

# FCI Industry Guide



**Chemical Industry**

**User Application Guide**



**FCI** FLUID COMPONENTS INTERNATIONAL LLC

**The mass flow experts for flow, level and temperature instrumentation**

## Solving critical process applications for the Chemical Industry



From the early 1960s, Fluid Components International recognized the need for flow and level instrumentation which met specific customer requirements and demands for the Chemical Industry. By utilizing Thermal Dispersion and Coriolis technology exclusively in all FCI flow, level, interface, temperature switches and mass flow meters, our products solve typical Chemical Industry application challenges with standard product features such as:

- › No moving parts
- › All welded materials of construction
- › Direct mass flow measurement
- › No pressure drop
- › Explosion-proof design
- › Wide flow range
- › Low flow capability

By closely monitoring the everchanging requirements for the Chemical Industry, FCI has maintained its reputation as the technology leader with new product features such as:

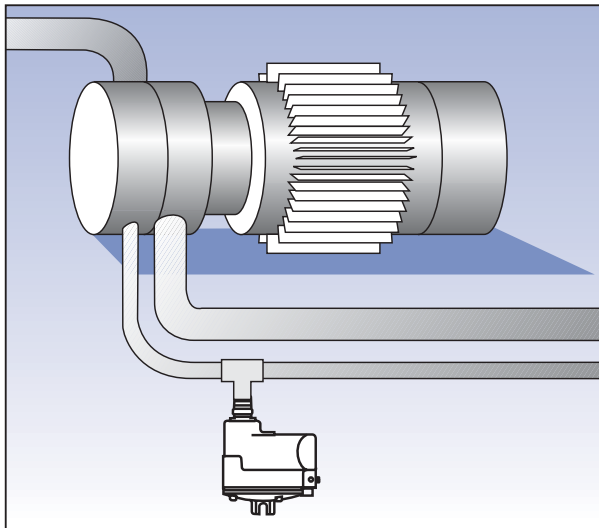
- › Modern digital communications with HART, Modbus, Profibus, Ethernet and ASI
- › Fail-safe mode selection per Namur NE43
- › Compliance with the latest approval requirements of FM, CSA, CRN, ATEX, CE Mark and PED
- › Application focused marketing and engineering research and design
- › Secondary sealed flow element sensor design
- › Integral flow conditioners
- › Two-wire loop-power flow, level and interface detection

### **FCI Chemical Industry customers**

- › Dow Chemicals/Union Carbide
- › Eastman Chemicals
- › Bayer
- › BASF
- › E.I. DuPont
- › General Electric Plastics
- › Reilly Chemicals
- › Monsanto
- › Rohm and Haas
- › Nova
- › Cytec
- › DeGussa
- › Aventis
- › Monsanto
- › Akzo
- › ATO Fina
- › Eka Chemicals
- › Engelhard
- › Oxychem

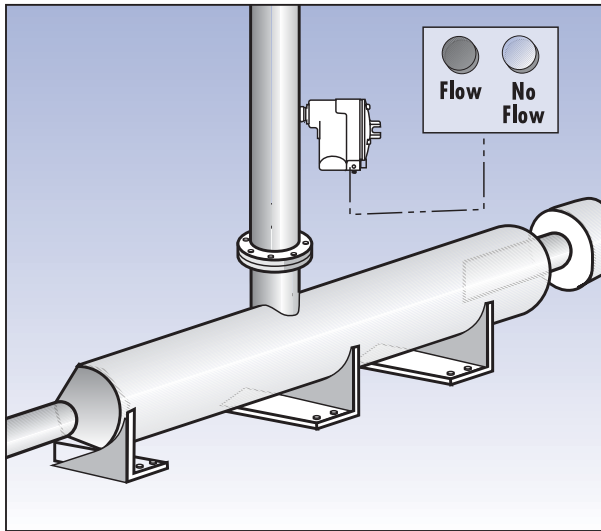
### **FCI Chemical Industry customers for Engineering, Procurement & Construction (EPC)**

- › Kvaerner
- › Foster Wheeler
- › Fluor Daniel
- › Raytheon
- › Stork
- › Lurgi
- › ABB Lummus
- › Mustang Engineering
- › Kellogg Brown & Root
- › KTI
- › AMEC
- › Stone & Webster
- › Jacobs Engineering
- › Howe-Backer
- › Technip



