

FCI Green Energy Applications Guide

Specifying Gas Flow Meters in Green Energy
and Pollution Reduction Applications

Biogas-to-Energy



Greenhouse Gas Reduction



Methane-to-Market

Emissions Measurement,
Control & Reduction



- Landfill Gas Recovery
- Biogas/Organic Biomass Fermentation Systems
- Wastewater Treatment Plant Digester Gas
- Livestock and Dairy On-Farm Biogas Recovery
- Ethanol Production and Refining
- Coal Mine Methane Recovery
- Biomass Gasification
- Flare Gas Measurement
- Flue Gas Monitoring



Specifying Gas Flow Meters in Green Energy and Pollution Reduction Applications

Fluid Components International (FCI) is a leading manufacturer and pioneer in applying thermal dispersion technology to gas flow measurement. FCI has been supplying gas flow meter solutions for traditional and alternative energy process controls, as well as for pollution and environmental management applications for decades.

FCI's *Green Energy Applications Guide* describes several applications where FCI flow meters, flow switches and level switches are typically installed. FCI customers use our products to optimize process performance, measure and report for regulatory agency compliance and capture accurate data for carbon trading and greenhouse gas reduction incentives and credits.

There are many challenges to consider when specifying flow meters, including wet or dirty gases, mixed composition gases, potentially explosive gas installations, widely variable flow rates and other unique application conditions. Evaluating your specific application conditions can help you avoid implementing a poorly-designed system that creates excessive maintenance needs, may be dangerous to operate, and may require costly re-engineering. This guide is intended to provide you with a better understanding of these challenges and the flow metering solutions FCI offers to obtain the high performance and long service life that you want.

Detailed information and specifications for the products discussed in this guide can be downloaded from FCI's web site or by contacting your local FCI representative.

www.fluidcomponents.com

CONTENTS

Landfill Gas Measurement and Recovery	3
Biogas: Organic Biomass Fermentation and Recovery.....	4
Wastewater Treatment Plant Digester Gas.....	5
On-Farm Methane, Biogas Recovery Systems.....	6
Ethanol Production and Refining	7
Coal Mine Methane Recovery.....	8
Biomass Gasification	9
Flare Gas Flow Measurement, Monitoring and Leak Detection	10
Flue Gas Monitoring.....	11
FCI Gas Flow Measurement Solutions Overview	12



Photo courtesy of LFG Specialties

LFG Specialties is an industry leading supplier of landfill gas extraction and recovery systems. LFG installs FCI Model ST98 mass flow meters as the precision landfill gas flow meter in its systems. The ST98 provides flow rate and totalized flow from each well to ensure continuous operation and optimal data collection. The ST98 was selected because of its ease of installation, agency approvals for installation in hazardous gas locations (e.g. Division 1) and because FCI can calibrate the ST98 to specifications for the mixed composition gases unique to landfill gas applications.

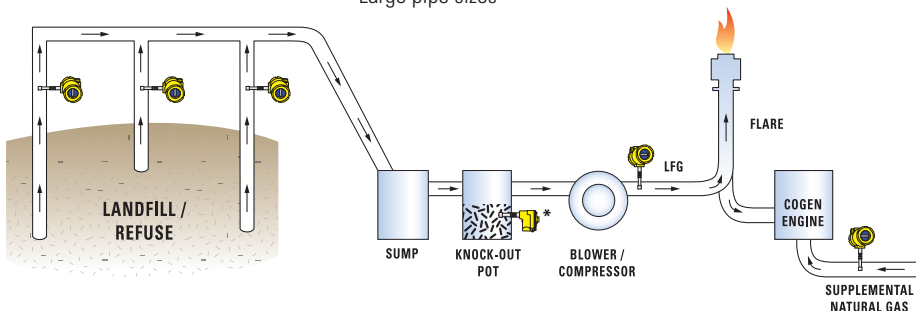
Landfill Gas Measurement & Recovery

Landfills produce a mixture of methane and carbon dioxide with traces of nitrogen, oxygen and other gases. These gases are extracted from multiple wellheads and collected through a network of pipes to a common header pipe. Typical systems also involve blowers, pumps, knock-out pots and a flare or oxidizer. The collected "greenhouse gas" may be disposed of or recovered as a fuel source for a co-generation engine to produce electric power.

An accurate measurement of the landfill gas flow through the system provides operators with information on the amount of gas being extracted for optimizing effectiveness, for reporting to environmental agencies and for carbon credit programs.

