

FCT FLUID COMPONENTS
INTERNATIONAL LLC

Thermal Flow Meters

Gilson Engineering Sales

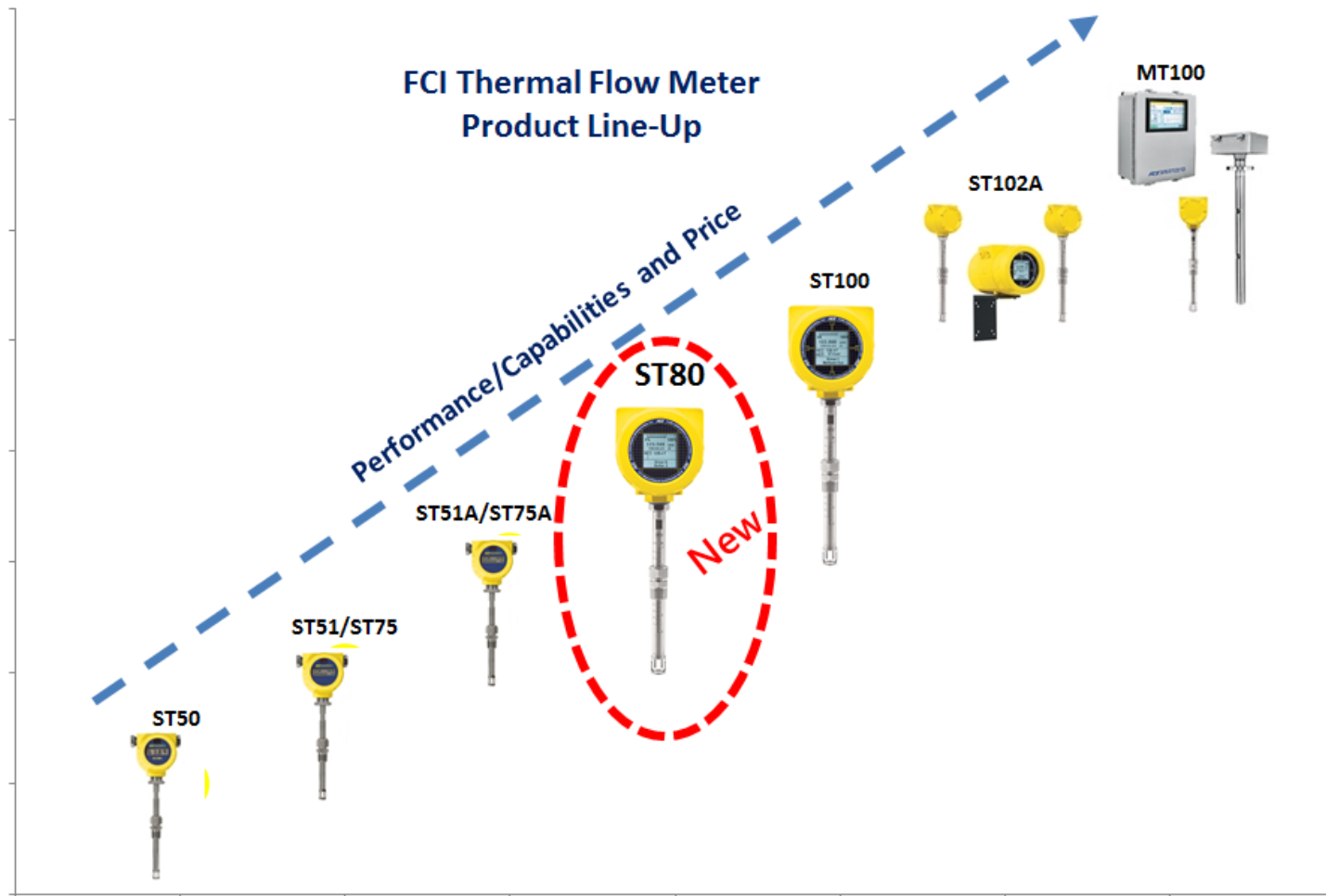
June 3, 2020



FCI has an Extensive Thermal Mass Flow Meter Offering



Economical to High Performance



Single Point Thermal Flow Meters



Single Point Flow Meter Types



Insertion



In-Line (Spool)

FCI Models: Insertion Style; Single Point > 2-inch Line Sizes



ST50



ST51/51A



ST80



ST100 Series

FCI Models: In-Line Style ≤ 2-inch Line Sizes



ST75/75A



ST75V/75AV



ST80L/100L



In-Line for ≤ 2 -inch Applications

- In-Line models are calibrated as a unit to ensure accuracy in the field



Why In-Line for ≤ 2 -inch Applications?

- Impact on Accuracy
 - Rotational
 - Insertion Depth
 - Sensor Blockage
- Exception
 - 2-inch Lines where maximum velocity is below 125 SFPS
 - Typically ST50/51/51A



Insertion: Process Connections



Compression Fitting



Compression Fitting with Thread-On Flange



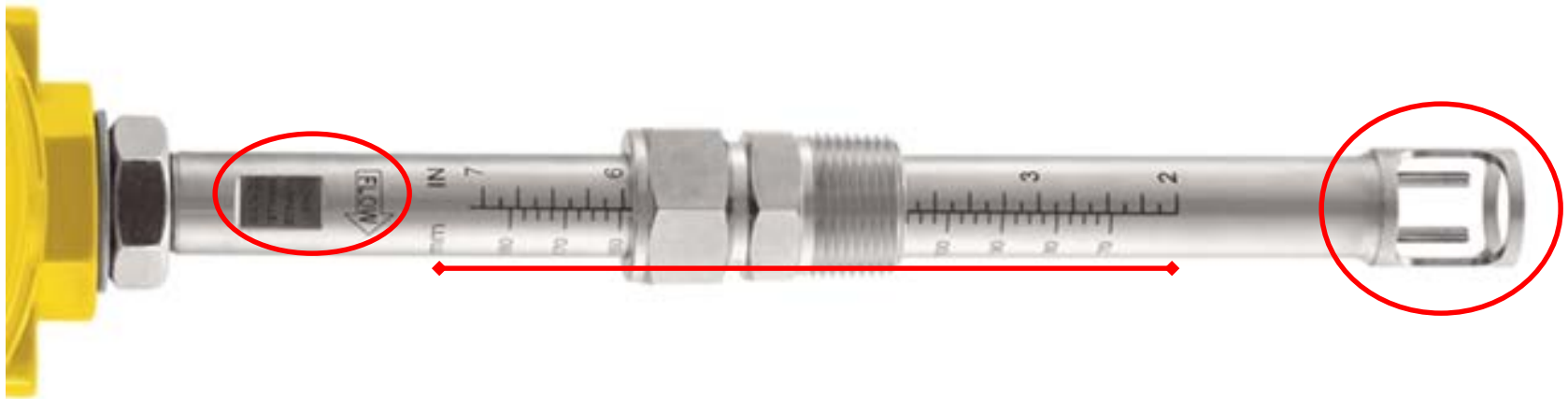
Packing Gland



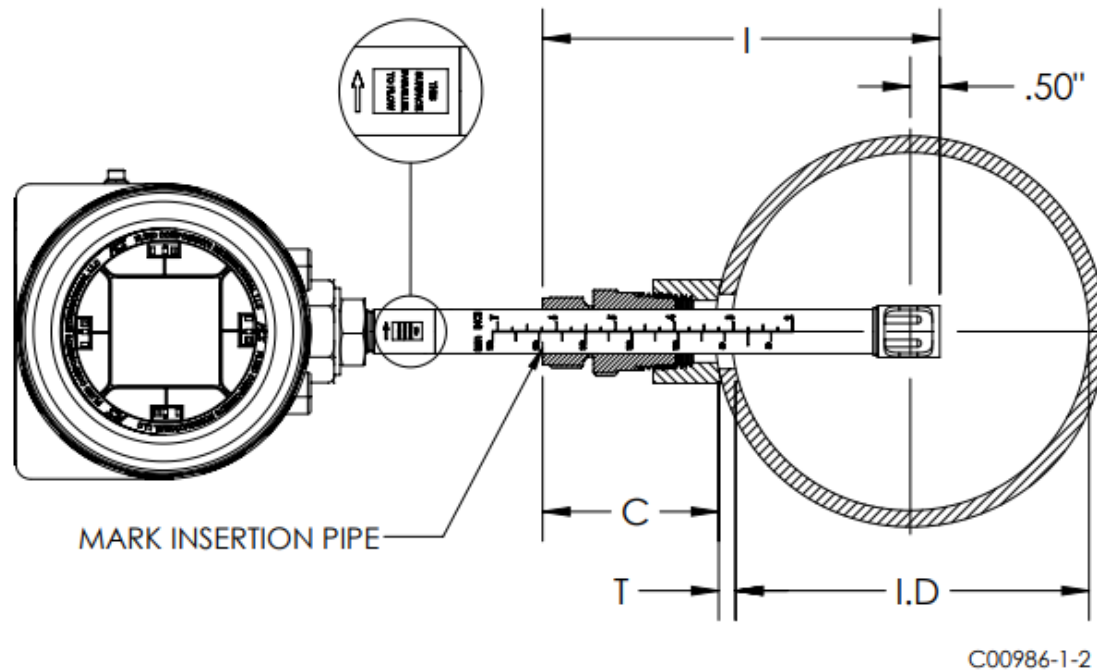
Welded Flange

Insertion: Flow Element Markings

- Flat & Flow Directional Arrow to Ensure Proper Orientation of Sensor
- Depth Gage Etched on Standard Length Flow Elements to Simplify Proper Installation
- Captive Flow Elements (Safety Feature)



