

EnduroFlow™ Series

EF11 Ultrasonic Transit-Time Flowmeter

For Permanent Installation



FEATURES AND BENEFITS

- High-accuracy bi-directional flow measurement
- Velocity, flowrate, volumetric totalizer, scheduler, batch controller and more
- Economical installation
- Easy to use and set up, no moving parts, no maintenance required
- Compatibility with various types of industrial grade transducers:
 - Clamp-on transducer: non-invasive, non-contact offer easy installation requiring no pipe working
 - Insertion transducer: excellent long-term stability, robust, optional hot-tapping kit allows installation with continuous flow (no need to shut down flow).
 - Flow-cell transducer: most accurate and robust. Plug and play. Excellent long-term performance
- Wide pipe range, suitable for all commonly used pipes
- IP65 weatherproof enclosure
- NIST-traceable factory calibration
- Suitable for pure liquids and liquids with some particles. No dependency on conductivity
- Large data logger for recording multiple variables (optional)
- Communication: RS485/MODBUS
- Compatibles with Spire Metering's uGalaxy telemetry system

APPLICATIONS

- Water (city water, sea water, waste water, etc.)
- Hot/Chilled Water/Mixture of Water and Glycol
- Chemical Liquids and Solvents (alcohol, acids, etc.)
- Petroleum Products
- Oil (crude oil, lubricating oil, diesel oil, fuel oil, hydraulic oil etc.);
- Water management in buildings, metropolitans, water / wastewater treatment plants, irrigation systems, and more.
- Plant effluent
- Sewage with small particle content
- Beverage, liquid food
- Ultra-pure liquids
- Flow monitoring and control in Desalination plants, steel plants, power plants, machining plants
- Liquid process control in chemical plants and industrial automation
- Retrofit capability, to upgrade or augment existing systems
- Automated batching and scheduling
- Efficiency monitoring and improvement of liquid-based heating / cooling systems, including solar/geothermal systems
- Beverage, food and pharmaceutical processors where non-contact is essential
- Remote flow monitoring network and leakage detection
- Mining and metallurgy plants etc.

A member of the EnduroFlow™ Series, the EF11 General Purpose Wall-Mount Flow Converter is a compact, high performance ultrasonic flow measurement device. It integrates the latest technology advancements in surface-mount electronics, ultrasonic transducer design, high accuracy transit-time flow measurement and digital signal processing.

The EF11 ultrasonic flowmeter is designed to be installed at a fixed location for long-term flow measurement. Based on the transit-time principle, the EnduroFlow™ EF11 is able to measure liquid flow in a closed pipe carrying pure liquids or liquids with some suspended particles reliably and accurately. With a wide variety of transducer types to choose from (clamp-on or flow-cell), the EF11 can meet a range of application challenges. The EF11 flowmeter offers high performance and a rich feature set, all at a low price.

Signal Quality Tracking

EF11 flowmeter utilizes cutting-edge technologies such as advanced transducer design, low voltage transmission, digital signal processing, self adaptation, and more, to achieve high performance. Its proprietary quality tracking mechanism analyzes the quality of the received signal and automatically tunes the meter system to its optimized condition. This mechanism leads the system to be easily adaptable to pipe material variations and liquid property changes.

Transducer Pairing and Wetted Calibration

As QUALITY is of crucial importance, all ultrasonic transducers are carefully paired, and all flowmeters are wet-calibrated on the flow loop in the factory to further ensure the system accuracy and reliability. This wet-calibration process insures the system high accuracy and reliability at all points within the system's flow range.

Versatile Interfaces

EF11 provides versatile input/output interfaces, such as digital and relay outputs, batch control, alarm and flow totalizing, 4-20mA output and optional thermal energy measurement, which can be easily used by a host computer, PLC or a flow controller for process monitoring and control. Additionally, the built-in isolated RS-485 port and the optional GPRS/GSM module make remote flow monitoring easy and reliable.

Non-intrusive. Non-obstructive

With clamp-on transducers, the installation becomes very simple and easy. No pipe work is required, allowing continuous fluid flow during installation and eliminating the risk of leaking or contamination.