Accurate flow measurement requires performance under challenging application conditions such as:

- Mixed composition gases
- Potentially explosive installation environment
- Wet and/or dirty gas
- Wide variations in flow rates
- Large swings in gas and ambient temperatures
- Large pipe sizes



Key Criteria For Flow Meter Selection

- Accurate and calibrated for mixed methane, landfill gas composition
- Temperature compensation
- No moving parts to clog or foul in the presence of wet, dirty gas
- Lowest cost and easiest to install in larger line sizes
- Wide turndown for accurate, repeatable measurement over wide flow range
- Excellent low flow sensitivity
- Agency approved for use in Division 2 [Zone 2] and often Division 1 [Zone 1] hazardous environments
- Multi-function – flow rate, totalized flow and temperature display outputs

FCI thermal dispersion flow meters, in both insertion and in-line styles are the landfill recovery industry's most often selected solution and the preferred choice of the leading landfill gas collection and flare system manufacturers. With robust designs and a broad selection of product solutions that meet all of the criteria above it is easy to understand why FCI is the preferred solution.

For line sizes larger than 2.5" [63 mm]

Model ST51 Insertion Mass Flow Meter
Model ST98 Insertion Mass Flow Meter
Model ST100 Series Insertion Mass Flow Meters

For line sizes 2.0" [51 mm] and smaller

Model ST75 In-line Mass Flow Meter
Model ST98L In-line Mass Flow Meter
Model ST100L In-line Mass Flow Meter

* FCI Model FLT93 switches provide level detection for Knock-Out Pot (KOP) applications.



Biogas: Organic Biomass Fermentation and Recovery

Klärgastechnik Deutschland GmbH is a leading engineering designer, manufacturer and installer of biogas and digester gas processing systems headquartered in Germany.

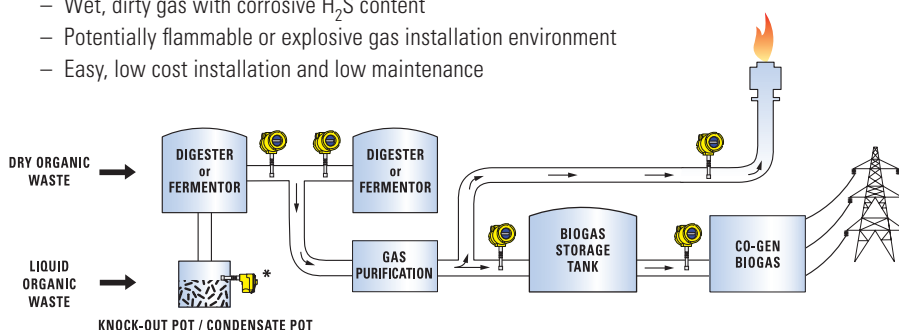
After extensive testing and evaluation of various flow metering technologies, Klärgastechnik Deutschland GmbH selected and standardized FCI ST98 and ST51 flow meters for use within their gas systems.

Klärgastechnik Deutschland GmbH found that FCI's no moving parts to plug or foul design, low pressure drop, biogas-specific calibration, hot tap ball valve installation and agency safety approvals provided the best engineered and most economical solution. Additionally, with FCI's years of experience in biogas and digester gas applications, installations and ability to provide global service support, Klärgastechnik Deutschland GmbH was assured of delivering the highest level of satisfaction to their customers worldwide.

Organic industrial waste from food processing and slaughterhouses, food waste from restaurants and homes, manure collected from livestock, as well as energy crops can be digested in anaerobic conditions in reactor tanks, also called fermentation towers. The output from this biomass digestion process is biogas, a mixture of methane (CH_4), carbon dioxide (CO_2), water and trace hydrogen sulfide (H_2S). The entire process involves gas creation, cleansing, storage (tank or bag-type accumulator), and ultimately the use of biogas as a fuel source for heating or generating electricity. A ground flare is an integral part of the safety system for the process. Measuring biogas flow at several points in the system provides operators with critical information for optimal gas production, control, safety and reporting.

Biogas applications present several challenges in selecting the proper flow meter:

- Low flow sensitivity during start-up and for seasonal changes which produce lower flow rates
- Temperature compensation for correct readings in varying temperatures
- Calibration for mixed gas composition of $\text{CH}_4 + \text{CO}_2 + \text{trace gases}$
- Wet, dirty gas with corrosive H_2S content
- Potentially flammable or explosive gas installation environment
- Easy, low cost installation and low maintenance



Key Criteria For Flow Meter Selection

- Mass flow measuring of both rate and totalized flow
- No moving parts or small holes to clog or foul in dirty or wet gas environments
- Biogas-specific calibration
- Low flow sensitivity, at least 0.6 FPS [0,2 m/s] and wide turn-down of 100:1
- Pressure drop over flow element should be limited to 0.01Psi [1 mBar]
- All wetted parts resistant to H_2S corrosion; minimum of 316L stainless steel
- Easy and safe removal under line pressure with simple ball valve
- System agency approvals for safe installation in Division 2 [Zone 2] or Division 1 [Zone 1]

FCI ST Series thermal dispersion flow meters, in both insertion and in-line styles, are optimal for biogas flow measurement. In addition to meeting all of the key selection criteria above, FCI uses a constant power measuring technique that, because of a slight heating effect, actually dries condensate moisture off the sensor. This feature provides better performance and repeatability in moist biogas measuring applications. Where ever the installation along the biogas system, FCI has successfully applied ST Series gas flow meters.

