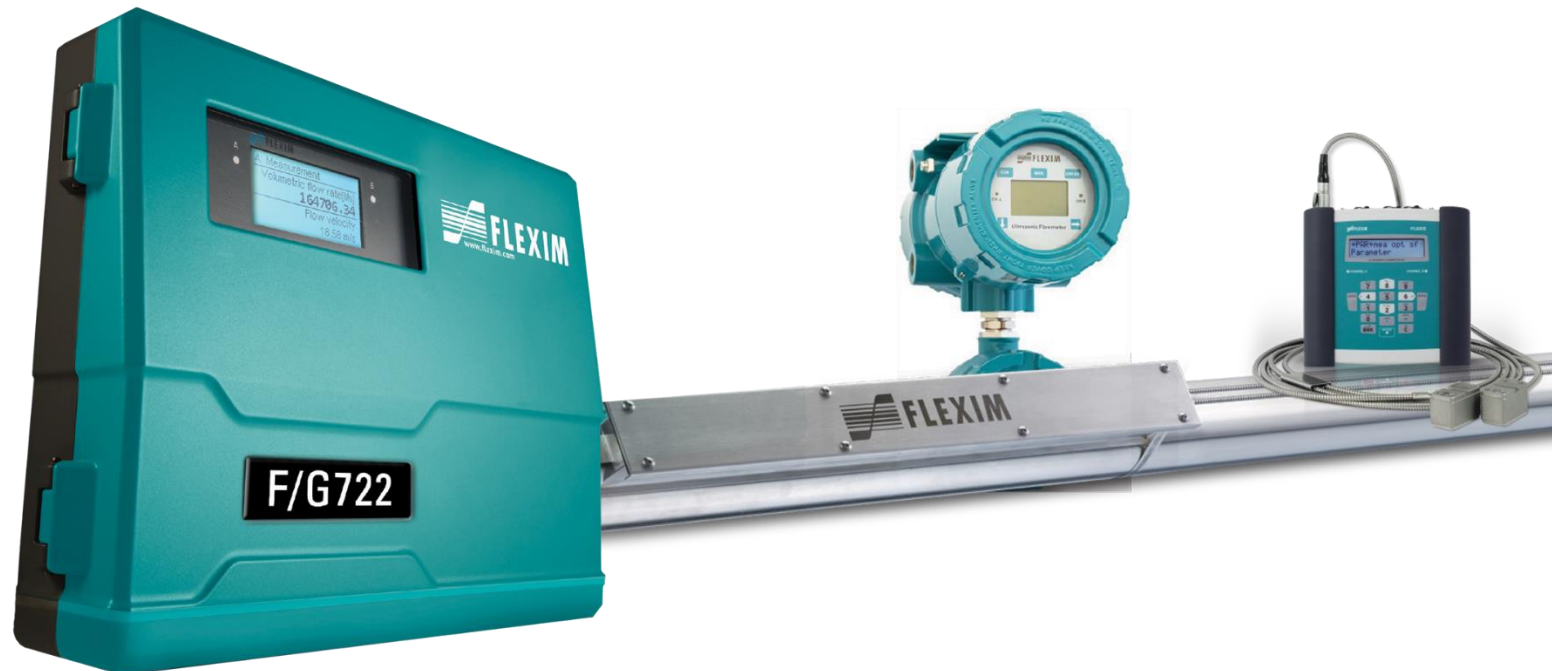


Recent Advancements in Ultrasonic Transit-Time Clamp On Metering



Brad Papa
Chaltron Systems, Inc.



- **Providing measurement instrumentation and data collection since 1984**
- **State of the art solutions for the Industrial, Municipal and Commercial Energy Management Markets**
- **Sales Professionals come from strong technical backgrounds and are committed to building lasting relationships with our customers**



The focus of this presentation is to provide Superintendents, Operators, Engineering Firms, and Maintenance Personnel with an overview of modern day ultrasonic flow metering technology advancements and field applications.



3 Key Discussion Points of this Presentation

- 
- 
- 1. Technology / Innovation**
 - 2. Targeting Water Loss**
 - 3. Local Applications**



***TECHNOLOGY &
INNOVATION***

1970's -----1980's



1990's



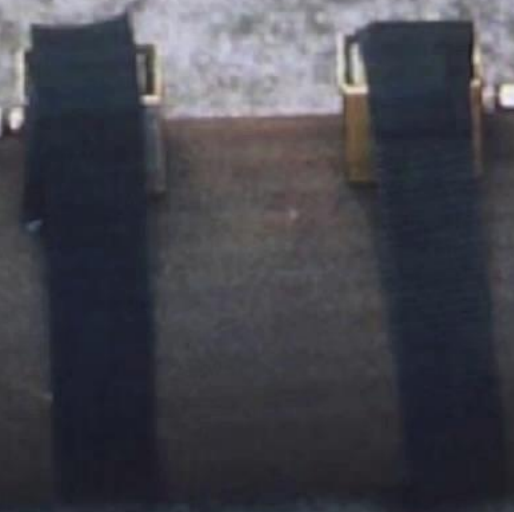
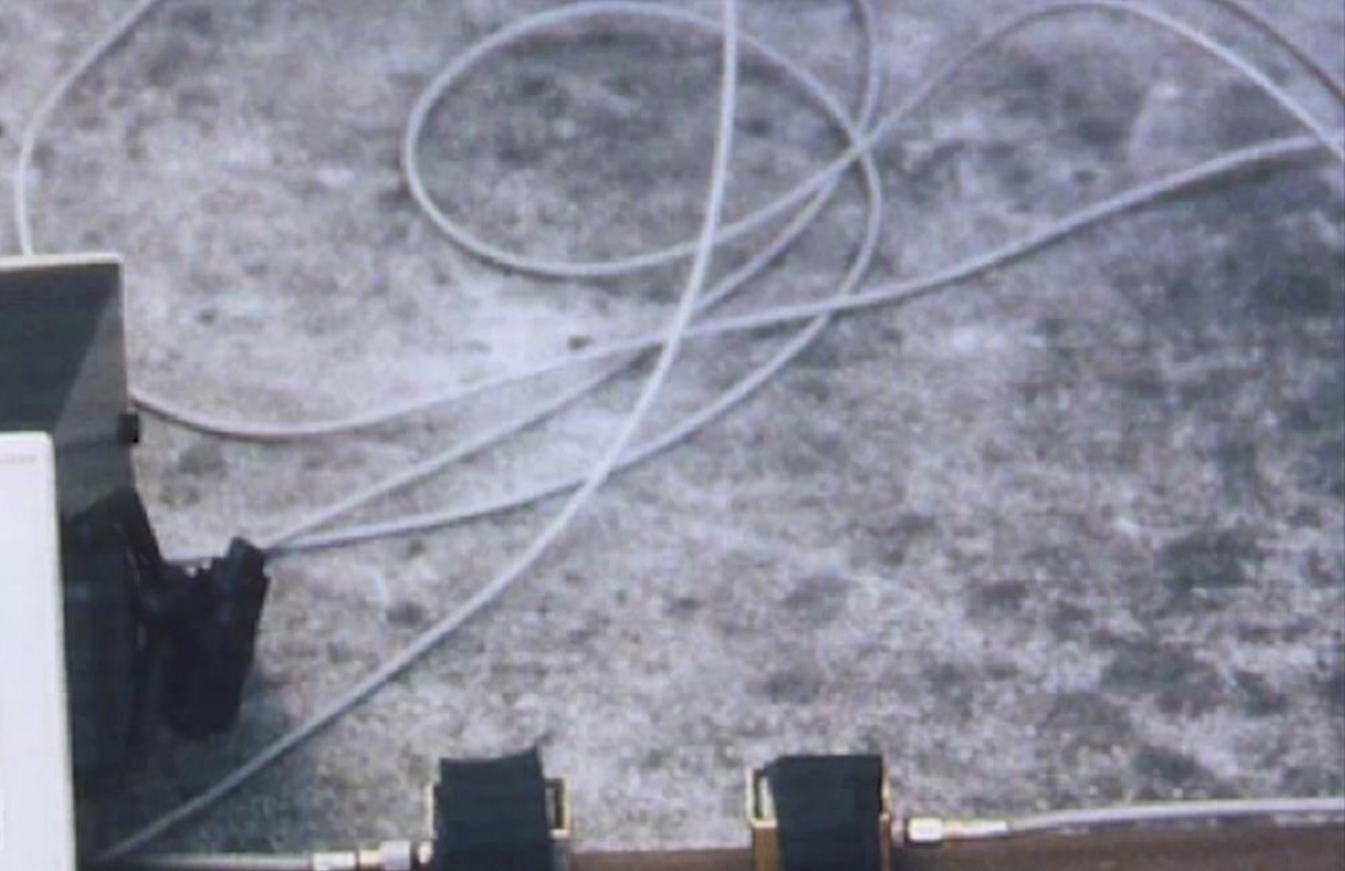
1995 ----- 2005



