

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
- Compatible with both clamp-on and flow-cell transducers:
 - Clamp-on transducer (for DN20-DN65 or ¾"-2 ½" pipes only): non-invasive, non-contact offer easy installation requiring no pipe working
 - Flow-cell transducer (for DN10-DN200 or 3/8"-8" pipes): most accurate and robust. Plug and play. Excellent long-term performance
- 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

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 economical flowmeter 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 for pipes from ¾" to 2 ½" or flow-cell for wide pipe size range), the EF11 can meet a range of application challenges. It 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 RS485 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

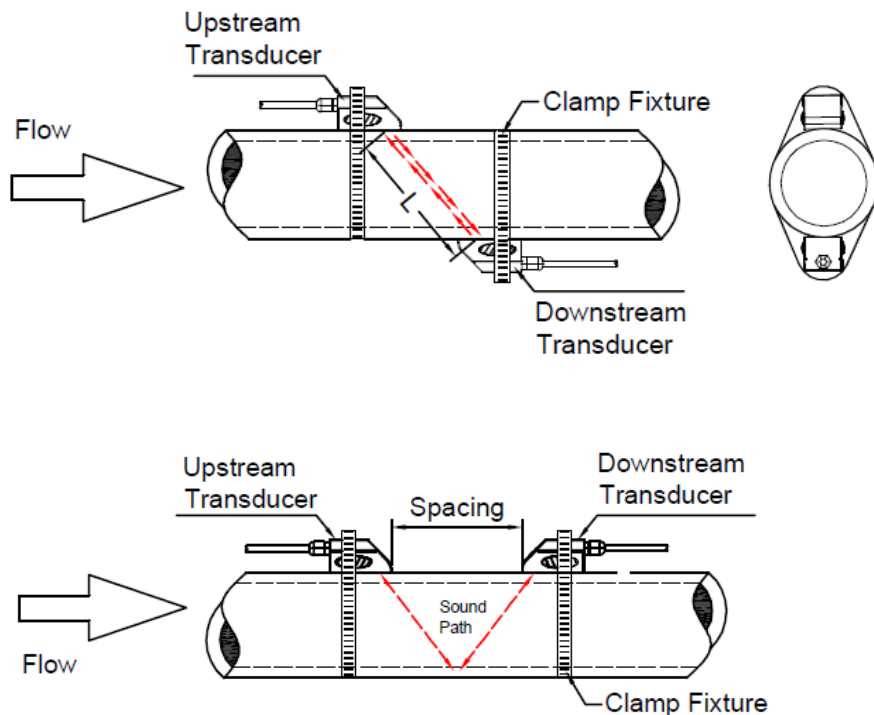
The ultrasonic transducers are made from crystal. There are no moving parts to wear and tear. The entire meter system is completely solid state. Therefore, EF11 is a robust and reliable system. It does not require maintenance or downtime which eliminates any potential incurred costs.

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

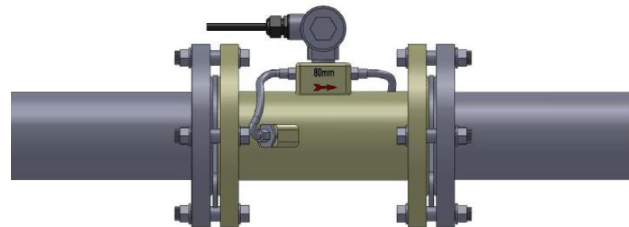
The three figures below illustrate how the transducers are installed on a pipe. The clamp-on transducer (figure a) is mounted on the outside of a pipe with a mounting fixture using the V-method. The flow-cell (spool-piece) transducer comes in two varieties: for size DN40 (1 ½") or smaller, PI-type transducer (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)



