

FCI Industry Guide



Pharmaceutical 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 Pharmaceutical 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 Pharmaceutical 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 Pharmaceutical 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 Pharmaceutical Industry, FCI has maintained its reputation as the technology leader with new product features such as:

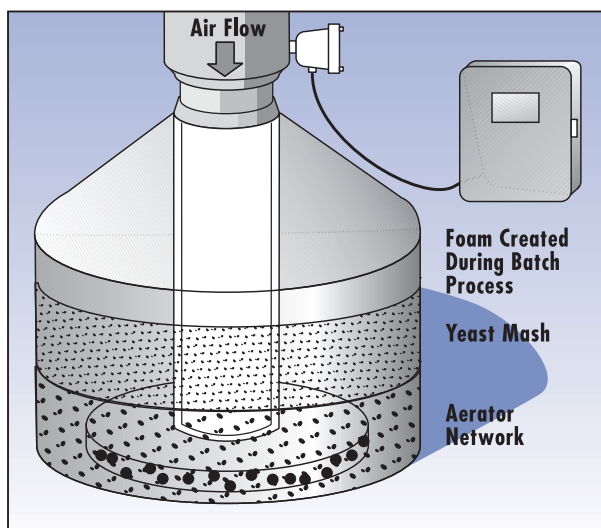
- › Modern digital communications with HART, Modbus, Profibus, Ethernet and ASI
- › Fail-safe mode selection per Namur NE43
- › Compliance with the latest approval requirements of FM, CSA, CRN, ATEX, CE Mark, and PED
- › Application focused marketing and engineering research and design
- › Secondary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

FCI Pharmaceutical Industry customers

- | | |
|----------------------|--------------------|
| › Abbott Labs | › Amgen |
| › Wyeth Labs | › Bayer AG |
| › Merck | › Bayer USA |
| › Pfizer | › Ciba-Geigy |
| › Bristol-Myers | › Hoechst Celanese |
| › Eli Lilly | › Hoffman LaRoche |
| › Roche | › Immunex |
| › Millipore | › Schering Plough |
| › Sani-Matic | › Searle |
| › Pharmacia & Upjohn | |

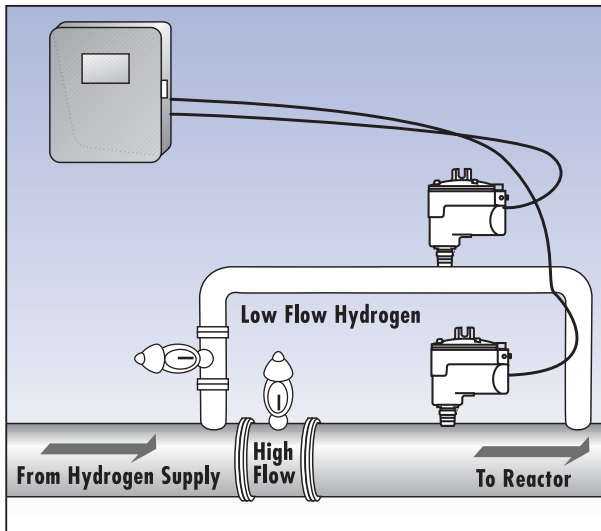
FCI Pharmaceutical Industry customers for Engineering, Procurement & Construction (EPC)