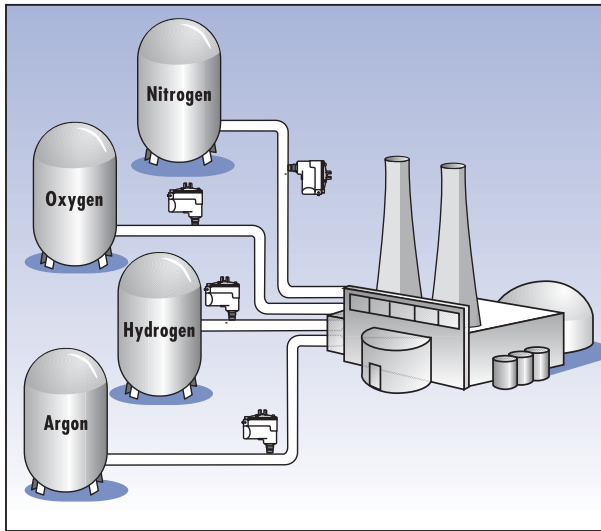
### **› Seal detection**

Rotating equipment, such as pumps, typically use a seal system to prevent process fluids from leaking into the atmosphere. These seals are charged with either an inert gas or a liquid similar to glycol. FCI's FLT93L FlexSwitch® inline flow switch is typically installed in the line feeding fluid to the pump to detect the extremely low flow volumes consumed by a normal operating seal. When a seal deteriorates, the leakage flow volume increases and is detected by the switch immediately activating a set point alarm for the operator to schedule an overhaul of the seal before actual contamination of process fluid appears. FCI offers various styles of inline flow switches capable of detecting flows as low as 0.05 cc/min in liquids and 1 cc/min in gases.



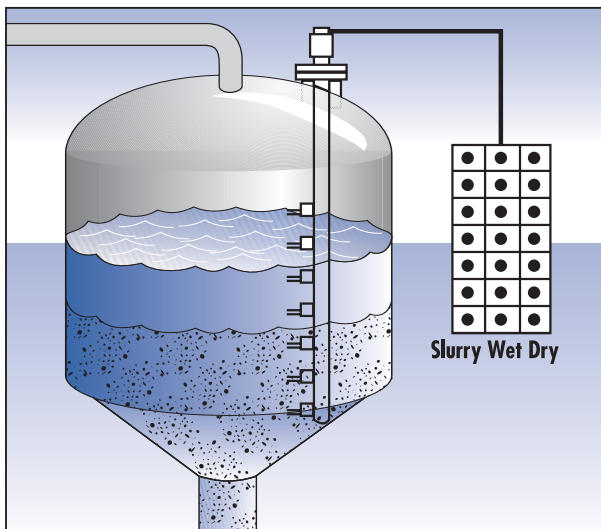
### > Pump protection

Pumping systems are extremely important to the safety and economical operation of chemical plants. Demand is very high for plant systems to be 100% operational with minimal downtime. As a result, flow monitoring for reliable and trouble-free pump protection is a necessary requirement. FCI's FLT93S FlexSwitch detects extremely low flow rates which can prevent the potential for pump-run-dry events. Preventative flow monitoring extends the pump lifecycle and increases the intervals between scheduled maintenance. The FLT93S FlexSwitch flow sensing element features no moving parts with all welded material of construction in virtually any kind of exotic metal. The flow switch features two adjustable alarms that can be set at low flow and no flow (indicating an empty pipe). Temperature compensation is a standard product feature that allows the alarm set points to be set for seasonal operating temperature ranges or start-up conditions. The FLT93S FlexSwitch is optimally installed in the feed line or discharge line of the pump.



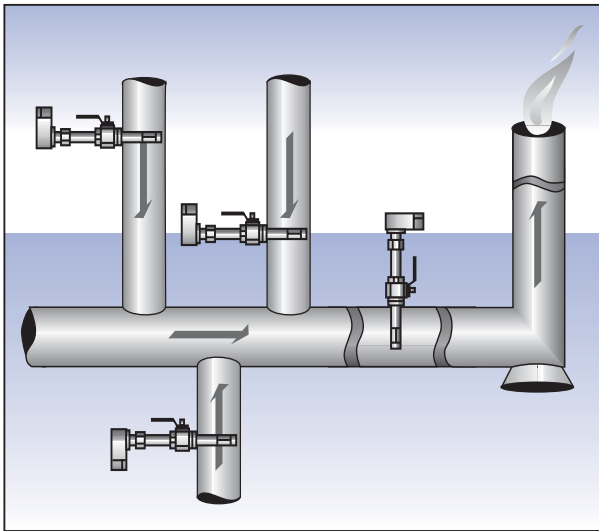
### > Gas distribution

Many chemical processes require large varying volumes of nitrogen, argon and oxygen for inert ion or purging, hydrogen as a catalyst, and many other gases. FCI's GF90 Series mass flow meters measure mass flow directly for process control and/or inventory purposes. FCI flow meters measure very low gas flows for leakage monitoring and are installed with no pressure drop in the process media. The GF90 Series features wide flow range turndown ratios up to 800:1 and integral or remote electronic configurations with HART, Profibus or Modbus in accordance with FM and ATEX approval standards. NIST traceable calibration certificates are supplied with every flow meter as a standard product feature.



