CHALTRON SYSTEMS, INC.

Advancements in Clamp-on Ultrasonic Flow Measurements

2016 Biosolids Workshop
December 1st 2016


FLEXIM

FLEXIM

Market Leader in Clamp-On Ultrasonic Flowmeters with >50,000 instruments sold

Background Information

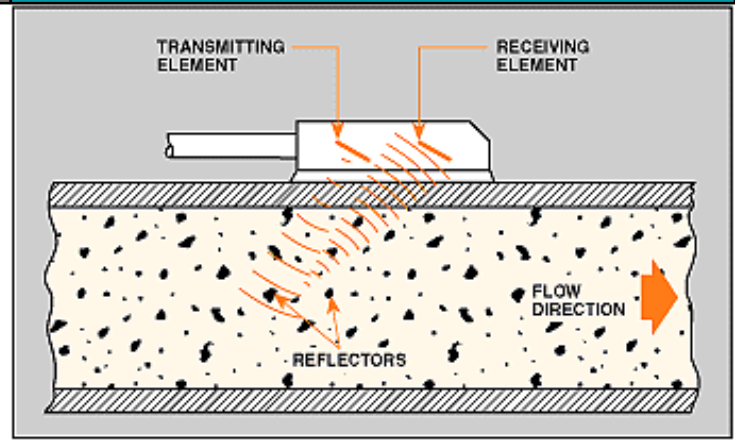
- Extraordinary performance over the last 10 Years
- > 25% of investments put into Research & Development
- Privately owned Company – 26 Years
- Protected by international patents
- Unique adaptive Dual-µC signal processing

Clamp-on Technology Leader

- More than 150 man-years of combined application knowledge
- Widest application range on the market
- Permanent Coupling Pads – NO GREASE!
- Rugged Design for all Environments

Technology: Types of Ultrasonic Flow Meters

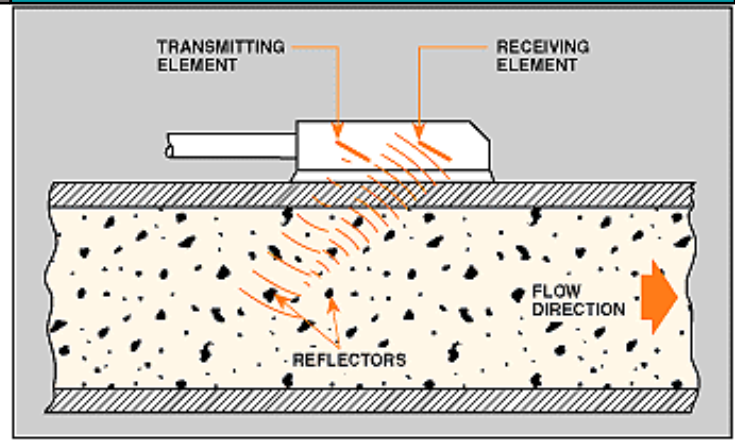
Doppler Measurement

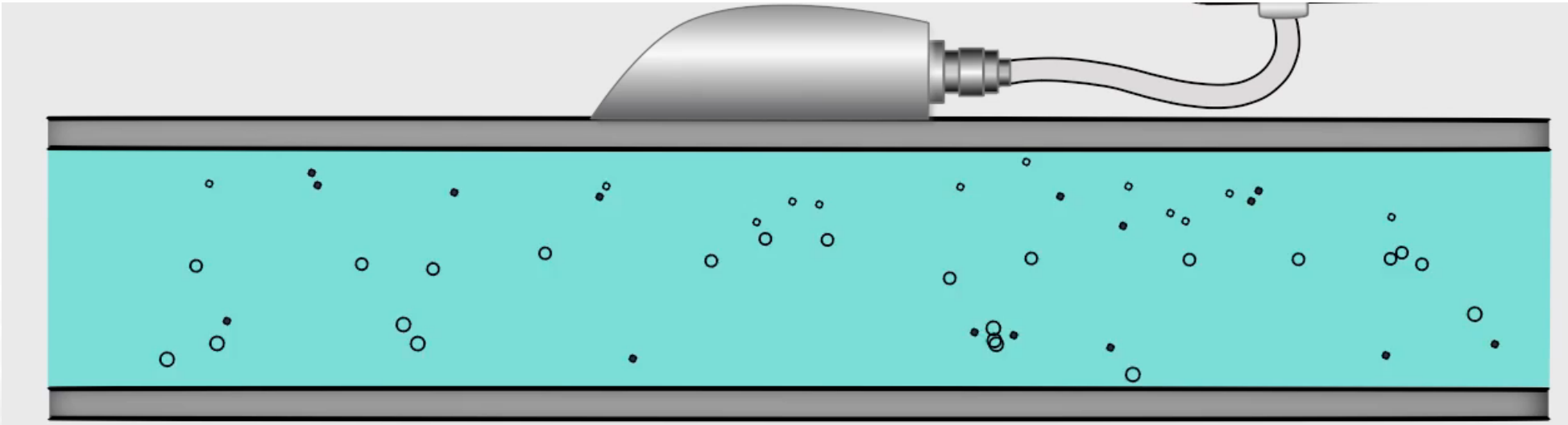


Doppler meters use sound pulse reflection principle to measure liquid flow rate, solids or bubbles in suspension in the liquid reflect the sound back to the receiving transducer.

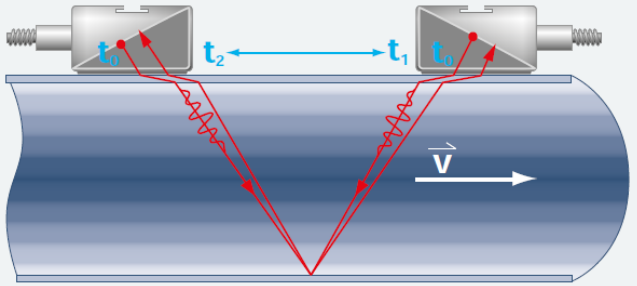
Assumption - Reflected particle is representative of the average flow.