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



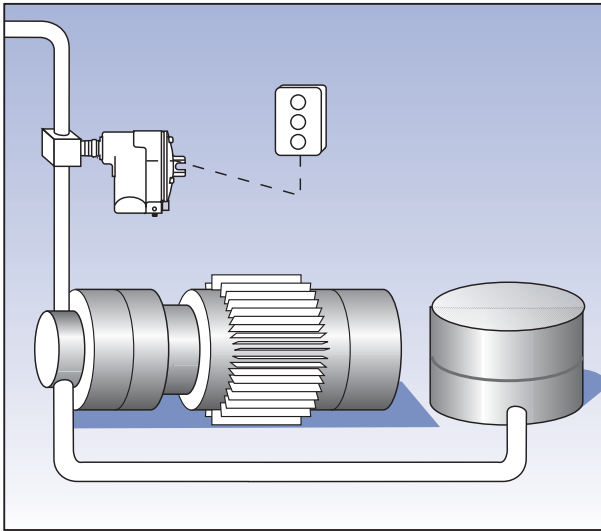
› Monitoring air flow and temperature

Food processors require proper air flow to ensure optimum growth and high quality of many products, for example -- yeast, cheeses, etc. A reliable and accurate flow meter for this application is FCI's ST98 FlexMASter® Series. The ST98 is installed on the air inlet line to the batching vessel to monitor inlet air flow and temperature. The 4-20mA output may be used to input the plant distributed control system or programmable controller.



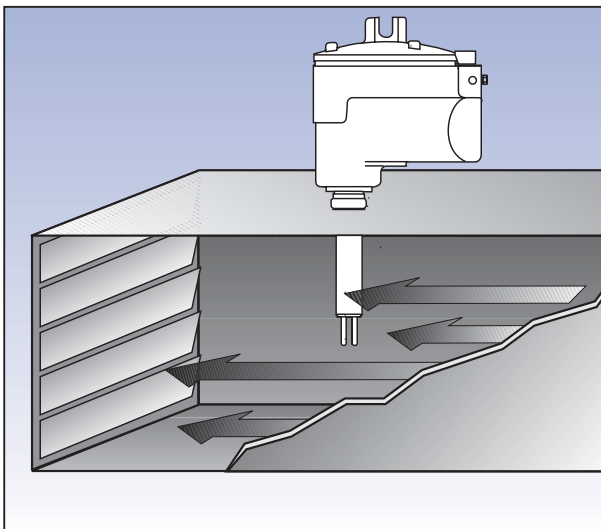
› Monitoring hydrogen bleed-off

Measuring hydrogen flow to a hydrogenation reactor is crucial in the manufacture of pharmaceuticals. Reduced hydrogen consumption by the process is a critical indication of the completion of the batching process. The ST98L FlexMASter Series, with its wide turn-down, is ideal for measuring flow during both the high demand batching process and the low demand at the completion of the batch. A second critical factor in this process is reducing hydrogen leaks to safe limits. An integrated system of FCI's inline mass flow meters is required to continuously measure the hydrogen flow. The ST98L provides accurate indications of uptakes of hydrogen in the reaction process. And coupled with a wide range totalizer, our system will serve as a much needed safety interlock by initiating a shut-down sequence to manage hydrogen bleed-off.



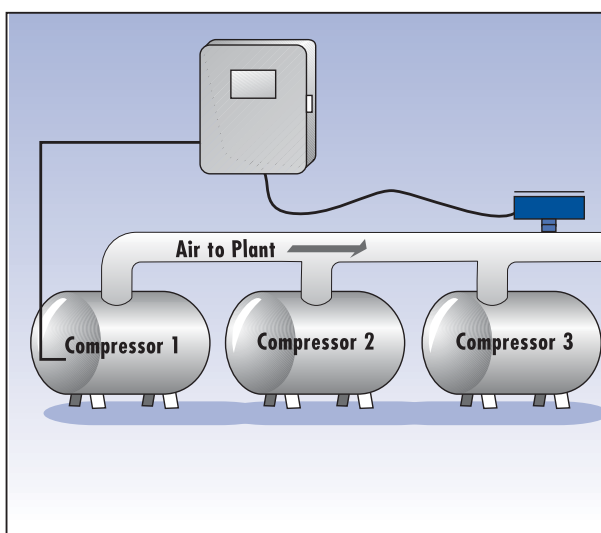
› Nitrogen tank blanketing/monitoring

Applicable in a variety of manufacturing industries, tank blanketing is being used worldwide. A low pressure "blanket" of inert gas, usually nitrogen, is injected into the vapor space of a storage tank above the liquid. The primary reason this is done is to avoid emission of toxic fumes, and prevent fire or explosion. FCI's ST98L FlexMASter Series installed upstream of the tank regulator monitors nitrogen flow rates. An FCI FLT93S FlexSwitch® Series can also be added to detect relief valve venting. With its standard dual switch point feature, it may be set to detect both the valve fully open and a leaking condition if it fails to seal properly.