With flow-cell transducers, there is no obstruction to the flow, thus, there is no pressure drop. The option of hot tapping also allows continuous fluid flow during transducer installation.

Economical to Operate, Economical to Own

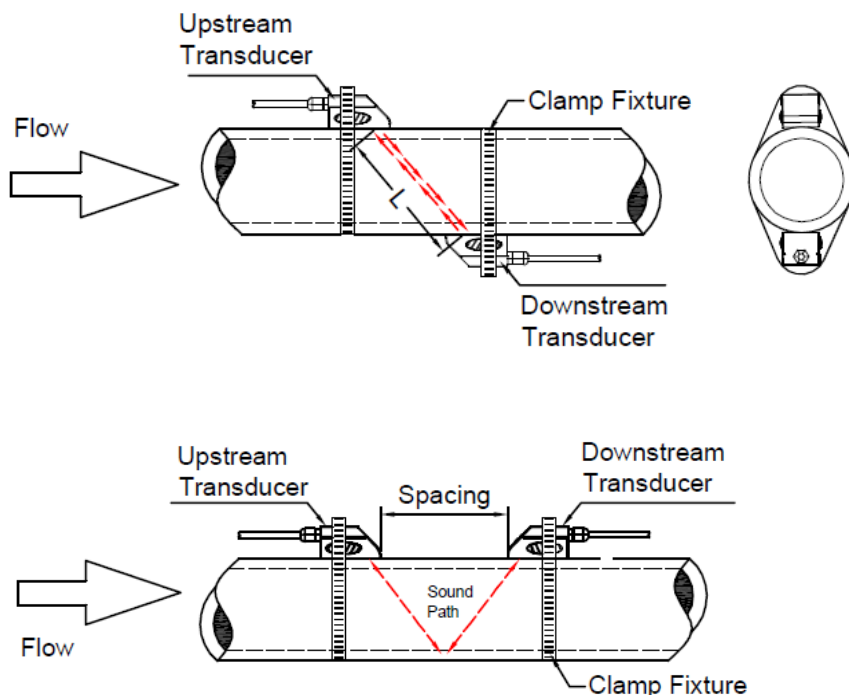
The ultrasonic transducers are made from crystal. There are no moving parts to wear and tear. The entire meter system is completely solid state. Therefore, EF11 is a robust and reliable system. It does not require maintenance or downtime which eliminates any potential incurred costs.

MEASUREMENT PRINCIPLE

The EnduroFlow™ Series EF11 ultrasonic flowmeter is designed to measure the velocity of liquid within a closed conduit using the transit-time measurement principle along with our proprietary signal processing and ultrasonic transceiving technologies. The system utilizes a pair of ultrasonic transducers which are mounted on the pipe upstream and downstream respectively. Each transducer functions as both ultrasonic transmitter and receiver. The EnduroFlow™ EF11 flow converter operates by alternately transmitting and receiving a coded burst of sound energy between the two transducers. The transit-times in both upstream and downstream directions are measured. The difference of the two transit times is directly and exactly related to the velocity of the liquid in the pipe. The flowrate is then calculated based on the transit-time difference, the geometry of the pipe and the fluid dynamics formula.

The sensors are commonly mounted using the Z-method or the V-method. With the Z-method, the two sensors are installed on opposite side of a pipe. This method offers shorter sound path, thus, better signal strength. It is often used for large size pipe where signal strength is more important. With the V-method, the two sensors are installed on the same side of the pipe. The sound path is doubled, and as a result, the measurement accuracy is better. This method is often used for small and medium size pipes.

For flow-cell type transducers, however, only the Z-method is used.