2022



FLEXIM





FLUXUS

Hubendurchmesser
75.2
MP

FLUXUS ADM 6402

BATTERY

SIGNAL

7 8 9
4 5 6
1 2 3
0 LIGHT -
ON
C ENTER

3x OFF

BRK

INT

RESET



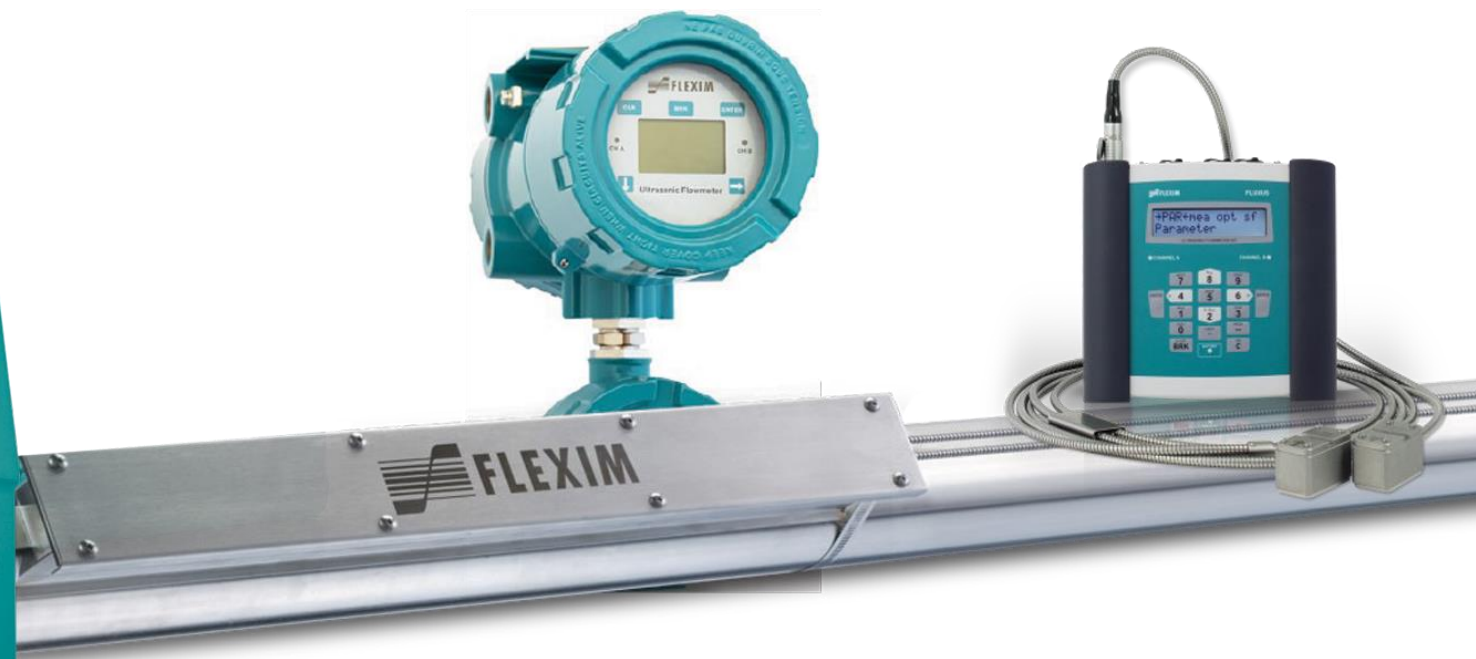


FLEXIM



FLEXIM FFLUOUS ADM 7407
ULTRASONIC FLOWMETER

WISSELE

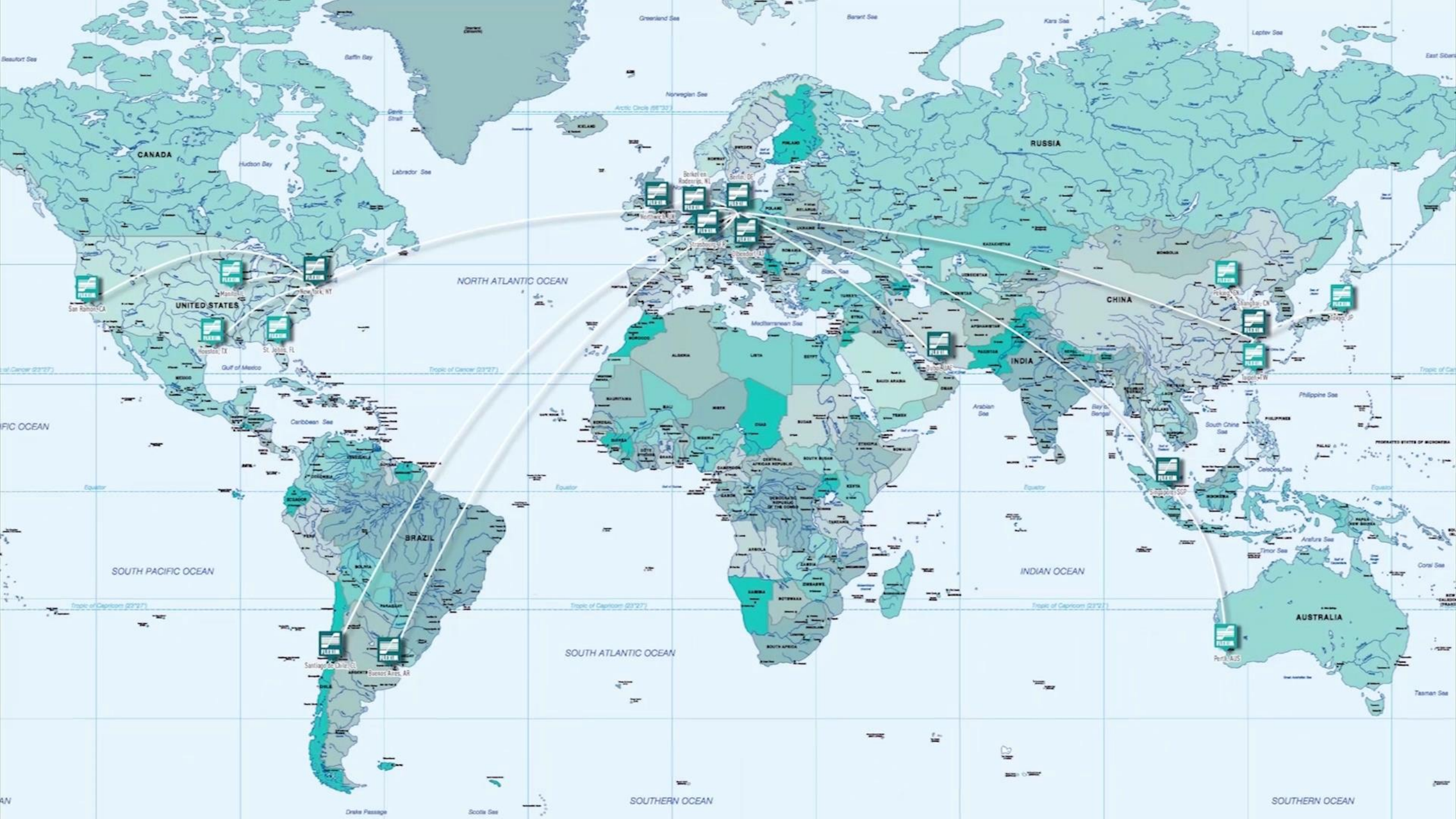




FLEXIM



FLEXIM



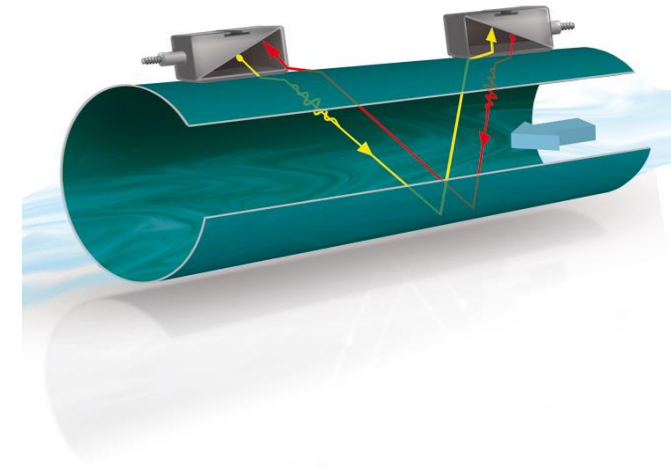


Doppler Measurement

- **Johann Christian Doppler – 19th Century Austrian Physicist**
- **High frequency sound penetrates pipe wall and reflects off of solids or bubbles in the fluid (required)**
- **If fluid is in motion, the echoes return at an altered frequency proportionate to flow velocity**
- **Frequency shift is measured to calculate flow**

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 signal against the current**
- **This time difference is measured and allows for the calculation of the flow velocity and the volume flow rates**



$$Q = A \cdot k_{re} \cdot V_k$$

mit $V_k = \frac{\Delta t}{2t_k}$

$$\Leftrightarrow Q = A \cdot k_{re} \cdot \frac{\Delta t}{2t_k}$$

mit $k_{re} = f(r_e)$

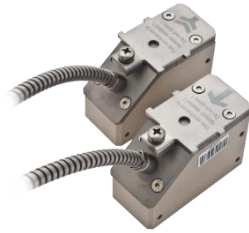
mit $r_e = \frac{v_k \cdot d_i}{r}$

$$\Leftrightarrow Q = A \cdot \frac{v_k \cdot d_i}{r} \cdot \frac{\Delta t}{2t_k}$$



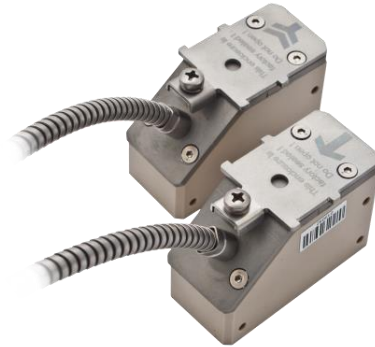
Transducers - Line sizing

Q



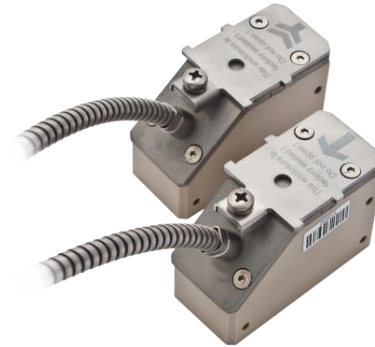
0.4" - 3"

P



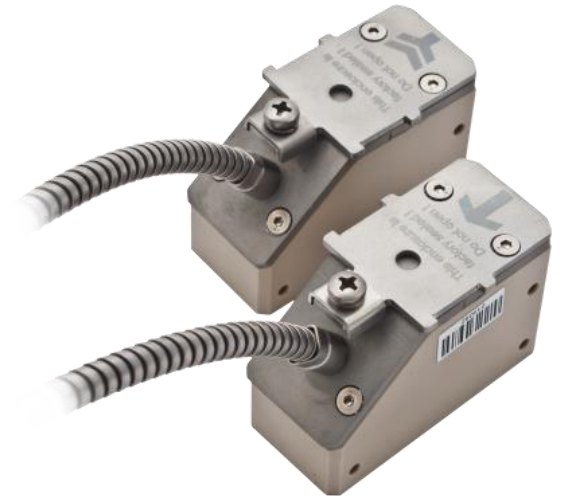
1" - 14"

M



4" - 20"


K or G



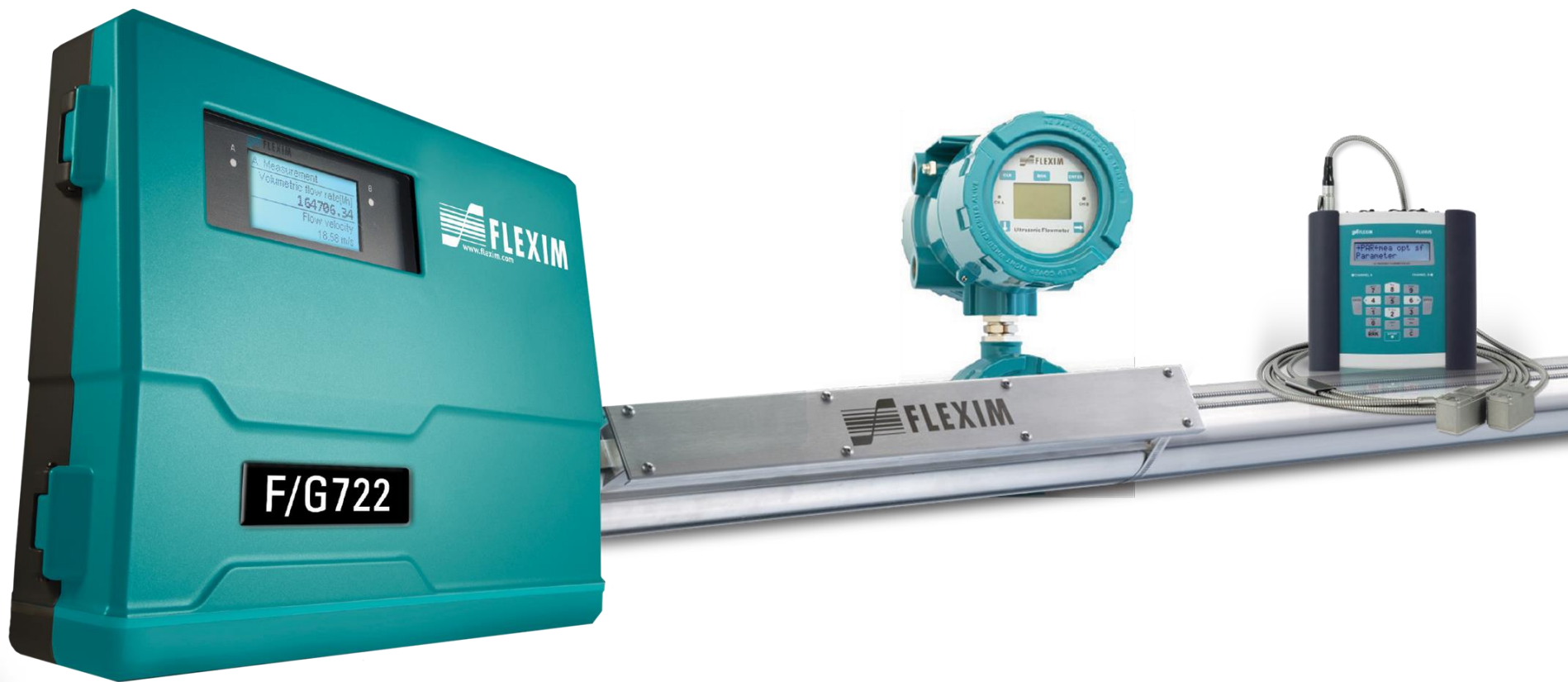
12" - 256"



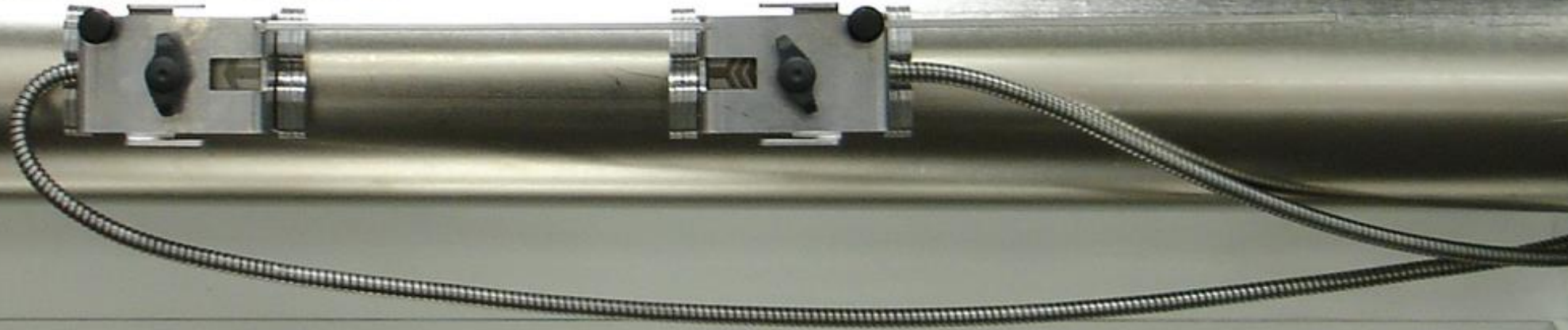
Programming Parameters

- **Outer Diameter of Pipe**
 - **Wall Thickness**
 - **Pipe Material**
 - **Lining (no/yes, type/size)**
 - **Medium (Water)**
 - **Temperature**
 - **Sound Path (2/reflect mode)**
 - **Meter provides transducer separation distance**
- 