Doppler Measurement





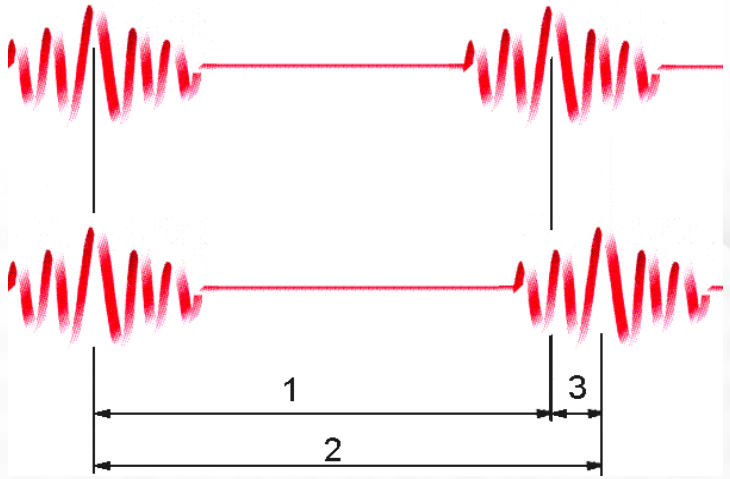
Transit Time Measurement



Two Ultrasonic Transducers alternatively emit and receive signals protruding into the pipe

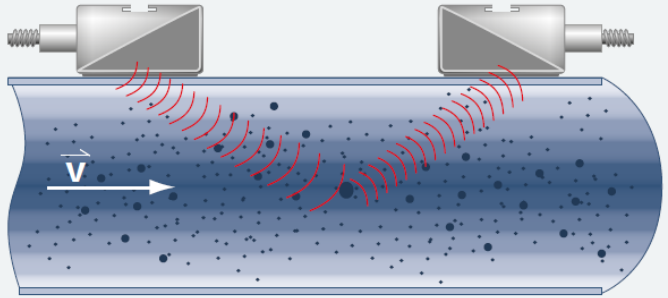
The Signal going with the flow travels the distance faster than the one against the current

This time difference is measured and allows for the calculation of the flow velocity and the volume flow rates



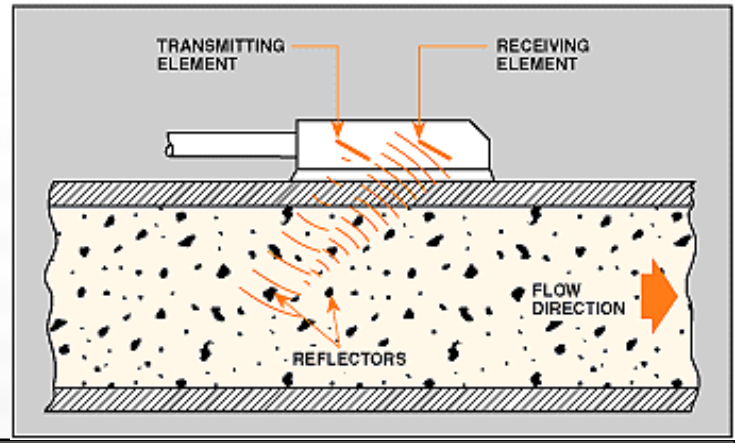
Measurement Principle – Transit Time (Video)

HybridTrek



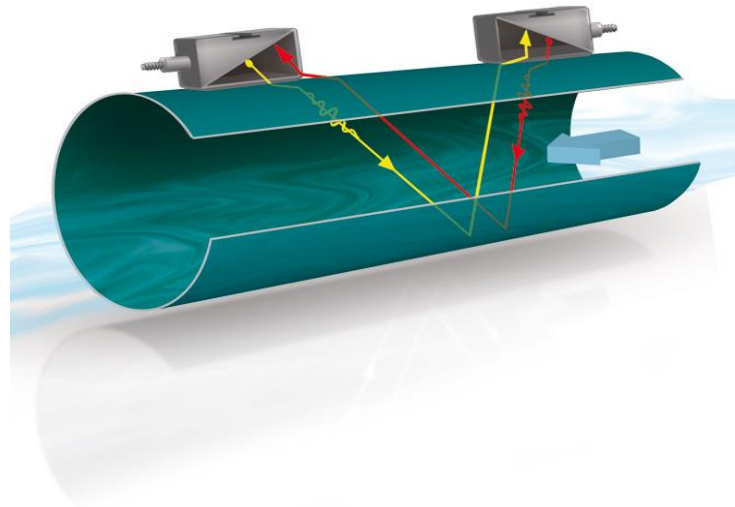
In media with higher solids content (>10%) such as sludge's, where the ultrasonic signal becomes attenuated, the meter can automatically shift to Noisetrek (Doppler).

The frequency shift of the ultrasonic signal is measured by the particles floating in the liquid, providing a continuous measurement during upsets in the process.



Advancements in Electronics and Signal Processing

Measurement Principle – Transit Time



FLEXIM's flow meters measure according to the Transit-Time principle.