TYPICAL TRANSDUCER INSTALLATION

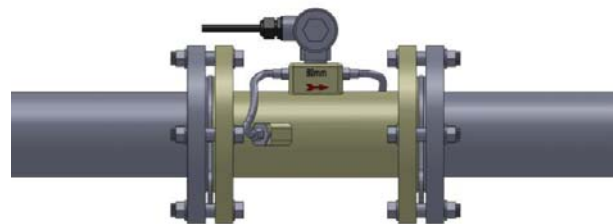
The four figures below illustrate how the transducers are installed on a pipe. The clamp-on transducer (figure a) is mounted on the outside of a pipe with a mounting fixture using the V-method. The flow-cell (spool-piece) transducer comes in two varieties: for size DN40 (1 ½") or smaller, PI-type transducer (figure b) is used, where its pipe joint could be threaded or flanged. For size DN50 (2") or larger, the transducer is a standard spool-piece with two ultrasonic sensors installed using the Z-method (figure c) where it is normally connected to a pipe line using a flange connection.



(a)



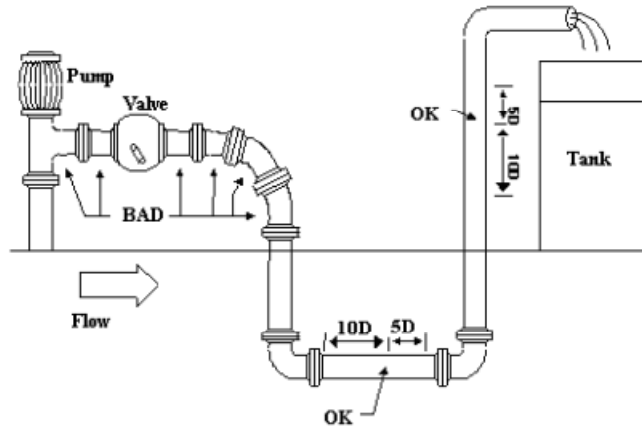
(b)



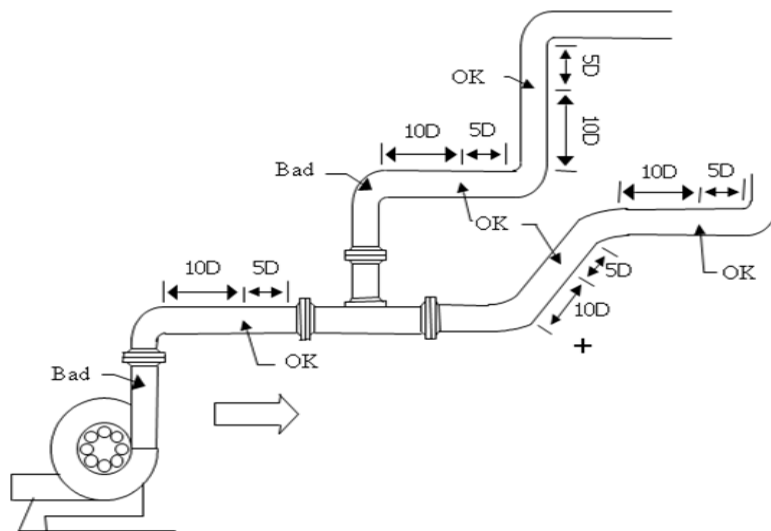
(c)

The site of the transducer installation is very important. Here are some recommendations for selecting the right site:

- In order to achieve good accuracy, it is recommended to have 15D straight-pipe run: upstream 10D and downstream 5D, where D is pipe diameter.
- If there is a valve upstream and the valve is not fully open, it could generate flow disturbance. A longer upstream straight pipe is recommended.
- If there is a pump upstream, we recommend having 25D straight pipe run.
- If pipe is vertical, make sure the flow is going upward, not downward. Downward flow could have air gap if the flow is free fall.
- If pipe is horizontal, make sure the pipe is full! The transducers should be installed on the side of the pipe, not on the top or bottom of the pipe.



