



# Water and Wastewater Treatment Applications Guide

## Specifying Flow Instrumentation in Municipal Applications



- Aeration Air Flow Meters
- Digester Gas Flow Meters
- Pump Protection Low / No Flow Alarm
- Digester + Natural Gas Fuel Feed Controls to Cogen and CHP Engines
- Ozone Flow Meters
- Emergency Shower / Wash Station Flow Operation Signal
- Natural Gas Submetering
- Digester Gas Flare Flow Meter
- Odor Control and Ventilation Systems
- Disinfection Gas / Liquid Injection Assurance

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# Committed to the Water and Wastewater Industry

From aeration lines to digester gases, from disinfection processes to pump flow protection, the right flow measurement instrumentation ensures optimal process operations and minimized maintenance that will save you time and expenses. With more than 10 unique and optimized products to select from, FCI has installed more air/gas flow meters and flow switch solutions in wastewater and water treatment applications than any other supplier. Our global product and service support, along with local agency approvals, certifications, and compliance is further assurance that you can rely on FCI instrumentation in your facility wherever it is located. With products in continuous operation in WWTP and WTP facilities for 30 years and longer, FCI assures you of the highest quality, lowest maintenance, longest service life, and peerless expertise to maximize your instrumentation investment.

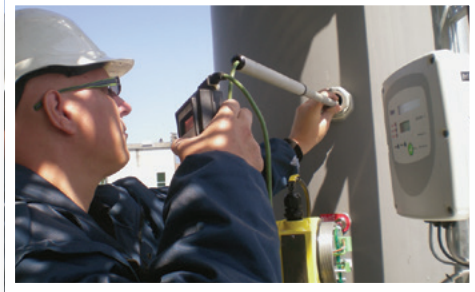
Whether you are adding process measurements, replacing under-performing flow technologies, undertaking major automation upgrades, or designing new or expanded facilities, FCI has the right choice products for air/gas flow measurement, water/liquid/air/gas flow switch and alarms, and point level applications in municipal and industrial WWTP and WTP operations.

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## FCI Thermal Dispersion Flow Meters, Flow Switches, Flow Conditioners, and Level Switches

- Experience and expertise
  - Largest installed base in municipal applications
- Superior flow meter calibrations
  - On-premises NIST/ISO traceable flow laboratory
  - Actual gas at process condition calibrations
  - Mixed gas composition calibrations
- Most extensive and comprehensive agency approvals for hazardous gas installations
  - Global instrument approvals: FM, FMc, ATEX, IECEx, NEPSI, CPA, INMETRO, EAC/TR CU, UKCA, ECAS, and more
- Most extensive and comprehensive offering of industrial bus communication protocols
  - HART, Modbus, PROFIBUS-DP, PROFIBUS-PA and FOUNDATION™ Fieldbus
- Global sales and post-sale service support
  - Field service
  - Local repair and recalibration depot service
  - Installation and start-up assistance
  - Local sales and application engineering in more than 60 countries



## FCI Customer Commitment

FCI is focused on providing superior support to end users, engineers and contractors to ensure each project is successful and not burdened with issues that could have been easily resolved on the front end. To achieve this, FCI and our experienced and dedicated sales representatives and distributors are here to assist in various stages of the project from FEED to start-up.

- Development of instrument data sheets and general specifications
- Application evaluation and product selection
- Assistance with detailed engineering submittals
- Site visits to review as-built versus design conditions
- Start-up assistance and on-site training by FCI Field Services or local FCI representative

## What Our Customers Are Saying

***"...Repeatable ...confident in using... we are very happy with FCI flow meters."***

– Supervisor, Municipal Water Treatment Plant





# Increasing Wastewater Treatment Plant Efficiency

From the world leader in wastewater treatment plant air/gas flow measurement, and water/liquid and flow switches/alarms, use this guide to learn how to put FCI flow solutions to work for you.