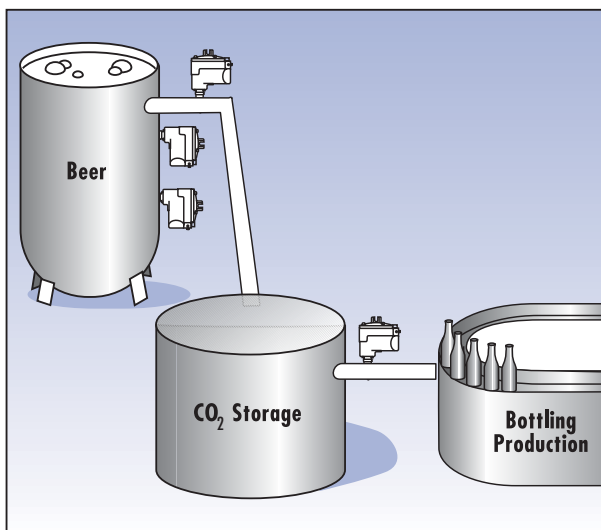
› Monitoring heating, ventilation and air conditioning (HVAC) systems

FCI has been a major supplier of flow switch/monitors for HVAC systems since 1978. Selected for its reliability and sensitivity, the FLT93F is available to meet standard industrial and commercial HVAC requirements. Models can be supplied for detecting at rates as low as 0.25ft/sec -- compared with differential pressure and mechanical flow detectors that become insensitive below 30ft/sec. By directly sensing flow, the FLT93F FlexSwitch Series is able to detect filter blockage, blocked ducts and other failures not detected by blower current monitoring detectors.



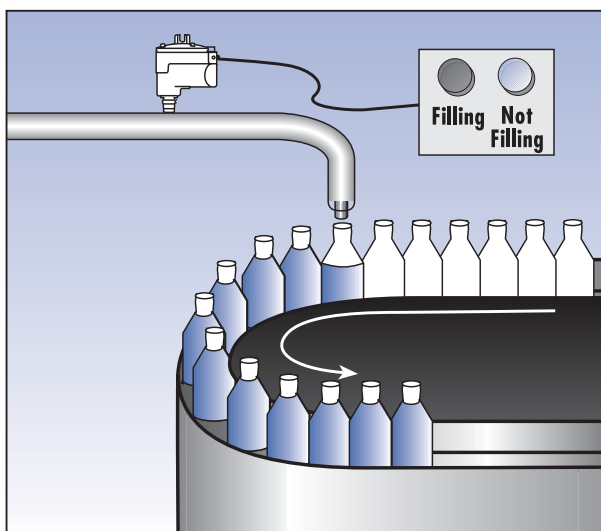
› Compressed air flow monitoring

Frequently, in a plant environment, there is a controller that monitors the use of compressed air within the facility. The controller automatically determines the optimum number of compressor units that need to be in operation at any given time to handle the facility load. By only operating the units that the demand requires, a tremendous amount of energy is saved. The demand is determined by the total mass flow of air used by the plant, and FCI's ST98 FlexMASter Series is designed specifically for this purpose. The controller then sets the compressor usage based on the mass flow rate indicated by the ST98.



› Low flow monitoring

Carbon dioxide is used in the bottling process to displace air from containers during filling and capping. Velocity flow meters are not suitable for this application because they are not able to accurately measure the widely varying mass flow rates encountered in start-up and low production periods. FCI's ST98 FlexMASter Series has the low flow sensitivity required for these start-up and low flow rates, as well as wide turndown capability to handle normal production rates for accurate accounting and quality control.



› Low flow switching

In the bottling business, there are many critical applications that depend on reliable indication of liquid flow. These include preventing carbon dioxide addition, stopping the bottling line, or shutting down chillers or refrigerant systems upon loss of product flow. FCI's FLT93C Sanitary FlexSwitch and FS2000L NuTec® inline flow switches are specifically designed to provide the highest level of dependability and cleanliness in these critical applications.