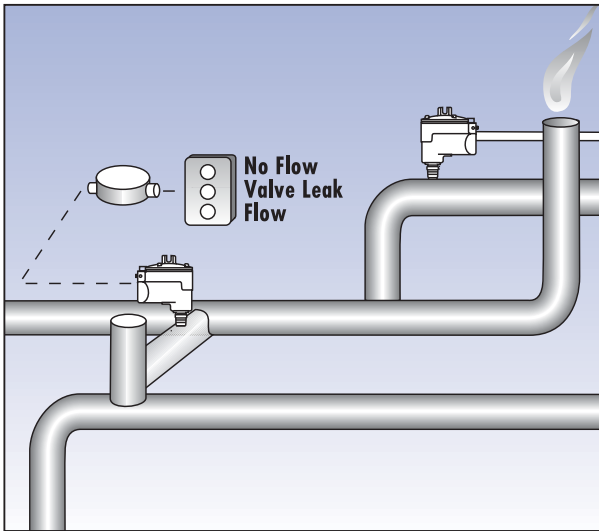
### > Level/interface detection

The reactor is often the central process of every chemical plant. FCI's FLT93 FlexSwitch Series is used for various applications to protect and insure the accuracy of reactor processes. FCI flow and level switch products feature rugged design with a high level of reliability. For low level monitoring, the FLT93S is mounted in the reactor or the reactor discharge line to detect an empty reactor thereby eliminating contamination between batches. The FLT93S is also used for high level monitoring and to detect the interface of foam or emulsion. Inside the reactor vessel, FCI multipoint level assemblies are used to detect interface levels and indicate non-miscible fluid volumes.



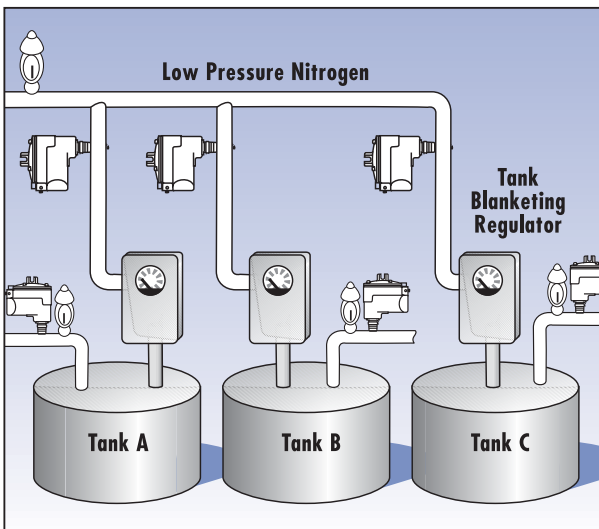
### > Flare/waste gas monitoring

A variety of industrial chemical environments use the FCI GF90 Series mass flow meters to measure total gas flow to flare stacks and in feed lines to the main flare headers. The GF90 Series features a no moving parts design, high reliability with durable construction and extremely low flow range detection as mandated by EPA regulations. FCI mass flow meters are also used to balance and optimize the control of steam addition, and blower/louwer adjustment for smokeless flares. An optional retractable packing gland assembly permits hot tap installation and retraction of the flow element without system shutdown. Microprocessor-based electronics and a built-in keypad provide user-friendly operation and maintenance, high performance, and easy on-site programming.



### > Relief valve flow monitoring

When installed in lateral lines or downstream of relief valves feeding into the main flare header, the FCI FLT93 FlexSwitch Series can quickly and precisely indicate the source of flare gas thereby allowing the plant operator to readily identify problems in the process. As a relief valve monitor in flare systems or other processes, one FLT93S FlexSwitch can be calibrated to detect product "blowdown" and leakage using the standard product features for sensing wide flow ranges and two set point alarms.



### > Nitrogen gas supply

In many plant operations, nitrogen is used to control the process media or avoid unwanted contact of the process media with oxygen/air. Reactors are filled and/or blanketed during operation with nitrogen. Continuous flow monitoring of nitrogen feed lines can prevent: excessive gas consumption, hazardous situations due to insufficient gas supply, and expensive gas leakages. FCI's FLT93 FlexSwitch flow switches and ST98 FlexMASter® Series flow meters are used for these applications and feature a wide flow range (turndown ratio), direct mass flow measurement, and no pressure drop in the process media.