Installation Site Example 1



Installation Site Example 2

SPECIFICATIONS: Flow Transmitter (Main Unit)

| | | |
|------------|--|--|
| Main Unit | Linearity | Better than $\pm 1\%$. |
| | Accuracy | $\pm 1\%$ of velocity reading, plus $\pm 10\text{mm/s}$. Could be better when in-situ calibration is conducted. Between the two types of transducers, flow-cell has better accuracy than clamp-on type. |
| | Repeatability | $\pm 0.5\%$. |
| | Velocity | $-25 \sim 25 \text{ ft/s}$ ($-8 \sim 8 \text{ m/s}$), bi-directional. Flow range may vary with the type of transducer. |
| | Measurement Period | 0.5s. Can be set to $0 \sim 99\text{s}$. |
| | Display | 2x20 char LCD with backlight. |
| | Keypad | 4 keys |
| | Units | English (U.S.) or metric. |
| | Output | Analog output: Isolated 4-20mA or 0-20mA current output. Impedance $0 \sim 1\text{k}\Omega$. Accuracy 0.1%. Internal Alarm (Buzzer): user programmable. Isolated RS485: 2-wire half-duplex with surge protection, supports MODBUS protocol and proprietary flowmeter protocol. |
| | Others | Self-diagnosis. RTC (real-time clock) for calendar. Data logger (optional). Capable of offline compensation for flow totalizer, automatic / manual selectable. Automatically record the following information: · The totalizer data of the last 64 days / 64 months / 5 years; · The power-on time and corresponding flow rate of the last 64 power on and off events. Allow manual or automatic flow loss compensation · The instrument working status of the last 64 days |
| Enclosure | Protection Class: IP65, weather-proof, metal. Size: 7.7"x7.3"x4.3" ($195 \times 185 \times 110\text{mm}^3$) | |
| Transducer | Standard temperature, FITTED | Temperature range $0^\circ\text{F} \sim 140^\circ\text{F}$ ($-20^\circ\text{C} \sim 60^\circ\text{C}$). Compact 2MHz transducer. Fit to one pipe size only TWC-HF1: for $\frac{1}{2}$ " (DN15) pipe TWC-HF2: for $\frac{3}{4}$ " (DN20) pipe TWC-HF3: for 1" (DN25) pipe TWC-HF4: for $1 \frac{1}{4}$ " (DN32) pipe TWC-HF5: for $1 \frac{1}{2}$ " (DN40) pipe |
| | Standard temperature, clamp-on, 2MHz | Temperature $0^\circ\text{F} \sim 176^\circ\text{F}$ ($-20^\circ\text{C} \sim 80^\circ\text{C}$) Clamp-on 2MHz transducer TWC-HF0: for $\frac{3}{4}$ "-2" (DN20-DN50) pipes |

Technical Specifications

| | | |
|-------------|---|--|
| | High temperature, clamp-on | High temperature 32°F - 300°F (0°C - 150°C) Clamp-on 2MHz transducer For ¾"-2" (DN20-DN50) pipes |
| | Flow-cell Transducer | Size from DN15 (1/2") to DN200 (8") |
| Liquids | Liquid Types | Virtually all commonly used clean liquids. Liquids with small quantity of tiny particles may also be applicable. Particle size should be less than 100um, particle concentration less than 20,000ppm (2%). Liquids should contain no or very minor air bubbles. Examples are chilled/hot water, sea water, waste water, chemical liquids, oil, crude oil, alcohol, beer, etc. |
| | Liquid Temp | 32°F ~ 212°F (0°C ~ 100°C) for standard clamp-on transducers 32°F ~ 302°F (0°C ~ 150°C) for high-temperature clamp-on transducers, as well as flow-cell transducers |
| | Suspension concentration | < 20,000ppm and particle size less than 100um. May contain very small amount of air bubbles. |
| Pipe | Pipe Size | 1/2" ~ 2" (DN15mm ~ DN50mm) for clamp-on 3/8" ~ 8" (DN10mm ~ DN200mm) for flow-cell |
| | Pipe Material | All metals, most plastics, fiber glass, etc. Allow pipe liner. |
| | Pipe Straight run | 15D in most cases, 30D if a pump is near upstream, where D is pipe diameter. |
| Cable | Shielded transducer cable. Standard length 15' (5m). Can be extended to 1640' (500m). Contact the manufacturer for longer cable requirement. Cable should not be laid in parallel with high-voltage power line, neither should it be close to strong interference source such as power transformers. | |
| Environment | Temperature | Main unit: 14°F ~ 158°F (-10°C ~ 70°C). Clamp-on transducer: -22°F ~ 212°F (-30°C ~ 100°C) for standard type and -22°F ~ 302°F (-30°C ~ 150°C) for high-temperature type Flow-cell transducer: -22°F ~ 302°F (-30°C ~ 150°C). |
| | Humidity | Main unit: 85% RH Transducer: water-immersible, water depth less than 10' (3m) |
| Power | DC: 12 ~ 24VDC, Power consumption: < 1W at 12VDC. If you need lower power consumption, please contact the manufacturer | |
| Weight | Main unit: 6 lbs | |