For line sizes larger than 2.5" [63 mm]

Model ST51 Insertion Mass Flow Meter
Model ST98 Insertion Mass Flow Meter
Model ST100 Series Insertion Mass Flow Meters

For line sizes 2.0" [51 mm] and smaller

Model ST75 In-line Mass Flow Meter
Model ST98L In-line Mass Flow Meter
Model ST100L In-line Mass Flow Meter

* FCI Model FLT93 switches provide level detection for Knock-Out Pot (KOP) and condensate pot applications.



Wastewater Treatment Plant Digester Gas

In municipal and industrial Wastewater Treatment operations throughout the world, FCI digester gas flow meters are the industry's most installed solution.

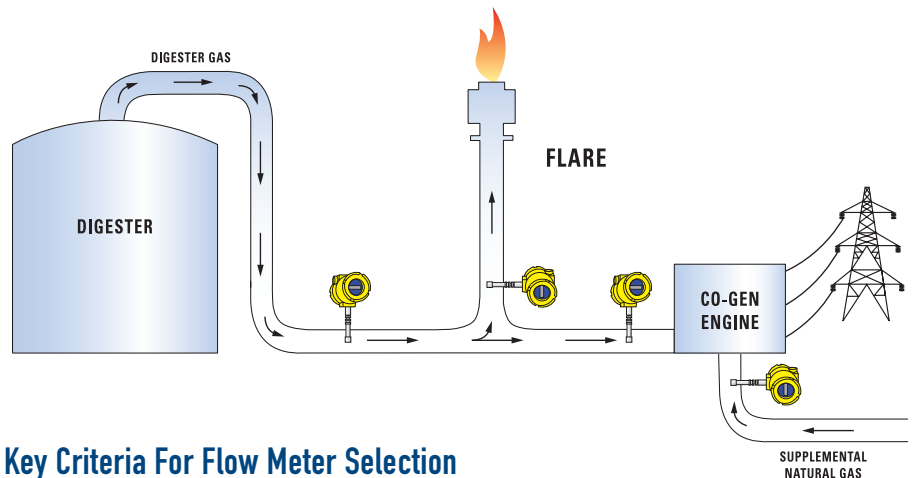
WWTP engineers have standardized FCI product use because they have been proven to deliver superior calibrated accuracy for digester gases. FCI's unique constant power technology delivers the most repeatable measurements and lowest maintenance solution.

FCI is also the WWTP industry's leading supplier of thermal dispersion flow measuring instruments for aeration systems, gas disinfection systems and pump flow assurance applications.

Wastewater treatment plant (WWTP) digester processes produce digester gas, a combination of methane (CH_4) and carbon dioxide (CO_2) with a small percentage of other trace gases. The gas composition can vary with the process and temperature (e.g. seasonally) but a typical average is in the 65% ($\pm 5\%$) CH_4 35% ($\pm 5\%$) CO_2 range. Digester gas is also a wet and dirty gas, typically containing entrained hydrogen sulfides, which condense and deposit on pipe walls and anything else in the pipe.

Modern WWTP processes incorporate digester gas flow measurement for:

- Data on digester process performance and control
- Compliance with environmental regulations to report, control and reduce greenhouse gas emissions
- Data for greenhouse gas reduction or carbon credits
- Process control of co-generation systems using digester gas as fuel source



Key Criteria For Flow Meter Selection

- No moving parts to clog or foul
- Simple threaded insertion for easy installation and easy wipe-off cleaning
- Wide turndown for accurate low and high flow rate measuring
- Agency approved for use in Division 2 [Zone 2] and often Division 1 [Zone 1] hazardous environments
- Specifically calibrated for digester gas compositions.
- Direct mass flow measuring
- Temperature compensated flow measurement for accuracy and repeatability in changing ambient and process gas temperatures.

FCI has a broad selection of thermal dispersion flow meters to provide the most effective solution wherever digester gas is measured. FCI flow meters for digester gas applications meet all of the above criteria and feature robust electronics and industrial transmitters that provide the longest service life in WWTP installations.