## Serving critical process instrumentation needs around the world

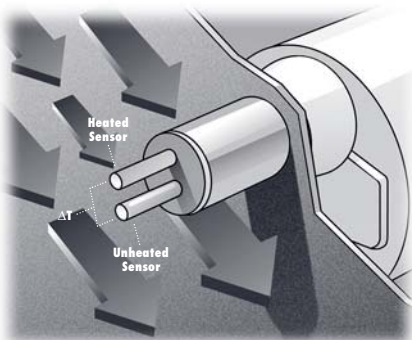


CI introduced the first thermal flow switch/monitor in 1964 and has since established a worldwide reputation for the design and production of precision high performance flow, level and temperature instrumentation. With reliability second to none, FCI has placed over 200,000 units in the field covering the full range of liquid, gas and slurry process requirements. FCI products service some of the world's most demanding processes in industries such as food & beverage, pharmaceutical, chemical, oil and gas, pulp and paper, power and energy, water and wastewater, nuclear power, aerospace and more. FCI offers a broad range of instrumentation solutions and services, from off-the-shelf devices to custom engineered systems. FCI's engineering staff provides expertise in mechanical, electronic and thermo-dynamic disciplines offering innovative solutions to specialized customer application needs, configuration objectives, software enhancements, and material problems.

### Thermal Dispersion principle

The typical sensing element contains two thermowell-protected precision platinum Resistance Temperature Detectors (RTDs). When placed in the process stream, one RTD is heated and the other RTD senses the process temperature. The temperature difference between the two RTDs is related to the process flow rate as well as the

*Thermal mass flow technology supports virtually all gas or air measurement needs. It is especially well suited for dirty gas because of its no-moving parts design with no orifices, bearings, or seals to foul or fail.*



*Product development, testing and calibration are performed in FCI's laboratory using NIST traceable equipment, which ensures highly reliable performance in hundreds of applications.*

properties of the process media. Higher flow rates or denser media cause increased cooling of the heated RTD and a reduction in the RTD temperature difference.

### FlexSwitch® FLT93 Series

The FLT93 Series utilizes proprietary thermal dispersion technology to provide the highest reliability in flow, level and temperature detection. The sensing element is composed of two matched RTD's. One RTD is preferentially heated. The other RTD is unheated and thermally isolated to provide continuous process condition temperature and baseline indication. At no flow or under dry conditions, the temperature differential between the two RTDs is greatest.

#### > For flow/no flow detection

No-flow conditions produce a large signal. As flow increases, the heated RTD is cooled and proportionally reduces the temperature differential. Changes in flow velocity directly affect this rate of heat dissipation. An electronic circuit normalizes the differential measurement with the process media temperature and converts

the RTD temperature/resistance differential into a DC voltage signal. This signal is provided at output terminals and used to drive two adjustable setpoint alarm circuits that are independently field configurable for specific flow service applications.

#### > For liquid level/ interface detection

Dry conditions (no liquids present) produce the greatest temperature differential. The signal decreases when the level element is submerged as the cooling effects of the fluid drive the temperature/resistance differential downward. Since all process fluids have different thermo physical properties, different fluids exhibit unique heat transfer characteristics. Interface detection between non-miscible fluids can be factory or field calibrated to alarm when the fluid changes from liquid to foam, between two different fluids, or between fluid and rag layer or emulsion.

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# FCI's complete line of flow, level and temperature instrumentation