Notes:

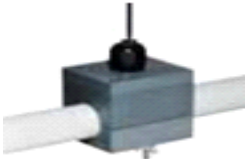


* Under reference condition and velocity should be above 0.5ft/s. Flowrate is calculated by multiplying velocity with the inner cross-section area of the pipe.

** For wireless telemetry system solution, please contact solutions@spiremt.com.

How to Order Flow Transmitter:

| | | | | | | | | | |
|---------------------|---|----------|----------|----------|----------|----------|----------|----------|----------|
| EF11 | | x | x | x | x | x | x | x | x |
| Type | C – Clamp-on F – Flow-cell | | | | | | | | |
| Frequency | 1 – Frequency for flow-cell transducer (1MHz) 2 - Frequency for clamp-on or fitted transducer for pipe size ½”-2” (2MHz) | | | | | | | | |
| Enclosure | A - Standard IP65 B - Other, please specify | | | | | | | | |
| Power Supply | 1 - 12-24VDC 2 - Other, please specify | | | | | | | | |
| Data Logger | N -None Y - 2GB SD data logger | | | | | | | | |
| Wireless | 0 - None (default) 1 - GSM 2 - GPRS 3 - RF 4 - Other, please specify | | | | | | | | |
| Adapter | A - None B - RS485-USB C - RS485-Ethernet | | | | | | | | |
| PC Software | 0 - None (default) 1 - StufManager 2 - uGalaxy Telemetry | | | | | | | | |

SPECIFICATIONS: Clamp-on Transducer

| Model | Picture | Description |
|------------------------------------|--|---|
| Type: HFX PN#: TWC-x (x=1-5) |  | Standard temperature, FITTED Temperature range 0°F-140°F (-20°C - 60°C). Compact 2MHz transducer. Fit to one pipe size only TWC-HF1: for ½" (DN15) pipe TWC-HF2: for ¾" (DN20) pipe TWC-HF3: for 1" (DN25) pipe TWC-HF4: for 1 ¼" (DN32) pipe TWC-HF5: for 1 ½" (DN40) pipe |
| Type: HF0 PN#: TWC-6 |  | Standard temperature, clamp-on, 2MHz Temperature 0°F - 176°F (-20°C - 80°C) Clamp-on 2MHz transducer TWC-HF0: for ¾"-2" (DN20-DN50) pipes |
| Type: HF0HT PN#: TWC-9 |  | High temperature, clamp-on High temperature 32°F - 300°F (0°C - 150°C) Clamp-on 2MHz transducer For ¾"-2" (DN20-DN50) pipes |

How to Order Clamp-on Transducer:

| TWC | | X | XXXX | X | X | X | X | X |
|--------------------------------------|---------------------------------------|---|------|---|---|---|---|---|
| Transducer Type | Standard temperature, FITTED: | | | | | | | |
| | 1 - HF1 : 2MHz, for pipe size ½" | | | | | | | |
| | 2 - HF2: 2MHz, for pipe size ¾" | | | | | | | |
| | 3 - HF3: 2MHz, for pipe size 1" | | | | | | | |
| | 4 - HF4: 2MHz, for pipe size 1 ¼" | | | | | | | |
| | 5 - HF5: 2MHz, for pipe size 1 ½" | | | | | | | |
| | Standard temperature, clamp-on, 2MHz: | | | | | | | |
| | 6 - HF0: 2MHz, for pipe sizes ¾"-2" | | | | | | | |
| | High temperature, clamp-on: | | | | | | | |
| 9 - HF0HT: 2MHz, for pipe size ¾"-2" | | | | | | | | |
| Pipe Size | Please write actual pipe size. | | | | | | | |
| Pipe Size Unit | I - Inch | | | | | | | |
| | M - Millimeter | | | | | | | |
| Pipe Type | A - Copper | | | | | | | |
| | B - Rigid Tubing | | | | | | | |
| | C - ANSI Plastic | | | | | | | |
| | D - ANSI Metal | | | | | | | |
| | E - Stainless Steel | | | | | | | |
| | F - Other, please specify | | | | | | | |
| Cable Length | 1 - 5m (15ft) | | | | | | | |
| | 2 - 15m (50ft) | | | | | | | |
| | 3 - 50m (150ft) | | | | | | | |
| | 4 - Other, please specify | | | | | | | |
| Liquid Temperature | A - 32-176°F (0-80°C) | | | | | | | |
| | B - 32-300°F (0-150°C) | | | | | | | |
| | C - Other, please specify | | | | | | | |
| Clamp Fixture | 0 - None | | | | | | | |
| | 1 - ½" - 2" DN15-50) | | | | | | | |
| | 2 - Other, please specify | | | | | | | |

SPECIFICATIONS: Flow-cell Transducer

| Flow Cell | Pipe Size Range | Temperature Range | Flow Vel. Range | Pipe Joint |
|---------------|-----------------------|--------------------|-----------------|---------------|
| PI-type | 3/8"-1 1/2" (DN10-40) | 32-266°F (0-130°C) | ±15ft/s (±5m/s) | Thread/Flange |
| Standard-type | 2"-8" (DN50-200) | 32-266°F (0-130°C) | ±24ft/s (±8m/s) | Flange |

PI Type Flow-cell Transducer:

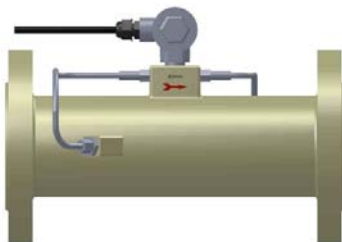


Note: BST or NPT threading connection is also available.