Same Process for Permanent or Portable



Portable

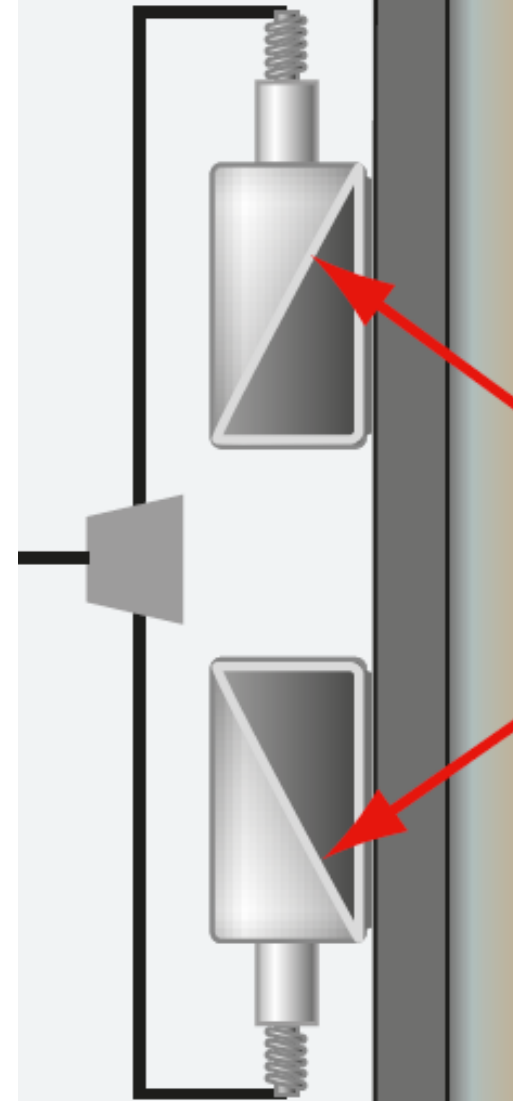


Permanent

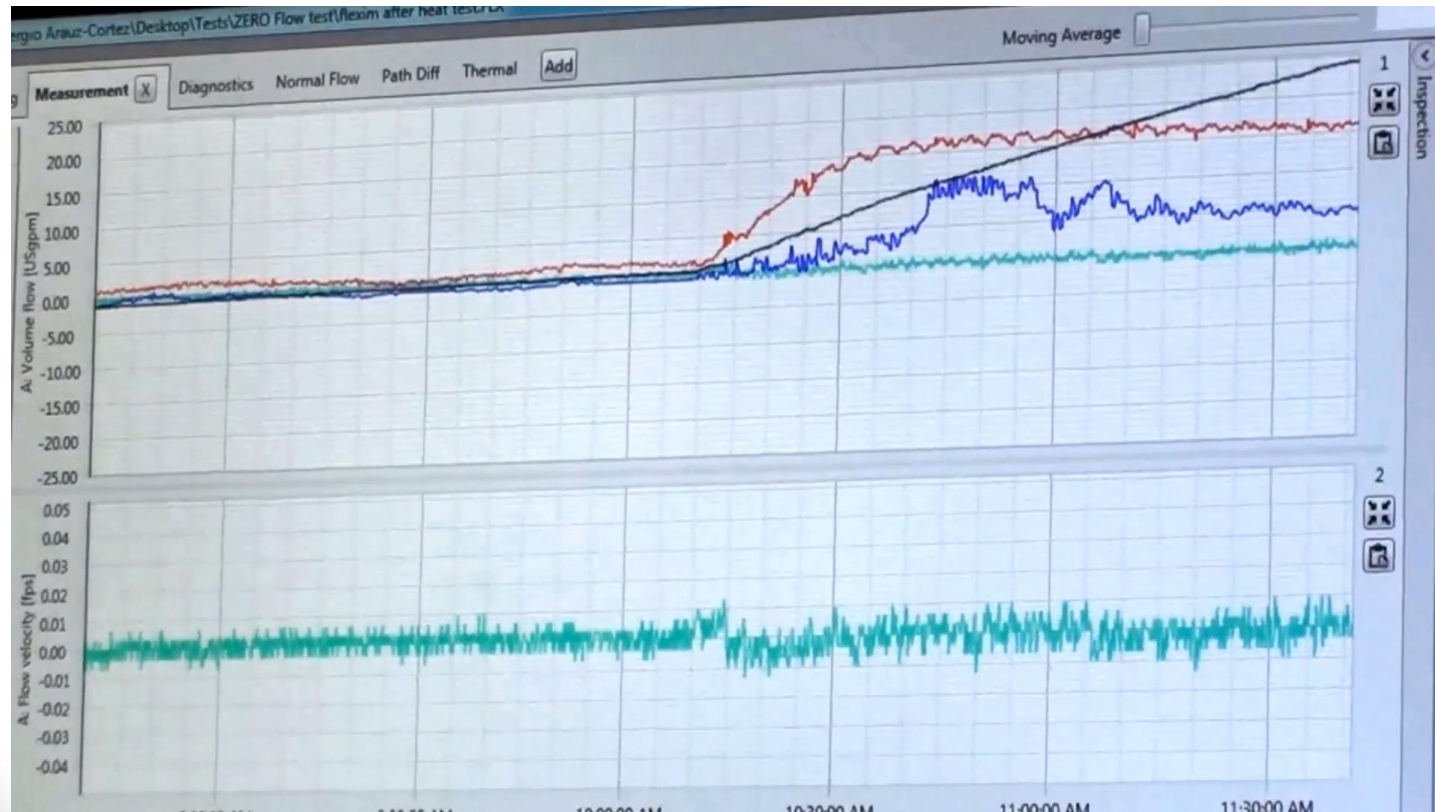


Transducers – Temp Compensation

- **Embedded RTD's**
- **Eliminates Needed Adjustments**
- **Eliminates Meter Drift**

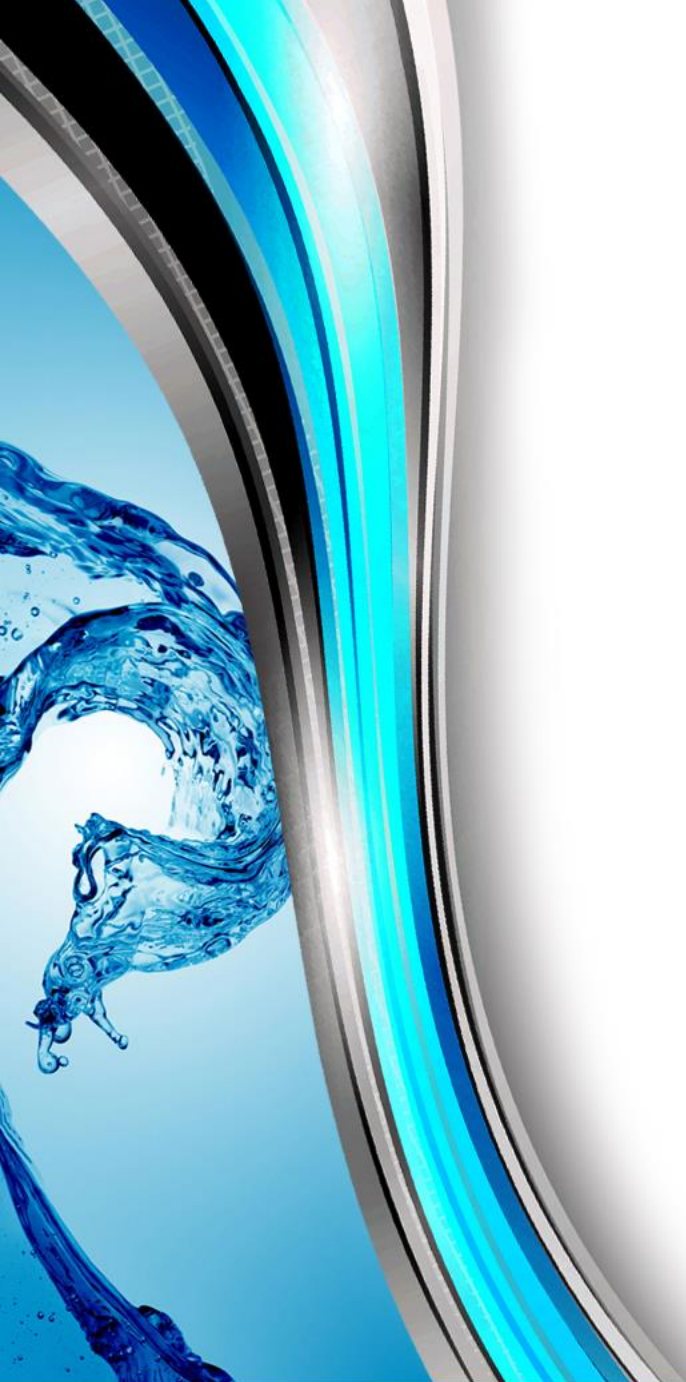


Flexim Eliminates “Drift” During Temperature Changes



Transducers – Coupling

- **Rubber Coupling Pad**
- **No Re-greasing of Sensors**
- **Truly Permanent**
- **Maintenance Free**



Transducers – Construction

- **Sealed Potted Cable Connections**
- **Stainless Steel Armored Cables**
- **Eliminates Corrosion or Failure**
- **IP68 Available for Full Submersion**





Transducers – Mounting

- **Rugged Permalok Mounting Track**
- **Protects Sensor**
- **Eliminates Movement**



*** Average Competitor Meter**







***TECHNOLOGY &
INNOVATION***

New Aperture Calibration

Calibration Certificate

Device under test (DUT) Certificate No. 20200910-009

Transducer CDM2N52 Ser. No. 110996 End User Name
Address, City, State, Zip Code

Reflector distance [inch] 7.92 Fluid Temperature Water 71.108 °F

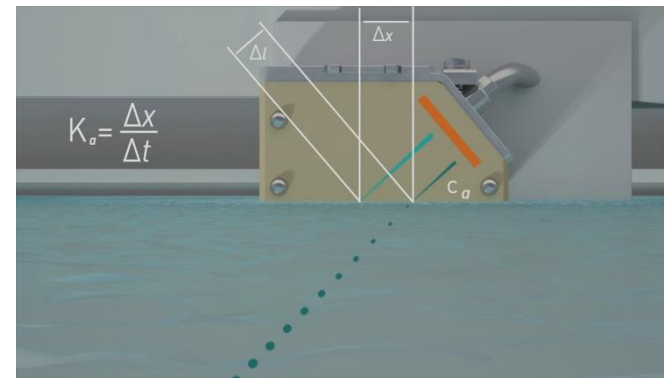
Test results

| | | | | | |
|---------------------|--------------------|---------|----|---|--------|
| Transducer Constant | Mean value | 4070.96 | mk | ± | 0.15% |
| | standard deviation | 0.013% | | | Passed |

The software interface displays a graph of pressure (mk) versus distance (inch) with a red data series and a black trend line. Below the graph, a table lists calibration results for various distances (20.0, 20.5, 21.0, 21.5, 22.0, 22.5, 23.0, 23.5, 24.0, 24.5, 25.0, 25.5, 26.0, 26.5, 27.0, 27.5, 28.0, 28.5, 29.0, 29.5, 30.0, 30.5, 31.0, 31.5, 32.0, 32.5, 33.0, 33.5, 34.0, 34.5, 35.0, 35.5, 36.0, 36.5, 37.0, 37.5, 38.0, 38.5, 39.0, 39.5, 40.0, 40.5, 41.0, 41.5, 42.0, 42.5, 43.0, 43.5, 44.0, 44.5, 45.0, 45.5, 46.0, 46.5, 47.0, 47.5, 48.0, 48.5, 49.0, 49.5, 50.0, 50.5, 51.0, 51.5, 52.0, 52.5, 53.0, 53.5, 54.0, 54.5, 55.0, 55.5, 56.0, 56.5, 57.0, 57.5, 58.0, 58.5, 59.0, 59.5, 60.0, 60.5, 61.0, 61.5, 62.0, 62.5, 63.0, 63.5, 64.0, 64.5, 65.0, 65.5, 66.0, 66.5, 67.0, 67.5, 68.0, 68.5, 69.0, 69.5, 70.0, 70.5, 71.0, 71.5, 72.0, 72.5, 73.0, 73.5, 74.0, 74.5, 75.0, 75.5, 76.0, 76.5, 77.0, 77.5, 78.0, 78.5, 79.0, 79.5, 80.0, 80.5, 81.0, 81.5, 82.0, 82.5, 83.0, 83.5, 84.0, 84.5, 85.0, 85.5, 86.0, 86.5, 87.0, 87.5, 88.0, 88.5, 89.0, 89.5, 90.0, 90.5, 91.0, 91.5, 92.0, 92.5, 93.0, 93.5, 94.0, 94.5, 95.0, 95.5, 96.0, 96.5, 97.0, 97.5, 98.0, 98.5, 99.0, 99.5, 100.0). A large green 'Calibration PASSED' message is displayed at the bottom of the interface.

Two metal transducer units are shown at the bottom, connected by a cable. The units are rectangular with a circular port on the side and a cable connector on the top.