ST98 FlexMASter



ST98HP FlexMASter



GF92



MT Series

## Thermal Mass Flowmeter Series

	<b>ST98 FlexMASter®</b> Insertion Gas Mass Flowmeter	<b>ST98L FlexMASter®</b> Inline Gas Mass Flowmeter	<b>ST98HP</b> <b>FlexMASter</b> Inline High Purity and Ultra High Purity Mass Flowmeter	<b>GF90</b> Insertion Gas Mass Flowmeter	<b>GF92</b> Inline Gas Mass Flowmeter	<b>GF03</b> Insertion Flare & Mixed Gas Mass Flowmeter	<b>MT Series</b> Multi-Point Mass Flowmeters
<b>Sensing/Flow Element Range</b>	0.75 to 600 SFPS* [0.21 to 172 NMPS]	0.0062 to 1850 SCFM* [0.01 to 3,140 NCMH]	2.0 to 3183 SCFM* [3.4 to 5409 NCMH]	0.25 to 1600 SFPS* [0.08 to 488 NMPS]	0.006 to 2000 SCFM* [0.01 to 3398 NCMH]	0.5 to 275 SCFM* [0.15 to 84 NCMH]	0.25 to 150+ SFPS* [0.08 to 46 NMPS]
<b>Adjustable Response Time</b>	N/A	N/A	N/A	N/A	N/A	N/A	N/A
<b>Process Connection</b>	3/4" male NPT stainless steel adjustable compression fitting with Teflon or metal ferrule. Flange connections and field retractable packing gland assemblies available.	Female NPT standard on 1" tubing; 1", 1.5" or 2" schedule 40 pipe; flange connections available.	3/4" to 4" [19 to 102 mm] with butt weld or sanitary flange connections. <b>Standard:</b> 14 Ra electropolish <b>Optional:</b> 10 Ra electropolish	1" male NPT. Flange connections and field retractable packing gland assemblies available.	3/4" female NPT standard. 1", 1.5" and 2" male or female NPT. Flange connections available.	1" male NPT standard. 1 1/4" male NPT. Flange connections and field retractable packing gland assemblies available.	2" male NPT or 3" 150 lb raised-face carbon steel flange. Other flange connection sizes and materials available.
<b>Insertion Length or Inline Sensor Assembly Body Length</b>	Field adjustable lengths: 1 to 6" [25 to 152 mm], 1 to 12" [25 to 305 mm] or 1 to 21" [25 to 533 mm]; custom lengths optional.	1" tubing/pipe: 9" [228 mm] 1.5" pipe: 13.5" [342 mm] 2" pipe: 18" [684 mm]	1" flow tube: 5.25" [133 mm]; 1.5" flow tube: 5.75" [146 mm]; 2" flow tube: 6.75" [171 mm]; 3" flow tube: 7.75" [197 mm]	Variable insertion lengths; customer specified.	1" tubing/pipe: 7.25" [184mm] 1.5" to 2" pipe: 12" [304mm]	Variable insertion lengths; customer specified.	Variable insertion lengths; customer specified.
<b>Enclosure Classification</b>	<b>Standard:</b> NEMA/CSA Type 4X (equivalent to IP66) and Division 2 (Ex n). <b>Option:</b> Aluminum is rated for hazardous location use Class I and II, Division 1 and 2, Group B, C, D, E, F, and G; and EEx d IIC and resists the effect of weather and corrosion.	<b>Standard:</b> NEMA/CSA Type 4X (equivalent to IP66) and Division 2 (Ex n). <b>Option:</b> Aluminum is rated for hazardous location use Class I and II, Division 1 and 2, Group B, C, D, E, F, and G; and EEx d IIC and resists the effect of weather and corrosion.	<b>Standard:</b> NEMA/CSA Type 4X (equivalent to IP66) and Division 2 (Ex n). <b>Option:</b> Aluminum is rated for hazardous location use Class I and II, Division 1 and 2, Group B, C, D, E, F, and G; and EEx d IIC and resists the effect of weather and corrosion.	<b>Standard:</b> Fiberglass NEMA Type 4X remote. <b>Option:</b> Aluminum and stainless steel enclosures are rated for hazardous location use(Class I and II, Division 1 and 2, Group B, C, D, E, F and G; and EEx d IIC) and resists the effect of weather and corrosion. NEMA and CSA Type 4X (meets IP66).	<b>Standard:</b> Fiberglass NEMA Type 4X remote. <b>Option:</b> Aluminum and stainless steel enclosures are rated for hazardous location use(Class I and II, Division 1 and 2, Group B, C, D, E, F and G; and EEx d IIC) and resists the effect of weather and corrosion. NEMA and CSA Type 4X (meets IP66).	<b>Standard:</b> Fiberglass NEMA Type 4X remote. <b>Option:</b> Aluminum is rated for hazardous location use(Class I and II, Division 1 and 2, Group B, C, D, E, F and G; and EEx d IIC) and resists the effect of weather and corrosion. NEMA and CSA Type 4X (meets IP66).	<b>Standard:</b> Carbon steel, epoxy coated NEMA Type 4. <b>Option:</b> Aluminum is rated for hazardous location use (Class I and II, Division 1 and 2, Group B, C, D and G; and EEx d IIC) and resists the effect of weather and corrosion. NEMA and CSA Type 4 (meets IP66).
<b>Sensing/Flow Element Operating Conditions</b>	<b>Temperature:</b> -40° to +350° F [-40° to +177° C] <b>Option:</b> -40° to +500° F [-40° to +260° C] <b>Pressure:</b> to 250 psig [17 bar(g)]	<b>Temperature:</b> -40° to +350° F [-40° to +177° C] <b>Pressure:</b> to 250 psig [17 bar(g)]	<b>Temperature:</b> -40° to +350° F [-40° to +177° C] <b>Pressure:</b> to 250 psig [17 bar(g)]	<b>Temperature:</b> -50° to +350° F [-45° to +177° C] <b>Option:</b> -100° to +850° F [-73° to +454° C] <b>Pressure:</b> to 1000 psig [69 bar(g)]	<b>Temperature:</b> -50° to +350° F [-45° to +177° C] <b>Pressure:</b> to 1000 psig [69 bar(g)]	<b>Temperature:</b> -50° to +350° F [-45° to +177° C] <b>Pressure:</b> to 1000 psig [69 bar(g)]	<b>Temperature (MT86/MT91):</b> -50° to +350° F [-45° to +177° C] <b>Option:</b> -50° to +850° F [-45° to +454° C] <b>Pressure:</b> to 50 psig [3.4 bar(g)]