Insertion: Installation Details

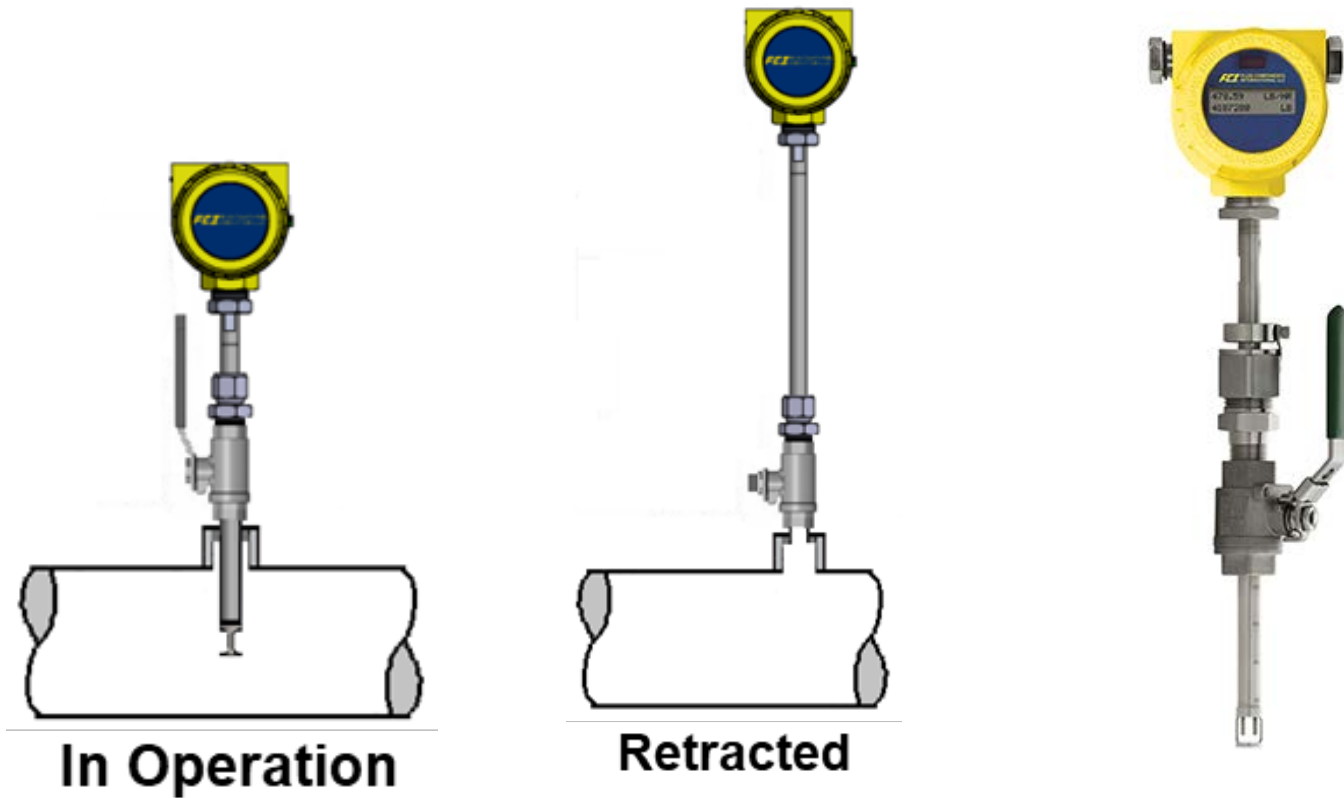


- I = Insertion depth
- I.D. = Pipe inside diameter
- T = Pipe wall thickness
- C = Mounting coupling with and installed compression fitting length

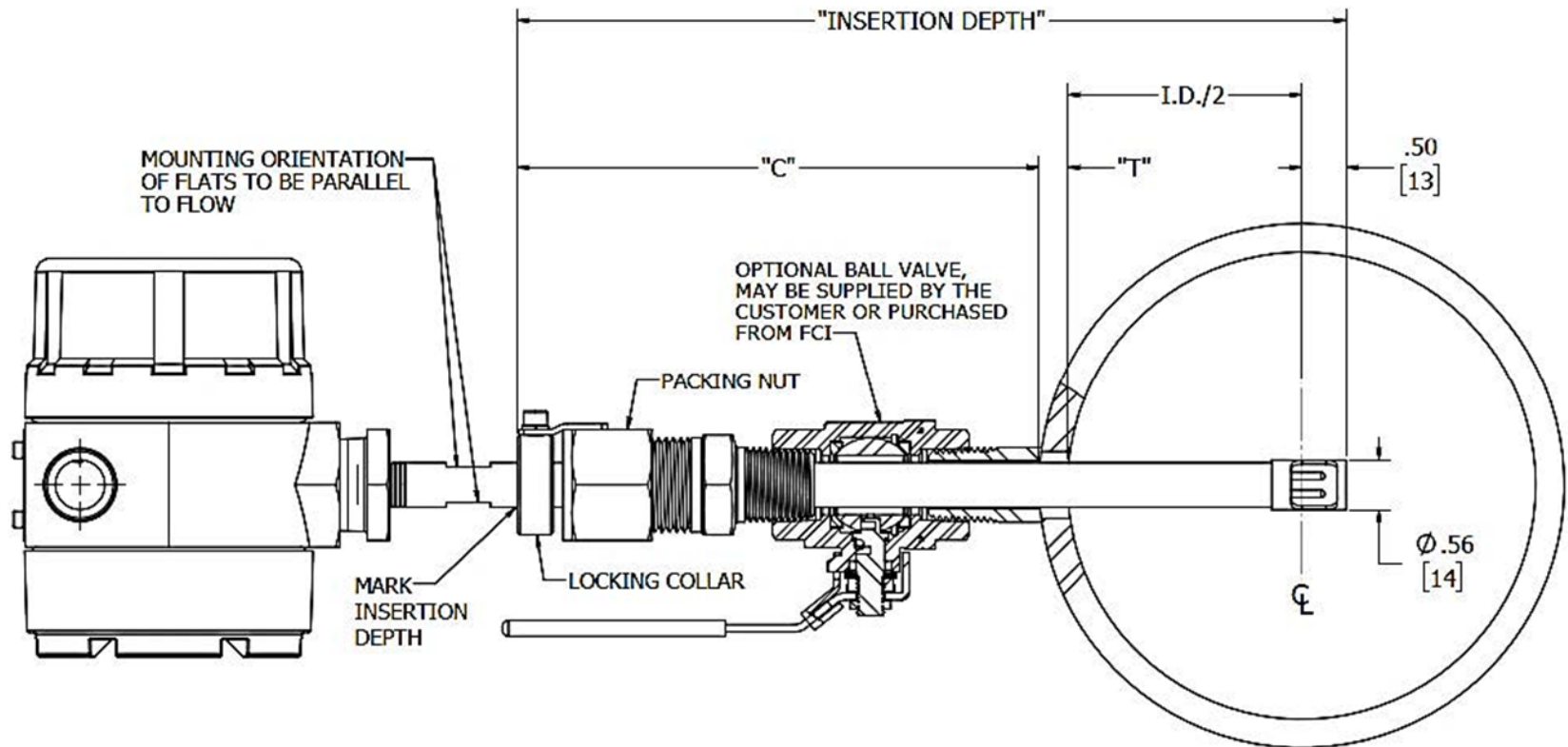
$$\text{Insertion Depth} = I = 0.50 \text{ inches} + (\text{I.D.} / 2) + T + C$$

The scale etched on the side of the insertion pipe indicates the length to the tip of the flow element.

Example of Isolation Ball Valve Usage (Customers May Refer to as “Hot Tap”)



Insertion: Isolation Ball Valve Installation



Insertion: Sensor / Head Types

- Optimized Sensors for Gas Application



FPC: Conditioned for Compressed Air/High Pressure



FP: Faster Response in Clean/Dry Gases



S: Designed for More Corrosive/Wet Media



WG: Shrouded for Wet Gas (not Dual-Phase)

General Sensor Recommendations

Flow Element	-FPC	-FP	-S	-WG
Conditions or Characteristics				
All clean gases	■	□	□	⊘
Air/compressed air	■	□	□	⊘
Slightly dirty gases	□	■	□	⊘
Damp/moist gases	□	□	■	■
Very dirty gases	⊘	□	■	⊘
Wet gases	⊘	⊘	⊘	■
Open vertical stack or pipe with gas flow coming up, rain/moisture coming down	⊘	⊘	⊘	■
Erosive	⊘	⊘	■	⊘
Corrosive	⊘	⊘	■	⊘
Particulates in flow stream	⊘	□	■	⊘
Pulsing	■	⊘	■	⊘
Fastest response time	■	■	□	⊘
Dynamic temperature swings	■	■	⊘	⊘
Rapid or erratic changes in flow requiring smoothed response and output	⊘	⊘	■	⊘
Less-than-ideal straight run (without Vortab® flow conditioning)	■	⊘	⊘	⊘
Frequent cleaning required	⊘	□	■	⊘

- = Excellent performance, preferred solution
- = Good performance, acceptable solution
- ⊘ = Not recommended

Insertion: Sensor / Head Types



FPC: Automatically Selected for ST50/51/51A based on Application Process Conditions



WG: Standard Option on ST80

- Can be special on ST100
- Not Available on ST50/51/51A
- Moisture content no greater than 10% Volume

ST80/100: One of a Kind “Wet Gas” Sensor Head

The Wet Gas Head is FCI’s equal mass, -FP style sensors isolated from the water droplets by a custom shroud extension which shunts and drains the water away, so it never reach the sensors