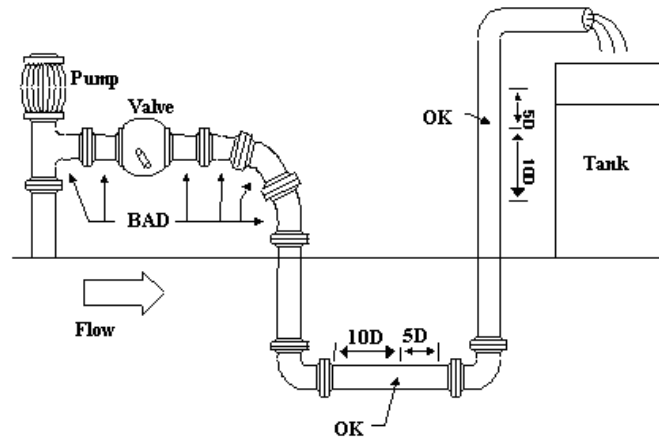
(b)



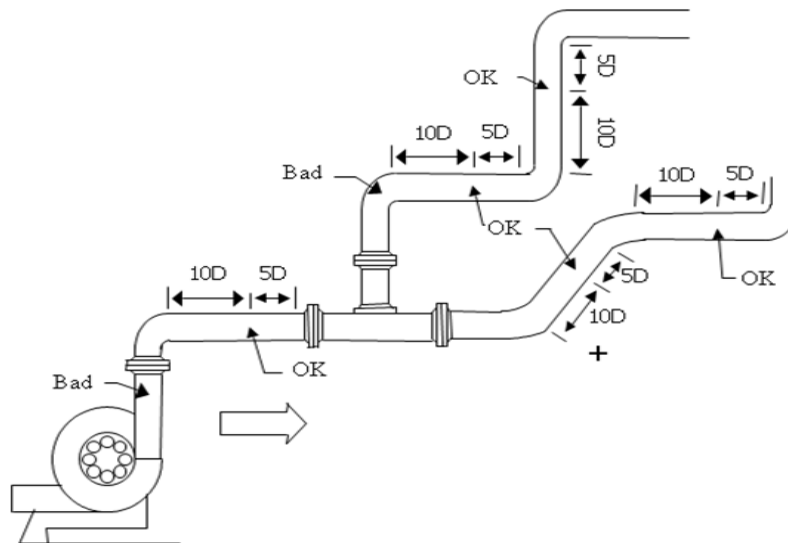
(c)

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: $7.7'' \times 7.3'' \times 4.3''$ ($195 \times 185 \times 110\text{mm}^3$)	

Transducer	Clamp-on Transducer (2MHz)	<p>(1) Clamp-on transducer, standard temperature Temperature range: 0°F-140°F (-20°C - 60°C). TWC-RS2: for 1"-2 ½" (DN25-DN65) pipes Fitted transducer (suitable for one specific pipe size only): TWC-RS2C20: for ¾" (DN20) copper pipe TWC-RS2C25: for 1" (DN25) copper pipe or ¾" (DN20) ANSI pipe TWC-RS2C32: for 1 1/4" (D32) copper pipe or 1" (DN25) ANSI pipe</p> <p>(2) Clamp-on transducer, high temperature Temperature range: 0°F - 300°F (-20°C - 150°C) TWC-RS2HT: for 1"-2 ½" (DN25-DN65) pipes Fitted transducer (suitable for one specific pipe size only): TWC-RS2C20HT: for ¾" (DN20) copper pipe TWC-RS2C25HT: for 1" (DN25) copper pipe or ¾" (DN20) ANSI pipe TWC-RS2C32HT: for 1 1/4" (D32) copper pipe or 1" (DN25) ANSI pipe</p>
	Flow-cell Transducer (1MHz)	Size from DN10 (3/8") to DN200 (8")
Liquids	Liquid Types	<p>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.</p>
	Liquid Temp	<p>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</p>
	Suspension concentration	< 20,000ppm and particle size less than 100um. May contain very small amount of air bubbles.
Pipe	Pipe Size	<p>3/4" ~ 2 ½" (DN20mm ~ DN65mm) for clamp-on 3/8" ~ 8" (DN10mm ~ DN200mm) for flow-cell</p>
	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	<p>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.</p>	
Environment	Temperature	<p>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).</p>
	Humidity	<p>Main unit: 85% RH Transducer: water-immersible, water depth less than 10' (3m)</p>