Serving critical process instrumentation needs around the world

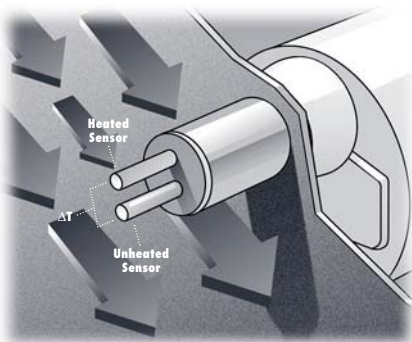


CI introduced the first thermal flow switch/monitor in 1964 and has since established a worldwide reputation for the design and production of precision high performance flow, level and temperature instrumentation. With reliability second to none, FCI has placed over 200,000 units in the field covering 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

	ST98 FlexMASter® Insertion Gas Mass Flowmeter	ST98L FlexMASter® Inline Gas Mass Flowmeter	ST98HP FlexMASter Inline High Purity and Ultra High Purity Mass Flowmeter	GF90 Insertion Gas Mass Flowmeter	GF92 Inline Gas Mass Flowmeter	GF03 Insertion Flare & Mixed Gas Mass Flowmeter	MT Series Multi-Point Mass Flowmeters
Sensing/Flow Element Range	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]
Adjustable Response Time	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Process Connection	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. Standard: 14 Ra electropolish Optional: 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.
Insertion Length or Inline Sensor Assembly Body Length	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.
Enclosure Classification	Standard: NEMA/CSA Type 4X (equivalent to IP66) and Division 2 (Ex n). Option: 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.	Standard: NEMA/CSA Type 4X (equivalent to IP66) and Division 2 (Ex n). Option: 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.	Standard: NEMA/CSA Type 4X (equivalent to IP66) and Division 2 (Ex n). Option: 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.	Standard: Fiberglass NEMA Type 4X remote. Option: Aluminum and stainless steel enclosures are 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).	Standard: Fiberglass NEMA Type 4X remote. Option: Aluminum and stainless steel enclosures are 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).	Standard: Fiberglass NEMA Type 4X remote. Option: 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).	Standard: Carbon steel, epoxy coated NEMA Type 4. Option: Aluminum is rated for hazardous location use (Class I and II, Division I 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).
Sensing/Flow Element Operating Conditions	Temperature: -40° to +350° F [-40° to +177° C] Option: -40° to +500° F [-40° to +260° C] Pressure: to 250 psig [17 bar(g)]	Temperature: -40° to +350° F [-40° to +177° C] Pressure: to 250 psig [17 bar(g)]	Temperature: -40° to +350° F [-40° to +177° C] Pressure: to 250 psig [17 bar(g)]	Temperature: -50° to +350° F [-45° to +177° C] Option: -100° to +850° F [-73° to +454° C] Pressure: to 1000 psig [69 bar(g)]	Temperature: -50° to +350° F [-45° to +177° C] Pressure: to 1000 psig [69 bar(g)]	Temperature: -50° to +350° F [-45° to +177° C] Pressure: to 1000 psig [69 bar(g)]	Temperature (MT86/MT91): -50° to +350° F [-45° to +177° C] Option: -50° to +850° F [-45° to +454° C] Pressure: 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