For line sizes larger than 2.5" [63 mm]

Model ST51 Insertion Mass Flow Meter
Model ST98 Insertion Mass Flow Meter
Model ST100 Series Insertion Mass Flow Meters

For line sizes 2.0" [51 mm] and smaller

Model ST75 In-line Mass Flow Meter
Model ST98L In-line Mass Flow Meter
Model ST100L In-line Mass Flow Meter



On-Farm Methane, Biogas Recovery Systems

In addition to recovering gases to be used as fuel for the facility, biogas farming and ranching operations are rewarded with incentives such as carbon offsets and credit trading, clean energy development credits (CDM) and certified emission reduction (CER) programs.

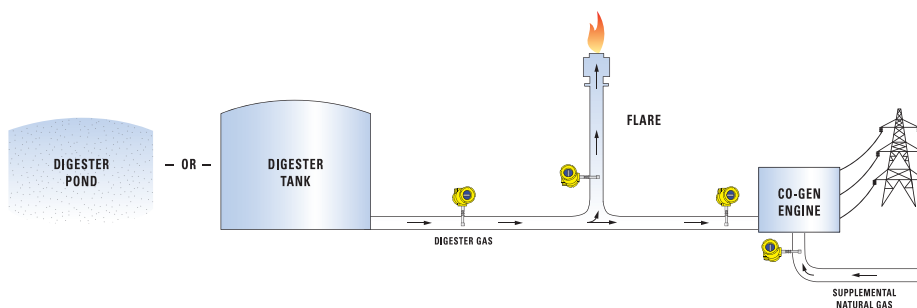
Bos Farms and Fair Oaks Dairy Farms are innovative, major farm operations located in Indiana USA, utilizing FCI gas flow meters in their biogas recovery systems.

Decomposition of livestock waste and other agricultural operations are a major source of methane rich biogas being harvested as fuel gas. Rather than emit greenhouse gases into the environment, modern farm operations invest in a digester system to recover gases and reduce emissions. Recovered gases are used to fuel co-generation engines to power the facility, and often excess power is sold to the local electric power grid. Clean energy development credits (CDM) and certified emission reduction (CER) programs offer additional incentives to implement recovery systems.

In all biogas recovery systems, measuring flow rate is required to ensure effective and efficient operation of the digester process as well as providing tangible evidence of saved emissions in order to receive credits and incentives.

Biogas applications present several challenges in selecting the proper flow meter:

- Low flow sensitivity during start-up, and for seasonal changes which produce lower flow rates
- Temperature compensation for correct readings in varying temperatures
- Calibration for mixed gas composition of methane (CH_4) + carbon dioxide (CO_2) + trace gases
- Wet, dirty gas with corrosive hydrogen sulfide (H_2S) content



Key Criteria For Flow Meter Selection

- Accurate and calibrated for specific biogas composition
- Mass flow measurement (e.g. lbs/hr, kg/day, etc.)
- Low flow sensitivity, as low as 0.3 FPS [0.08 m/s]
- Wide ranging, 100:1 turndown
- Non-clogging, no moving parts for low maintenance
- No added pressure drop
- Approved for safe installation in explosive gas environment – system agency approvals for Division 1 [Zone 1, IIC GD Ex d IIC]

FCI has the product line and more than 20 years of experience with thousands of installations to ensure that you will get the product and installation expertise you need for your application. FCI biogas flow meters combine patented thermal dispersion flow measurement technology, rugged packaging, biogas specific calibrations, simple installation, direct mass flow measurement, no moving parts and unequalled safety approvals on the entire instrument to bring you the most application effective, lowest installed cost and safest biogas flow meter solution.

For line sizes larger than 2.5" [63 mm]

Model ST51 Insertion Mass Flow Meter
Model ST98 Insertion Mass Flow Meter
Model ST100 Series Insertion Mass Flow Meters

For line sizes 2.0" [51 mm] and smaller

Model ST75 In-line Mass Flow Meter
Model ST98L In-line Mass Flow Meter
Model ST100L In-line Mass Flow Meter

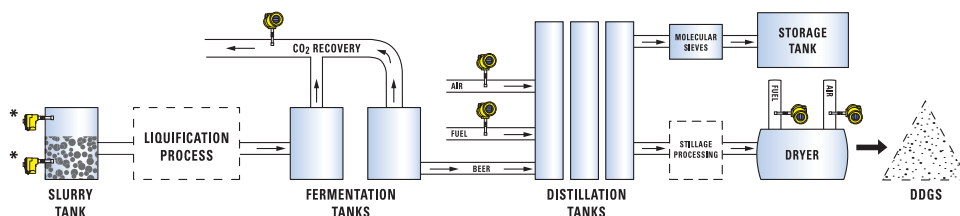


Ethanol Production and Refining

ADM and Cargill are two major producers and refiners of ethanol fuels and fuel additives who count on FCI mass flow meters to optimize their operations. Both companies have improved and optimized process combustion efficiency with the installation of FCI flow meters on air and natural gas supplies.