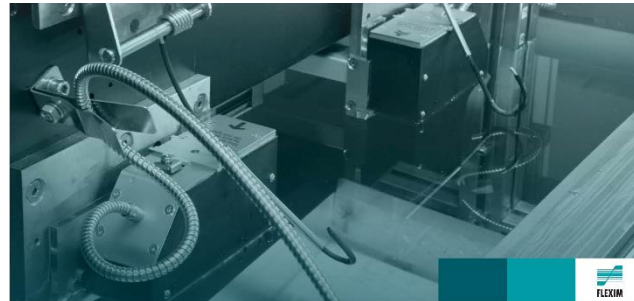
Acoustic Calibration Factor



- **Transducers Positioned at Surface of Water Basin with Reflector**
- **Measured Independently (without influence) from Pipe and Flow Profile Uncertainties**

Aperture Calibration Technology

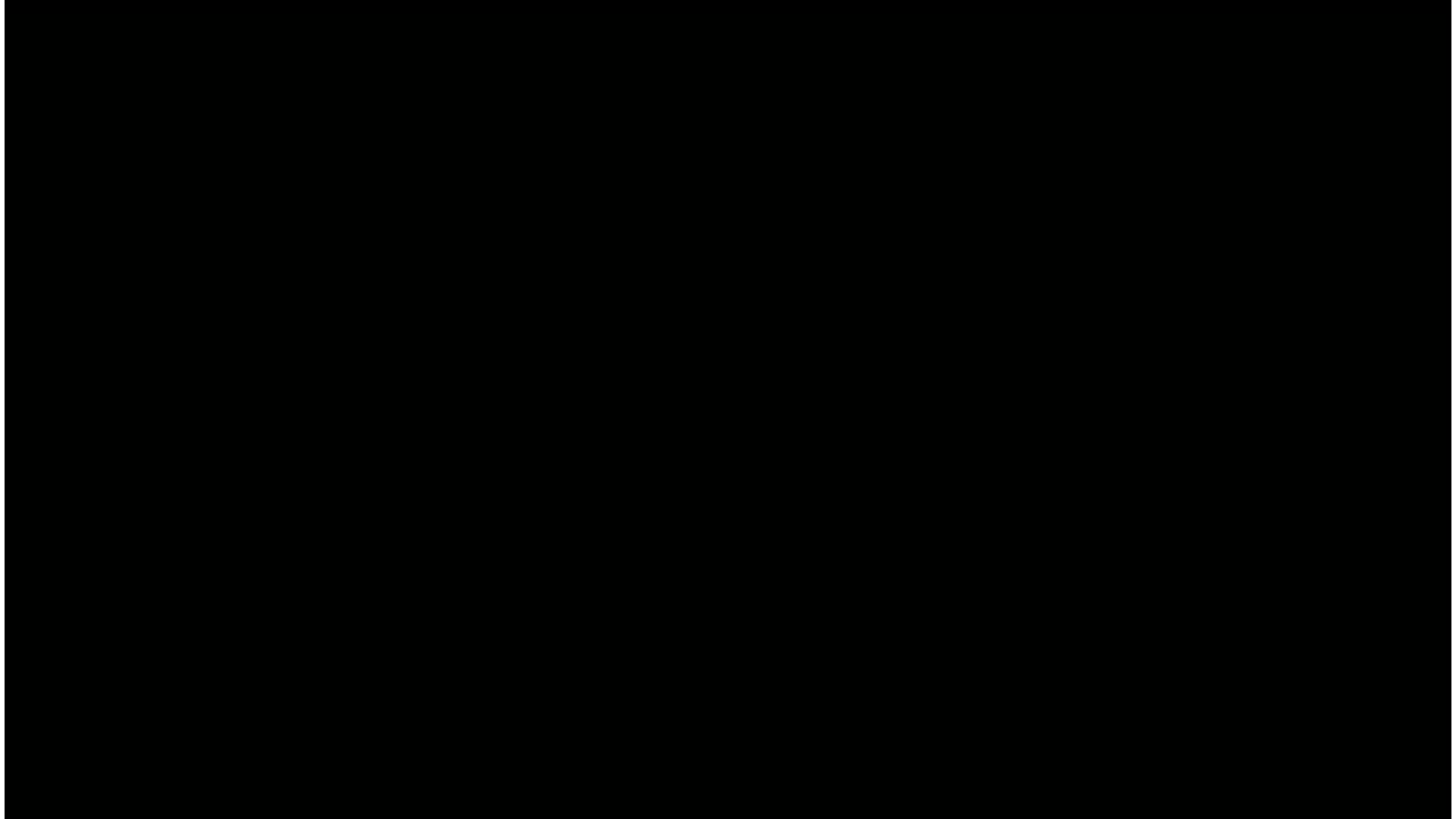
- **Patented Technology**
- **More Accurate than Conventional Wet Flow Calibration**
- **Independent from Pipe Geometry, Flow Profile, and Time Measurement**
- **One Transducer at Fixed Position, Second Transducer Displaceable**



Aperture Calibration Technology

- **Animated Video**
- **Illustrating Wet Flow Calibration Process**
- **Illustrating New Aperture Calibration Process**





Traditional Calibration Certificate



Calibration Certificate

Device under test (DUT) 1 Certificate No.: (US) 20150722-004

Transducer: CDP1N27 Ser. No.: 57780

Transmitter: Flexim F601 Ser. No.: 06011644

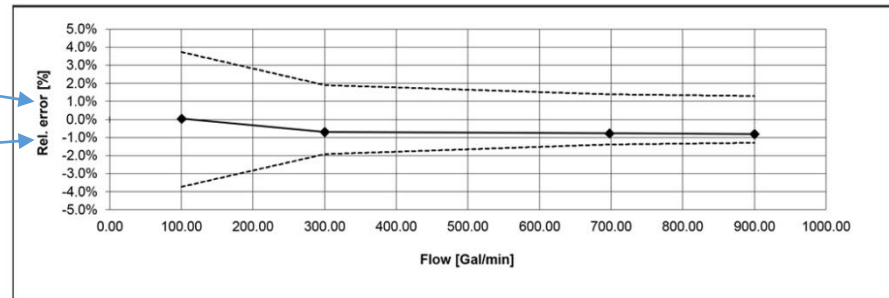
Pipe ID [inch]: 6.11 Fluid: Water Temperature: 75.6 °F

Range[Gal/min]: 900 Spec. Accuracy: 1.0% of rate Offset Allowance: ±0.03 ft/s

Customer Name & Address:
 Gerdau Long Steel North America
 PO Box 468
 Calvert City, KY 42029

Test results

| Meas. Point | Meas. Time s | Standard | DUT | measurement error | | Limit | Standard | pass/ fail |
|-------------|-----------------|---------------------------|---------------------------|--------------------------------|-------------------------------|----------------------------|-----------------------|---------------|
| | | Flowrate Qn Gal/min | Flowrate Qp Gal/min | Flowrate (Qp-Qn) Gal/min | Flowrate (Qp-Qn) / Qn % | Flowrate Q Gal/min;% | Velocity v ft/s | |
| 1 | 120 | -0.07 | -0.05 | 0.02 | 0.0Gpm | 2.7Gpm | 0.0 | p |
| 2 | 120 | 100.02 | 100.06 | 0.04 | 0.0% | 3.7% | 1.1 | p |
| 3 | 120 | 299.90 | 297.83 | -2.07 | -0.7% | 1.9% | 3.3 | p |
| 4 | 120 | 697.52 | 692.12 | -5.40 | -0.8% | 1.4% | 7.6 | p |
| 5 | 120 | 899.94 | 892.71 | -7.23 | -0.8% | 1.3% | 9.9 | p |



Aperture Calibration Certificate



Calibration Certificate

Device under test (DUT)

Transducer: CDG1NZ7 Ser. No.: 72771
 Transmitter: Flexim G721 Ser. No.: Master25
 Pipe ID [inch]: 19.72 Fluid: Water Temperature: 66.2 °F

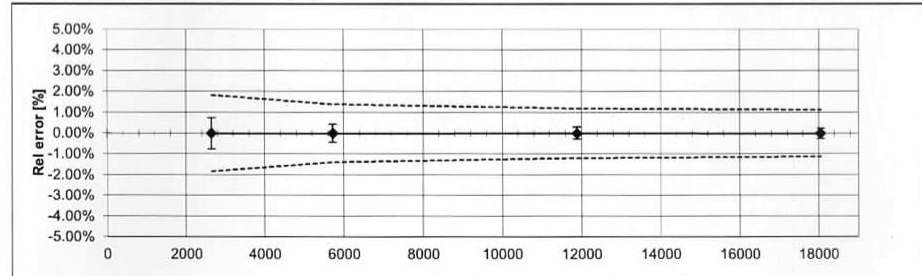
Certificate No.: (US) 20170228-001

Customer Name & Address:
 Chaltron Systems, Inc.
 PO Box 836 Chardon, OH 44024-0836

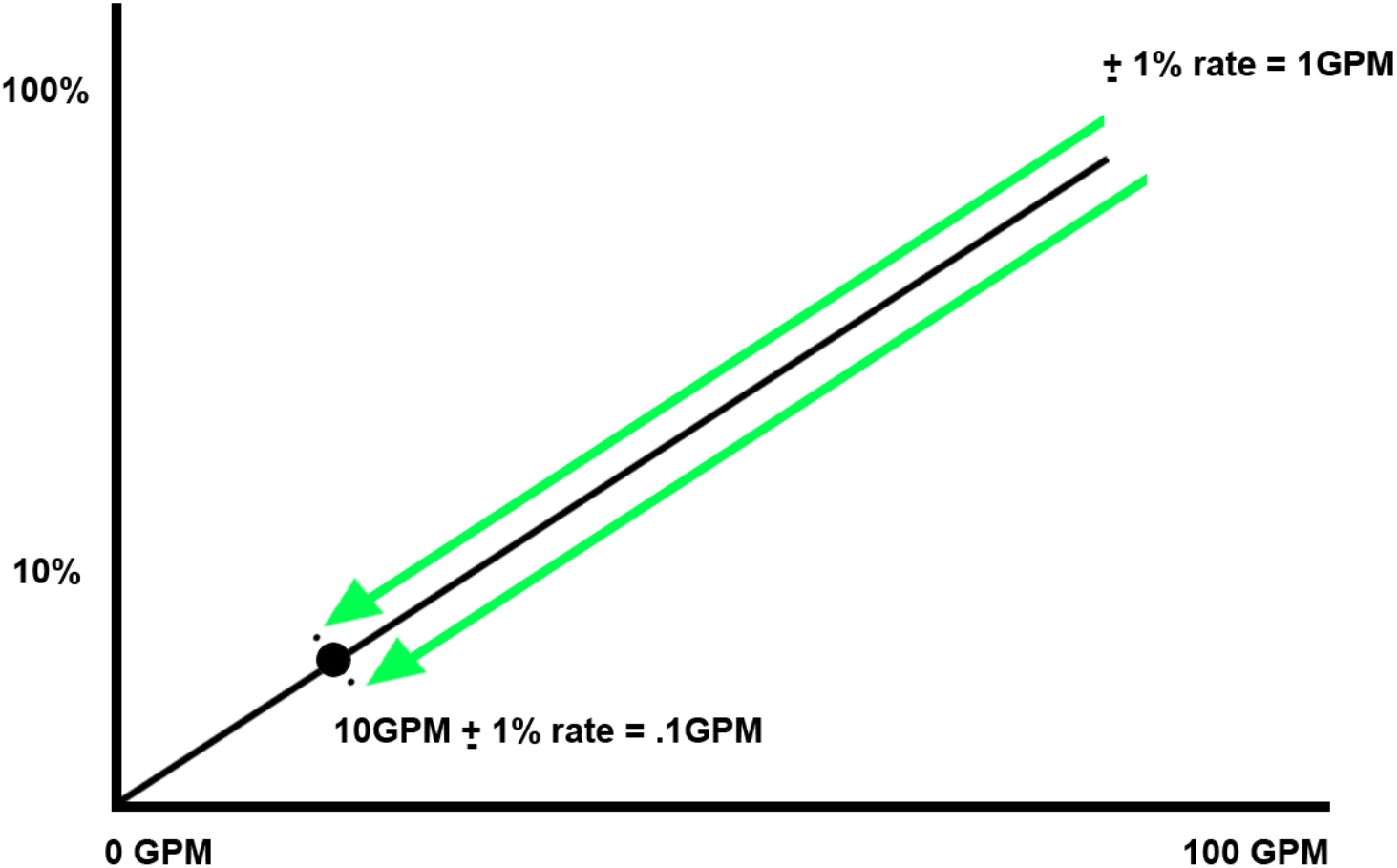
Range [Gal/min]: 31000.00 Spec. Accuracy: 1.0% of rate Offset Allowance: 0.023 ft/s
 Measurement uncertainty (k=2): 0.16% of rate Offset uncertainty: 0.016 ft/s

Test results

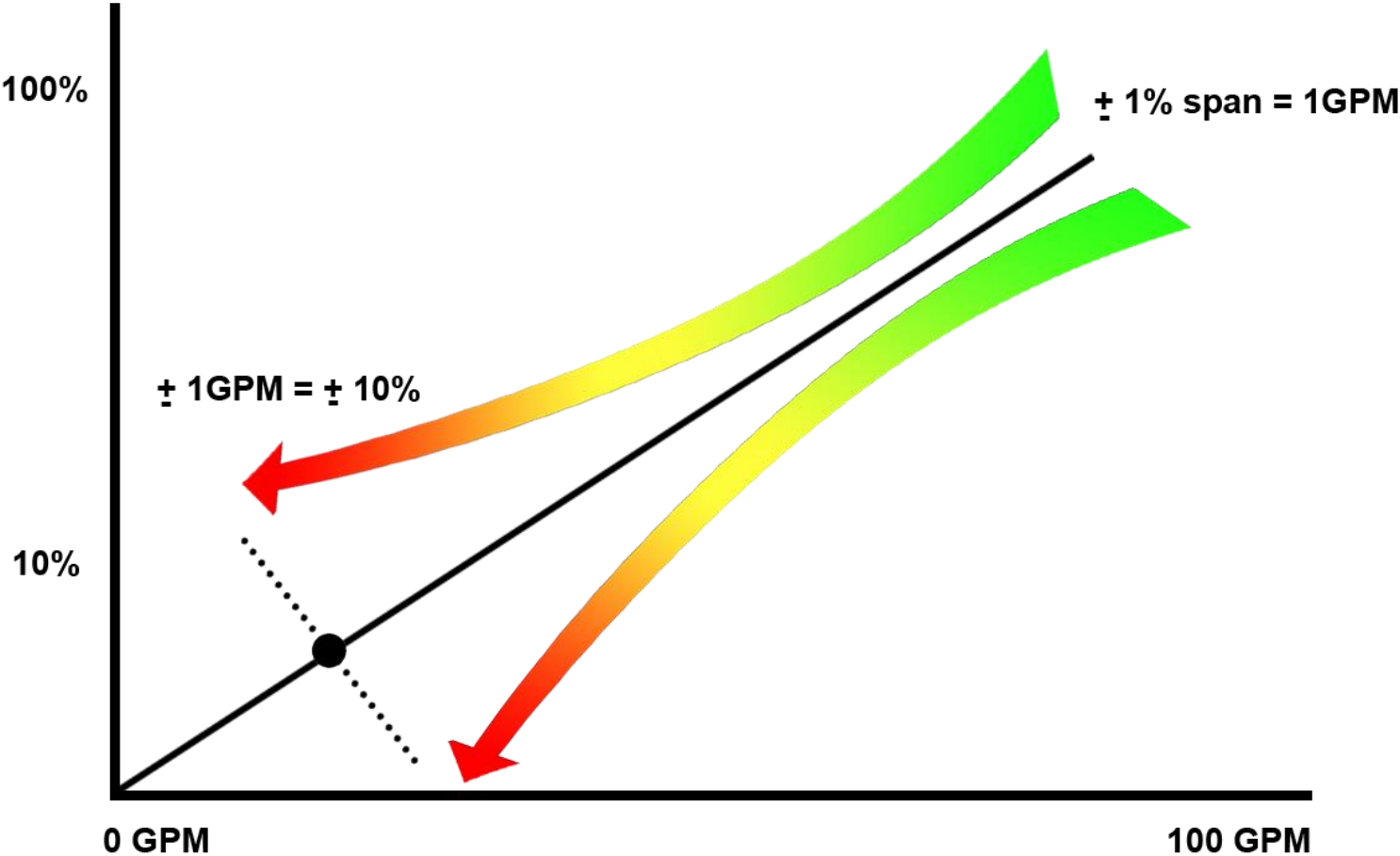
| Meas. Point | Meas. time s | Standard | DUT | measurement error | | Limit | Standard | pass/ fail |
|-------------|-----------------|---------------------------|---------------------------|--------------------------------|-------------------------------|-----------------------------|-----------------------|---------------|
| | | Flowrate Qn Gal/min | Flowrate Qp Gal/min | Flowrate (Qp-Qn) Gal/min | Flowrate (Qp-Qn) / Qn % | Flowrate Q Gal/min; % | Velocity v ft/s | |
| 1 | 20 | 0.00 | 0.75 | 0.75 | - | 21.86Gpm | 0.00 | p |
| 2 | 20 | 2639.85 | 2639.34 | -0.51 | -0.02% | 1.8% | 2.77 | p |
| 3 | 20 | 5720.73 | 5719.94 | -0.79 | -0.01% | 1.4% | 6.01 | p |
| 4 | 20 | 11880.81 | 11880.61 | -0.20 | 0.00% | 1.2% | 12.49 | p |
| 5 | 20 | 18044.86 | 18042.18 | -2.68 | -0.01% | 1.1% | 18.96 | p |