\* Air at 70 °F [21.1 °C] and 14.7 psia [1.01325 bar (g)] (reference)



FLT93 FlexSwitch



12-64B and 8-66B



FR78B



NuTec FS2000L

## Flow, Level and Temperature Switch Series

<b>FLT93S FlexSwitch®</b> <b>FLT93F FlexSwitch®</b> Insertion Flow/Level/ Temperature Switches	<b>FLT93L FlexSwitch®</b> Inline Flow/Level/ Temperature Switch	<b>FLT93C FlexSwitch</b> Insertion Sanitary Flow/Level/Temperature Switch	<b>12-64B</b> Insertion Flow Switch <b>8-66B</b> Insertion Level/ Interface Switch	<b>FR78B</b> Low Flow Inline Monitor	<b>FR73B</b> Ultra Low Flow Inline Monitor	<b>NuTec® FS2000</b> Insertion Flow Switch <b>NuTec® LS2000</b> Insertion Level Switch	<b>NuTec® FS2000L</b> Inline Non-Intrusive Flow Switch																
Water-Based Liquids: 0.01 to 3.0 FPS [0.003 to 0.91 MPS]  Hydrocarbon-Based Liquids: 0.01 to 5.0 FPS [0.003 to 1.52 MPS]  Air/Gas: 0.25 to 120 SFPS [0.08 to 37 NMPS]	Water-Based Liquids: .015 to 50 cc/sec. [0.0009 to 3 lps]  Hydrocarbon-Based Liquids: .033 to 110 cc/sec. [0.002 to 6.6 lps]  Air/Gas: 0.6 to 20,000 cc/sec. [0.036 to 1197.6 lps]	Water-Based Liquids: 0.01 to 3.0 FPS [0.003 to 0.9 MPS]  Hydrocarbon-Based Liquids: to 5.0 FPS [0.0003 to 1.5 MPS]  Air/Gas: 0.25 to 120 SFPS [0.08 to 36.6 SMPS]	<b>12-64B:</b> Water-Based Liquids: 0.015 to 0.5 FPS [0.005 to 0.15 MPS] Hydrocarbon-Based Liquids: 0.01 to 2.0 FPS [0.003 to 0.61 MPS] Air/Gas: 1.0 to 125 SFPS [0.3 to 38 NMPS]  <b>8-66B:</b> Point Level/Interface	Water-Based Liquids: 0.08 to 2.25 cc/sec.  Hydrocarbon-Based Liquids: 0.05 to 25 cc/sec.  Air/Gas: 4.0 to 1500 cc/sec.	Water-Based Liquids: 0.01 to 1.25 cc/min.  Hydrocarbon-Based Liquids: 0.04 to 2 cc/min.  Air/Gas: 1.0 to 1000 cc/min.	<b>FS2000:</b> Water-Based Liquids: 0.015 to 1.5 FPS [0.045 to 0.45 MPS] Hydrocarbon-Based Liquids: 0.015 to 1.5 FPS [0.045 to 0.45 MPS] Air/Gas: 0.5 to 100 SFPS [0.15 to 30 SMPS]  <b>LS2000:</b> Point Level/Interface	Water-Based Liquids: 0.03 to 85.5 FPS [0.11 to 324 MPS]  Air/Gas: 0.02 to 342 SCFM [0.0006 to 9.70 NCMM]																
From 0.5 seconds	From 0.5 seconds	From 0.5 seconds	<b>Flow:</b> 10 to 300 seconds <b>Level:</b> From 5.0 seconds	1 to 150 seconds	1 to 150 seconds	0.5 to 2.5 seconds	From 0.5 to 2.5 seconds																
3/4" male NPT, 1" BSP, 1" male NPT; Flange connections and field retractable packing gland assemblies available.	1" male NPT or 3/4" female NPT both ends. Flange connections available.	3/4", 1", 1.5" and 2" sanitary flanges	1" male NPT	0.25" tubing x 1.8" [46 mm] long with 0.028" [0.7 mm] wall thickness; 0.375 and 0.50" tubing available.	0.125" OD tubing x 2" [50 mm] long with 0.028" [0.7 mm] wall thickness.	3/4" male NPT	<b>Standard:</b> Butt weld  <b>Optional:</b> Male NPT or sanitary flange																
Standard lengths of 1.2" [30 mm], 2" [51 mm], 4" [102 mm], 6" [152 mm], 9" [229 mm], 12" [305 mm], and 18" [457 mm], custom lengths available.	3.375" [86 mm]; custom lengths available.	<table border="1"> <thead> <tr> <th>Line Size</th> <th>Teel Length</th> </tr> </thead> <tbody> <tr> <td>3/4"</td> <td>5.25" [133 mm]</td> </tr> <tr> <td>1"</td> <td>4.75" [121 mm]</td> </tr> <tr> <td>1.5"</td> <td>5.50" [139 mm]</td> </tr> <tr> <td>2"</td> <td>7.00" [177 mm]</td> </tr> <tr> <td>2.5"</td> <td>5.68" [144 mm]</td> </tr> <tr> <td>3"</td> <td>7.50" [190 mm]</td> </tr> <tr> <td>4"</td> <td>9.00" [229 mm]</td> </tr> </tbody> </table>	Line Size	Teel Length	3/4"	5.25" [133 mm]	1"	4.75" [121 mm]	1.5"	5.50" [139 mm]	2"	7.00" [177 mm]	2.5"	5.68" [144 mm]	3"	7.50" [190 mm]	4"	9.00" [229 mm]	1.2" [30 mm], 2.0" [51 mm]	5.3" [135 mm]; Custom lengths available.	7.0" ± 0.25" [178 mm ± 6 mm]	2" [51 mm]; 6" [152 mm]; Custom lengths available.	9" [229 mm] male NPT; 6" [152 mm] butt weld or sanitary flange