Transit-Time is inherently bi-directional

Flexim has a wide range of transducers for all applications

$$Q = A \cdot k_{Re} \cdot V_L$$

$$\text{mit } V_L = \frac{\Delta t}{2 t_{fl}}$$

$$\Leftrightarrow Q = A \cdot k_{Re} \cdot \frac{\Delta t}{2 t_{fl}}$$

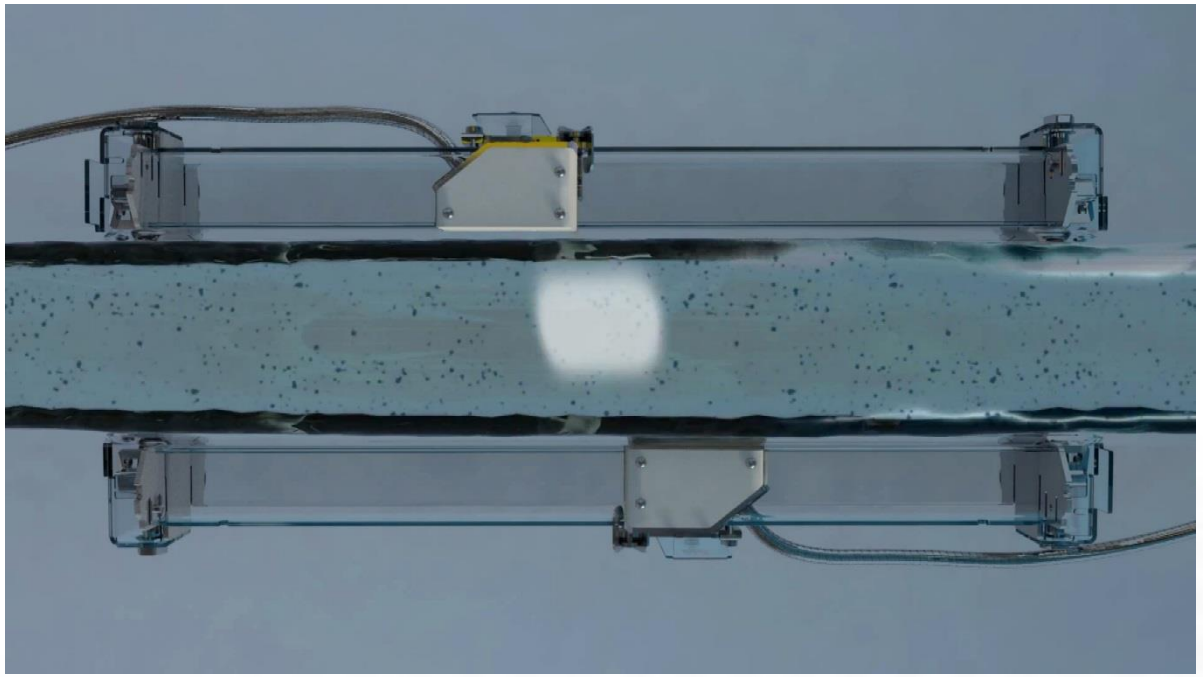
$$\text{mit } k_{Re} = f(Re)$$

$$\text{mit } Re = \frac{v_{fl} \cdot di}{\nu}$$

$$\Leftrightarrow Q = A \cdot \frac{v_{fl} \cdot di}{\nu} \cdot \frac{\Delta t}{2 t_{fl}}$$

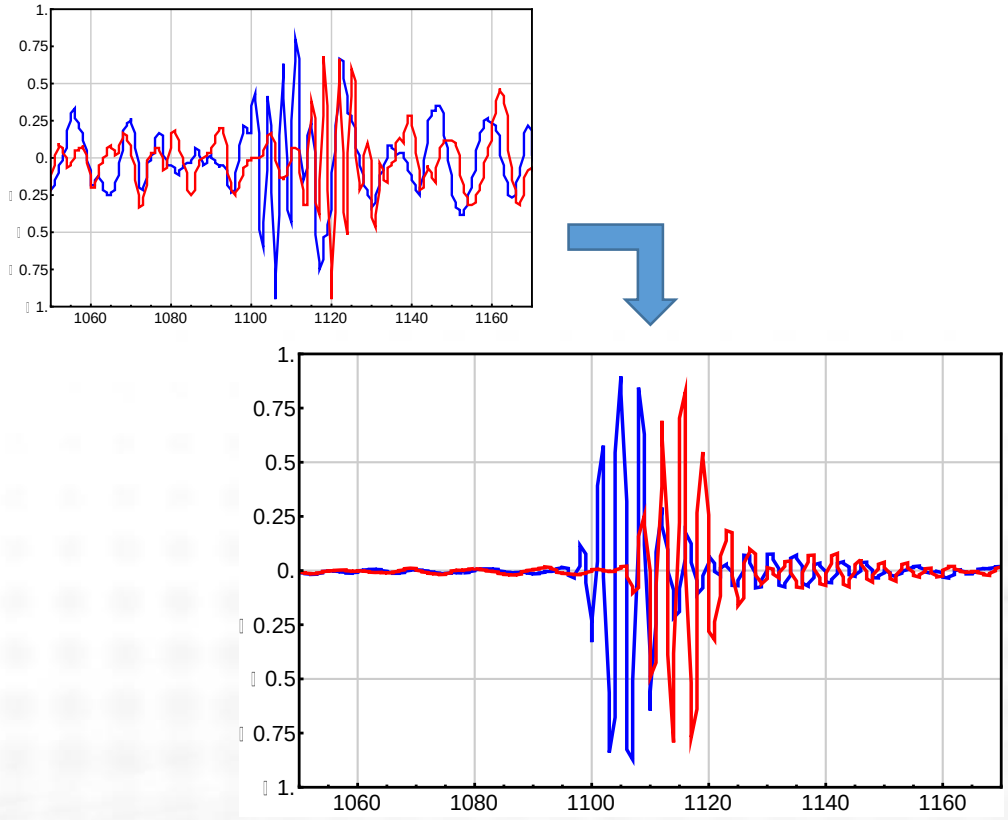
Highly Accurate Signal Processing

- FLEXIM's flow meters generate up to 1,000 signals per second.
- Internal DSP allows for fast and secure processing of these signals