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:

	E F 1 1	- x	- x
Operational Frequency	1 – 1MHz (Flow-cell transducer)		
	2 – 2MHz (Clamp-on transducer for pipe sizes from DN20 / ¾" to DN65 / 2 ½")		
Output Interface	A - RS485/Modbus (default)		
	B - RS485/Modbus and 4-20mA		
	C - RS485/Modbus and pulse		

Note: you must select a transducer to make a complete system.

Optional Accessories

External Adapters

Name	Model#	Description
485-USB Adapter	WA-485USB	RS584 to USB adapter (to connect to a PC)
485-Ether Adapter	WA-485Ether	RS584 to Ethernet adapter (to connect to a LAN/WAN network)
485-BACnet/MSTP Adapter	WA-BACMSTP	RS485 to BACnet/MSTP adapter (to connect to a BACnet Gateway)
485-BACnet/IP Adapter	WA-BACIP	RS485 to BACnet/IP adapter (to connect to a BACnet network)
485-LonWorks Adapter	WA-LONW	RS485 to LonWorks adapter (to connect to a LonWorks network)

Data Logger

Name	Model#	Description
SD Data Logger	WA-SD	2GB SD data logger for recording flow and other parameters



PC Software

Name	Model#	Description
PC Software	SW-STMGR	StufManager PC software (to read meter data from a PC)
uGalaxy Telemetry System		Please contact solutions@spiremt.com for information

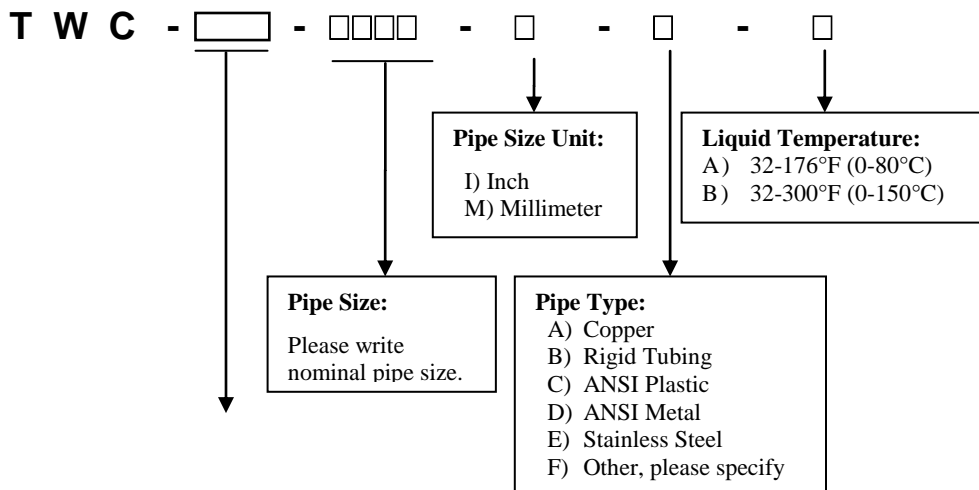
Power Adapter

Name	Model#	Description
12V AC/DC Power Adapter	WA-DC12	12V AC/DC power adapter for EF11 main unit