Collection Sewers

## FLT93 Liquid and Air/Gas Flow Switch, Level Switch

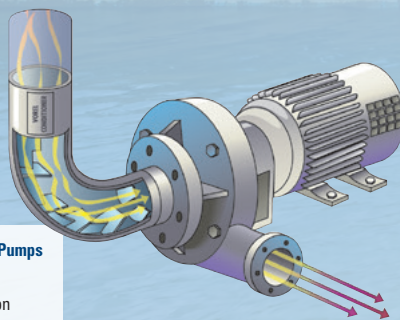
Applications: Pump flow assurance, clarifier level detection

- Dual relay outputs
- Best-in-class accuracy and repeatability
- Most extensive installation choices
- Temperature compensated
- Longest life, robust construction



Pumping Systems

Bar Screening



## VEL Elbow Flow Conditioner for Pumps

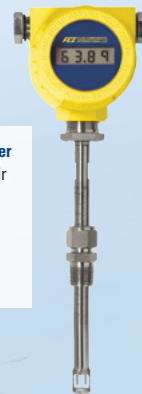
Applications: Extends pump life

- Eliminate swirl, reduce cavitation
- Reduce pump impeller wear, increase bearing life
- Lower pump maintenance costs
- Save space on inlet pipe straight-run

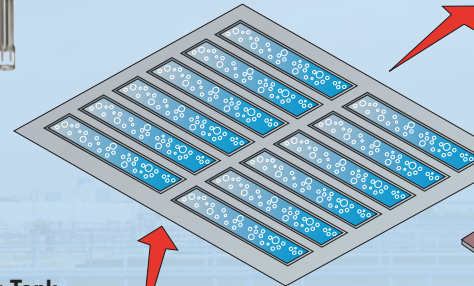
## ST50 Economical Aeration Flow Meter

Applications: Air and compressed air

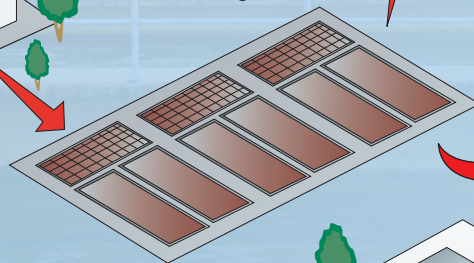
- Optimized for aeration lines
- Lowest cost solution
- Small, compact
- Integral or remote display options



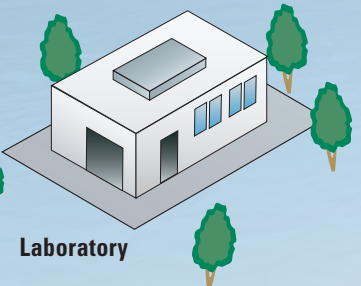
Aeration Tank



Settling Tank



Belt Presses



Laboratory



#### ST75 Economical Gas Flow Meter for Smaller Line-Sizes

Applications: Natural gas, fuel gases, disinfection gases

- Low cost mass flow measurement solution
- Dual 4-20 mA and pulse outputs
- For 1/4" to 2" [6 mm to 50 mm] line sizes
- Small, lightweight, yet rugged