Percent of Rate

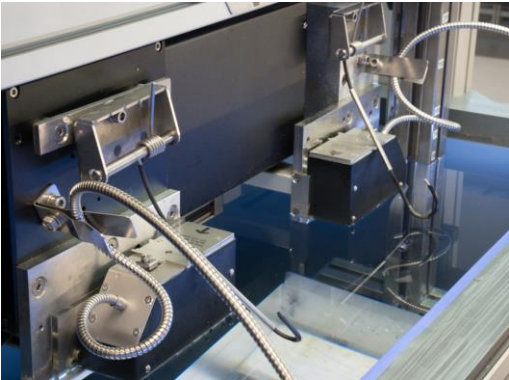


Percent of Span



Aperture Calibration Benefits

- **Direct Time and Direct Distance Calibration**
- **No Pipe = No Pipe Uncertainty**
- **No Flow = No Flow Uncertainty**
- **Final Transducer Calibration Uncertainty Rating: 0.15%**
- **SENSPROM Auto Detection / Calibration Loading**

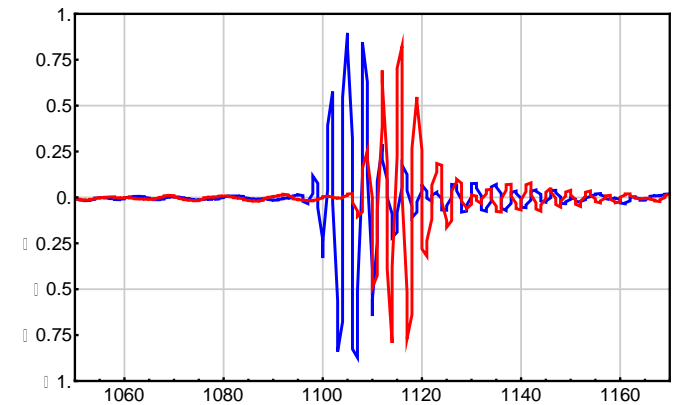
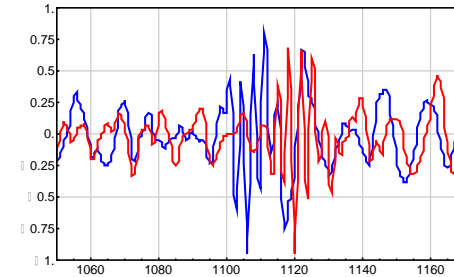


External Labs Traceable to National Standards



New Transmitter – Signal Processing

- **1000 signals per second**
- **Dual Processor**
- **Noise Suppression**
- **Data Recorder**



Transmitter – Diagnostics

Meter Diagnostics

| Quantity | Unit | A |
|----------------|------|--------|
| SCNR | dB | 39.11 |
| SNR | dB | 36.89 |
| Gain | dB | 64.41 |
| Amplitude | % | 56.18% |
| Quality | % | 99.07% |
| Vari.time | % | 0.00% |
| Vari.amplitude | % | 0.00% |
| Sound speed | m/s | 1447.6 |
| Flow velocity | fps | 0.74 |



Transmitter – Sound Speed

| Sonic Velocity Relative to Temperature of Pure Water | | | | | | | | |
|--|-------|----------|-------------|------|----------|-----|-------|--------|
| Temperature | | Velocity | Temperature | | Velocity | | | |
| °F | °C | M/S | °F | °C | M/S | | | |
| 0 | -17.8 | 1292.5 | 100 | 37.8 | 1525.0 | 200 | 93.3 | 1548.4 |
| 2 | -16.7 | 1300.6 | 102 | 38.9 | 1527.0 | 202 | 94.4 | 1547.6 |
| 4 | -15.6 | 1308.6 | 104 | 40.0 | 1528.9 | 204 | 95.6 | 1546.8 |
| 6 | -14.4 | 1316.4 | 106 | 41.1 | 1530.7 | 206 | 96.7 | 1547.6 |
| 8 | -13.3 | 1324.1 | 108 | 42.2 | 1532.4 | 208 | 97.8 | 1545.0 |
| 10 | -12.2 | 1331.5 | 110 | 43.3 | 1534.1 | 210 | 98.9 | 1544.1 |
| 12 | -11.0 | 1338.8 | 112 | 44.4 | 1535.6 | 212 | 100.0 | 1543.1 |
| 14 | -10.0 | 1345.9 | 114 | 45.6 | 1537.2 | 214 | 101.1 | 1542.1 |
| 16 | -8.9 | 1352.8 | 116 | 46.7 | 1538.6 | 216 | 102.2 | 1541.1 |
| 18 | -7.8 | 1359.5 | 118 | 47.8 | 1540.0 | 218 | 103.3 | 1540.0 |
| 20 | -6.7 | 1366.1 | 120 | 48.9 | 1541.3 | 220 | 104.4 | 1538.9 |
| 22 | -5.6 | 1372.6 | 122 | 50.0 | 1542.6 | 222 | 105.6 | 1537.7 |
| 24 | -4.4 | 1378.8 | 124 | 51.1 | 1543.7 | 224 | 106.7 | 1536.5 |
| 26 | -3.3 | 1384.9 | 126 | 52.2 | 1544.9 | 226 | 107.8 | 1535.3 |
| 28 | -2.2 | 1390.9 | 128 | 53.3 | 1545.9 | 228 | 108.9 | 1534.0 |
| 30 | -1.1 | 1396.7 | 130 | 54.4 | 1546.9 | 230 | 110.0 | 1532.7 |
| 32 | 0.0 | 1402.4 | 132 | 55.6 | 1547.8 | 232 | 111.1 | 1531.4 |
| 34 | 1.1 | 1407.9 | 134 | 56.7 | 1548.7 | 234 | 112.2 | 1530.1 |
| 36 | 2.2 | 1413.3 | 136 | 57.8 | 1549.5 | 236 | 113.3 | 1528.7 |
| 38 | 3.3 | 1418.6 | 138 | 58.9 | 1550.3 | 238 | 114.4 | 1527.3 |
| 40 | 4.4 | 1423.7 | 140 | 60.0 | 1551.0 | 240 | 115.6 | 1525.8 |
| 42 | 5.6 | 1428.6 | 142 | 61.1 | 1551.6 | 242 | 116.7 | 1524.3 |
| 44 | 6.7 | 1433.5 | 144 | 62.2 | 1552.2 | 244 | 117.8 | 1522.8 |
| 46 | 7.8 | 1438.2 | 146 | 63.3 | 1552.7 | 246 | 118.9 | 1521.3 |
| 48 | 8.9 | 1442.8 | 148 | 64.4 | 1553.2 | 248 | 120.0 | 1519.7 |
| 50 | 10.0 | 1447.3 | 150 | 65.6 | 1553.6 | 250 | 121.1 | 1518.1 |
| 52 | 11.1 | 1451.6 | 152 | 66.7 | 1554.0 | 260 | 126.7 | 1507.0 |
| 54 | 12.2 | 1455.9 | 154 | 67.8 | 1554.3 | 270 | 132.2 | 1497.0 |
| 56 | 13.3 | 1460.0 | 156 | 68.9 | 1554.6 | 280 | 137.8 | 1487.0 |
| 58 | 14.4 | 1464.0 | 158 | 70.0 | 1554.8 | 290 | 143.3 | 1476.0 |
| 60 | 15.6 | 1467.9 | 160 | 71.1 | 1555.0 | 300 | 148.9 | 1465.0 |
| 62 | 16.7 | 1471.6 | 162 | 72.2 | 1555.1 | 310 | 154.4 | 1453.0 |
| 64 | 17.9 | 1475.3 | 164 | 73.3 | 1555.1 | 320 | 160.0 | 1440.0 |
| 66 | 18.9 | 1478.9 | 166 | 74.4 | 1555.2 | 330 | 165.6 | 1426.0 |
| 68 | 20.0 | 1482.3 | 168 | 75.6 | 1555.1 | 340 | 171.1 | 1412.0 |
| 70 | 21.1 | 1485.7 | 170 | 76.7 | 1555.0 | 350 | 176.7 | 1398.0 |
| 72 | 22.2 | 1489.0 | 172 | 77.8 | 1554.9 | 360 | 182.2 | 1383.0 |
| 74 | 23.3 | 1492.1 | 174 | 78.9 | 1554.7 | 370 | 187.8 | 1368.0 |
| 76 | 24.4 | 1495.2 | 176 | 80.0 | 1554.5 | 380 | 193.3 | 1353.0 |
| 78 | 25.6 | 1498.2 | 178 | 81.1 | 1554.2 | 390 | 198.9 | 1337.0 |
| 80 | 26.7 | 1501.0 | 180 | 82.2 | 1553.9 | 400 | 204.4 | 1320.0 |
| 82 | 27.8 | 1503.8 | 182 | 83.3 | 1553.6 | 410 | 210.0 | 1302.0 |
| 84 | 28.9 | 1506.5 | 184 | 84.4 | 1553.1 | 420 | 215.6 | 1283.0 |
| 86 | 30.0 | 1509.1 | 186 | 85.6 | 1552.7 | 430 | 221.1 | 1264.0 |
| 88 | 31.1 | 1511.7 | 188 | 86.7 | 1552.2 | 440 | 226.7 | 1244.0 |
| 90 | 32.2 | 1514.1 | 190 | 87.8 | 1551.7 | 450 | 232.2 | 1220.0 |
| 92 | 33.3 | 1516.4 | 192 | 88.9 | 1551.1 | 460 | 237.8 | 1200.0 |
| 94 | 34.4 | 1518.7 | 194 | 90.0 | 1550.5 | 470 | 243.3 | 1180.0 |
| 96 | 35.6 | 1520.9 | 196 | 91.1 | 1549.8 | 480 | 248.9 | 1160.0 |
| 98 | 36.7 | 1523.0 | 198 | 92.2 | 1549.1 | 490 | 254.4 | 1140.0 |

1447 = 50F





What is Turndown Ratio?

“Ratio of maximum value measured to the minimum value that can be measured.”

