only. Note that maximum pressure rating is 100 bar maximum.*
*(3) Requires remote-mount Model 2700 transmitter with mounting option H - 4 wire connection option (power and communications).*
*(4) 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.*
*(5) When Transmitter Outputs model code is C or D, the application configuration low & high limits are also programmed as the Channel A mA output 4 mA and 20 mA points.*
*(6) Multiple test or certificate options may be selected.*

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