#### ST102AA Dual-Point, Averaging Air Flow Meter for Large Line Sizes

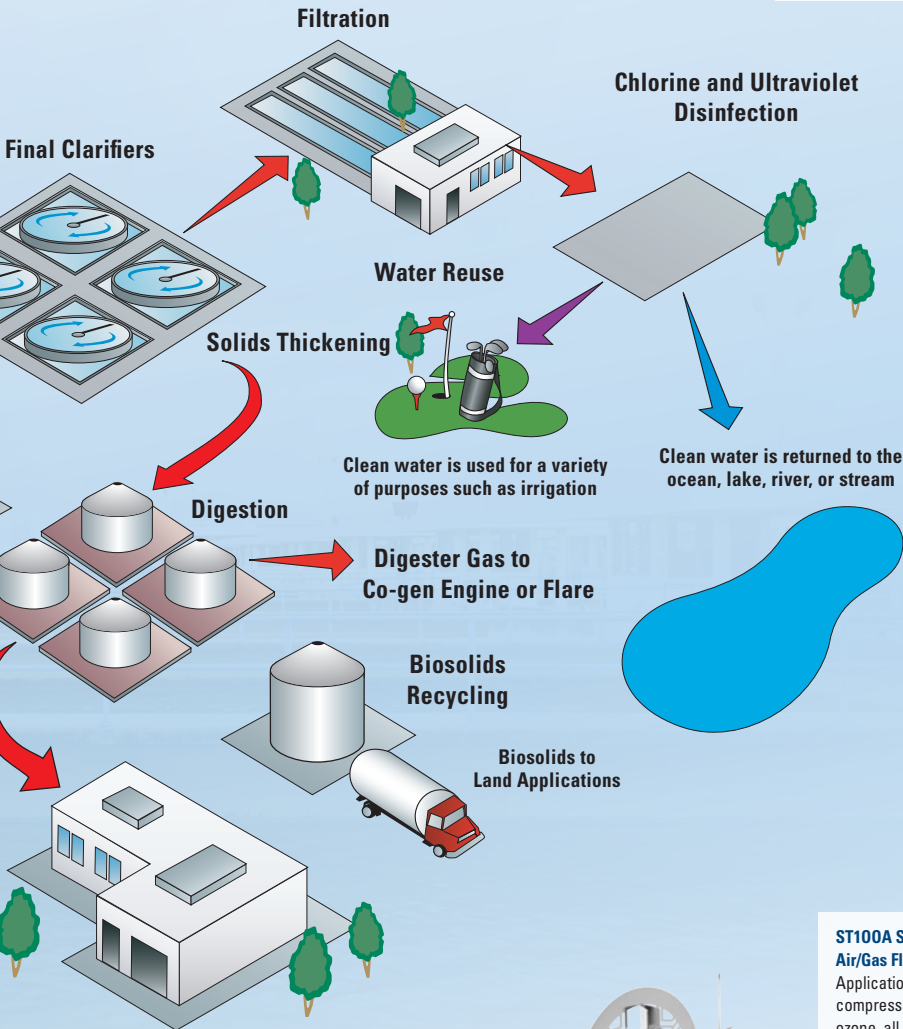
Applications: Aeration blower main headers, odor control systems

- Higher accuracy in line sizes  $\geq 12"$  [305mm]
- No moving parts, no orifices to foul or clog
- Wide 100:1 turndown
- Flexible installation, process connection
- Analog and digital bus communications
- Calibration self-checking, advanced diagnostics

#### ST80 Series All Purpose Air/Gas Mass Flow Meters

Applications: Aeration blower and compressor air, digester gas, natural gas, ozone, all gases

- Dual 4-20 mA outputs, HART and Modbus included
- Rugged, heavy-duty transmitter
- Excellent 1% rdg accuracy
- Optional onboard set-up buttons and digital/graphical readout
- Optional PROFIBUS communications
- Special "wet gas" sensor for digester applications
- Advanced self-checks and diagnostics



#### ST51/51A Economical Digester Gas Flow Meter

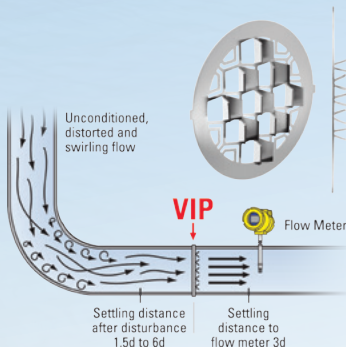
Applications: Digester gas, natural gas, aeration blower, and compressed air

- Small, compact size, yet rugged
- Low cost solution
- Dual 4-20 mA and pulse outputs
- Simple threaded insertion style
- Integral or remote display options
- HART and Modbus options

#### Vortab VIP Flow Conditioner for FCI Flow Meters

Applications: Straight-run limited aeration lines, ozone lines

- Use with FCI Models ST50, ST51/51A, ST80, and ST100A
- Low cost, easy to install
- Lowest pressure drop technology
- Flange-mount or weld-in-place
- Reduces straight-run requirement by up to 77%