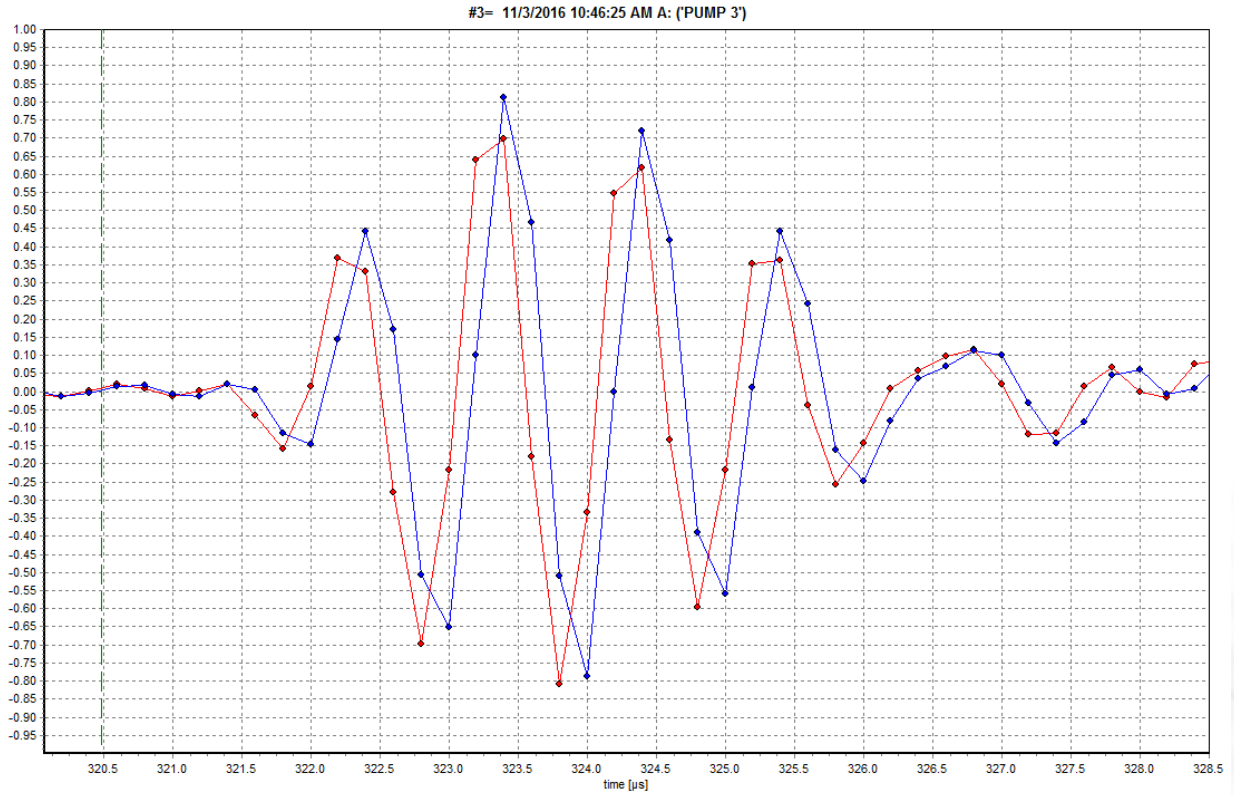
Highly Accurate Signal Processing

- FLEXIM's superior noise and correction algorithms along with the DSP guarantee, that signals are fully processed and noise is significantly suppressed
- Automatic variable gain control adapts to the process to provide a reliable signal



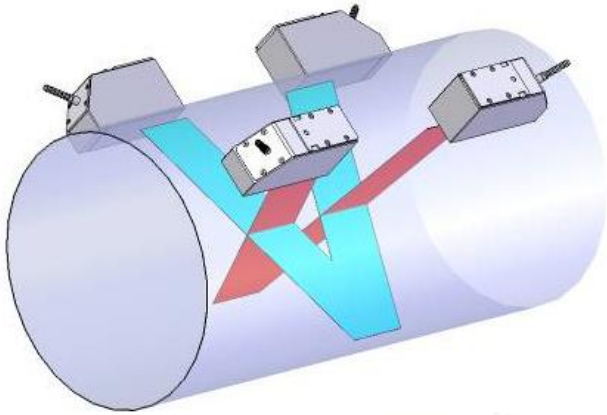
Highly Accurate Signal Processing

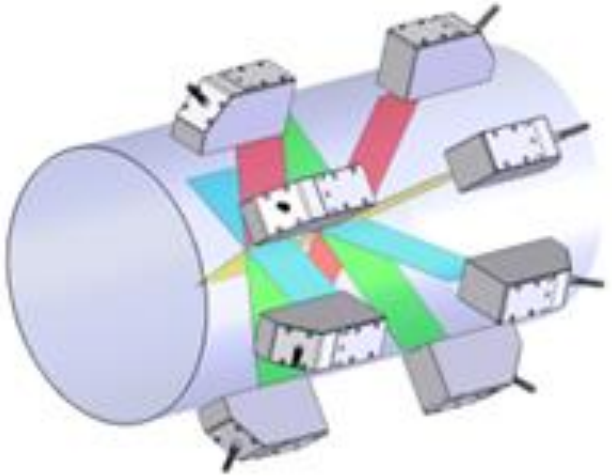
- Flexim Correlates up to 200 points of waveform between upstream and downstream measurements
- Other Ultrasonic meters measure time at only 1 point, that point can shift due to temperature changes



Highly Accurate in Non-Ideal Situations

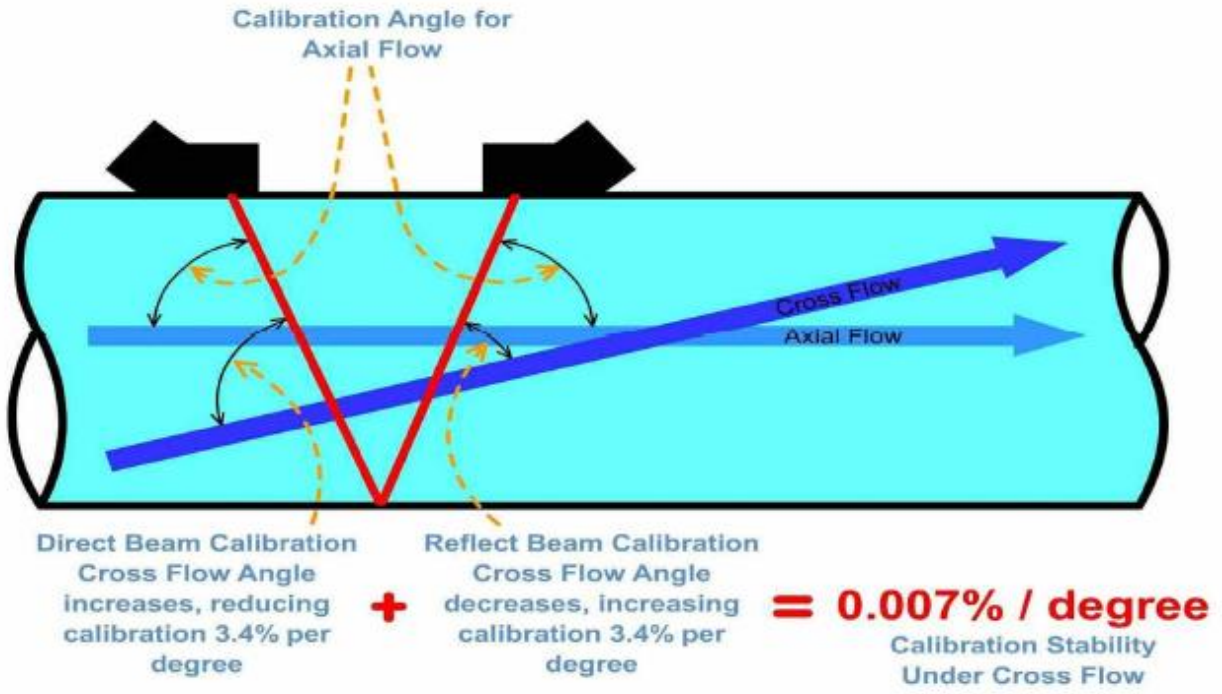
- All FLEXIM flow meters can be equipped with two (4 Beam) or four (8 Beam) flow channels to compensate for non-ideal flow profiles
- Channels are averaged together and provided as one output