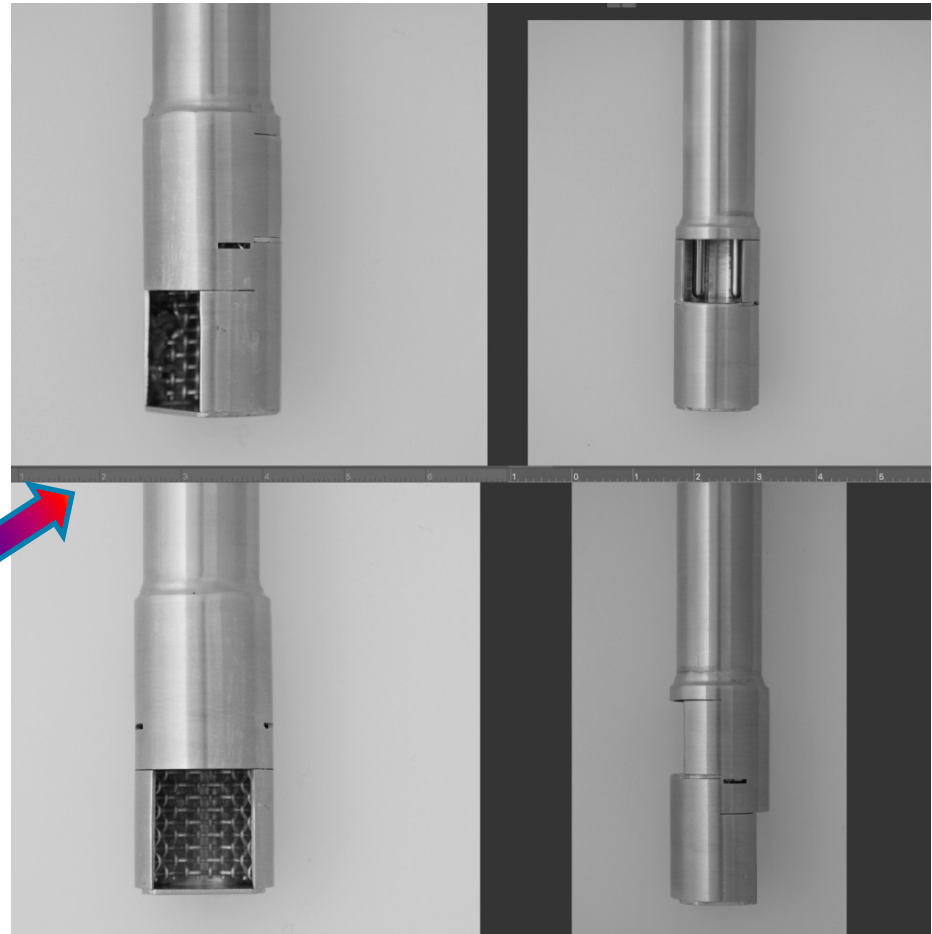
Standard -FP



Wet gas



Various Views



Traditional Installation Considerations for Biogas and other “Wet” Gases



Angled at 45° from Horizontal



Side Mounted



Bottom Mounted



Mechanical Approach to Entrained Moisture in a Gas

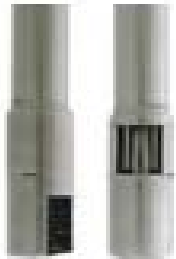
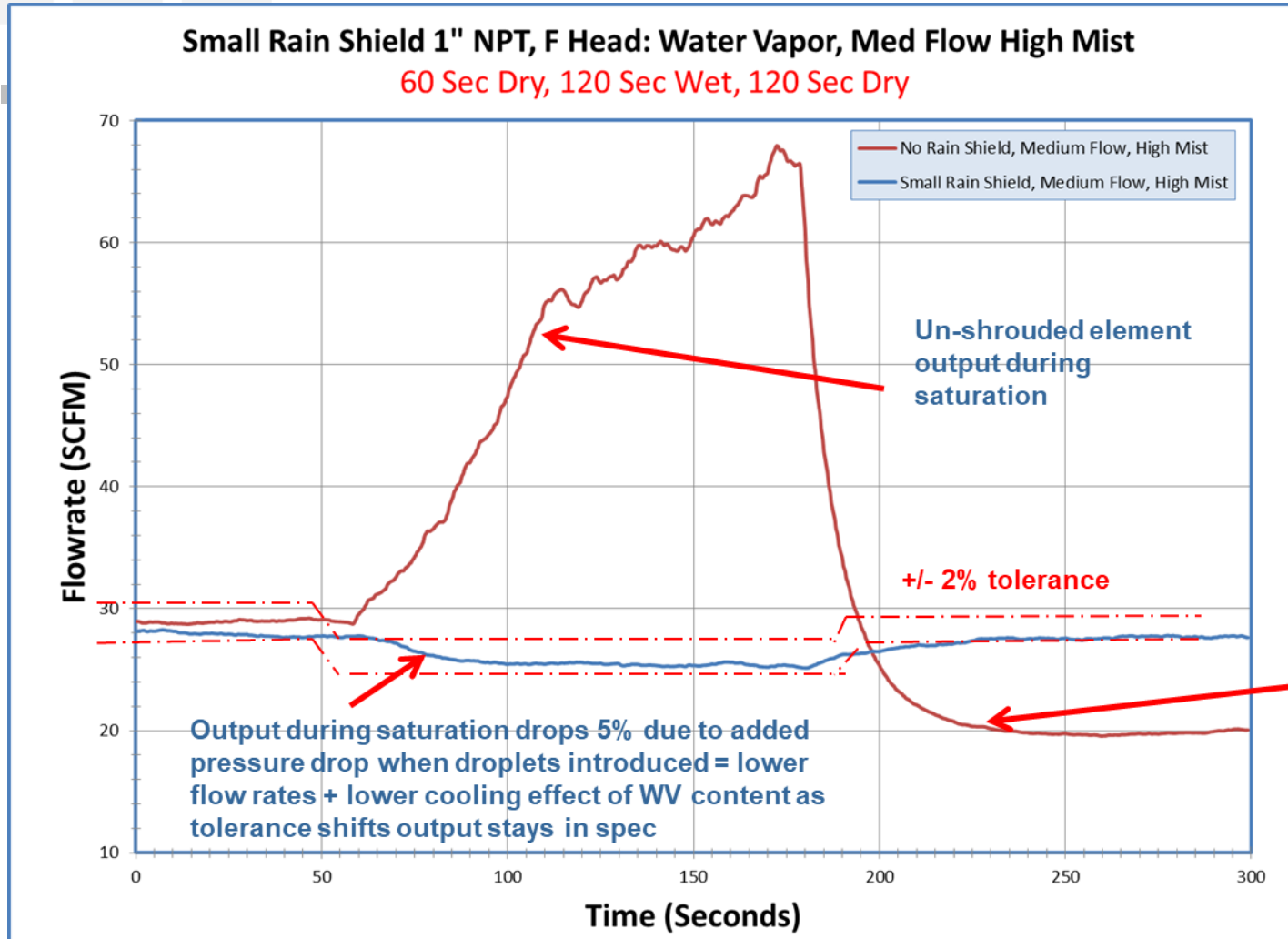


Figure 1. Angle mounted at 135° or 225° position



Figure 2. Side mounted at 90° or 270° position

Flow Indication of Wet Gas Sensor v Standard Sensor



In-Line: Process Connections



Female NPT
(Pipe Tee)



Tube Tee



Male NPT



Welded Flange

Integral Vortab Flow Conditioners



ST75V/75AV



Integral Vortab



ST80L/100L

Side Bar: Reynolds Number Transitional Zone

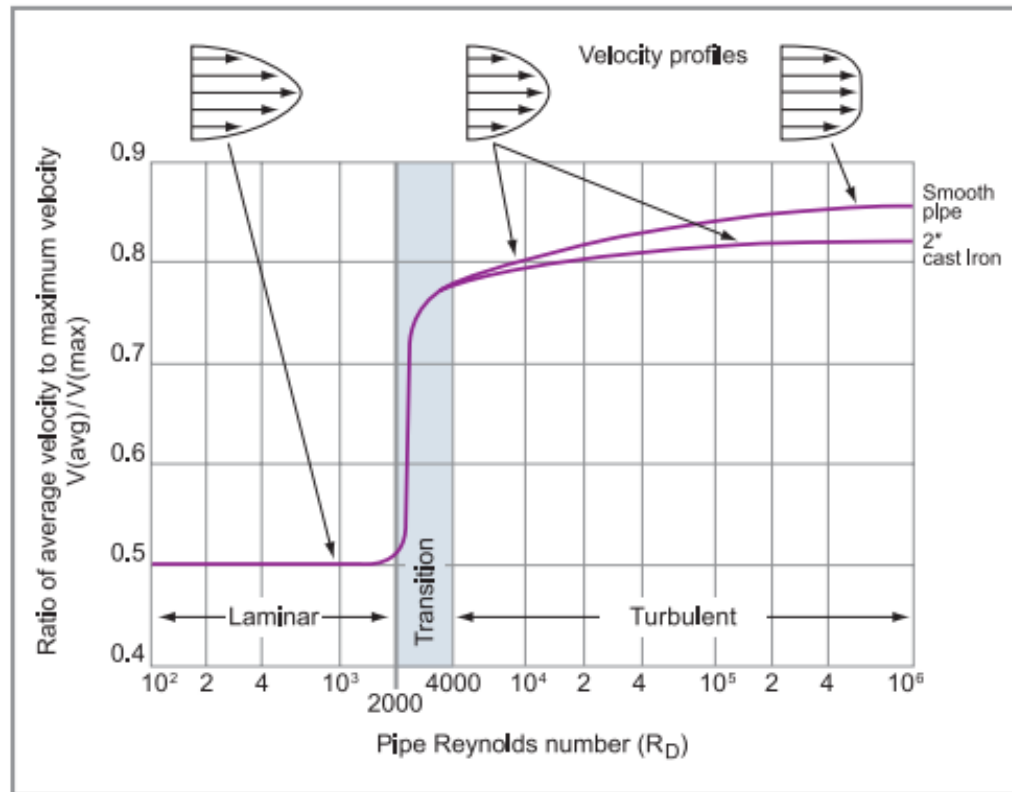
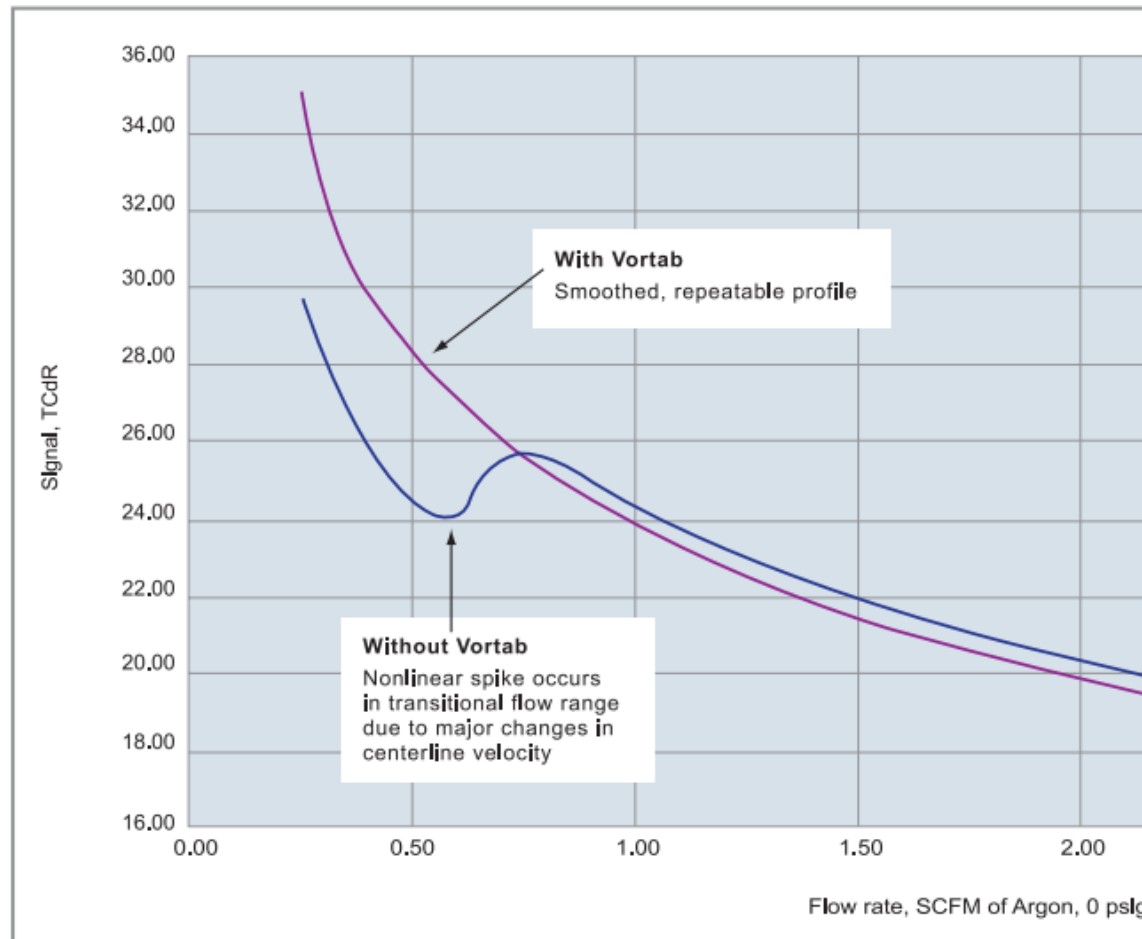


Figure 2. Ratio of average to maximum (centerline) velocity for smooth and rough pipe

Source: Richard Miller, *Flow Measurement Engineering Handbook*

What does it mean to the Customer?