#### ST100A Series High Performance Air/Gas Flow Meters

Application: Aeration blower and compressor air, digester gas, natural gas, ozone, all gases

- Multi-function: Flow rate, totalized flow, and temperature
- Triple 4-20 mA and freq/pulse outputs, HART and Modbus included
- Best-in-class 0.75% accuracy
- Calibration self-check and advanced diagnostics
- Optional PROFIBUS communications
- Exclusive "wet gas" sensor for digester apps







## FCI offers measurement and control solutions for many key applications in wastewater and water facilities

FCI has proven our product capabilities through successful implementation in many applications within water and wastewater treatment facilities.

### Wastewater Treatment



#### **Aeration Blower Systems**

In order to optimize the efficiency of aeration basin blower systems under varying demands, accurate mass flow measurement of each drop line and the blower's main header is advantageous. Volumetric flow measurement is inadequate due to temperature and pressure variations that will negatively impact measurement accuracy and repeatability in these installations. Based on the staging of multiple blowers, instruments with wide flow turndown capabilities as high as 100:1 are best suited to maximize the benefits of today's variable speed blowers. In applications with limited piping straight run, as found in many modern aeration systems, FCI uses Vortab flow conditioners to ensure the flow meter solution achieves the accuracy and repeatability performance specified in the actual installation.



#### **Anaerobic Digestion/Biogas Systems**

Digester gas consists of methane, CO<sub>2</sub> and other trace elements and requires mass flow measurement to properly quantify production in order to meet environmental regulations. This gas can be used for on-site power (cogeneration), processed into renewable natural gas (RNG), allowing for the captured CO<sub>2</sub> to be used for water treatment or sold, or flared to minimize the impact on the environment. Volumetric flow measurements are inadequate. The ability to measure flow velocities as low as 0.25 SFPS [0,08 NMPS] is often required. Capacity demand can require instrumentation with flow turndown capabilities as high as 100:1. Instruments with no moving parts or small ports that can be fouled by particulates in the gas stream are preferred. When it is not economically feasible to remove water from the biogas, it is important to select an instrument that is not affected by entrained moisture in order to ensure measurement accuracy and repeatability. Gas specific calibrations ensure overall performance of the mass flow meter under actual field conditions. The use of flow conditioners (Vortab VIP) allows for reducing the footprint of the digester room.



#### **Cogeneration and Combined Heat and Power (CHP) Systems**

It is common to use digester gas/biogas to help power co-generation and CHP systems. Depending upon the amount of digester gas/biogas produced at any given time, a supplemental supply of natural gas (NG) may be required. It is essential to understand the calorific value of the digester gas feed in order to supplement it with the correct

amount of NG, maintaining a proper ratio to ensure the calorific value of the blended gas being fed to the engine. Mass flow measurements maintain this proper ratio in order to achieve higher energy efficiencies. Volumetric flow measurements are inadequate. Capacity demand requires instrumentation with flow turndown capabilities as high as 100:1. Gas specific calibrations ensure overall performance of the mass flow meter under actual field conditions. The use of flow conditioners (Vortab VIP) allows for reducing the footprint of meter runs.



### **Renewable Natural Gas (RNG)**

The demand for renewable energy increases every year. As a result, converting digester gas to RNG through biomethane upgrading for both site usage and wholesale is an increasing trend within the industry. Stripping out the  $\text{CO}_2$ ,  $\text{O}_2$ ,  $\text{N}_2$  and other impurities produces a high methane content, utility grade gas. Whether it is to determine fuel flow to processes such as cogeneration or a “check” meter prior to custody transfer to a pipeline, mass flow readings are desirable. Capacity demand requires instrumentation with flow turndown capabilities as high as 100:1. Gas specific calibrations ensure overall performance of the mass flow meter under actual field conditions. The use of flow conditioners (Vortab VIP) allows for minimizing the footprint of skid mounted systems and for maximizing meter performance in limited piping straight run system designs.