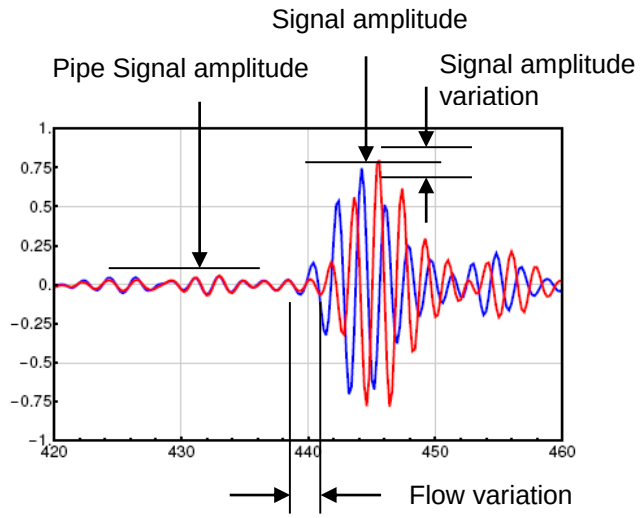
Short Run - Cross Flows

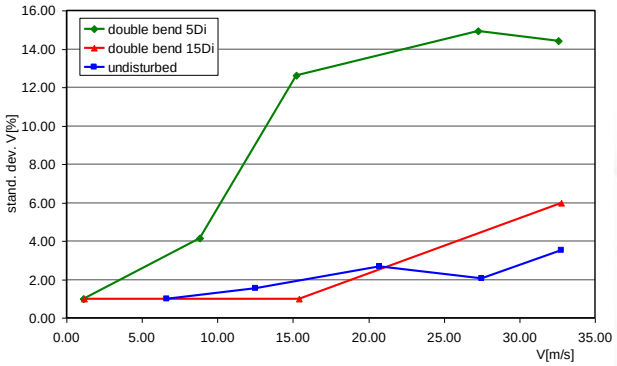
- Cross Flow Compensation
- Flexim meters have the ability to mitigate error associated with short straight runs



Diagnostic Parameters

- Each measurement can be evaluated by using numerous diagnostic parameters:
  - Signal Strength, Signal Quality, SNR, SCNR, Gain, Soundspeed
- Ensures an optimal operation at installation
- Provides baseline diagnostics for future verification





Unique Transducer Design

Transducer SENS-Prom:

- Fool-Proof Transducer Detection
- Auto Transducer Recognition and Calibration Upload
- Ensures an Unchangeable Accuracy – Calibration Resides with Transducers

Matched & Temperature Compensated Transducers

- Enables Drift Free Measurement
- Eliminates Zeroing in the Field
- Provides Reliable Measurement Under Difficult Conditions

Advancements in Hardware and Physical Design

Rugged Solution

Transducers and Transmitters:

- Transducers are resistant to chemicals (PEEK), watertight (IP68) and hazardous areas (FM) approved
- Stainless Steel armoured transducer connection cables ensure no weak junctions
- Transmitters are available as hazardous area approved versions (FM Class I, Div. I and II) with intrinsic safe outputs

Rugged Solution

Mounting Fixtures:

- Stainless Steel (SS 304 and SS 316) PermaLok mounting fixtures for optimal protection
- Fully gasketed enclosure
- Designed for rough environments guaranteeing long term stability

How Flexim has Solved Typical Ultrasonic Failure Points

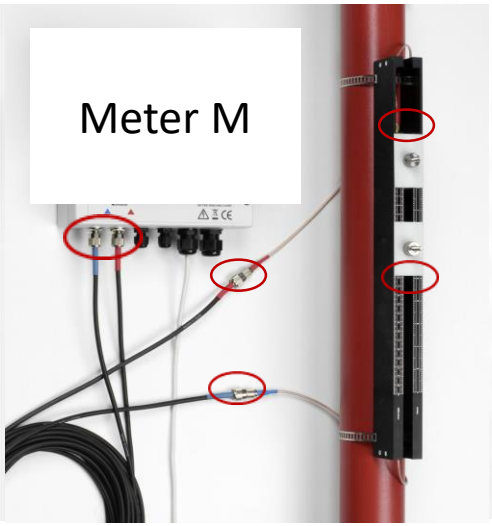
Problem: Coupling Compound Between Pipe and Transducer

Solution: *Flexim Uses Rubber Coupling Pads – No More Grease. No More Maintenance*

Problem: Corrosion/Failure of Transducer Connection

Solution: *Flexim Uses Sealed Potted Cable Connections. No Twist-on Type Connectors*