Electronics Configuration



Integral Configuration



Remote Configuration

Local Enclosure (FE)

Remote Enclosure/Electronics (FIT)

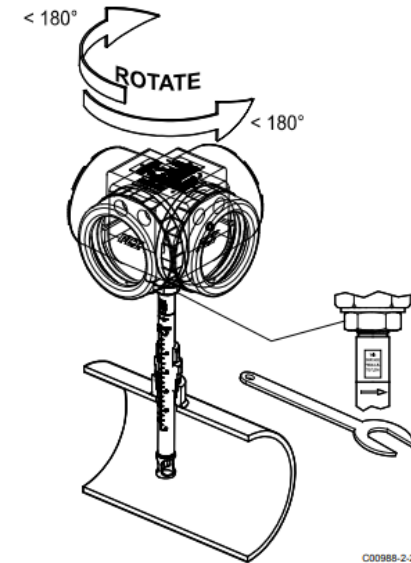
Integral Enclosures



ST50/51/75 Series
Fixed Position

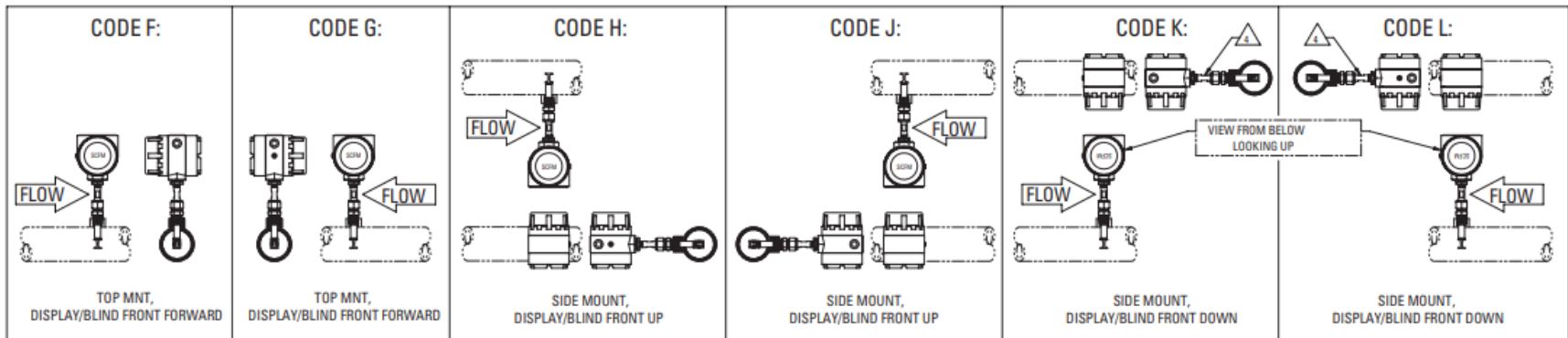


ST80/100 Series
Rotatable

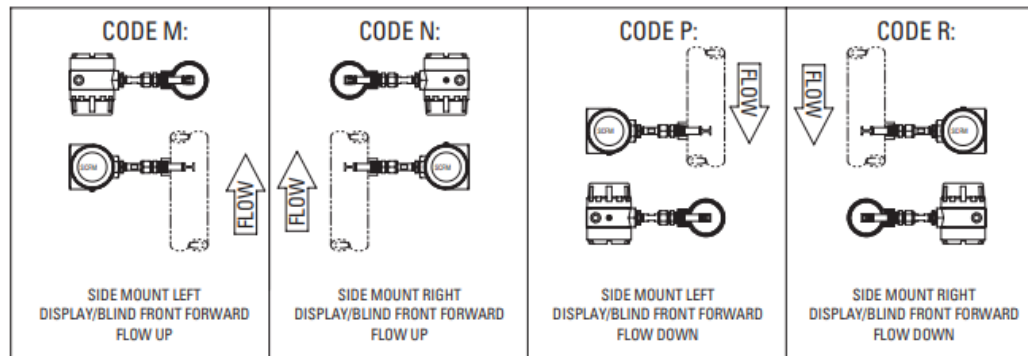


Integral Units: Flow Direction

INTEGRAL Horizontal Mountings



INTEGRAL Vertical Mountings



Enclosure Types



Aluminum /
Polyester Powder Coated

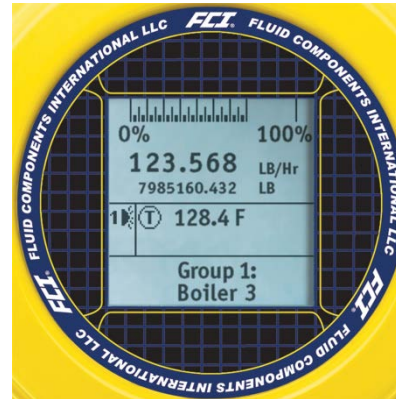


Stainless Steel
(Enhanced Corrosion Resistance)

Instrument Displays



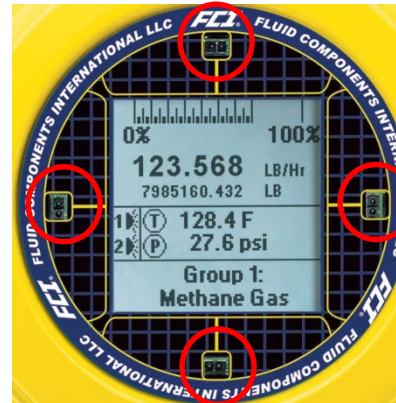
ST50: 4-Digit LCD (Label)



ST80: 2"x2"
Graphical LCD
(Backlit, No HMI)



ST51/75: 2-Line x 16-Character LCD



ST80/100: 2"x2"
Graphical LCD
(Backlit, HMI)

Custom Sun Shield: ST80/100 Series



Helps Protect LCD from
Direct Sunlight

ST80/100 – Validation Self-Test

- Validates the electronics against (3) precision resistors to determine if out of acceptable tolerance
 - Initiate Using Display with HMI or via PC Configuration Tool (freeware)



What's in the Box?

ST110



VeriCal
Sonic Nozzle/Valve



STP110

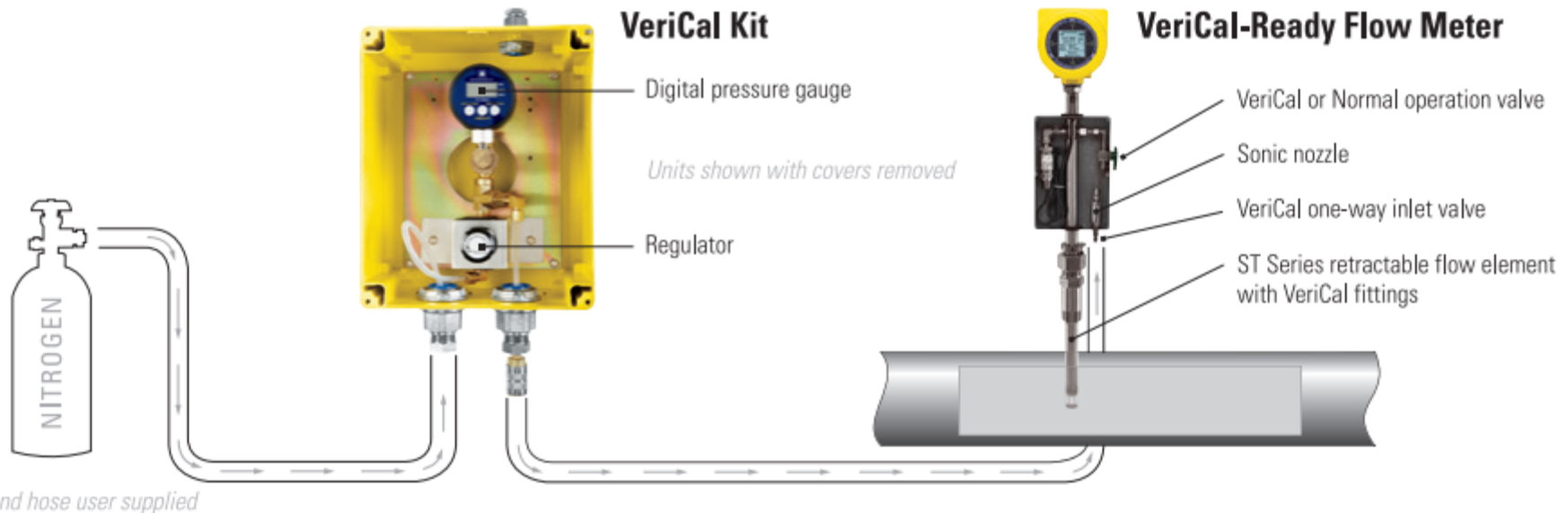


Integrated Pressure
Transducer (NEMA 4X or Exd)

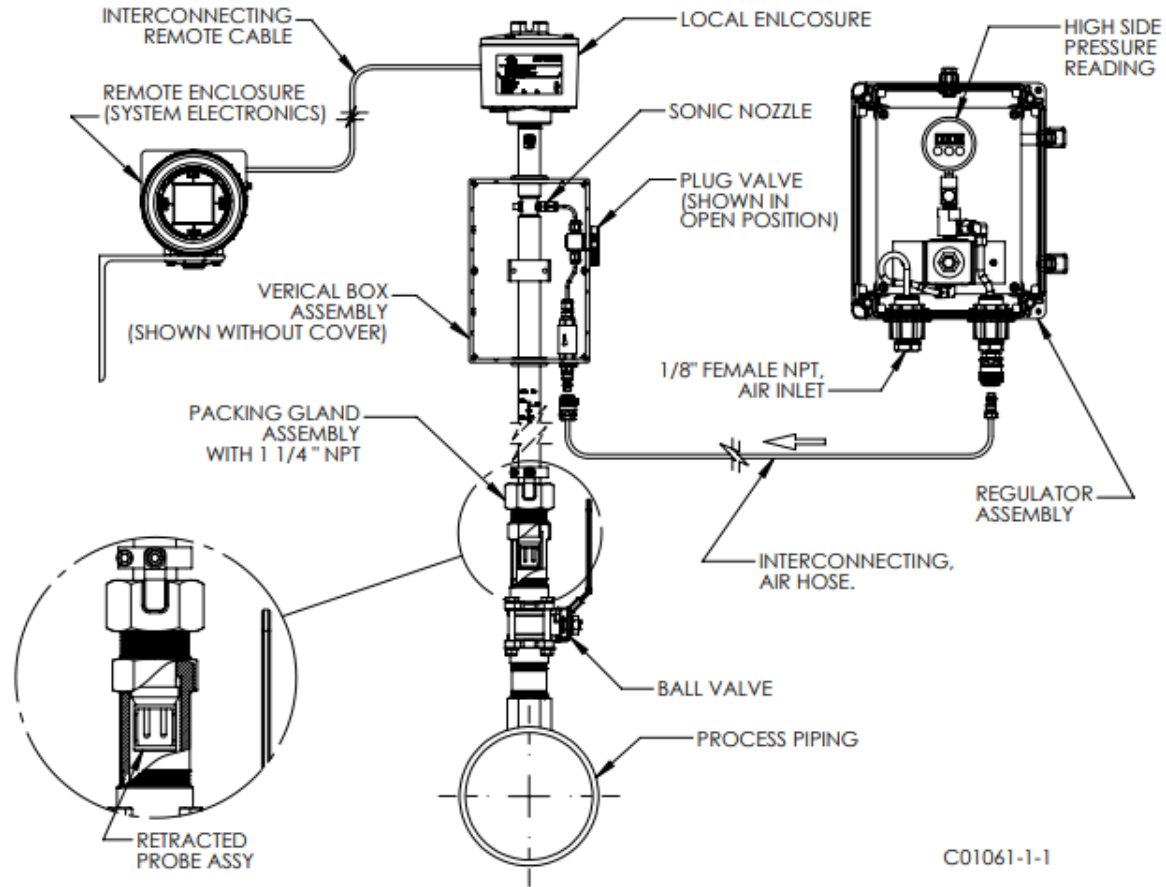
VeriCal – An FCI Exclusive

Verification of **C**alibration is in the Name!