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<b>Standard:</b> Aluminum is rated for hazardous location use (Class I and II, Division I and 2, Group B, C, D, E, F and G; and EEx d IIC) and resists the effect of weather and corrosion. NEMA and CSA Type 4X (meets IP66). <b>Option:</b> Stainless steel	<b>Standard:</b> Aluminum is rated for hazardous location use (Class I and II, Division I and 2, Group B, C, D, E, F and G; and EEx d IIC) and resists the effect of weather and corrosion. NEMA and CSA Type 4X (meets IP66). <b>Option:</b> Stainless steel	<b>Standard:</b> Aluminum is rated for hazardous location use (Class I and II, Division I and 2, Group B, C, D, E, F and G; and EEx d IIC) and resists the effect of weather and corrosion. NEMA and CSA Type 4X (meets IP66). <b>Option:</b> Stainless steel	<b>Standard:</b> Aluminum is rated for hazardous location use (Class I and II, Division I and 2, Group B, C, D, E, F and G; and EEx d IIC) and resists the effect of weather and corrosion. NEMA and CSA Type 4X (meets IP66).	<b>Standard:</b> No enclosure <b>Option:</b> Aluminum is rated for NEMA and CSA Type 4 and resists the effects of weather and corrosion (meets IP66).	<b>Standard:</b> No enclosure <b>Option:</b> Aluminum is rated for NEMA and CSA Type 4 and resists the effects of weather and corrosion (meets IP66).	<b>Standard:</b> Aluminum is rated for general purpose use (Class I and II, Division I and 2, Group B, C, D).	<b>Standard:</b> Weatherproof  <b>Optional:</b> Aluminum NEMA Type 4X and hazardous location use (Class I and II, Division I and 2, Group B, C, D, E, F and G; and EEx d IIC)																
<b>Temperature:</b> -40° to +500° F [-40° to +260° C] <b>Option:</b> -100° to +850° F [-73° to +454° C] <b>Pressure:</b> to 3500 psig [241 bar(g)]	<b>Temperature:</b> -40° to +500° F [-40° to +260° C] <b>Pressure:</b> to 2000 psig [138 bar(g)]	<b>Temperature:</b> -40° to +500° F [-40° to +260° C] <b>Pressure:</b> to 2000 psig [138 bar(g)]	<b>Temperature:</b> -100° to +350° F [-73° to +177° C] <b>Pressure:</b> to 3000 psig [207 bar(g)]	<b>Temperature:</b> -100° to +350° F [-73° to +177° C] <b>Pressure:</b> to 1000 psig [69 bar(g)]	<b>Temperature:</b> -100° to +350° F [-73° to +177° C] <b>Pressure:</b> to 1000 psig [69 bar(g)]	<b>Temperature:</b> -40° to +250° F [-40° to +121° C] <b>Pressure:</b> to 500 psig [35 bar(g)]	<b>Temperature:</b> -40° to +250° F [-40° to +121° C] <b>Pressure:</b> to 500 psig [35 bar(g)]																

### › *For temperature detection*

The unheated RTD serves as the baseline for establishing the differential temperature and continuous monitoring of the process temperature. Being thermally isolated, the unheated RTD provides accurate indication and detection of process fluid temperatures. Simultaneous temperature and flow and level detection can provide comprehensive process monitoring as well as critically supplement operator process health and efficiency awareness.