As costs of fossil fuels continue to climb and air pollution reduction regulations become more stringent, the production of ethanol fuel and fuel supplements grows. At the forefront of ethanol production is the need to continuously improve processes and reduce costs to maximize effectiveness and efficiency.

Ethanol production is a distillation process which involves boilers. Efficiency is optimized with measurement and control of air-to-fuel mixtures/ratios. The process may also utilize catalytic or thermal oxidizers to reduce emissions of greenhouse gases or VOCs. Accurate air and gas flow measurements in large pipes or duct applications are challenged by distorted flow profiles and swirls, varying air temperatures, installation costs, and accessibility for maintenance. Measuring gases vented from the process can provide information about process inefficiencies or other problems. Further, measurement and reporting may be mandated by local air pollution regulations.



Key Criteria For Flow Meter Selection

- Temperature compensated flow measurement for accuracy and repeatability in changing ambient and process gas temperatures
- Easy to install and cost effective in large diameter pipes
- Non-clogging, no moving parts design for low maintenance
- Wide turndown for accurate low and high flow rate measuring
- Multi-parameter – flow rate, totalized flow and temperature in a single device
- Calibration matched to specific gas and application
- Multi-point sensing for accuracy in large pipes, stacks and ducts with distorted and/or swirling flow profiles
- Flow conditioning for limited straight-run application

FCI thermal dispersion, insertion mass flow meters in single-point and multi-point configurations for large line sizes and in-line styles for smaller line sizes provide cost effective and accurate engineering solutions throughout the ethanol process. In addition to meeting the above requirements, FCI flow meters feature robust transmitter electronics in rugged enclosures for long service life.

For line sizes larger than 2.5" [63 mm]

Model ST100 Series Insertion Mass Flow Meters
 Model ST102A Dual-point Averaging Insertion Mass Flow Meter
 Models MT86 and MT91 Multi-point Insertion Mass Flow Meters
 Model ST98 Insertion Mass Flow Meter
 Vortab® Flow Conditioners

For line sizes 2.0" [51 mm] and smaller

Model ST100L In-line Mass Flow Meter
 Model ST75 In-line Mass Flow Meter
 Model ST98L In-line Mass Flow Meter
 Vortab® Flow Conditioners

* FCI Model FLT93 switches provide a level detection solution for slurry tanks.



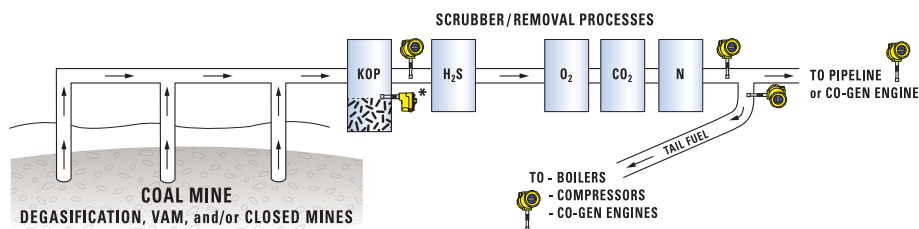
Coal Mine Methane Recovery

Global activity for coal mine methane recovery continues to grow. Numerous projects and various technologies are being tested and deployed around the world to capture and utilize this methane as a fuel source.

Whether to maximize the process or report actual methane captured, measuring methane flow is integral to ensuring the success of this process. FCI provides the accurate, reliable and safe flow metering solution for flow rate and total flow.

An emerging application gaining attention from stakeholders in mining operations and from environmentalists is coal mine methane recovery. It has been estimated that 8% of the world's anthropogenic methane air pollution is a by-product of coal mining. There are three major sources of coal mine methane (CMM): degasification systems (drainage) both pre-mine and gob; ventilation air (VAM); and abandon or closed mines. As technology, economics, environmental regulations and greenhouse gas reduction incentives increase, this gas is increasingly being captured and used as a fuel source. Gas flow meters are required to comply with regulations, to ensure efficient operation of co-gen engines or methane oxidizers, and to provide data for incentive credits.

Depending on the source application, concentration of methane in the extracted gas can be as little as 1% (e.g. VAM) to more than 20% in drainage systems. Other components in the gas include air, carbon dioxide (CO_2) and/or nitrogen (N_2) in various combinations depending on the site and source. Therefore proper flow meter calibration matched to the actual gas mix is critical for accurate performance. Additional considerations and challenges in this application include safe installation in an explosive atmosphere, low power consumption, low flow sensitivity and ease of installation in a variety of pipe sizes and locations.