- VeriCal allows the Customer to perform a “wet” in-situ verification of the meter calibration



VeriCal: Isolation for In-Situ Test



Retracted VeriCal Mounting Configuration



Thermal: Multivariable Outputs

- Thermal Mass Flow Meters are a True Multivariable Device
 - Measures both Flow Rate and Process Temperature
- The STP Versions of the ST100 Series are an Enhanced Multivariable Device
 - Measures Flow Rate, Process Temperature and Process Pressure
 - More Comparable to a Multivariable DP/P/T Instrument without all of the Installation Concerns

Example: Cost of Ownership

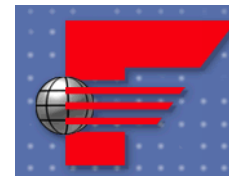
DP or MV with Orifice (Mass Flow) v Thermal

	Differential Pressure	Multivariable	Thermal
Transmitter	\$1,500	\$4,000	\$4,200
Isolation Valve Manifold (5-valve)	\$300	\$300	-
Isolation Ball Valve (Full Port)	-	-	\$175
Pressure Transmitter	\$1,000	Integral	n/a
Temperature Transmitter/RTD	\$450	Integral	Integral
Thermowell	\$350	\$350	-
Primary Flow Element - Orifice Plate (6-inch)	\$200	\$200	-
Impulse Tubing/Fittings	\$50	\$50	-
300 lb. Weld Neck Orifice Flange Union	\$1,200	\$1,200	-
Threadolet/Half Coupling	-	-	\$25
Separate AC/DC Instrument Power	-	-	\$100
Hardware Subtotal	\$5,050	\$6,100	\$4,375
Installation Costs	\$840	\$600	\$240
Maintenance Costs, Annual	\$420	\$240	\$120
Energy Loss, Annual	\$33,750	\$33,750	\$8,665
Initial 1-Year Cost of Ownership Total	\$38,860	\$39,490	\$13,400

- Estimated energy loss based on a blower producing 8 psig @ 250 KW; 8,000 hours of operation at a cost of \$0.15 /KWH
 - Pressure loss at Max Flow: DP/MV ~ 25" w.c.; Thermal ~ 8" w.c.

Registered Bus Protocols

- HART
 - www.fieldcommgroup.org
- Modbus
 - www.modbus.org
- Fieldbus Foundation
 - www.fielcommgroup.org
- Profibus
 - www.us.profinet.com
 - Types
 - PA – Process Automation
 - DP – Discrete Automation (Decentralized Periphery)



Digital Bus Communication Options

Model	HART (Rev 7)	Modbus	Fieldbus Foundation	Profibus PA	Profibus DP
ST50, ST51, ST75, ST75V					
ST51A, ST75A, ST75AV	•	•			
ST80 Series	•	•	•	•	•
ST100 Series	•	•	•	•	
MT100 Series	•	•	•	•	

ST50 vs ST51/51A

ST50 Positioned as the Most Economical for Air/Nitrogen/Compressed Air

Capabilities	ST50	ST51	ST51A
Application	Air/Nitrogen	All Gases	All Gases
HART or Modbus	No	No	Yes
Pulse Totalizer Output	Optional	Standard	Standard
Process Operating Temp	0°F [18°C] to 250°F [121°C]	0°F [18°C] to 250°F [121°C]	-40°F [-40°C] to 350°F [177°C]
Display	4-Digit	2-line	2-line
Maximum Remote Distance	50 ft [15m]	50 ft [15m]	100 ft [30m]
Hazardous Area	CL 1/Div 2	CL 1/Div 1	CL 1/Div 1
SIL Compliance	No	No	SIL 1 (HFT=0)
Standard Warranty	1 Year	1 Year	2 Years

ST51/51A



ST50



ST80 vs ST51A

ST80 Positioned as the “Better” Offer in the Line

Different capabilities	ST51/ST51A	ST80
Max Flow Rate	400 SFPS	1000 SFPS
Operating Temperature Range	350°F	850°F
Wet Gas/Rain Shield Sensor	No	YES (opt)
Frequency / Pulse Output	Yes	No
Foundation Fieldbus	No	YES (opt)
Profibus-PA	No	YES (opt)
Profibus-DP	No	--(pending)--
Configuration Software	RS232C	USB (Free Software)
Display/Readout	2-line, basic LCD	Backlighted Graphical LCD
On-board Keypad	No	YES (opt)
Ambient temperature range	-40... 140°F	-40... 140°F
Remote, max cable length	100 ft	1000 ft
Multiple calibration groups	No	YES (2 groups)
Dry calibration check function	No	YES



Profibus-DP now available on the ST80

ST80 vs ST100

ST100 Positioned as the “Best” Offer in the Line

Different capabilities	ST100	ST80
Accuracy	+/-0.75% rdg + 0.5% FS	+/-1.0% rdg + 0.5% FS
Turndown	1000:1	100:1
4-20 mA Analog Outputs	3	2
Frequency / Pulse Output	Yes	No
Optical Touch Buttons	Yes (standard)	Yes (opt)
Data Logger (SD Card)	Yes (8 GB SD-card)	No
Auxiliary analog input	Yes (1x Analog Input)	No
Multiple calibration groups	Yes (5 groups)	YES (2 groups)
Verical in-situ ‘wet’ verification	Yes (ST11X)	No
Pressure measurement	Yes (STP1XX)	No
Multi-point averaging	Yes (ST102A, dual point)	No

ST100



ST80

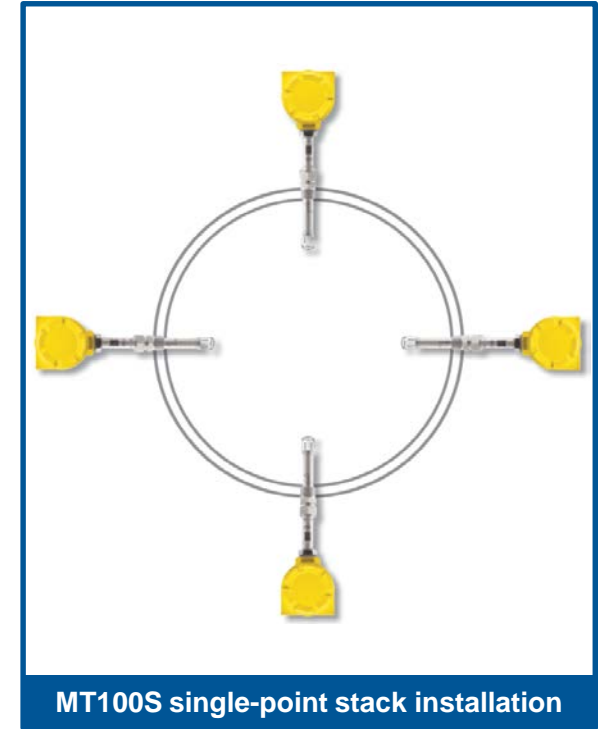
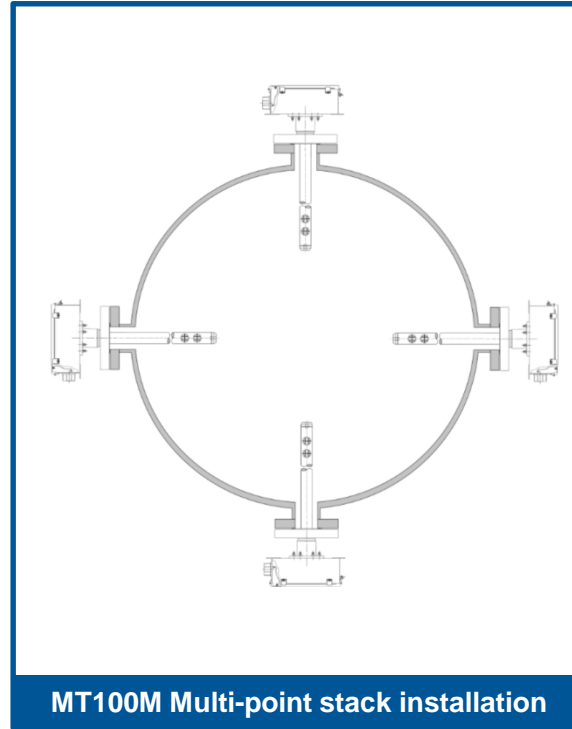
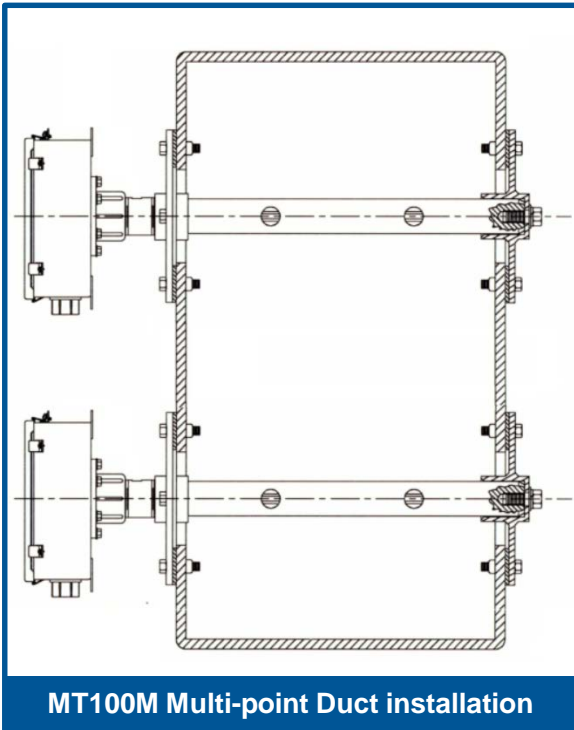


Multi-Point Thermal Flow Meters



Why a Multi-Point Meter Over a Single Point?