### **Digester Gas/Biogas Flare Systems**

In order to meet environmental guidelines, the use of a flare system is common to eliminate methane ( $\text{CH}_4$ ) emissions. Mass flow measurements are required to properly quantify production in order to meet environmental regulations. Volumetric flow measurements are inadequate. The ability to measure flow velocities as low as 0.25 SFPS [0.08 NMPS] is often required. Capacity demand requires instrumentation with flow turndown capabilities as high as 100:1. Instruments with no moving parts or small ports that can be fouled by particulate in the gas stream are preferred. When it is not economically feasible to remove water from the biogas, it is important to select an instrument that is not affected by entrained moisture in order to ensure measurement accuracy and repeatability. Gas specific calibrations ensure overall performance of the mass flow meter under actual field conditions. The use of flow conditioners (Vortab VIP) allows for reducing the footprint of the flare skid.



### **Aerobic Digestion Systems (Biological Aeration/Activated Sludge)**

Accurate and repeatable mass flow measurement of air flow to biological aeration tanks is critical when it comes to operating at maximum efficiency. Volumetric flow measurements are inadequate to ensure the correct amount of  $\text{O}_2$  is delivered to the biological media for efficient biodegradation of organic materials. Capacity demand requires instrumentation with flow turndown capabilities as high as 100:1. In applications with limited piping straight run, as found in many modern aeration systems, FCI uses Vortab flow conditioners to ensure the flow meter solution achieves the accuracy and repeatability performance specified in the actual installation.



### **Aerated Grit Removal Systems**

Proper aeration ensures that the majority of grit particles remain in suspension for their removal from the influent. Mass flow measurement is required to adjust the process for variations in the volume of raw water being processed in order to operate at maximum efficiencies. Volumetric flow measurements are inadequate. Capacity demand requires instrumentation with flow turndown capabilities as high as 100:1.



### **Odor Control Systems**

To ensure performance of scrubber, biological, or activated carbon absorption systems, mass flow measurement of air that is carrying trace components for elimination is required. The ability to measure flow velocities as low as 0.25 SFPS [0,08 NMPS] is often required. Capacity demand requires instrumentation with flow turndown capabilities as high as 100:1. It is also crucial that instruments utilize wetted materials that are chemically compatible with wet hydrogen sulfide ( $H_2S$ ), such as Hastelloy, to extend their useful life. When it is not economically feasible to remove water from the biogas, it is important to select an instrument that is not affected by entrained moisture in order to ensure measurement accuracy and repeatability. In cases where higher accuracy is required in line sizes greater than 12 inches [304 mm], the use of a multipoint, averaging flow meter may be desirable.

## **Water Treatment**



### **Ozone Generation Systems**

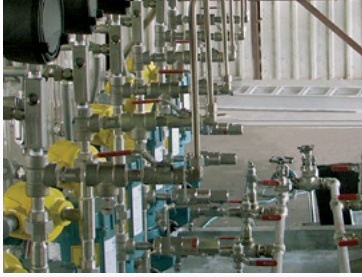
Whether oxygen or air fed, accurate mass flow measurement ensures operation of the system under varying conditions. Inaccurate measurements can negatively impact efficiencies and lead to poor water quality. Volumetric flow meter solutions are inadequate due to lack of temperature and pressure compensation. Capacity demand requires instrumentation with wide flow turndown capabilities as high as 100:1. Gas specific calibrations ensure overall performance of the mass flow meter under actual field conditions. The use of flow conditioners (Vortab VIP) allows for minimizing the footprint of skid mounted systems and for maximizing meter performance in limited piping straight run system designs. Further, flow meter suppliers should be capable of providing industrial oxygen cleaning of their flow meters.



### **Filtration Systems**

To ensure filtration media is performing properly, monitoring the throughput is advantageous. Utilizing a low flow switch can alert operators to undertake preventative maintenance measures before an unplanned shutdown occurs due to filter blockage. Flow switches without moving mechanical parts are preferred to reduce risk of unplanned maintenance and added repair costs.