Example: 100 GPM Maximum

5 GPM Minimum

Turndown = 20:1

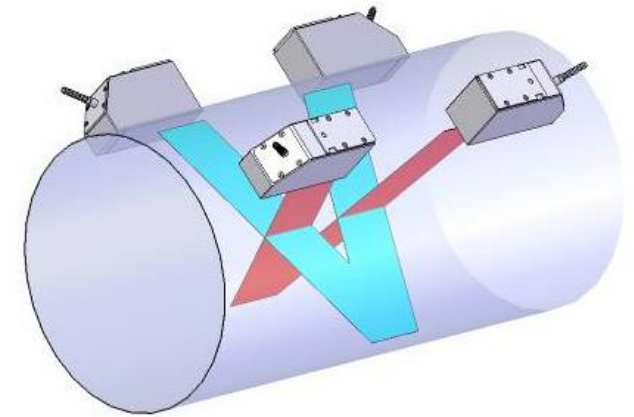
Unlimited Turndown Ratio

- **Low and High flows:**
- **Velocities 0.01 ft/sec to 200ft/sec**



Transmitter – Dual Beam

- **Dual Channel Transmitter (2) Sensor Sets**
- **$(A+B)/2$**
- **For Large Line Sizes / Short Straight Run**
- **Two Independent Flow Profiles**

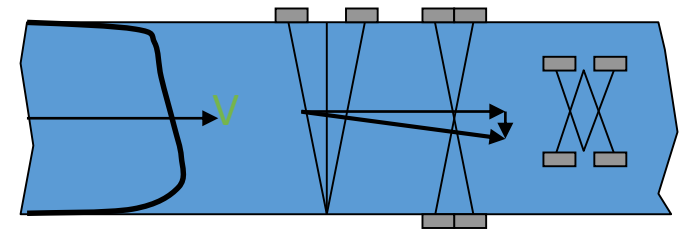
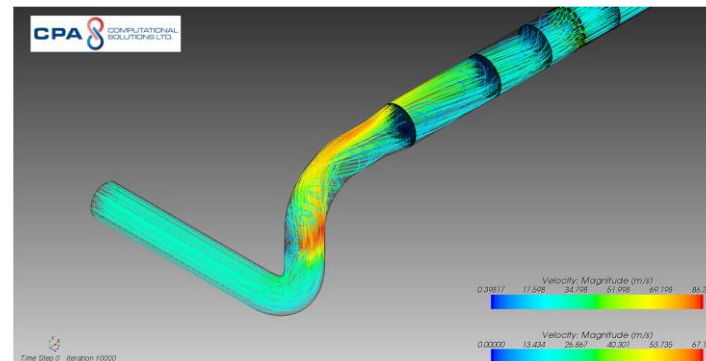


Flow Disturbance Correction



Profile Correction for Pipe Disturbances

- **Based on Fluid Modeling**
- **Extensive Testing and Data Analysis**
- **Correction Based on the Distance to the Disturbance**
- **Proven by Independent Flow Labs in Germany and USA**



Continued Testing at PTB Labs – Germany



Continued Testing at ALDEN Labs - USA



Advanced Meter Verification



 Advanced Meter
Verification



Advanced Meter Verification

- **Health Check of Meter Operation and Diagnostics**
- **Based on Data, Maintenance can be Planned, and Unexpected Failures can be Avoided**
- **Report Provides the Documentation Required for Your Quality Management System**
- **Documentation compliant with ISO9001:2015**



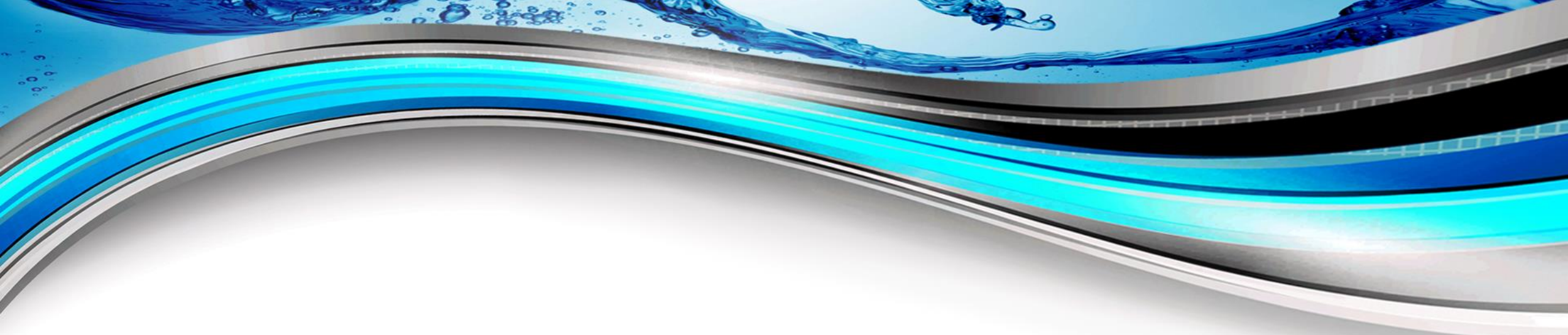
Recap on Ultrasonic Capabilities

- **0.25” Tubing to 256” Hydro Power Plant Lines**
- **Parameters for all Pipe Materials and Walls**
- **Heavy Duty Construction of Equipment**
- **Unlimited Turndown Ratio – Low and High Flows:
(Velocities 0.01 ft/sec to 200ft/sec)**
- **Cost Effective**
- **No Process Shutdown for Installation**
- **Reduced Time and Labor for Installation**



Recap on Ultrasonic Technology

- **Family of Transducers for Proper Line Sizing**
- **New, More Accurate Aperture Calibration**
- **NIST Traceable Certificate of Calibration**
- **SENSPROM Auto Detection / Calibration Loading**
- **Permanent Coupling with Rubber Pad**
- **Built in RTD Temperature Compensation**
- **Full set of Diagnostics, Now with AMV**
- **Dual Processor Transmitter, Dual Channel Capable**
- **Advanced Noise Reduction and Signal Processing**
- **Disturbance Correction: Short Run Capabilities**



Water Loss Prevention



Water Loss Prevention

- **Trends in the Water and Waste Water Industries**
- **Current and Common Situations**
- **Addressing Issues with Ultrasonic Metering**



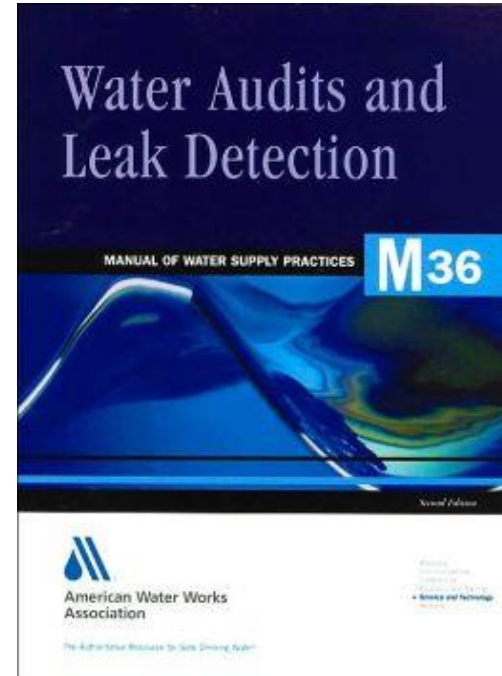
Pressure to Reduce Water Loss

- **Municipalities with High Loss Rates are Regarded as Poorly Managed**
- **Strong Focus on Lowering Water Loss Rates and Increasing Revenue Across all Municipalities**
- **EPA Direction to Lower Water Loss**
- **More Precise Monitoring of Utilities Needed**



AWWA Water Audit Manual

- **M36 – Manual for Water Resource Management**
- **Key Activity: Metering the Water**
- **Begin to View Water not as an Abundance, but as a Revenue Stream**



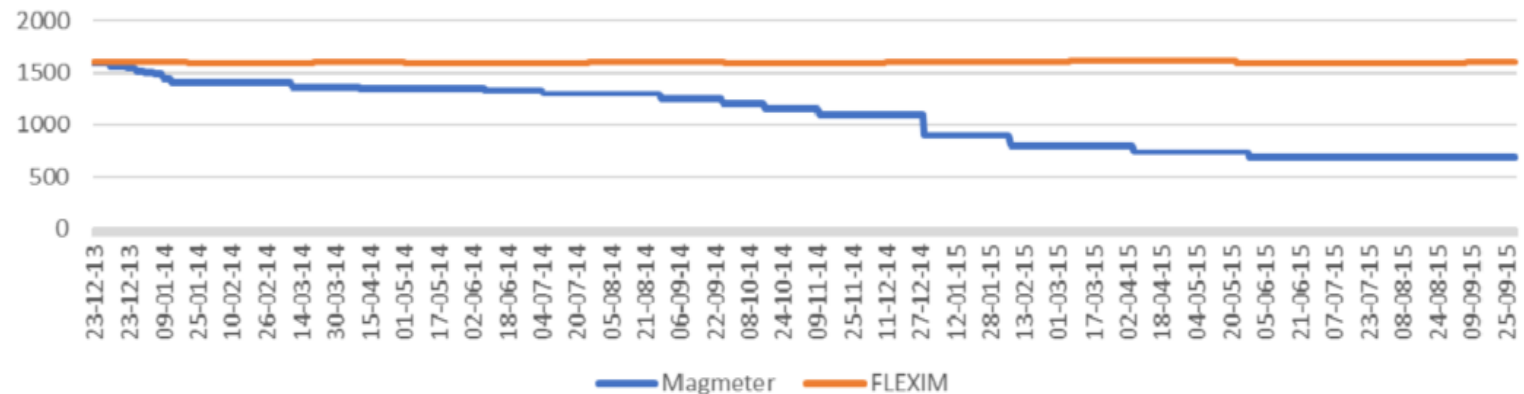
Direct Benefits of Controlling Your Water Loss

- **Management:** Limiting Wasteful or Unnecessary Source Water Withdrawals
- **Financial:** Optimizing Revenue Recovery and Promoting Equity Among Rate Payers
- **Operational:** Minimizing Distribution Disruptions and Optimizing Supply Efficiency



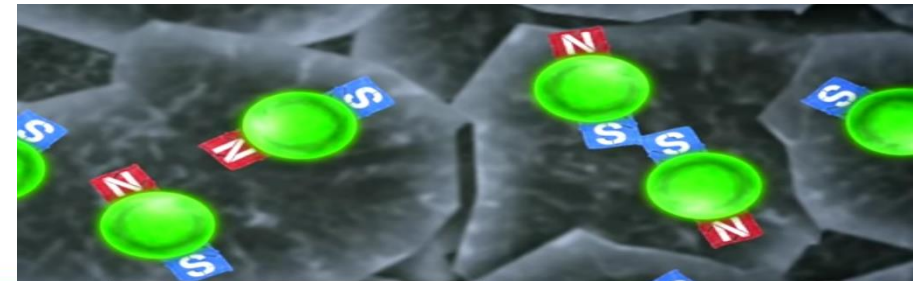
Current and Common Metering

- **Magnetic Flow Meter**
- **Injecting Chemicals and Specific Minerals in the Water has Unintended Consequences**
- **Overtime the Coating of Electrodes will Render the Flow Meter Unreliable**



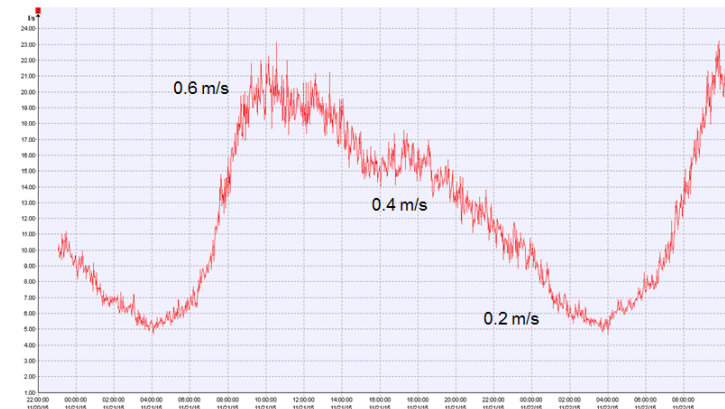
Current and Common Metering

- **Magnetic Flow Meter**
- **Periodic Cleaning of Electrodes Requires the Meter to be Removed from the Line and Physically Cleaned**
- **Does not Typically Happen**



Current and Common Metering

- **Low Flows – Who Cares about 0.03 – 1.0 FPS?**
- **Outside of the Accuracy Range of Most Other Meter Technologies**
- **Time to Start Metering all Flows, Including Minimum Nightly Operational Flows**





***How Chaltron Systems, Inc.
Can Help***



Flow Testing with Portable Meter

- **F601 Dual Channel Standard Portable**
- **Lightweight, Handheld, Battery Powered**
- **Accurate Measurement**
- **Set up in 5-10 minutes**
- **Internal Data Logging**
- **Report Generating Software**



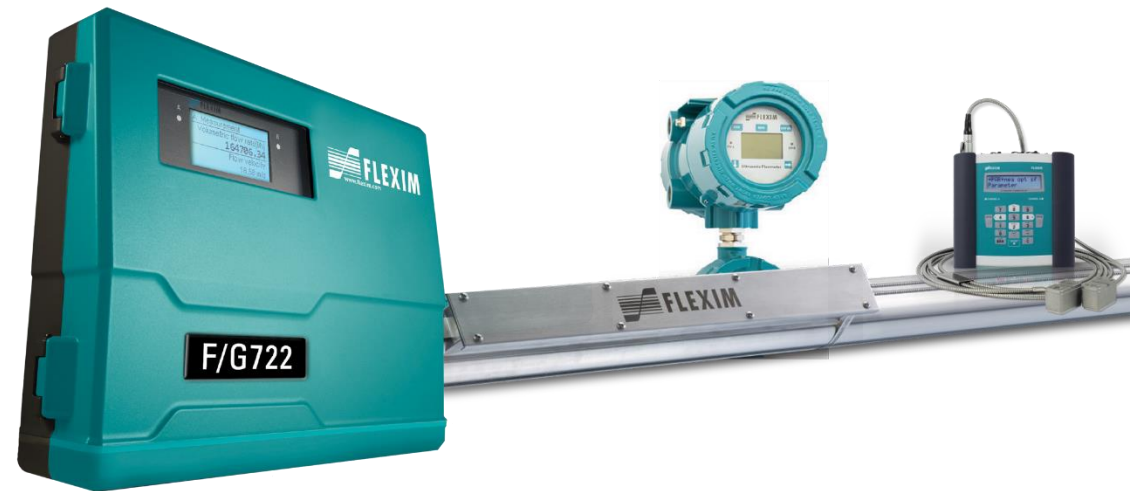
Flow Meter Rental

- **Rent for 1 Week or Multiple Weeks**
- **10 Meters Available (More if Needed Through Flexim)**
- **Chaltron Delivery, Set Up, Install and Removal**
- **Continuous Data Recording**
- **Report Generation**