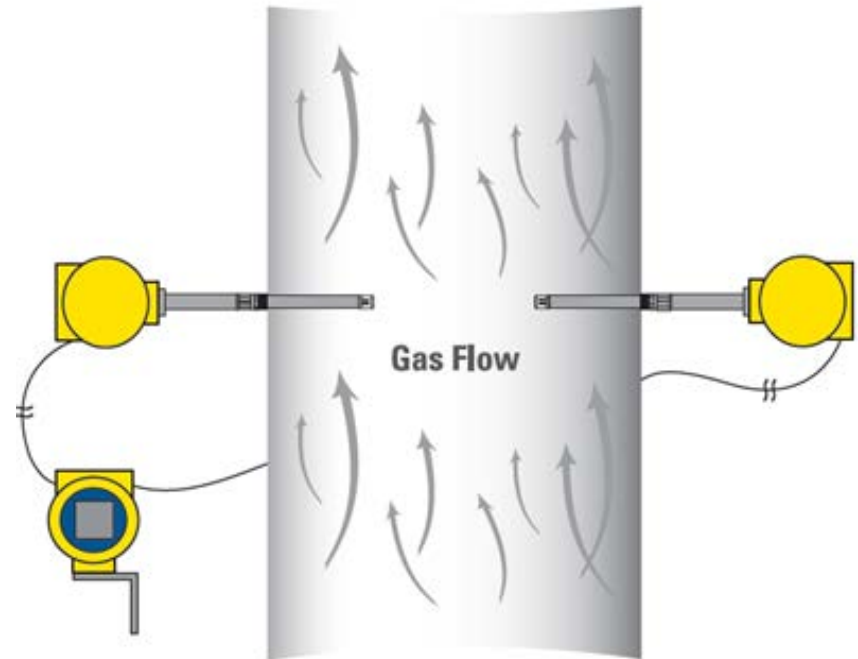
- Larger line sizes have additional error related to the cross sectional area



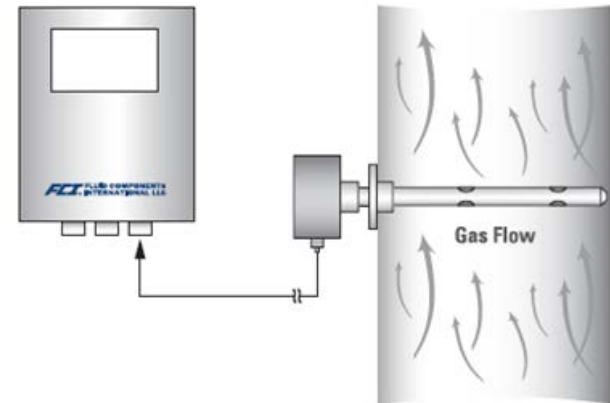
ST102A: Economical 2-Point Averaging System



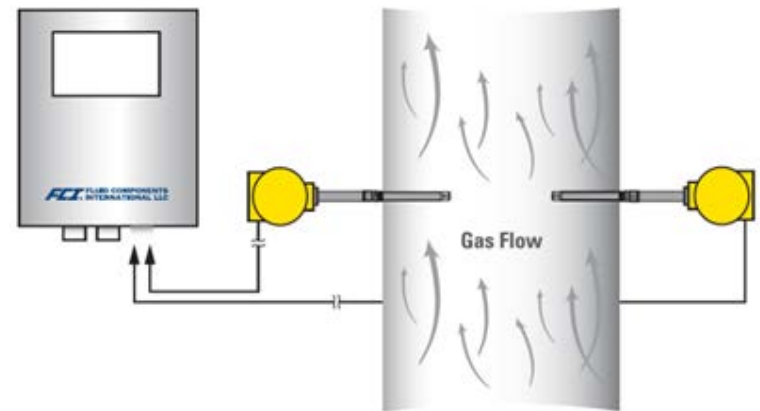
ST102A



MT100: Feature Rich for 2- to 8-Point Averaging Systems

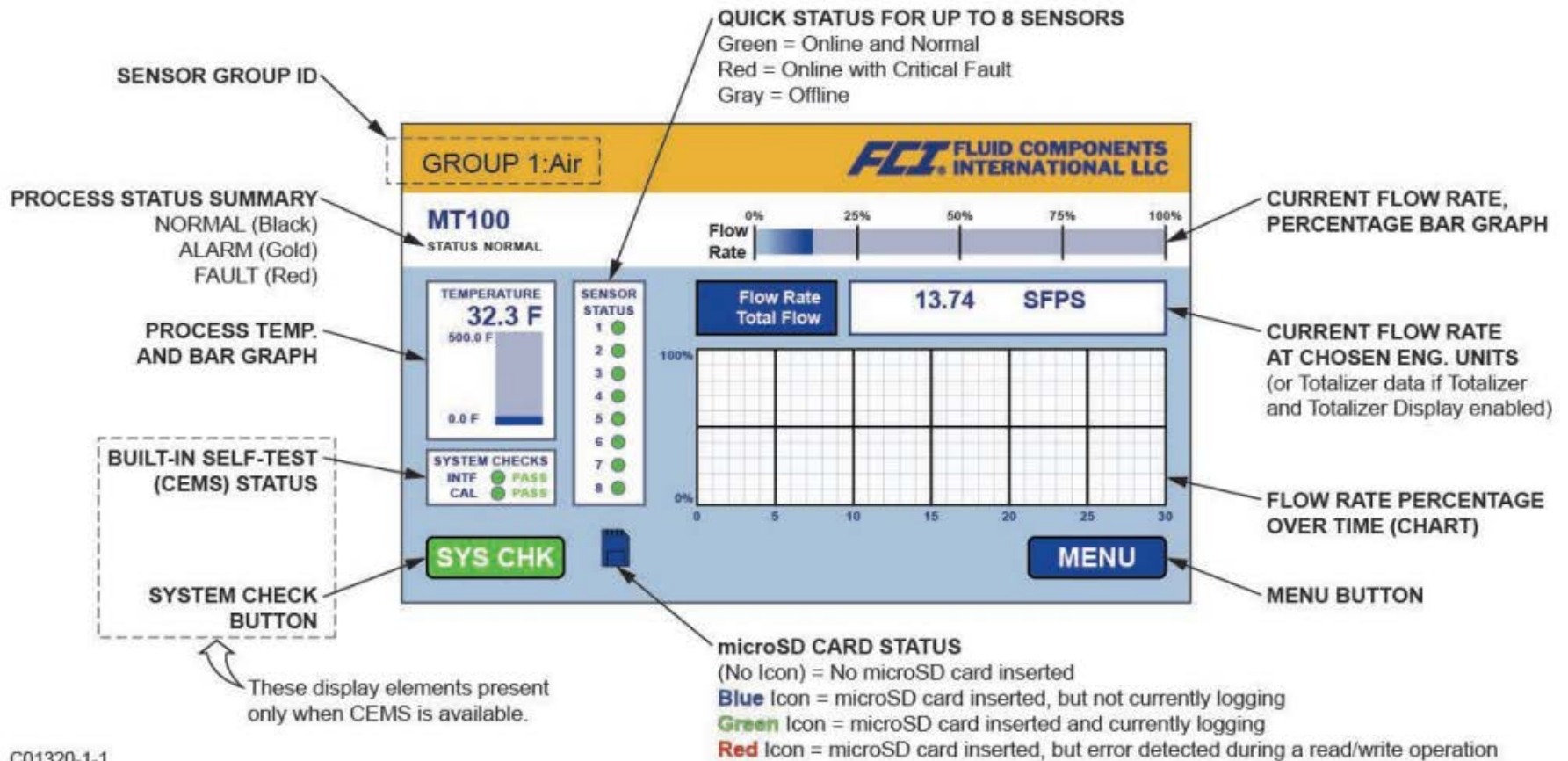


MT100M



MT100S

MT100 Graphical Touch LCD



C01320-1-1

Features FCI Thermal Mass Flow Meters

Multi point insertion type



ST102A

MT100S

MT100M

Media	All Gases	All Gases	All Gases
Approvals	FM Div 1&2 ATEX Zone 1&2	FE: FM Div 1&2 FE: ATEX Zone 1&2	FE: FM Div 1&2 FE: ATEX Zone 1&2
SIL Compliance	SIL 1	-	-
Std. accuracy Opt. accuracy	± 0.75% Rdg + 0.5% FS	± 1.75% Rdg + 0.5% FS	± 1.75% Rdg + 0.5% FS
Repeatability	± 0.5% Rdg	± 0.5% Rdg	± 0.5% Rdg
Flow range Air	0.25...1000 SFPS	0.25...1000 SFPS	0.25...150 SFPS
Max. Turndown	1000:1	100:1	100:1
Media Temp.	-40...850°F	-40...850°F	-45...850°F
Max. Press.	1000 PSIG	1000 PSIG	100 PSIG
Outputs	3x 4-20mA [NAMUR], HART 7, Pulse/Freq, Opt: Profibus PA, Modbus RS485, FF	2x 4-20mA [NAMUR], HART 7, Pulse/Freq, Modbus RS485 Opt: Profibus PA, FF	2x 4-20mA [NAMUR], HART 7, Pulse/Freq, Modbus RS485 Opt: Profibus PA, FF
Enclosure	Aluminium / 316L SST	316L SST	316L SST
Highlights	Fast: 1 sec to 63% Wet Gas Sensor Wet/Dry cal check Data logger (SD card) Up to 2 points	EPA CEMS Compliant Full self check Mast-type/Single point Touch screen +SD card 2 to 8 points	EPA CEMS Compliant Full self check Mast-type Sensor Touch screen +SD card 2 to 8 points

Flow Accuracy, Turndown & Min. Velocity

Model	Accuracy, % Reading	Max Turndown (Flow)	Minimum Velocity *
In-Line (Spool)			
ST75, ST75A	± 2% Std; ± 1% Opt	100:1	1.0 SFPS
ST75V, ST75AV	± 1%	100:1	1.0 SFPS
ST80L, ST100L	± 0.75%	200:1	1.0 SFPS
Insertion (Single Point)			
ST50	± 2% Std; ± 1% Opt	100:1	0.75 SFPS
ST51, ST51A	± 2% Std; ± 1% Opt	100:1	0.3 SFPS
ST80	± 1%	200:1	0.25 SFPS
ST100 Series	± 0.75%	1,000:1	0.25 SFPS
Insertion (Multi Point)			
ST102A	± 0.75%	1,000:1	0.25 SFPS
MT100M	± 1.75%	100:1	0.25 SFPS
MT100S	± 1.75%	100:1	0.25 SFPS
* -Air at standard conditions; 70 °F and 14.7 psia [0 °C and 1,01325 bar(a)]			

Safety Instrumented Systems IEC 61508 Compliance (SIL)

FCI uses independent, unbiased 3rd Parties to perform FMEDAs (each is also an Authorized Body)

- FLT93 Series: TÜV Nord
- All Other Products: exida

Safety Integrity Levels per IEC 61508 (Edition 2.0)

Product	Subsystem	HFT = 0	HFT = 1	HFT = 2
ST100 & ST102A, ST80 Series Flow Meters	Type B	SIL 1	SIL 2	SIL 3
ST51A/75A/75AV Series Flow Meters	Type B	SIL 1	SIL 2	SIL 3
FS10 Series Flow Monitor/Switch	Type B			
Relay or Open Collector Output		SIL 1	SIL 2	SIL 3
Analog Output		SIL 2	SIL 3	SIL 4
FLT93 Series Flow/Level Switch	Type A	SIL 2	SIL 3	SIL 4

Requires redundant instruments

Lets work together to do it
right the first time.