12 Points of Potential Failure for Corrosion in 1 Measurement Point

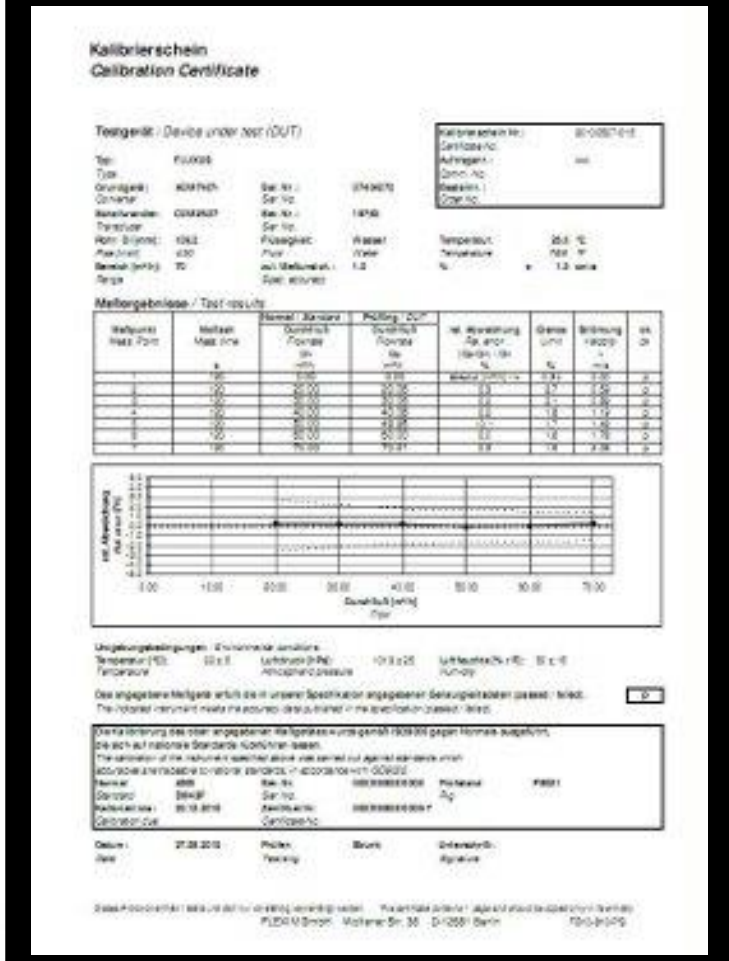


Problem: Damage to Transducer Cables

Solution: *Flexim Uses Stainless Steel Armoured Cable. No Un-Protected Coax Wires*

Problem: Field Zeroing Required – Full Pipe No Flow on Installation

Solution: *Flexim Pre-Zero's Meters During Wet Flow Calibration Ensuring Accuracy (NIST Traceable)*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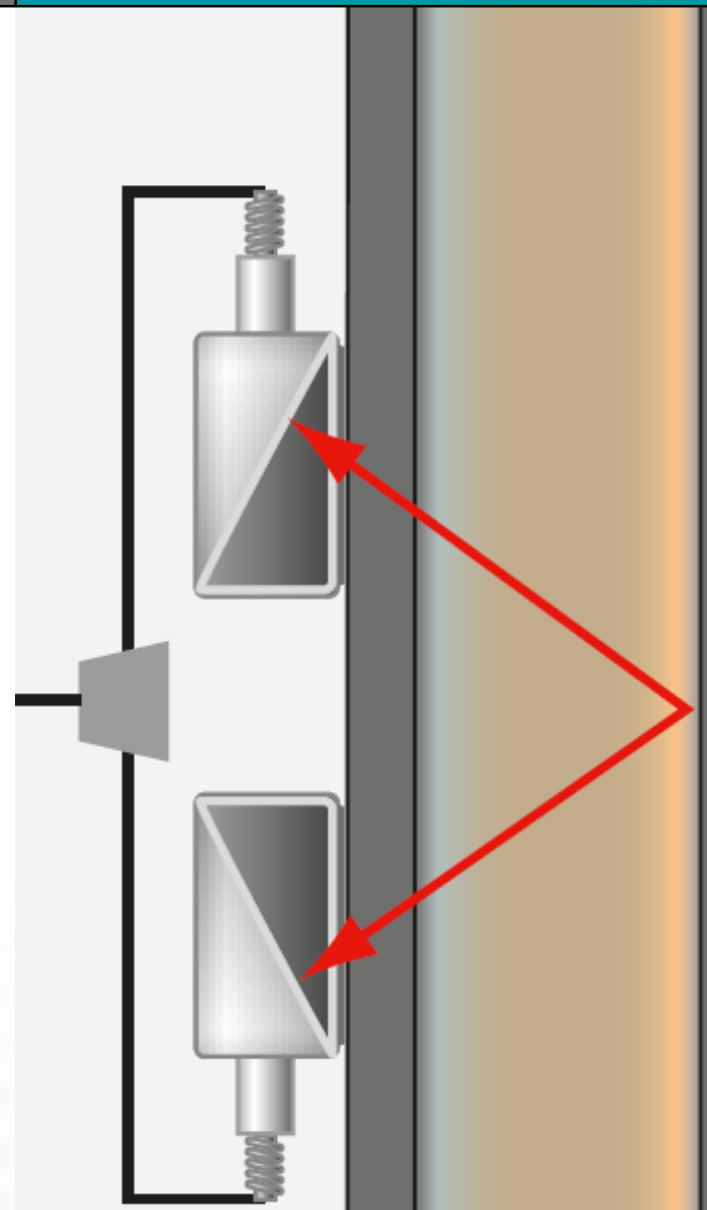
Calibration Certificate