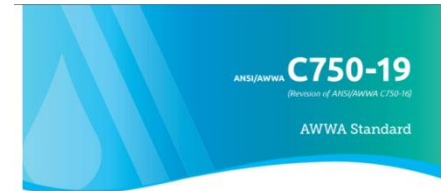
Retrofit Failed Meters

- **F721 Single Channel or Dual Channel Transmitter**
- **Highly Customizable**
- **4-20ma, HART, Modbus Communication**
- **Non-intrusive**
- **No Shutdown Installation**
- **Maintenance Free**



FLEXIM COMPLIANCE WITH AWWA C750-10

- **Compliant with all Standards for Transit Time Meter**
- **Performance**
- **Accuracy**
- **Linearity**
- **Repeatability**
- **Rangeability**
- **Verification / Calibration of Meter**
- **NIST Traceability**



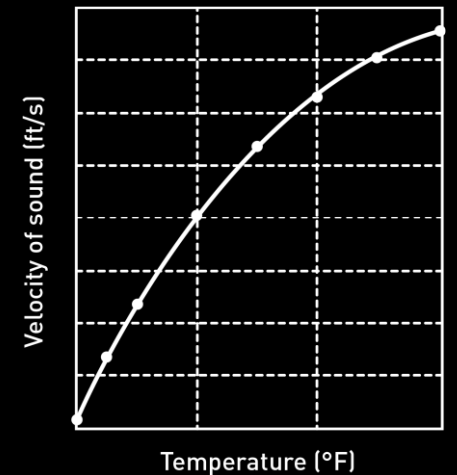
Transit-Time
Flowmeters in Full
Closed Conduits

Effective date: March 1, 2020.
This edition approved by Board of Directors June 19, 2020.
This edition approved Oct. 28, 2019.
Approved by American National Standards Institute Sept. 9, 2019.

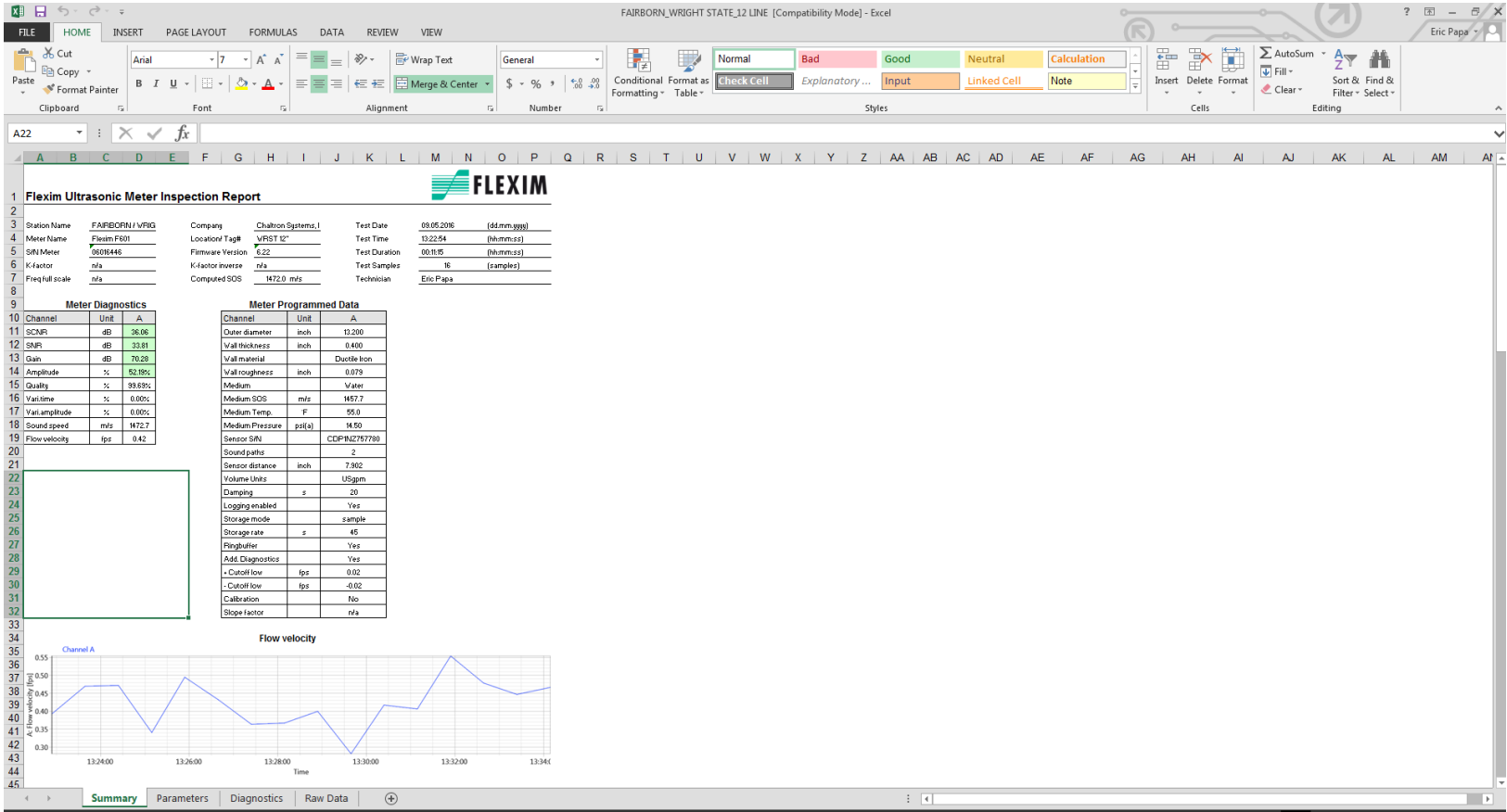


Now Providing Temperature Measurement

- **Water Temperature Calculated Through Speed of Sound Measurement**



Sample Flexim Data Report





LOCAL APPLICATIONS





Water Treatment Plant in Ohio with Magnetic Flow Meter

- **Domestic Water 12" Line**
- **City utility water supply to University**
- **Common use: Blending, Optional use: Total Supply**
- **Common use = 100 GPM (.30 ft/sec)**
- **Below minimum capability of existing magnetic flow meter**
- **Installation of ultrasonic meter measures as low as .01 ft/sec (3.50 GPM)**

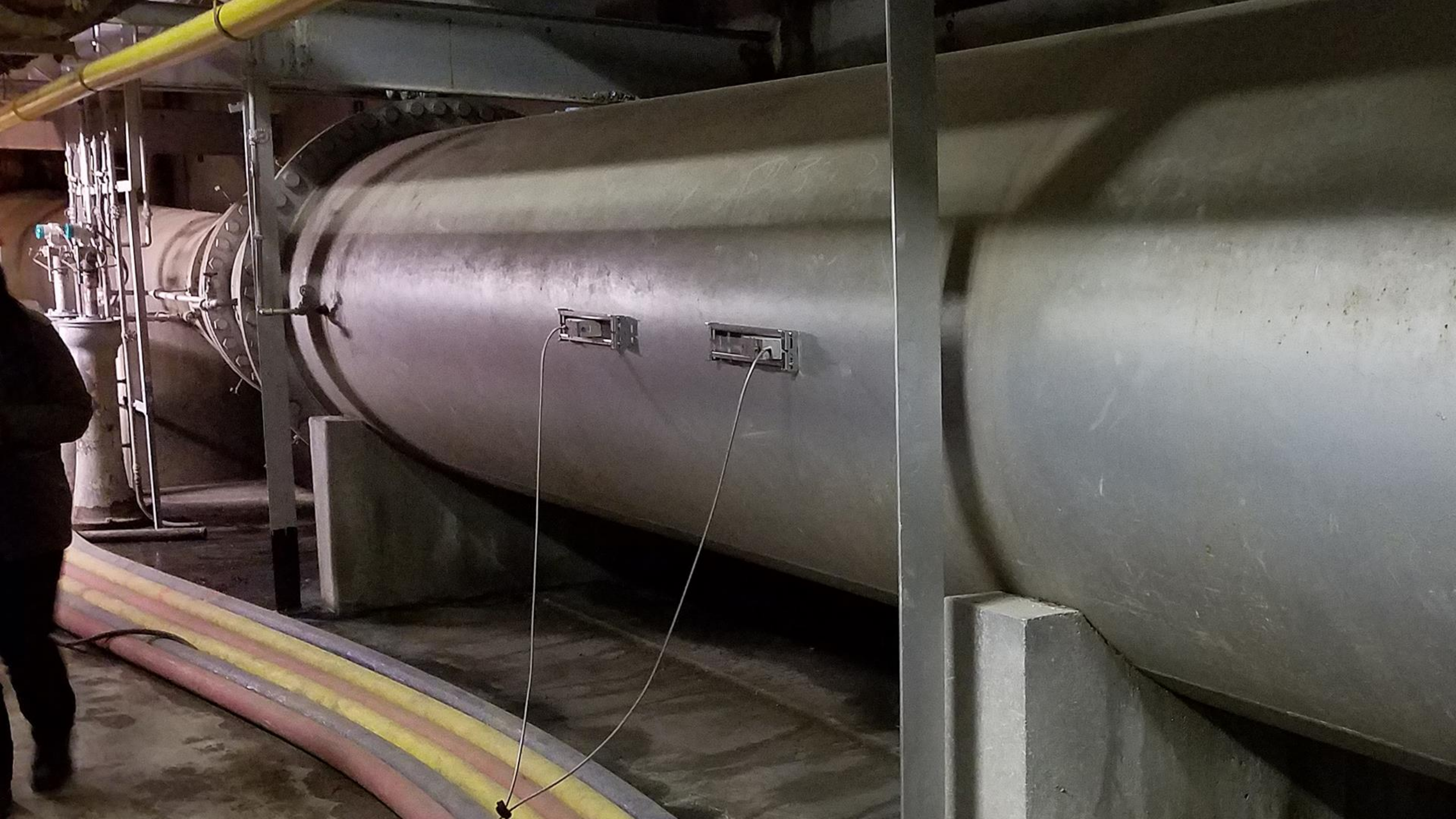


Water Treatment Plant in Ohio

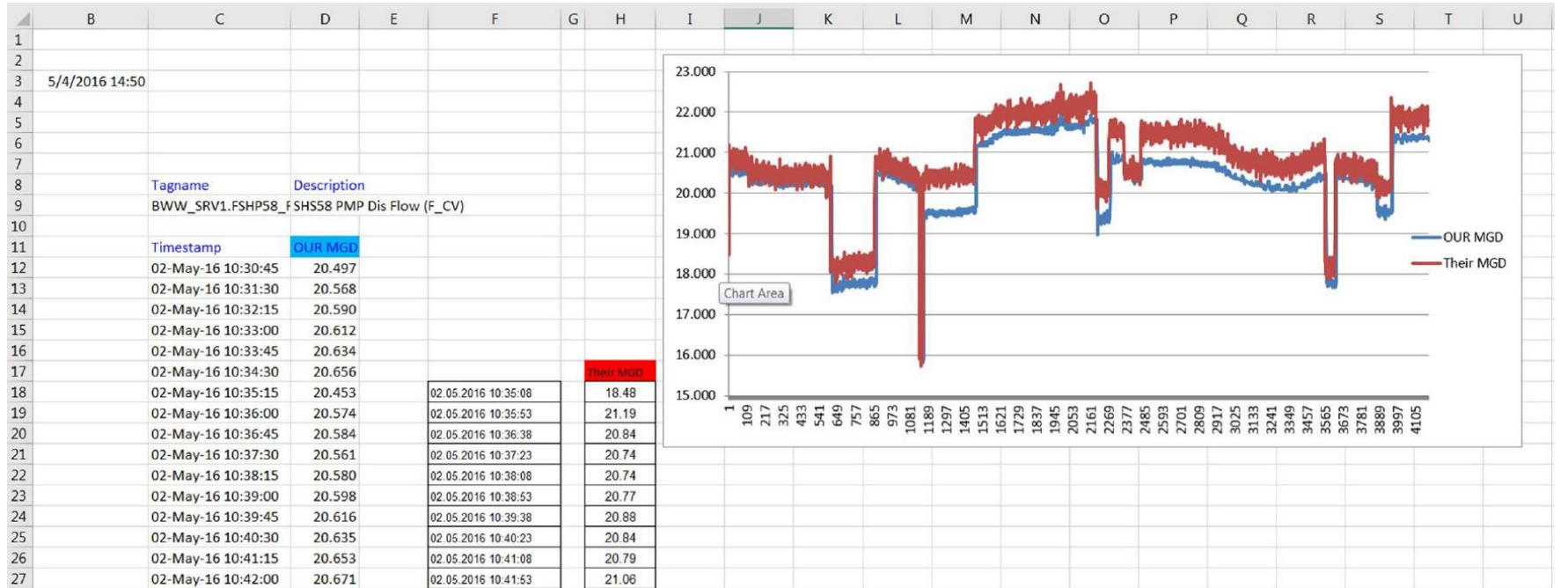
- **Loss of revenue \$600.00/Day**

\$18,000.00/month

Turndown allowing for measurement of extremely low flow rates is important.