### **Chemical Injection/Additives (Chemical Feed Systems)**

Sodium hypochlorite, calcium hypochlorite, sodium bisulfate, sodium hydroxide (caustic soda), and other additives are introduced at various stages in the treatment process for the purpose of removing chemicals and biological agents, as well as balancing pH. Given the relatively small volumes being injected into the process, it is important to select an instrument capable of monitoring flows as small as 0.015 cc/sec to ensure a minimum feed is maintained. Flow switches provide an independent verification that the system is operating properly. It is also crucial that instruments utilize wetted materials, such as Hastelloy, to extend the useful life of instruments.



### **Pump Conditioning**

Proper operation involves a uniform, swirl-free velocity profile at the pump inlet. If conditions are poor, pumps could be subject to cavitation, noise or uneven bearing wear, leading to excessive maintenance, premature wear, and unscheduled shutdowns. Inadequate straight run of piping on the suction side of the pump occurs frequently. A common condition is a piping elbow installed directly to the pump inlet, creating a non-uniform profile across the impeller. In these instances, performance can be improved and premature pump failure eliminated through the installation of Vortab elbow flow conditioners (VEL). The VEL will ensure the inlet flow has a uniform, swirl-free velocity profile, preferably optimized to limit permanent pressure loss that will impact the pump efficiency.



### **Chlorinator Systems**

To ensure proper dosing, the chlorine disinfection system must maintain optimal performance. Measuring the mass flow of the chlorine gas has proven to be more reliable than assuming flow based only on the control valve position. As such, accurate and highly repeatable measurements are required. The ability to achieve up to 100:1 flow turndown and make measurements as low as 0.25 SFPS [0,08 NMPS] prevents the waste of chlorine or the need for re-treatment while providing a consistent water quality to customers. Often, an in-situ calibration adjustment is preferred to further improve upon the reliability of the measurement. Due to the highly corrosive nature of chlorine gas, wetted materials such as Hastelloy are used to extend the useful life of the instruments.



### **Carbon Dioxide (CO<sub>2</sub>) Systems**

Injecting CO<sub>2</sub> into permeate water can assist in balancing pH through the formation of carbonic acid that will neutralize alkalis and help maintain an appropriate amount of calcium bicarbonate. This type of treatment is deemed safer than the use of sulfuric acid and provides additional cost and environmental benefits. Inaccurate measurements can negatively impact system efficiencies. Volumetric flow measurements are inadequate given the operating pressures and temperatures involved. Capacity demand requires instrumentation with flow turndown capabilities as high as 100:1. Gas specific calibrations ensure overall performance of the mass flow meter under actual field conditions. The use of flow conditioners (Vortab VIP) allows for minimizing the footprint of skid mounted systems and for maximizing meter performance in limited piping straight run system designs.



## General



### **Pump Protection**

Given the constant demands on pumps, it is important that they are operating at maximum efficiency. Pump damage can be prevented by monitoring the seal water feeds to gland packing (stuffing boxes) and mechanical seals, extending the maintenance cycle and life of the pump itself. Flow/no-flow verification can be achieved economically and effectively by monitoring the pump outlet to ensure damage does not occur from excessive heat, loss of flow, or absence of liquid commonly related to a dead-head condition. Flow switches with dual, independently adjustable relays can monitor and alarm on both low flow and either high temperature or absence of liquid conditions in a single instrument. Designs free of moving parts are beneficial, reducing maintenance, repair costs, and downtime often associated with mechanical designs.



### **Control Room Ventilation**

Monitoring inlet and exhaust air ensures control rooms are properly ventilated for the safety of personnel. Whether a simple flow switch to ensure a minimum air supply is met, or continuous monitoring to adjust for changes in demand, repeatable measurements are required. It is preferable to select an instrument that can detect and measure flows as low as 0.25 SFPS [0,08 NMPS]. For flow switches, mechanical designs that have specific orientation requirements are not desirable. Designs free of moving parts are inherently more reliable.