Key Criteria For Flow Meter Selection

- Agency approved for use in Division 1 [Zone 1] hazardous environment
- Specifically calibrated to match low concentration methane gas composition
- Temperature compensated flow measurement for accuracy and repeatability in changing ambient and gas temperatures
- Easy to install
- Non-clogging, no moving parts design for low maintenance
- Wide turndown for wide flow range measuring and with low flow sensitivity
- Multi-parameter – flow rate, totalized flow and temperature in a single device

FCI thermal dispersion flow meters, in both insertion and in-line styles, are ideal for application in CMM recovery. They address all of the key criteria and solve the challenges of the application to provide an accurate, highly repeatable and cost effective solution. FCI calibration laboratory ensures a meter calibration matched to gas composition. FCI flow meters have global agency approvals on the complete instrument for installations in hazardous/explosive environments.

For line sizes larger than 2.5" [63 mm]

Model ST51 Insertion Mass Flow Meter
Model ST98 Insertion Mass Flow Meter
Model ST100 Series Insertion Mass Flow Meters

For line sizes 2.0" [51 mm] and smaller

Model ST75 In-line Mass Flow Meter
Model ST98L In-line Mass Flow Meter
Model ST100L In-line Mass Flow Meter

* FCI Model FLT93 switches provide level detection for Knock-Out Pot (KOP) and condensate pot applications.



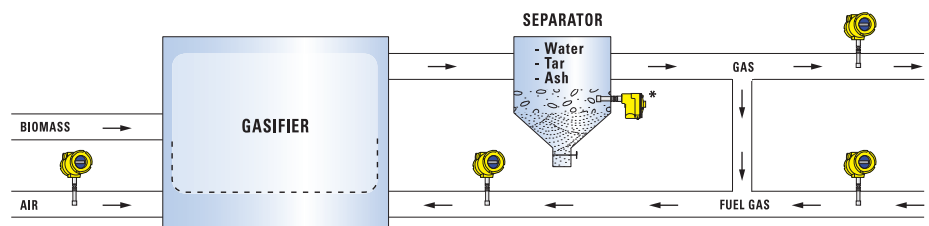
Biomass Gasification

Whether updraft, downdraft, fluid-bed, circulating fluid-bed, entrained flow or other technologies for biomass gasification, FCI flow and level measurement solutions are installed throughout the process for optimization and control.

For accurate and efficient process control, biomass gasification requires measurement and control of fuel, inlet air and measurement of the extract gas (outlet). The biomass gasification process produces a mixed composition gas consisting primarily of hydrogen (H_2) and carbon monoxide (CO) with trace methane (CH_4). The extracted gas stream will also contain water, tar or ash, so typical systems include a separator tank to remove these elements.

Biomass gasification applications present several challenges in selecting the proper flow meter:

- Ease of installation in a variety of pipe sizes and locations
- Extracted gas may be wet, dirty and/or heated
- Calibration for mixed gas composition of hydrogen (H_2) + carbon monoxide (CO) + methane (CH_4)
- Mass flow with limited pipe run to add pressure and temperature sensors
- Potentially flammable or explosive gas installation environment



Key Criteria For Flow Meter Selection

- | | |
|--|--|
| ■ Accurate and calibrated for mixed gas composition | ■ Wide turndown for wide range flow measurement |
| ■ Easy to install and cost effective in large diameter pipes | ■ Safe for use in potentially explosive gas installation environment |
| ■ Non-clogging, no moving parts design for low maintenance | ■ Direct mass flow measurement |

FCI thermal dispersion flow meters in an insertion-style or in-line configuration provide cost effective and accurate engineering solutions. In addition to meeting all of the above requirements FCI flow meters have comprehensive agency approvals for hazardous locations and feature robust transmitter electronics in rugged enclosure.

For line sizes larger than 2.5" [63 mm]

Model ST51 Insertion Mass Flow Meter
Model ST98 Insertion Mass Flow Meter
Model ST100 Series Insertion Mass Flow Meters

For line sizes 2.0" [51 mm] and smaller

Model ST75 In-line Mass Flow Meter
Model ST98L In-line Mass Flow Meter
Model ST100L In-line Mass Flow Meter

In systems with separators, the separated elements are often a mixture of water, suspended mass and other elements. When stored in a tank this often creates a combination of non-miscible fluids which can cause erroneous level readings resulting in over-filling or under-filling the tank.

* FCI Model FLT93 level switches provide accurate detection of level in the presence of mixed liquids and when applied as an interface sensor, can sense between liquids, foams and slurries.