National Institute of Standards and Technology
U.S. Department of Commerce

Problem: Meters Drift Based on Ambient Temperature Changes

Solution: *Flexim Temperature Compensates with Embedded RTD's*

Meets the ANSI/ASME MFC-5M-1985 Standard

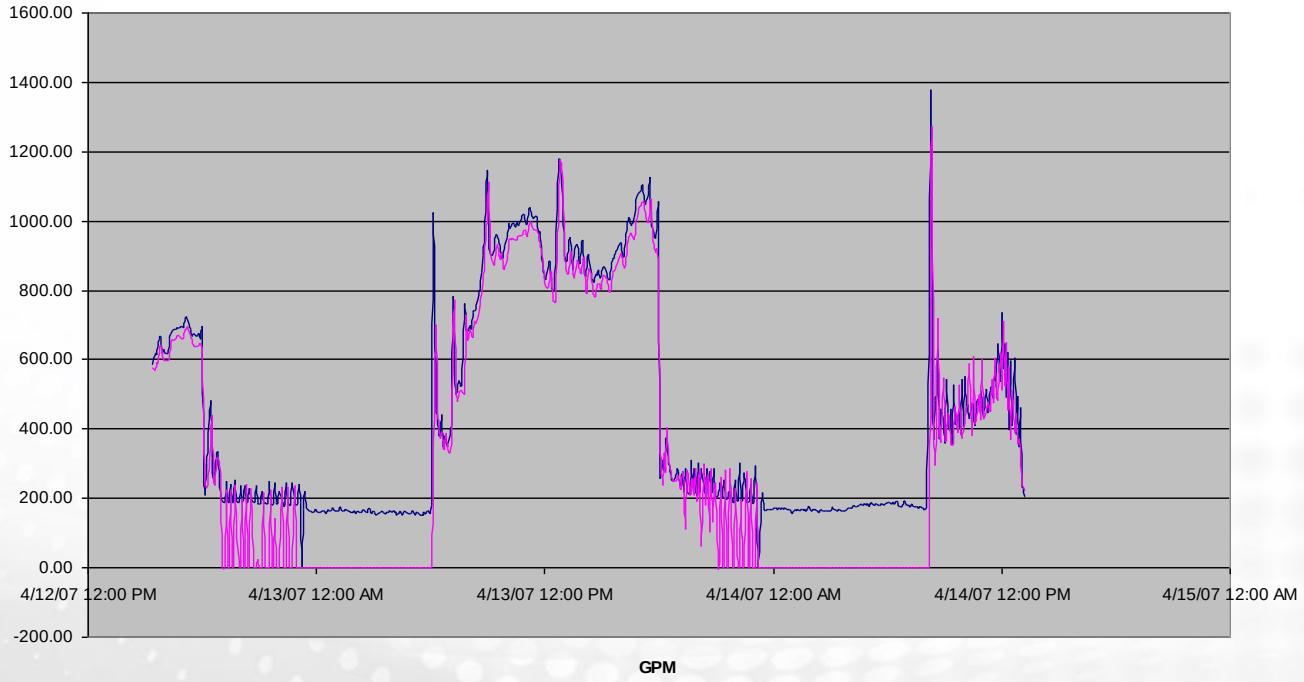


Problem: Poor Mounting / Transducer Movement on Pipe

Solution: *Flexim Has Rugged PermaLok Mounting Track*

Problem: Turn Down Ratio / Low Flows

Solution: *Bi-Directional - Unlimited Turn Down Ratio*



Clear Advantages of FLUXUS – Liquid Flow Measurement

Physical Limitations - None

- From ¼” Tubing Lines up to 256” Pipes
- Measurement in Every Environment – Including Submergence (IP68)
- No Limitation on Wall Thickness or Pipe Material
- Inherently Bi-Directional Measurement
- Unlimited Turndown Ratio – Highest Accuracy from Very Low up to High Flow Rates (0.01 ft/sec to >200 ft/sec) XLF down to 0.001 ft/sec
- Independent of Pipe Wall Temperatures -260 °F. to >1150 °F.
- Measurement of Virtually any Liquid – Independent of Entrained Particles or Gas Bubbles due to HybridTrek Mode

Highly Cost Efficient

- Meter Cost is Independent of Pipe Diameter or Internal Pressure
- No Process Shut-Downs
- No Maintenance
- No Internal Pressure Drops