FCT® **FLUID COMPONENTS**
INTERNATIONAL LLC

www.FluidComponents.com

FCI Unique Value Added Capabilities



Dual-Mode Operation Is An Un-Matched Competitive Differential

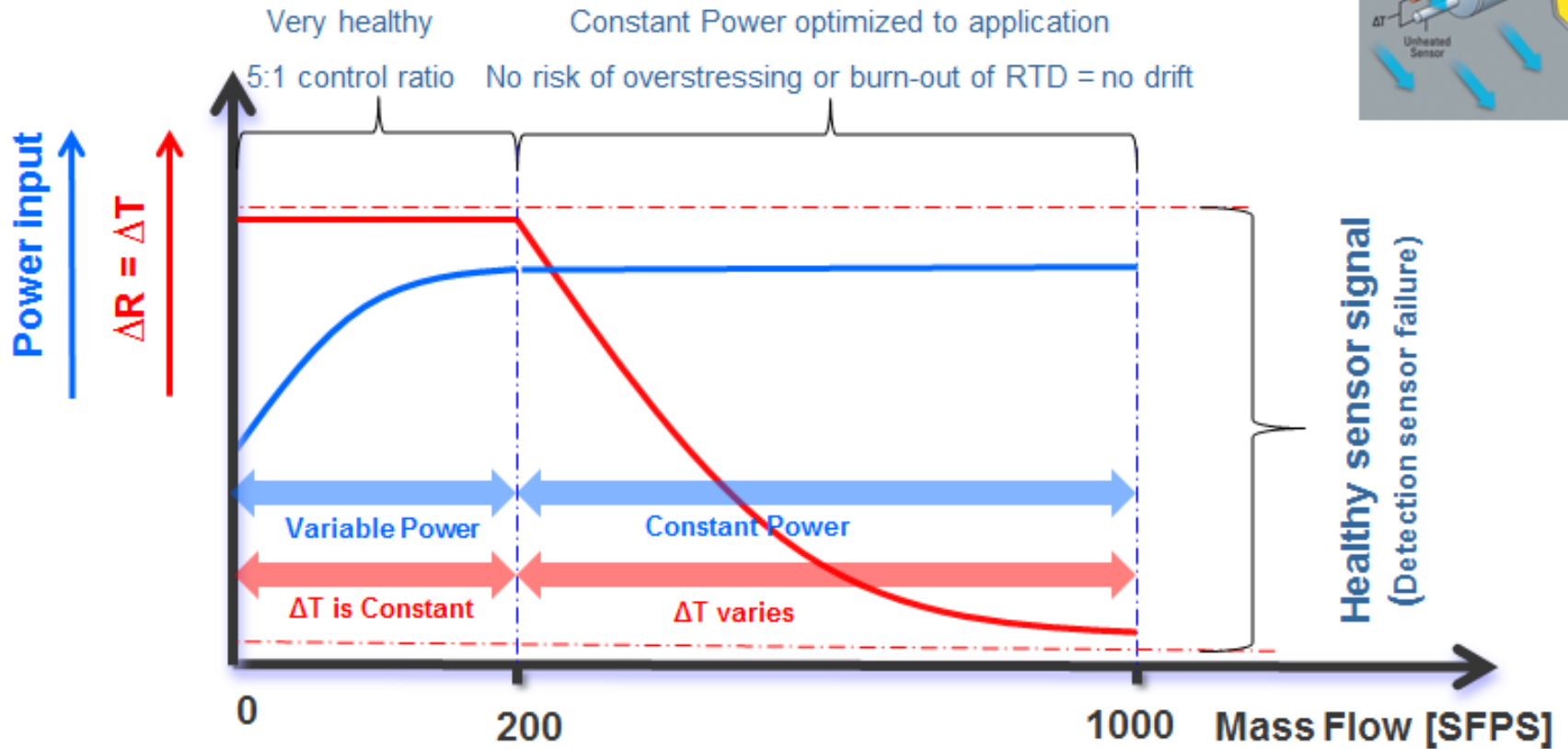
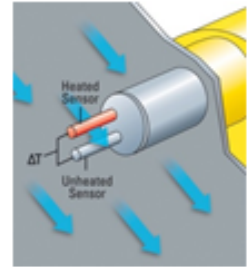
- **AST™ and Constant Power Measuring Modes Both Reside in ST80.**
 - Application Information At Time of Order Will Dictate Initial Set-up, But If Actual Conditions Are Different, User Can Change On Site.
- **AST is FCI Patent-pending Hybrid, Exclusive**
 - Deploys Constant ΔT Technique at Lower Flow Rates and Transparently Shifts to Constant Power Mode at Higher Flow Rates.
- **ST80's Brochure Page 2 Discusses This Feature.**
 - Also Covered in Lock-out Spec Sheets

*If You Focus Your Sales Attention On Getting Just This Feature Spec' d In,
It Will Lockout Competitors and Your Close Rate Will ↑↑↑↑*

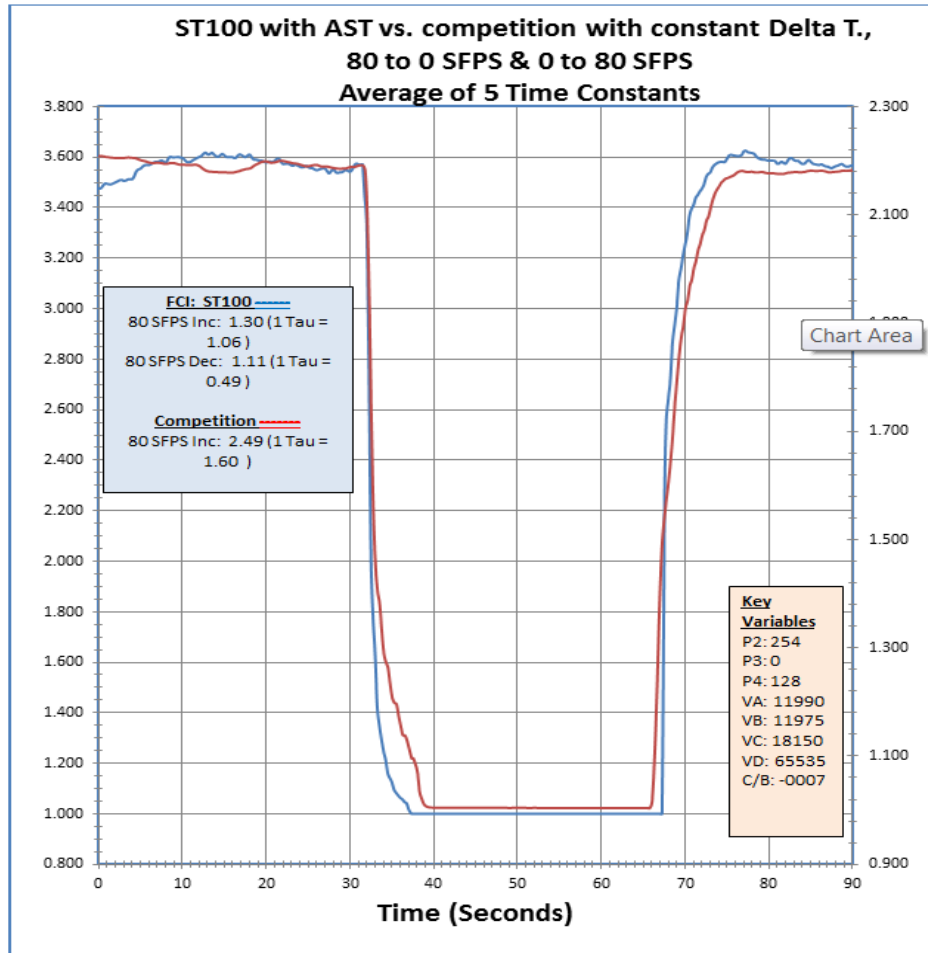
AST Mode Delivers Fast Response and Higher Flow Rates With Better Reliability

AST: How does it work?

**AST = maximize range-ability
minimize use of energy**

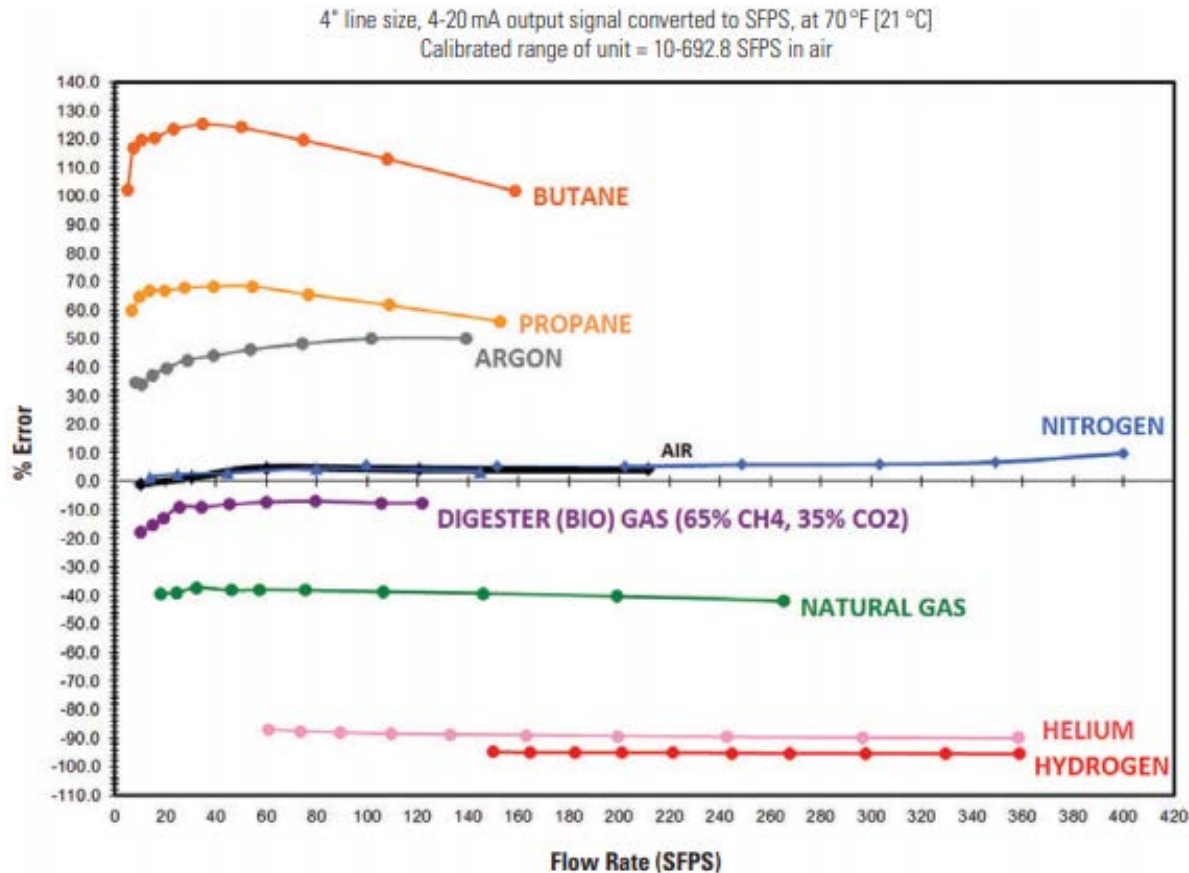


With AST, FCI ST80 (and ST100) Delivery Fast-Response (Actually Better than Brand S!).



Optimized Calibrations

- **Equivalencies versus Actual Gas**



Calibration options

Calibration flow stands for Flow meters

- More than 20 calibration flow stands (gases and liquids)
- Each flowmeter supplied with calibration certificate
- Fully NIST and ISO 17025 traceable



Overview flow calibration stands



Flare gas calibration



Flat flow profile flow stand (for large diameters)



Flare gas calibration

- Flare Metering



Where are Flares typically located?