SPECIFICATIONS: Clamp-on Transducer

Model	Picture	Description
Type: RS2/RS2C PN#: TWC-RS2 / TWC-RS2C20/25/32		<p>Standard temperature, clamp-on WITH mounting rail, 2MHz Temperature 0°F - 176°F (-20°C - 80°C) TWC-RS2: 2MHz transducer WITH mounting rail for pipe sizes DN25-65 (1" – 2 ½"). For copper pipes of DN20-32 (¾" – 1 ¼") and metal pipes of DN20-25 (¾" – 1"), please consider transducer TWC-RS2C20/25/32 TWC-RS2C20: 2MHz transducer WITH mounting rail fitted for DN20 (¾") copper pipe TWC-RS2C25: 2MHz transducer WITH mounting rail fitted for DN25 (1") copper pipe or DN20 (¾") ANSI pipe TWC-RS2C32: 2MHz transducer WITHOUT mounting rail fitted for DN32 (1 ¼") copper pipe or DN25 (1") ANSI pipe</p>
Type: RS2HT/RS2HTC PN#: TWC-RS2HT / TWC-RS2HTC20/25/32		<p>High temperature, clamp-on WITH mounting rail, 2MHz High temperature 32°F - 300°F (0°C - 150°C) TWC-RS2HT: 2MHz high temp transducer WITH mounting rail for pipe sizes DN25-65 (1" – 2 ½"). For copper pipes of DN20-32 (¾" – 1 ¼") and metal pipes of DN20-25 (¾" – 1"), please consider TWC-RS2HTC20/25/32 TWC- RS2HTC20: 2MHz transducer WITH mounting rail fitted for DN20 (¾") copper pipe TWC- RS2HTC25: 2MHz transducer WITH mounting rail fitted for DN25 (1") copper pipe or DN20 (¾") ANSI pipe TWC- RS2HTC32: 2MHz transducer WITHOUT mounting rail fitted for DN32 (1 ¼") copper pipe or DN25 (1") ANSI pipe</p>

How to Order Clamp-on Transducer:



**Transducer type:**

Standard temperature, clamp-on, 2MHz

RS2 - 2MHz transducer WITH mounting rail for pipe sizes DN20-65 ($\frac{3}{4}$ " – 2 $\frac{1}{2}$ "). For copper pipes of DN20-32 ($\frac{3}{4}$ " – 1 $\frac{1}{4}$ ") and metal pipes of DN20-25 ($\frac{3}{4}$ " – 1"), please consider RS2C20/25/32

RS2C20 - 2MHz transducer WITH mounting rail fitted for DN20 ($\frac{3}{4}$ ") copper pipe

RS2C25 - 2MHz transducer WITH mounting rail fitted for DN25 (1") copper pipe or DN20 ($\frac{3}{4}$ ") ANSI pipe

RS2C32 - 2MHz transducer WITH mounting rail fitted for DN32 (1 $\frac{1}{4}$ ") copper pipe or DN25 (1") ANSI pipe

High temperature, clamp-on, 2MHz

RS2HT - 2MHz high temp transducer WITH mounting rail for pipe sizes DN20-65 ($\frac{3}{4}$ " – 2 $\frac{1}{2}$ "). For copper pipes of DN20-32 ($\frac{3}{4}$ " – 1 $\frac{1}{4}$ ") and metal pipes of DN20-25 ($\frac{3}{4}$ " – 1"), please consider RS2HTC20/25/32

RS2HTC20 - 2MHz high temp transducer WITH mounting rail for DN20 ($\frac{3}{4}$ ") copper pipe

RS2HTC25 - 2MHz high temp transducer WITH mounting rail for DN25 (1") copper pipe or DN20 ($\frac{3}{4}$ ") ANSI pipe

RS2HTC32 - 2MHz high temp transducer WITH mounting rail for DN32 (1 $\frac{1}{4}$ ") copper pipe or DN25 (1") ANSI pipe

Required Accessories**Transducer Cable**

Model	Description
TW-CBL-5M	5m (15ft) shielded transducer cable (in pair)
TW-CBL-15M	15m (50ft) shielded transducer cable (in pair)
TW-CBL-50M	50m (150ft) shielded transducer cable (in pair)
TW-CBL-100M	100m (300ft) shielded transducer cable (in pair)

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:

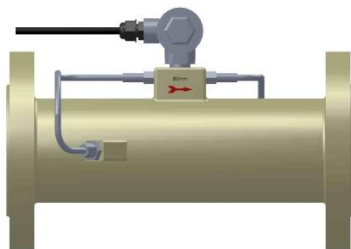


Note: BST or NPT threading connection is also available.