Venturi Retrofit





Venturi / Ultrasonic Comparison

- **At 20 MGD the Venturi is +/- 1% to 2%**
- **This would be .2 MGD to .4 MGD**
- **The Differential Pressure Transmitter inaccuracy is .25% to .5%**
- **This would be .05 MGD to .1 MGD**
- **At 20 MGD the Flexim is +/- 1%**
- **This would be .2 MGD**
- **The typical difference between the meters was in the range of 0.38 MGD to 0.20 MGD**



Application - Updating

- **Local Water Plant in Cleveland, Ohio**
- **Multiple 48” Cast Iron Water Lines Dispersing Water to Different Areas of the City**
- **70+ Years Old**
- **60’ Below Ground Level**
- **Worn/Failed Valves**
- **Tight Work Area with Limited Line Access: Direct Mode**
- **Pre-tested with Portable Unit**





Application – New Installations

- **Local Waste Water Plant in Cleveland, Ohio**
- **94MGD Average 400MGD Capable**
- **300,000 Residents/Businesses**
- **74 Meters on Line Sizes 10” to 48”**
- **Expansion Replacing Venturi Meters (Clogging Issues)**
- **Too much work to clean and meters were disregarded**
- **Dual Channel / Dual Beam Meters for Short Run**

Application – Venturi Replacement



Figure 1: Existing 48" Venturi meter



*Figure 2: 2path - 4beam Ultrasonic
On 48" spool piece*



Additional Highlights

- **Multiple Beam approach to overcome straight run**
- **More consistent, more repeatable than the venturi meters**
- **Non-intrusive: No contact, No shutdown, No pressure loss, (+12 years and counting in operation)**
- **Permanent Coupling vs. Traditional Re-greasing**
- **Consistent, Reliable Data for process control, monitoring and optimization**

- Paul McGuire, Senior Project Engineer, NEORSD



Application – Retrofitting

- **Small Water Plant in Ohio**
- **New Magnetic Flowmeter in Pit**
- **Improper installation and cable extending**
- **Meter reading -300GPM to 400GPM**
- **Serious Problem: Triggering Alarms, Questionable Water Treatment**
- **Would Require Meter to be Returned to Factory**
- **Large Job for Small Water Plant**

Application – Mag Retrofit



Figure 1: Located in pit



*Figure 2: Submersible M Sensors
Existing meter left in line*



Application – Mag Retrofit

- **Large WWTP in Ohio**
- **New Magnetic Flowmeter for Chemical Feeds**
- **Flow Much Lower (9 -16 GPH)**
- **Meter reading 0**
- **Serious Problem for Monitoring Chemical**
- **Would Require Re-Engineering**
- **Simple Application for Flexim**
- **Existing Meters left in the Line**

Application – Mag Retrofit



Figure 1: Magnetic Flowmeters



Figure 2: Flexim Flowmeters with Q Sensors in Direct Mode

Application – Optimization

- **VAMC - Cleveland, Ohio**
- **1.38 Million SQFT**
- **Over 1,700,000 Outpatient Encounters**
- **Thermal, Domestic Water (Main lines, Makeup water)**
- **51 Meters**



Application - Pump Stations

- **Easy to Outfit Existing and New Stations**
- **4" - 12" Typical Installation, Vertical Down**
- **M Sensors / Ductile Iron Concrete Lined Pipe**
- **Single Channel and Dual Channel Applications**
- **Nanodac Recorder Available**





Application – Pump Station

- **Large Waste Water Plant in Southern Ohio**
- **(4) 3,000 GPM Rated Pumps**
- **18” Ductile Iron Concrete Lined Pipe**
- **Beyond Capability of Low Cost Ultrasonic Meter**
- **Tested and Replaced**

Application – Pump Stations



Figure 1: Low Cost Ultrasonic Reading 0.00 GPM. Advanced Technology Reading 2,960 GPM



Figure 2: 18" Ductile Iron Line, G Sensor in Direct Mode next to Existing Low Cost Sensor

Application – Tracking 30% Solids

- **Greater Cincinnati Metropolitan Sanitary District**
- **10” Ductile Iron Line**
- **Schwing Pump (piston)**
- **Large Process to Estimate and Report Flow**



Application – Short Straight Run



Application – Short Straight Run

Station Name TOLEDO -
COLLINS PARK
F601 w/ G
Transmitter SENSORS
S/N Meter F 601 -06010961
K-factor n/a
Freq full scale n/a

Company CHALTRON
SYSTEMS
Location/ Tag# 24" DUCTILE IRON
Firmware Version 6.28
K-factor inverse n/a
Computed SOS 1463.4 m/s

Test Date 11/2/2017 (m/d/yyyy)
Test Time 1:41:25 PM (h:mm:ss tt)
Test Duration 00:05:00 (hh:mm:ss)
Test Samples 31 (Samples)
Technician ERIC PAPA

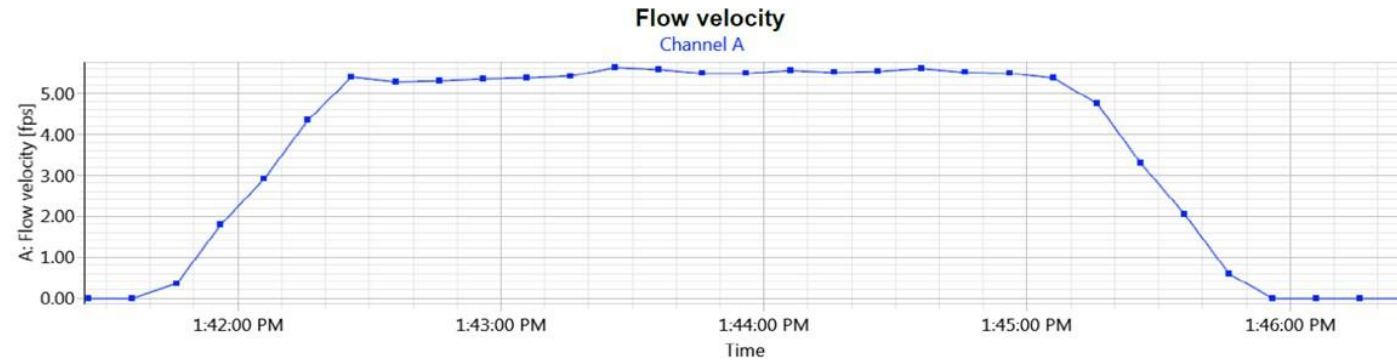
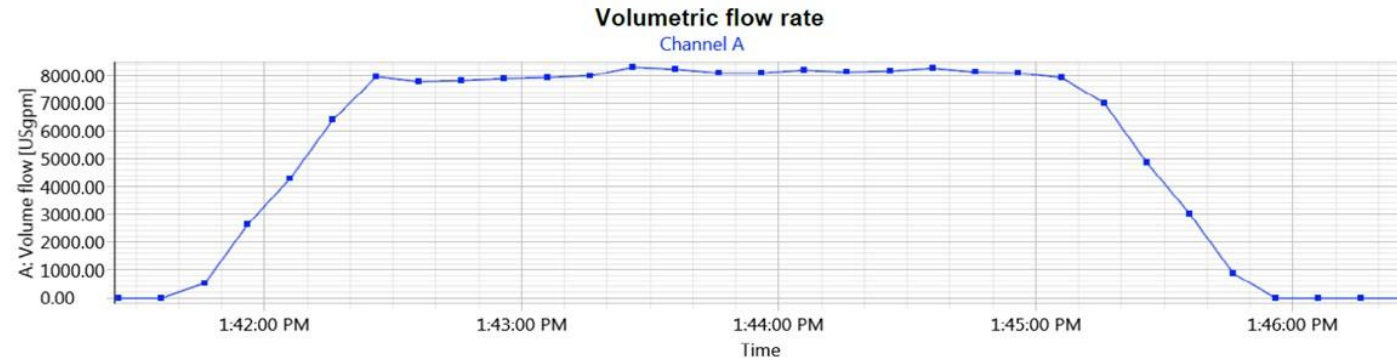
Meter Diagnostics

| Quantity | Unit | A |
|----------------|------|--------|
| SCNR | dB | 38.48 |
| SNR | dB | 42.19 |
| Gain | dB | 68.43 |
| Amplitude | % | 53.45% |
| Quality | % | 99.10% |
| Vari.time | % | 0.00% |
| Vari.amplitude | % | 2.00% |
| Sound speed | m/s | 1463.4 |
| Flow velocity | fps | 3.64 |

Meter Programmed Data

| Quantity | Unit | A |
|---------------------|--------|--------------|
| Outer Diameter | inch | 25.800 |
| Wall thickness | inch | 0.440 |
| Wall material | | Ductile Iron |
| Roughness | inch | 0.079 |
| Fluid | | Water |
| Fluid SOS | m/s | 1463.4 |
| Fluid temp. | °F | 57.9 |
| Fluid pressure | psi(a) | 14.504 |
| Transducer S/N | | CDG1NZ772771 |
| Sound paths | | 2 |
| Transducer distance | inch | 14.551 |
| Volume Units | | USgpm |
| Damping | s | 30 |
| Logging enabled | | Yes |
| Storage Mode | | Sample |
| Storage Rate | s | 10 |
| Ringbuffer | | Yes |
| Add. Diagnostics | | Yes |
| Cutofflow + | fps | 0.16 |
| Cutofflow - | fps | 0.16 |

Application – Short Straight Run



Application – Short Straight Run





RAINF
WATER

RECARB

RAINF
WATER



SLUDGE
PUMP ROOM
KEEP DOOR
CLOSED

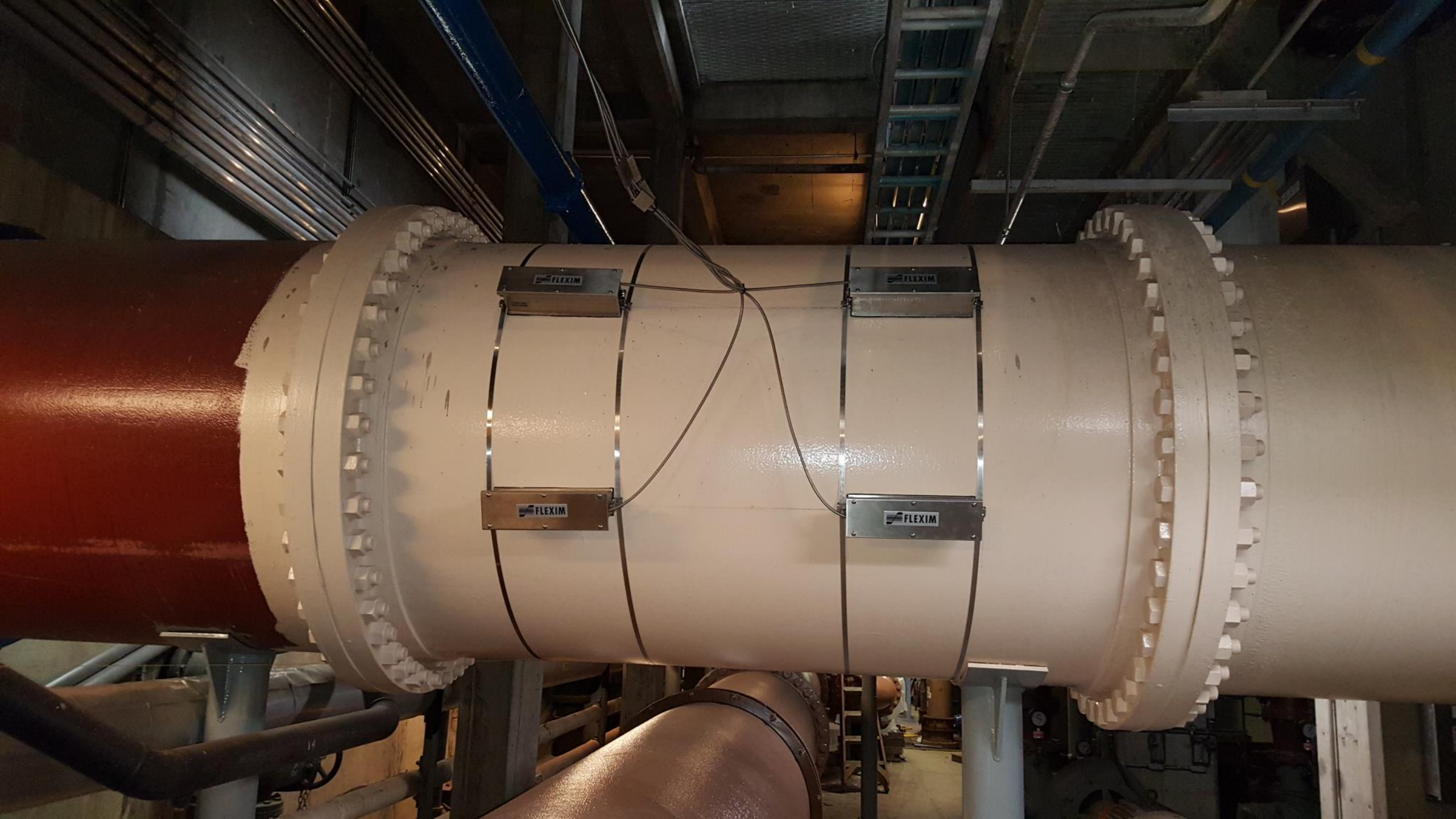




 FLEXIM









Ultrasonic Application Advantages

- **Non-intrusive Solution (no wetted parts, no wear and tear, no pressure losses)**
- **No process interruption for installation**
- **Virtually maintenance free**
- **No internal pressure drops**
- **Extreme precision and accuracy**
- **Cost effective**
- **Easy to “fix” other meter technology problems by retrofitting or replacing**



CHALTRON
SYSTEMS, INC.