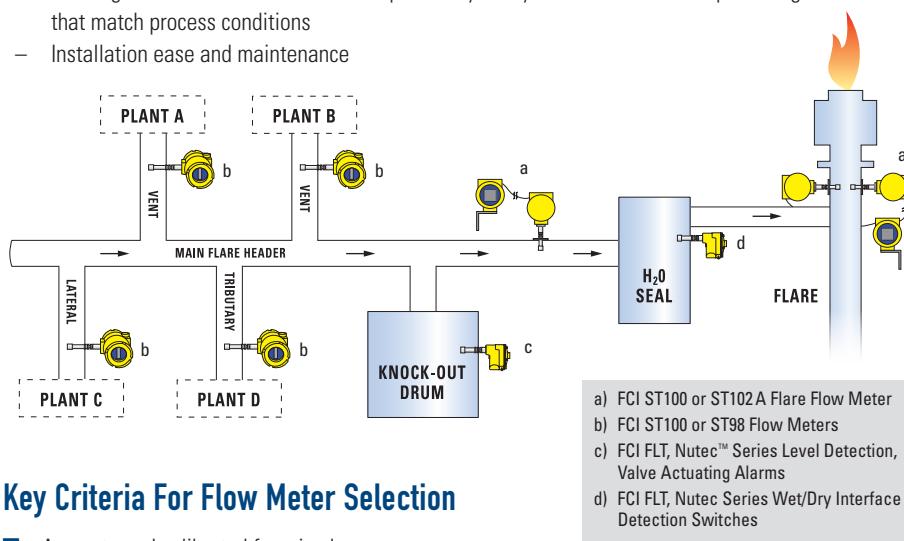
Flare Gas Flow Measurement, Monitoring & Leak Detection

You will find FCI flow meters installed throughout flaring systems around the world. Refineries, both chemical and petrochemical, have applied FCI flow meters as part of their process control, alarm, leak detection, and emissions monitoring and reporting systems. These companies include Dow, BP, ConocoPhillips, Chevron, Motiva, Shell, Aramco, Valero, Total, Petrobras, Pemex, Sinopec, and more.

Flaring systems are used to burn-off waste or off-gases in both normal and upset process conditions. Many processes are outfitted with relief valves to safely vent process gases to the flare system under upset conditions. Flare systems can be a simple single pipe run or a complex series of feeder and header pipes. All flares are highly scrutinized as a source of air pollution and often subjected to stringent regulation to measure, record and report the amount of flared gases and to show continuous improvement to reduce the amount produced.

Flare gas applications present several challenges in selecting the proper flow meter:

- Both low flow and high flow conditions – low flow sensitivity is critical to capture leaking relief valves, while very high flows occur in upset conditions
- Mixed gases – flow meter calibration specifically for hydrocarbon mixed composition gases that match process conditions
- Installation ease and maintenance



Key Criteria For Flow Meter Selection

- Accurate and calibrated for mixed composition gases
- Multiple calibrations for variations in composition
- Mass flow measurement
- Wide turndown for both low flow and high flow rate
- Easy to install, single penetration
- Non-clogging, no moving parts design for low maintenance
- Safe for use in potentially explosive gas installation environment

FCI thermal dispersion flow meters in an insertion-style configuration provide the preferred engineering solution. In addition to meeting all of the above requirements, FCI flow meters have comprehensive agency approvals for hazardous locations, feature robust transmitter electronics in rugged enclosure, hot-tap installation options, and VeriCal™ – an industry exclusive in-situ calibration verification option. Additionally, these FCI flow meters are direct mass flow measuring so that unlike volumetric flow techniques, there are no additional sensors to be purchased or installed to obtain mass flow.

For line sizes larger than 2.5" [63 mm]

Model ST98 Insertion Mass Flow Meter
Model ST100 Series Insertion Mass Flow Meters

Model ST102A Dual-point Averaging Insertion Mass Flow Meter
– up 1000:1 turndown, five calibrations, special flare split-range calibration, VeriCal in-situ calibration verification



Flue Gas Monitoring

Flue gases are exhausted from many processes including metals operations, chemical, food processing, petroleum processing, pharmaceutical productions, paper plants, power plants and boilers.

FCI's single- or multi-point flow meters offer accurate and cost effective solutions to flue gas measurement.