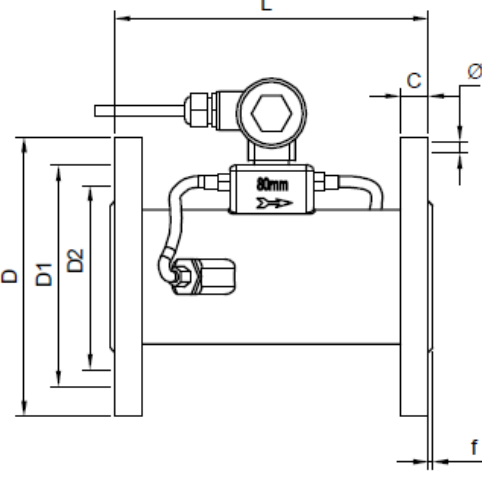
Unit: mm Pressure Rating: 2.5MPa

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



Nominal Size DN	Length L	Flange Dimension			Sealing Face		Thick ness C
		D	D1	Ø X n	D2	f	
50	200	165	125	18 X 4	99	3	20
65	200	185	145	18 X 4	118	3	20
80	225	200	160	18 X 4	132	3	20
100	250	220	180	18 X 8	156	3	22
125	250	250	210	18 X 8	184	3	22
150	300	280	240	22 X 8	211	3	24
200	350	340	295	22 X 12	266	3	24

Note:
The flange dimensions listed in the above tables are for DIN flanges. We also offer ANSI RF#150 flange upon request.

How To Order Flow-Cell Transducer

Please select one option (ID) from each category.

TWF - - - -

Flow-cell Size		ID	ID	
3/8"	(DN10)	01	8" (DN200)	13
1/2"	(DN15)	02	10" (DN250)	14
3/4"	(DN20)	03	12" (DN300)	15
1"	(DN25)	04	14" (DN350)	16
1 1/4"	(DN32)	05	16" (DN400)	17
1 1/2"	(DN40)	06	18" (DN450)	18
2"	(DN50)	07	20" (DN500)	19
2 1/2"	(DN65)	08	24" (DN600)	20
3"	(DN80)	09	28" (DN700)	21
4"	(DN100)	10	32" (DN800)	22
5"	(DN125)	11	36" (DN900)	23
6"	(DN150)	12	40" (DN1000)	24

Pipe Joint	ID
BSP Threading (only available for size <DN50/2")	A
NPT Threading (only available for size <DN50/2")	B
DIN Flange	C
ANSI 150# Flange	D
Other; please specify	E