- Oil & Gas
 - Wellheads
 - Midstream
 - Refineries/Petrochemical Plants
- Municipal WWTP
 - Unused Digester Gas
- Landfill
 - Collected/Unused Landfill Gas
- Other Biogas

Challenges

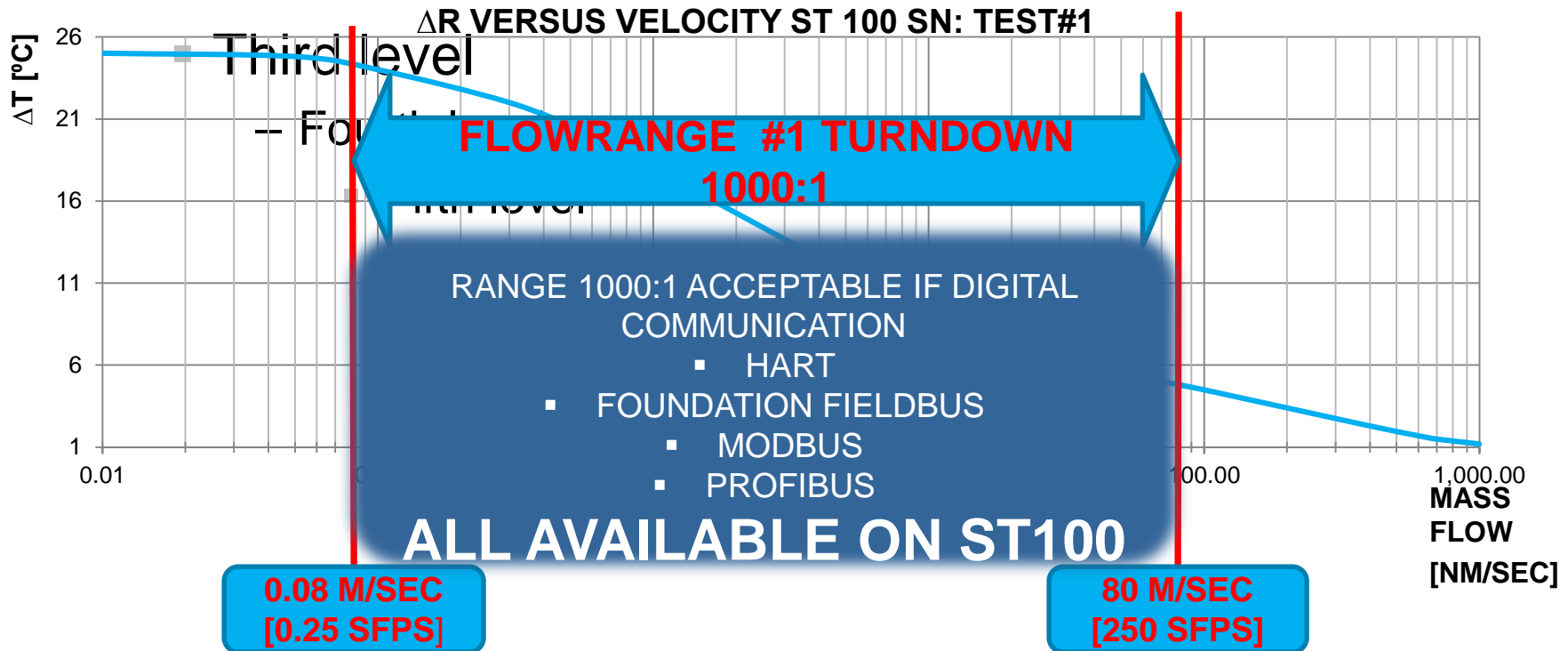
- High accuracy required over wide turndown

FCI response

- Turndown 1000:1
- Set to MIN flow of 0.08 m/sec [0.25 SFPS]
- Accuracy: max offset of 5% reading

Click to edit Master text styles

– Second level



Challenges

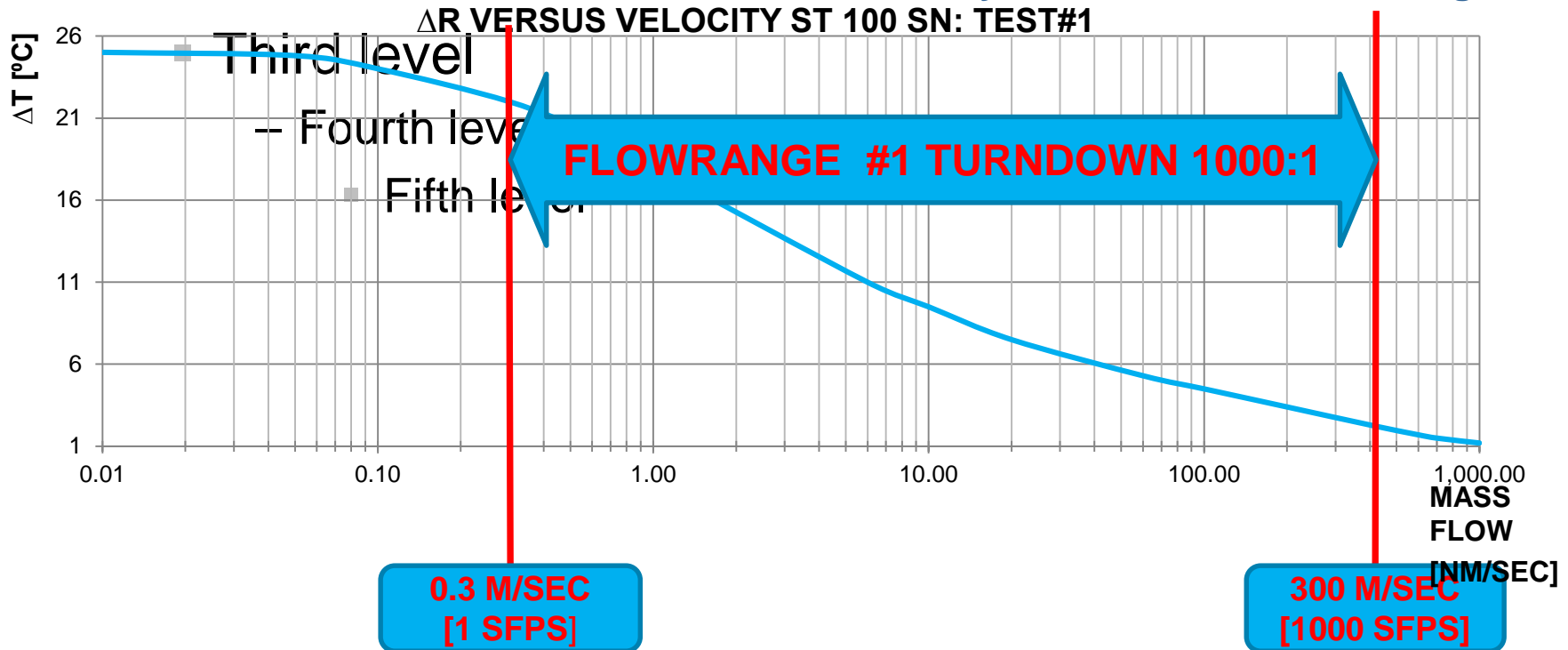
- High accuracy required over wide

FCI response

- Turndown 1000:1
- Set to MAX flow of 300 m/sec [1000 SFPS]
- Accuracy: max offset of 5% reading

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– Second level

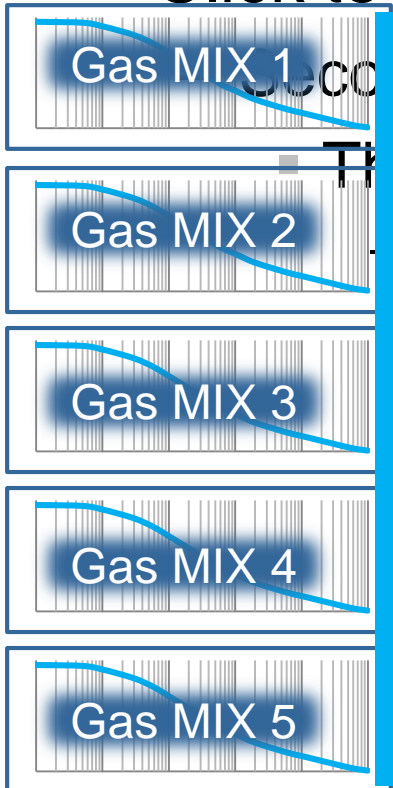


Challenges

- Complex gas composition
- Click to edit Master text styles

FCI response

- Effects of variations in Gas composition can be minimized by multiple calibrations



ST100 CAN STORE 5 CALIBRATION CURVES

CLIENT CAN SELECT BY:

- INFRARED KEYS AT DISPLAY WITHOUT REMOVING COVER
- USB CONNECTION
- HART OR FF OR PROFIBUS
- AUTOMATICALLY BASED ON:
 - GAS TEMPERATURE
 - GAS PRESSURE
 - GAS FLOWRATE
 - TIME
 - INPUT FROM GAS ANALZER

Challenges

- Complex gas composition
 - Click to edit Master text styles
 - Second level

FCI response

- Effects of variations in Gas composition can be minimized by multiple calibrations

GAS ANALYZER
ST100
TRANSMITTER



- Fou

■



ST100 HAS ANALOGUE INPUT AND HAS CALCULATION METHODS TO:

- AUTO SELECT APPLICABLE GAS MIX
- AUTO COMPENSATE OUTPUT BASED ON GAS ANALYZER UINPUT VALUES



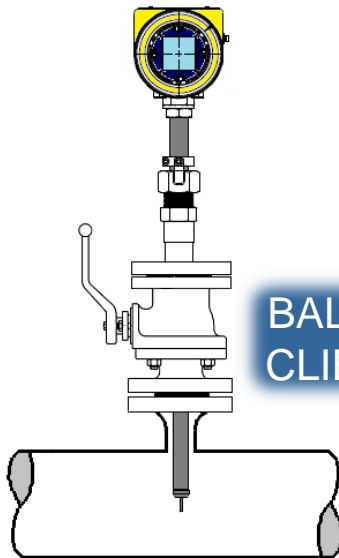
RETRACTABLE HOT TAPE INSTALLATION

ALLOWS RETRACTION UNDER PRESSURE

- NO DOWNTIME TO PLANT OPERATIONS
- MINIMAL LEAKAGE DURING RETRACTION
- SAFETY STOP PREVENTING FLOW ELEMENT TO BE PULLED FROM PIPE

Click to edit Master text styles

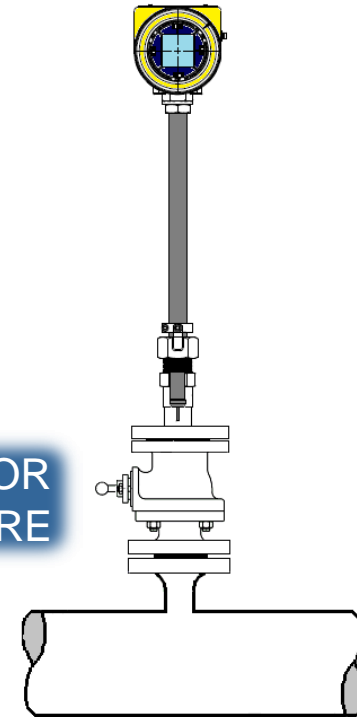
– Second level



level

1 level

BALL VALVE BY FCI, DISTRIBUTOR OR CLIENT, MINIMAL SIZE 1.5" FULL BORE



ST100 FE NORMAL OPERATION
WITH BALL VALVE OPEN

ST100 FE RETRACTED
WITH BALL VALVE CLOSED