Applications in Water and Waste

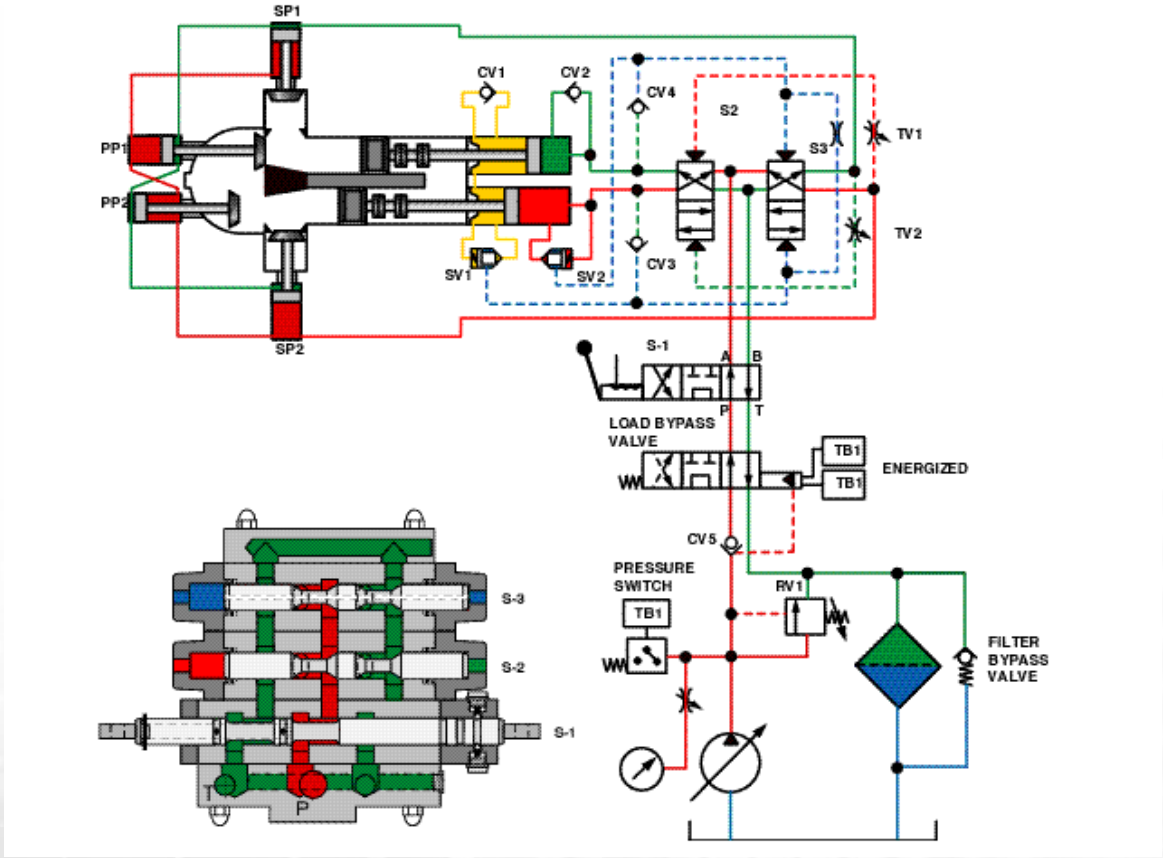
NEORSD – Easterly Plant
48“ RAS Lines

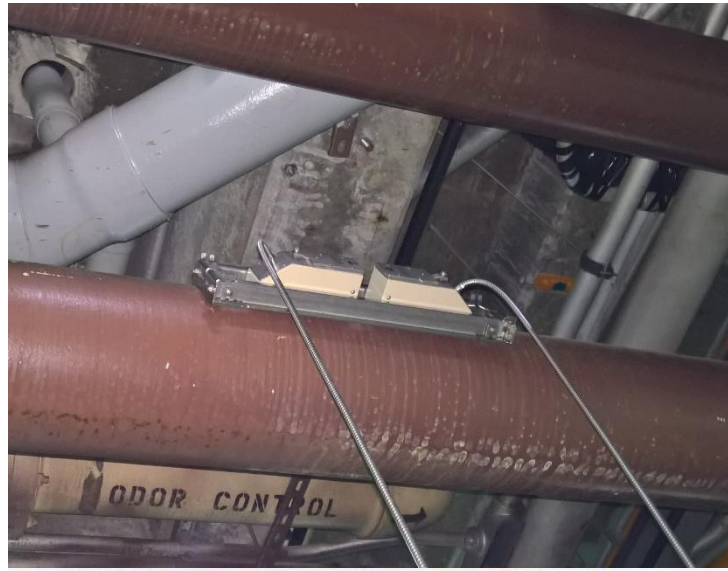
- Pipe Size: 48” Ductile Iron with .25” Cement Liner
- Dual Beam Meter to Overcome Short Straight Run
- PermaLok Mounting Tracks with Permanent Coupling Pads – No Maintenance

Cincinnati MSD
8“ Sludge to Incinerator

- Pipe Size: 8” SCH 80 Carbon Steel
- High Power Low Frequency G Sensors
- 2 Path Transit-Time Measurement
- 25-30 % Solids
- Schwing Alternating Piston Pumps
- Flow Velocities 0.02 to 0.35 feet/sec

Cincinnati MSD
8“ Sludge to Incinerator





Cincinnati MSD
8“ Sludge to Incinerator

Avon Lake – 30“ Carbon Steel Pipe Drinking Water

- Pipe size: 30” Carbon Steel
- Dual Path Meter Utilizing M-Sized Transducers in Reflect Mode, Providing 4 Paths of Measurement

Cleveland VAMC – 10“ and 8“ Cast Iron City Water

- Pipe size: 10” and 8”
- Pipe Material: Cast Iron
- Installed in Metering Pit
- Dual Path Meter Utilizing IP68 (Submersible) Transducers with PermaLok
- 4 Paths of fluid measurement

Ohio Pump Stations – 4“, 6“, 8“ Raw Sewage

- Pipe size: 4”, 6” 8”
- Pipe Material: Concrete Lined Ductile Iron
- Single Channel meters Utilizing “M-Sized” Transducers Installed in Reflect Mode
- 2 Paths of Measurement

Overcoming Short Straight Run – NEORSD - Westerly

- Recommended Straight Run: 10 Diameters Upstream / 5 Diameters Downstream
- < 1 Foot available
- Pipe Tested with F601 Portable Meter Which Provided Valuable Results
- Successfully Installed 6 Permanent Meters on Pump Discharge

Overcoming Short Straight Run – City of Pataskala Water Plant

- Recommended Straight Run: 10 Diameters Upstream / 5 Diameters Downstream
- 1 Foot available
- Pipe Tested with F601 Portable Meter Which Provided Valuable Results
- Successfully Installed 2 Permanent Meters on Pump Discharge

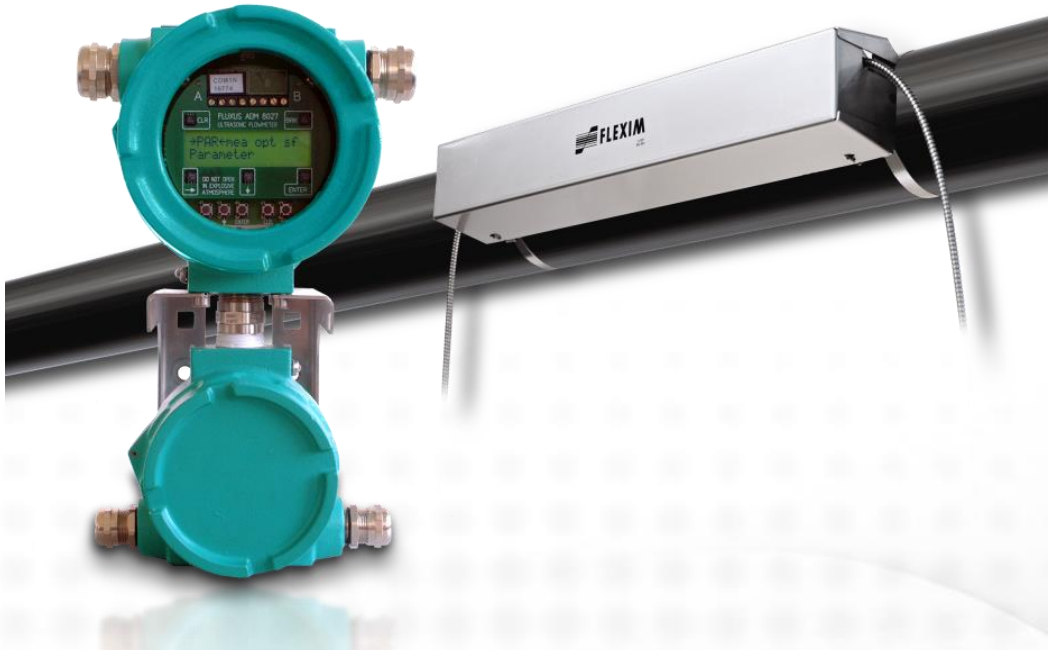
FLUXUS Product line

Permanent Flow Meter – FLUXUS ADM 7404

- Highly Customizable with a Wide Range of Individual Electrical Inputs & Outputs
- HART, BACnet, Modbus, and Ethernet Digital Communication
- FM Class I, Div. II Versions Available
- Optional 316 SS Enclosure for Corrosive Environments

Permanent Flow Meter – FLUXUS ADM 8027

- FM Class 1, Div 1 Approved Flow Meter for Direct use in Hazardous Areas
- Explosion-Proof Housing with Optional Intrinsically Safe Outputs
- Inherits all of the features the FLUXUS ADM 7407 offers (intrinsically safe version available)



Portable Flow Meter – FLUXUS F601

- Lightweight, ergonomic and highly intuitive portable flow meter and thermal energy meter
- Accurate measurement results in less than 5 minutes
- Sturdy housing designed for industrial environments with fully protected cable glands
- Over 14hrs of remote measurement

The Result: Flexim is a Maintenance Free Permanent Solution

CHALTRON SYSTEMS, INC.

Thank you