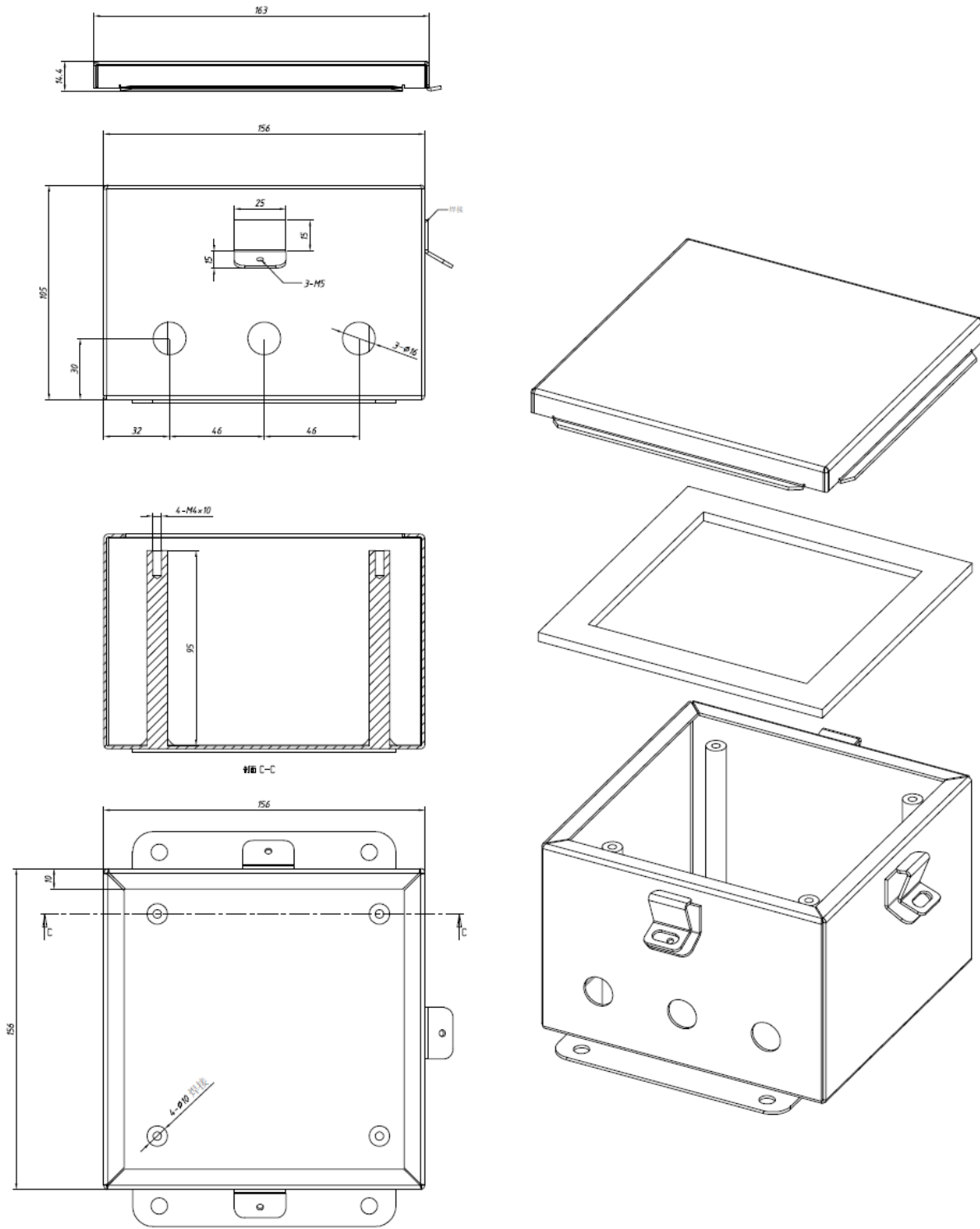
Flow-cell Material	ID
Carbon Steel (default)	1
Stainless Steel	2
Plastic	3
Other; please specify	4

Pressure	ID
0.6MPa (87psig) (for sizes >DN500/20")	A
1MPa (145psig) (for sizes from DN300/12" to DN500/20")	B
1.6MPa (232psig) (for sizes from DN50/2" to DN250/10")	C
2.5MPa (362psig) (for sizes <DN50/2")	D
Other; please specify	E

Required Accessories

Cable Length	Model No.
5m (15ft)	TW-CBL-5M
15m (50ft)	TW-CBL-15M
50m (150ft)	TW-CBL-50M
100m (300ft)	TW-CBL-100M

DIMENSION



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: EF11-2-B, 1unit

Clamp-on transducer: TWC-RS2-0002I-D-A, 1 pair

Transducer cable: TW-CBL-5M, 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 daily.

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

Flow transmitter: EF11-2-B, 1unit

Clamp-on Transducer: TWC-RS2HTC25-0001I-DB, 1 pair

Transducer cable: TW-CBL-5M, 1 pair

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