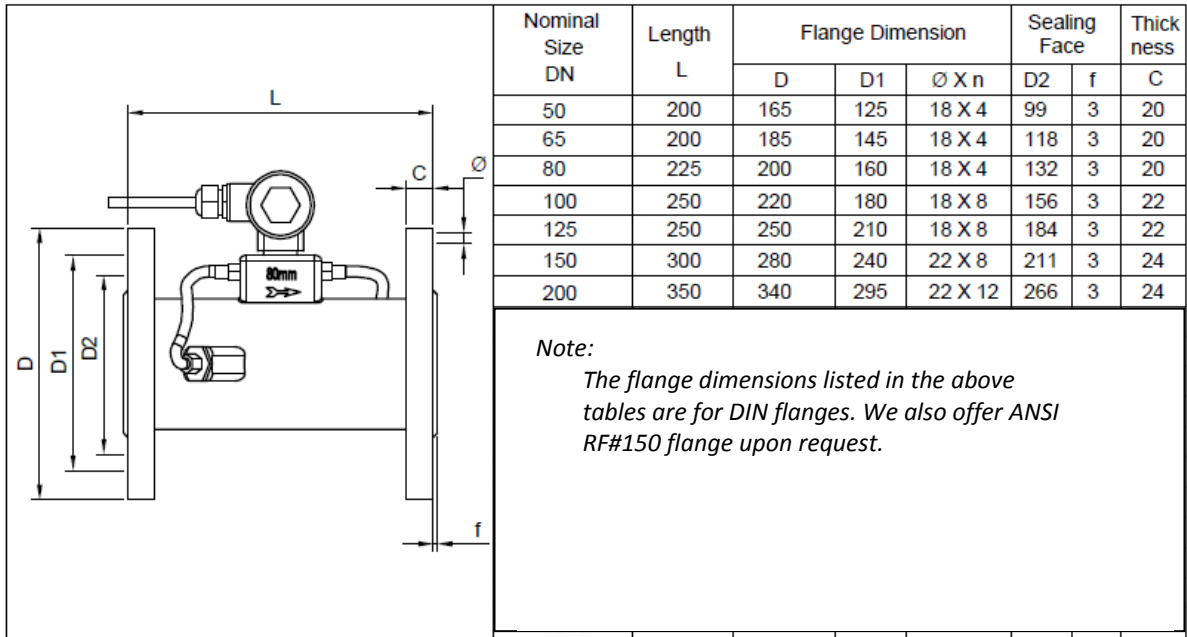
Unit: mm Pressure Rating: 2.5MPa

| Nominal Size DN | Length L | Flange Dimension | | | | | Flange Thickness C |
|--------------------|-------------|------------------|-----|------|----|---|--------------------------|
| | | D | D1 | D-Ø | D2 | f | |
| 10 | 300 | 90 | 60 | 4-14 | 41 | 2 | 14 |
| 15 | 320 | 95 | 65 | 4-14 | 46 | 2 | 14 |
| 20 | 360 | 105 | 75 | 4-14 | 56 | 2 | 16 |
| 25 | 390 | 115 | 85 | 4-14 | 65 | 3 | 16 |
| 32 | 450 | 140 | 100 | 4-18 | 76 | 3 | 18 |
| 40 | 500 | 150 | 110 | 4-18 | 84 | 3 | 18 |

Standard Type Flow-cell Transducer:



Unit: mm Pressure Rating: 1.6MPa



How to Order Flow-cell Transducer:

T W F - □ - □ - □ - □ - □ - □

Flow-cell Size:

| | |
|-------------------|----------------|
| 01) 3/8" (DN10) | 10) 4" (DN100) |
| 02) 1/2" (DN15) | 11) 5" (DN125) |
| 03) 3/4" (DN20) | 12) 6" (DN150) |
| 04) 1" (DN25) | 13) 8" (DN200) |
| 05) 1 1/4" (DN32) | |
| 06) 1 1/2" (DN40) | |
| 07) 2" (DN50) | |
| 08) 2 1/2" (DN65) | |
| 09) 3" (DN80) | |

Pipe Joint:

A) BSP Threading
 B) NPT Threading
 C) DIN Flange
 D) ANSI 150# Flange
 E) Other, please specify

Pressure:

A) 0.6MPa
 B) 1MPa
 C) 1.6MPa
 D) 2.5MPa
 E) Other, please specify

Cable Length:

A) None
 B) 5m (15ft)
 C) 15m (50ft)
 D) 50m (150ft)
 E) Other, please specify

Flow-cell Material:

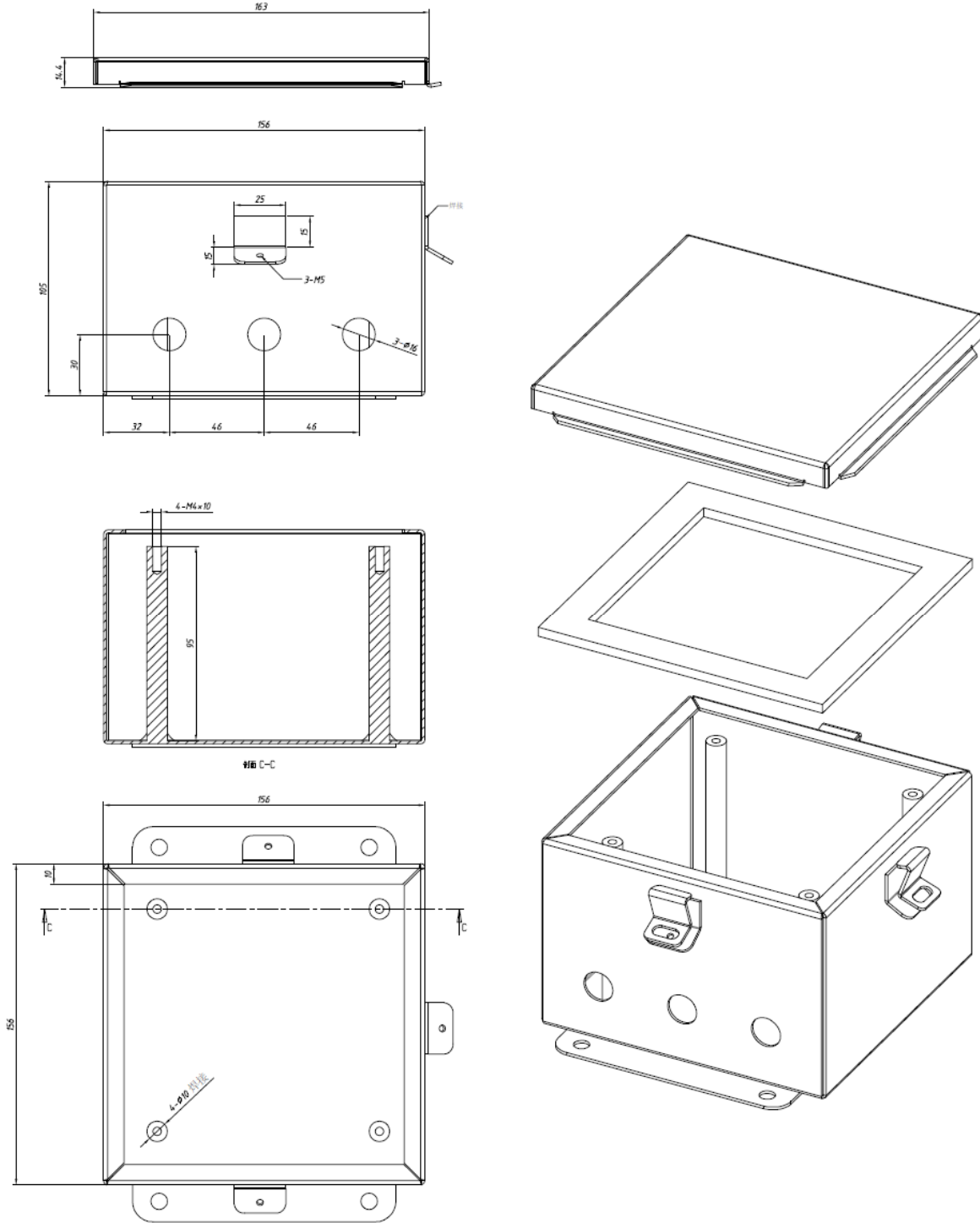
1) Carbon Steel
 2) Stainless Steel
 3) Plastic
 4) Other, please specify

Liquid Temperature:

1) 0-176°F (-20-80°C)
 2) 32-300°F (0-150°C)

DIMENSIONS

Standard Enclosure (EF11-x-A)



APPLICATION EXAMPLES

Example 1: Chiller System

Company A has a chiller pipe, 2" size, carbon steel, schedule 40. They want to monitor the flowrate in the pipe with clamp-on technology. There is a 10ft straight pipe run after an elbow and the flow transmitter (main unit) will be installed in a control room which is 15ft away from the transducer location.

In this application, they need to order the following parts:

Flow transmitter: EF11-C-2-A-1-N-0-A-0, 1unit

Clamp-on Transducer: TWC-6-0002I-D-1-A-1, 1 pair

Example 2: Geothermal System

Company B has a geothermal hot water system. They need to measure how much hot water has been generated each day. The main pipe is a 1" copper pipe with the water temperature being around 160°F. They want to use a non-intrusive method to measure the flow, and the flow data needs to be logged every 5minutes for 3months.

The operator of this geothermal plant wants to use their cell phone to check the flow so to further monitor the system status anywhere they go. Besides, in case the flow is over limit or below certain flowrate requirements, which could indicate a pump failure, the operator wants to receive an alarm message from the flowmeter immediately.

In this application, the customer needs to use the EF11-C clamp-on flowmeter with GSM wireless option. The following parts should be ordered:

Flow transmitter: EF11-C-2-A-1-Y-1-A-0, 1unit

Clamp-on Transducer: TWC-6-0001I-D-1-A-1, 1 pair

Spire Metering Technology LLC

15 Craig Road, Acton, MA 01720, USA
Tel. 978 263-7100 / 888 738-0188(toll-free) Fax 978 418-9170
sales@spiremt.com www.spiremt.com