### **NuTec® 2000 Series**

#### › *2-wire loop-power and non-intrusive switches*

Extraordinarily responsive and accurate, the versatile NuTec flow/level switch series offers superior reliability in extreme process conditions. The FS2000 and LS2000 switches feature the first 2-wire thermal flow/no flow and level detection switches. These insertion switches are designed with FCI's proven thermal mass flow sensor technology in a rugged package that is easy to install and requires minimal maintenance. The FS2000L inline flow switch has an advanced non-intrusive sensor design constructed of 316L stainless steel with up to a 10 Ra electropolish finish approved for 3A sanitary and high purity applications. The FS2000L is available with inline sizes of 1/2 inch, 1 inch and 2 inches for easy installation using male NPT, butt-weld or sanitary flanges.

### **FlexMASter® ST Series and GF Series mass flow meters**

Because the relationship between flow rate and cooling effect directly relates to mass flow in gas applications, FCI thermal mass flow meters provide a highly repeatable and accurate measurement of gas or air mass flow rates. The ST98 Series "smart" electronics, equipped with advanced micro-processor-based circuitry, enable

customers to reconfigure the signal outputs easily, as well as, display or alarm in the field by using either a built-in key pad or a handheld communicator. The GF Series offers wide turndown ratios up to 800:1 with multiple gas calibrations with analog electronic circuitry.

FlexMASter technology delivers performance and value by offering the most innovative, accurate and cost effective gas mass flow measurement systems available in the industrial flowmetering marketplace today. This highly reliable instrument provides the durability and speed required for today's harsh process environments and delivers true direct mass flow measurement. FCI's FlexMASter simplifies gas mass flowmetering with a single process penetration, eliminating costly temperature or pressure transmitters and a flow computer required with other technologies.

### **CMF FlexCOR® Series**

The CMF FlexCOR Series Coriolis flow meters push development a giant leap forward in Coriolis measurement technology. Unaffected by variations in pressure, temperature, density, electrical conductivity and viscosity, the FlexCOR Series provides highly accurate mass flow measurement over wide flow ranges while utilizing its advanced technology to achieve unsurpassed operational performance stressing safety, reliability and quality.

### **VORTAB® flow conditioners**

FCI ensures the field performance of its highly accurate mass flow meter product lines by offering VORTAB flow conditioners. VORTABs ensure accurate, repeatable gas flow measurement and are the efficient alternative to long lengths of straight piping or ducting upstream of a flow meter installation location. VORTAB units reduce or eliminate pressure drop, swirl, jetting and

more, while requiring just six diameters of pipe upstream from the flow meter. Each of the three available flow conditioner configurations consist of a short section of swirl reduction tabs combined with three arrays of patented VORTAB profile conditioning tabs.

### **FCI's extensive instrument test and calibration laboratory**

FCI maintains an extensive, instrument test and calibration laboratory at its headquarters in San Marcos, California. Utilizing the latest in advanced, computerized data acquisition systems and calibration test equipment, this facility permits comprehensive product development, testing, and calibration. Any FCI product can be calibrated in accordance with customer specifications. Laboratory standards are maintained with NIST (National Institute of Standards and Technology) traceable Cavitating Venturis (CVs) and precision calibrated, pressure and temperature corrected turbine flow meters. Combustible and non-combustible gas calibration flow stands allow for the calibration of FCI products in a wide range of gases as gas mixtures in flow stand sizes as small as 1/8 inch to 30 inches [3 to 760 mm] in diameter. A variety of flow profiles from laminar to turbulent conditions are generated to duplicate actual field conditions. Flow rates from 0 to 20,000+ SCFM [0 to 34,000 NCMH], velocities from 0 to 800 SFPS [0-240 NMPS], pressures from vacuum to 3000 psig [200 bar(g)], and temperatures from -100° to 850°F [-70° to + 454°C].

### **FCI on-site instrument calibration and training**

In-situ calibration is available from FCI's Field Service Engineers where precise test and calibration is accomplished in actual media conditions.

NIST Net

**FCI** FLUID COMPONENTS  
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HART  
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