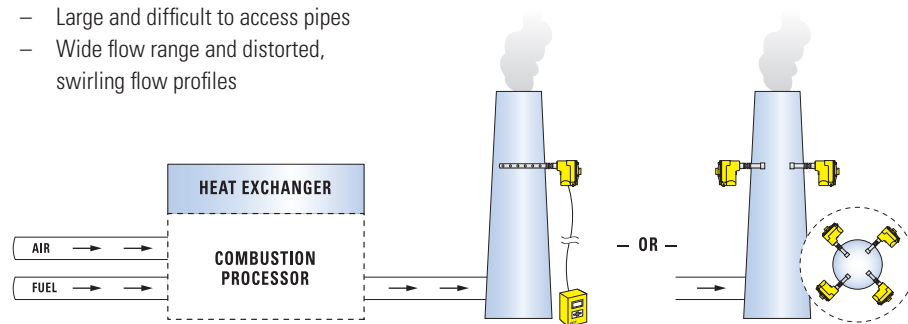
Companies utilizing FCI flow meters for flue gas applications include US Steel, Kraft Foods, Georgia-Pacific, Dupont, Rohm & Haas, Shijiazhuang Refinery, ELF Atochem, Kemirea Pigments, Fundia Wire, Noranda Mining, and Foster-Wheeler Energy, among others.

Flue gases are the general name given to the mixed composition gases that are the by-product of a combustion process. A flue is typically a large pipe, duct, stack, chimney or other venting attached to a process system such as a boiler, furnace, steam generator, oven, etc. through which waste flue gases are exhausted from the combustion process.

Depending on the process, the fuel used and efficiency, flue gases can consist of nitrogen, carbon dioxide, trace amounts of oxygen and water vapor, and environmentally sensitive pollutants such as sulfur oxides, nitrogen oxide, carbon monoxide and particulates. In addition to measuring the flow of flue gases for process control data, reporting is often mandated by environmental and regional air quality regulations.

Flue gas applications present several challenges in selecting the proper flow meter:

- Mixed composition gases
- Wet, hot and/or dirty gases
- Large and difficult to access pipes
- Wide flow range and distorted, swirling flow profiles



Key Criteria For Flow Meter Selection

- | | |
|---|--|
| ■ Accurate and calibrated for mixed composition gases | ■ Non-clogging, no moving parts design for low maintenance |
| ■ Low cost installation in large diameter pipes | ■ Wide turndown for wide range flow measurement |
| ■ Single-point and multi-point solutions | ■ Remote mountable transmitter/electronics |
| ■ Mass flow measurement | ■ Temperature compensation |

FCI thermal dispersion insertion flow meters provide a cost effective and accurate solution to flue gas flow measurement. These flow meters are designed to overcome the unique challenges of flue gas measurement and meet all of the above criteria. For line sizes up to 30 inches [760 mm], FCI single-point meters are typically applied. For larger line sizes, FCI multi-point systems provide up to 16 sensors to achieve flow averaging in large cross-sectional areas. Additionally, these FCI flow meters are direct mass flow measuring so that unlike volumetric flow techniques, there are no additional sensors to be purchased or installed to obtain mass flow.

For line sizes larger than 2.5" [63 mm]

Model ST98 Insertion Mass Flow Meter

Model ST100 Series Insertion Mass Flow Meters

Model ST102A Dual-point Averaging Insertion Mass Flow Meter

Models MT86 and MT91 Multi-point Insertion Mass Flow Meters

FCI Thermal Dispersion Gas Flow Meters

■ Experience and expertise

- Largest installed base in environmental and greenhouse gas applications

■ Superior flow meter calibrations

- On-the-premises NIST certified flow laboratory
- Actual gas and process condition calibrations
- Mixed gas composition calibration

■ Most extensive and comprehensive agency approvals for hazardous gas installations

- Global approvals (FM, ATEX, IEC, CSA, NEPSI, CPA, GOST/RTN, and more)
- Complete instrument approvals: Enclosure, electronics, sensor and seals

■ 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

■ Product selection to optimize flow meter for your application

- Single-point and multi-point solutions
- Line sizes from 1/4" [6 mm] to 33' [10 m] diameter stacks
- Analog and digital communications bus outputs
- Multi-function flow, total flow and temperature
- Single or multiple outputs
- Integral and remote mounting
- Gas temperatures to 850 °F [454 °C]
- Widest selection of process connections available
- Exclusive provider of Vortab flow conditioners



- **ST51** is a compact, accurate, easy to install solution for measuring biogases, digester gases, methane and natural gas flow.



- **ST98 and ST98L** combine high-performance measurement, an extensive selection of options and the widest selection of gas calibrations.



- **ST100 Series** – all gases, flow, temperature and pressure, multiple outputs, bus communications, graphical display, multiple calibrations, VeriCal™, on-board data logger, and more.



- **MT86 and MT91** “multi-point” flow measuring systems can be configured with two (2) to sixteen (16) flow sensing elements to optimize measurements in the largest pipe and duct sizes.



- **ST75** is an in-line meter with extensive standard features that is the economical, easy-to-specify alternative to other maintenance intensive flow technologies.



- **FLT93 Series** is a robust and flexible line of flow/level/temperature switches for liquid, gas and slurry applications.