FLT93S FlexSwitch® FLT93F FlexSwitch® Insertion Flow/Level/ Temperature Switches	FLT93L Flexswitch® Inline Flow/Level/ Temperature Switch	FLT93C FlexSwitch Insertion Sanitary Flow/Level/Temperature Switch	12-64B Insertion Flow Switch 8-66B Insertion Level/ Interface Switch	FR78B Low Flow Inline Monitor	FR73B Ultra Low Flow Inline Monitor	NuTec® FS2000 Insertion Flow Switch NuTec® LS2000 Insertion Level Switch	NuTec® FS2000L Inline Non-Intrusive Flow Switch
Water-Based Liquids: 0.01 to 3.0 FPS [0.003 to 0.91 MPS]	Water-Based Liquids: .015 to 50 cc/sec. [0.0009 to 3 lps]	Water-Based Liquids: 0.01 to 3.0 FPS [0.003 to 0.9 MPS]	12-64B: 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]	Water-Based Liquids: 0.08 to 2.25 cc/sec.	Water-Based Liquids: 0.01 to 1.25 cc/min.	FS2000: 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]	Water-Based Liquids: 0.03 to 85.5 FPS [0.11 to 324 MPS]
Hydrocarbon-Based Liquids: 0.01 to 5.0 FPS [0.003 to 1.52 MPS]	Hydrocarbon-Based Liquids: .033 to 110 cc/sec. [0.002 to 6.6 lps]	Hydrocarbon-Based Liquids: to 5.0 FPS [0.0003 to 1.5 MPS]	Hydrocarbon-Based Liquids: 0.01 to 2.0 FPS [0.003 to 0.61 MPS]	Hydrocarbon-Based Liquids: 0.05 to 25 cc/sec.	Hydrocarbon-Based Liquids: 0.04 to 2 cc/min.	Hydrocarbon-Based Liquids: 0.015 to 1.5 FPS [0.045 to 0.45 MPS]	Hydrocarbon-Based Liquids: 0.03 to 85.5 FPS [0.11 to 324 MPS]
Air/Gas: 0.25 to 120 SFPS [0.08 to 37 NMPS]	Air/Gas: 0.6 to 20,000 cc/sec. [0.036 to 1197.6 lps]	Air/Gas: 0.25 to 120 SFPS [0.08 to 36.6 SMPS]	Air/Gas: 1.0 to 125 SFPS [0.3 to 38 NMPS]	Air/Gas: 4.0 to 1500 cc/sec.	Air/Gas: 1.0 to 1000 cc/min.	Air/Gas: 0.5 to 100 SFPS [0.15 to 30 SMPS]	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	8-66B: Point Level/Interface Flow: 10 to 300 seconds Level: 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	Standard: Butt weld Optional: 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.	Line Size 3/4" 1" 1.5" 2" 2.5" 3" 4" Tee Length 5.25" [133 mm] 4.75" [121 mm] 5.50" [139 mm] 7.00" [177 mm] 5.68" [144 mm] 7.50" [190 mm] 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
Standard: 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). Option: Stainless steel	Standard: 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). Option: Stainless steel	Standard: 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). Option: Stainless steel	Standard: 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).	Standard: No enclosure Option: Aluminum is rated for NEMA and CSA Type 4 and resists the effects of weather and corrosion (meets IP66).	Standard: No enclosure Option: Aluminum is rated for NEMA and CSA Type 4 and resists the effects of weather and corrosion (meets IP66).	Standard: Aluminum is rated for general purpose use (Class I and II, Division I and 2, Group B, C, D).	Standard: Weatherproof Optional: 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)
Temperature: -40° to +500° F [-40° to +260° C] Option: -100° to +850° F [-73° to +454° C] Pressure: to 3500 psig [241 bar(g)]	Temperature: -40° to +500° F [-40° to +260° C] Pressure: to 2000 psig [138 bar(g)]	Temperature: -40° to +500° F [-40° to +260° C] Pressure: to 2000 psig [138 bar(g)]	Temperature: -100° to +350° F [-73° to +177° C] Pressure: to 3000 psig [207 bar(g)]	Temperature: -100° to +350° F [-73° to +177° C] Pressure: to 1000 psig [69 bar(g)]	Temperature: -100° to +350° F [-73° to +177° C] Pressure: to 1000 psig [69 bar(g)]	Temperature: -40° to +250° F [-40° to +121° C] Pressure: to 500 psig [35 bar(g)]	Temperature: -40° to +250° F [-40° to +121° C] Pressure: 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
INTERNATIONAL LLC

Web: www.fluidcomponents.com

1755 La Costa Meadows Drive, San Marcos, California 92078 USA | Phone: 760-744-6950 | Toll free: 800-854-1993 | Fax: 760-736-6250

European Office: Persephonestraat 3-01 5047 TT Tilburg, The Netherlands | Phone: 31-13-5159989 | Fax: 31-13-5799036

ISO 9001:2000 and AS9100 certified