### **Emergency Eyewash/Shower Systems**

For safety of personnel, it is critical to know when emergency eyewash and shower systems are in use and that the required minimum flow rate of water is met for adequate drenching or flushing of the eyes and body. Selecting instrumentation with in-situ calibration and failsafe capabilities ensures that the minimum flow is detected when there is a demand. Mechanical flow switches that are not adjustable have orientation requirements and must be proof tested regularly to ensure proper operation. Designs free of moving parts are beneficial, reducing maintenance, repair costs, and downtime often associated with mechanical designs.



### **Natural Gas Submetering**

Many heating processes within a facility require natural gas (NG) as a fuel source. Submetering NG distribution provides greater value in understanding operating costs throughout a plant. Mass flow measurement is required to fully understand the calorific value of the NG feed as well as maintaining a proper air ( $O_2$ ) to NG ratio in order to achieve higher energy efficiencies. Volumetric flow measurements are inadequate. Capacity demand requires instrumentation with flow turndown capabilities as high as 100:1. Gas specific calibrations ensure overall performance of the mass flow meter under actual field conditions. The use of flow conditioners (Vortab VIP) allows for reducing the footprint of meter runs.

## FCI Thermal Mass Air/Gas Flow Meters

■ = Standard / Available

□ = Available Option



Model	ST50	ST51 / ST51 A	ST75 / ST75 A	ST80 Series	ST100 A Series
Air/Gases	■	■	■	■	■
Pipe Sizes Compatible	2.5" to 30" [63 mm to 760 mm]	2.5" to 30" [63 mm to 760 mm]	1/4" to 2" [6 mm to 51 mm]	1" to >60" [25 mm to 1525 mm]	1" to >60" [25 mm to 1525 mm]
Aeration Air	■	■	■	■	■
Digester Gas		■	■	■	■
Flared Gases		■	■	■	■
Natural Gas		■	■	■	■
Nitrogen	■	■	■	■	■
Oxygen			■	■	■
Ozone			■	■	■
Others			■	■	■
Basic Accuracy	2% or 1%	2% or 1%	2% or 1%	1%	0.75%
Vortab Flow Conditioners Available?	□	□	□	□	□
Flow Rate	■	■	■	■	■
Totalized Flow		■	■	■	■
Temperature		■	■	■	■
4-20 mA	■ (2)	■ (2)	■ (2)	■ (2)	■ (3)
Pulse/Frequency	□	■	■		■
HART		□	□	■	■
Modbus		□	□	■	■
PROFIBUS-DP				□	
PROFIBUS-PA				□	□
FOUNDATION™ Fieldbus				□	□
Serial/PC Connection	■ (RS232 via RJ11)	■ (RS232 via RJ11)	■ (RS232 via RJ11)	■ (USB)	■ (USB)
DC Power	■	■	■	■	■
AC Power	■	■	■	■	■
Digital Readout/Display	□	□	□	□	□
On Board Buttons				□	□ (With Display)
Self-Checking and In-situ Verification				■	■
FCI Exclusive "Wet Gas" Sensor				□	□



## FCI Flow, Level, and Interface Switches

■ = Standard / Available

□ = Available Option



Model	FLT93	FS10A	FS10i
Flow Switch, Water/Liquids	■	■	■
Flow Switch, Air/Gases	■	■	■
Level Switch, Water/Liquids	■		
Level Interface Switch	■		
Liquid Pump Protection/Alarm	■		
Disinfection Liquid or Gas Flow Assurance	■		
Liquid Analyzer Sampling	■	■	
Gas Analyzer Sampling	■	■	
Ventilation Safety/Assurance	■	■	■
Safety Shower/Eye Wash Use Alarm	■		■
Relay Output	■ (Dual, 6A)	■ (Single, 1A)	■ (Single, 1A)
Open Collector Output		□	□
4-20 mA Monitoring Output		■	■
DC Power	■	■	■
AC Power	■		



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