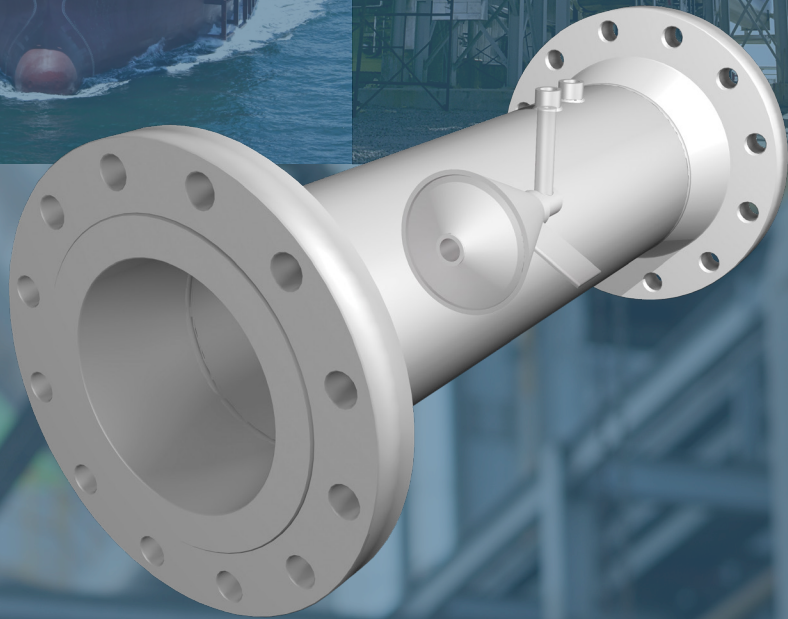




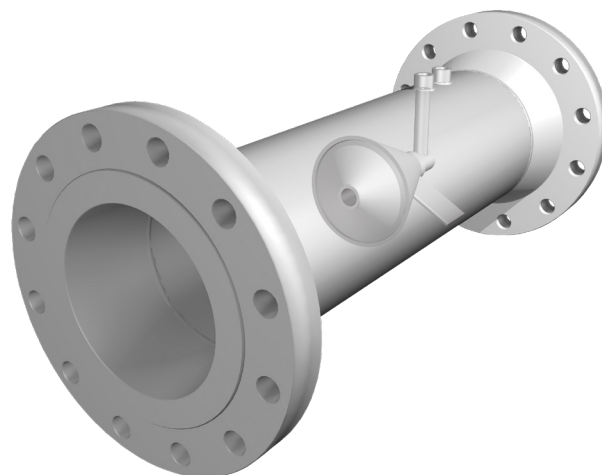
V-Cone®

Application Guide



V-Cone®

Engineers can rely on the V-Cone to make life easier. McCrometer's differential pressure meter is the versatile, highly compatible flow measurement solution for a variety of industries. When accuracy and repeatability are critical, the V-Cone's performance brings superior value.



The V-Cone is self-conditioning, creating minimal to no straight-run requirements and eliminating excess weight and space by up to 70%.

The V-Cone requires virtually no maintenance, featuring no moving parts and a 25+ year lifespan. The V-Cone is the robust, durable meter that prevents years of potential upkeep and expenditures.

Media Compatibility

	Potable Water	Waste Water	Cooling Water	Liquid Natural Gas	Steam	Natural Gas	Wet Gas	Liquid Hydrocarbons
V-Cone	X	X	X	X	X	X	X	X
VM V-Cone	X	X	X					
Wafer Cone	X	X	X	X	X	X		

Industry Compatibility

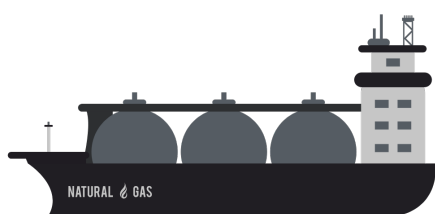
	Agriculture	Municipal	Oil and Gas	Industrial
V-Cone	X	X	X	X
VM V-Cone		X		X
Wafer Cone		X	X	X



Application: FPSO

Flow Measurement Projects on FPSOs

To meet the global demand for oil and gas production, Floating Production, Storage, & Offloading (FPSO) vessels have been utilized for a number of years to access deep water deposits. They process oil from subsea wells and store it until it can be offloaded onto waiting tankers or sent through a pipeline to other storage facilities onshore, refineries, etc. Liquid and gas flow meters play an important role in FPSO vessel operations by measuring hydrocarbons, water, and gas at multiple points in the process. Precise measurement allows for maximum recovery and efficient refining of crude oil on the vessels.



Typical Applications for Flow Meters

- Separators: test and production, all fluids
- Gas or water reinjection
- Gas lift
- Fuel gas
- Chemical injection

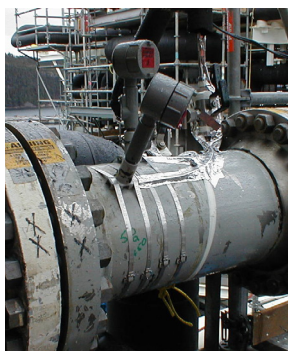
Challenges of the Application



Space Constraints | Accuracy | Repeatability | Turndown | Maintenance | Life Expectancy

V-Cone as a Solution

V-Cone plays an important role in FPSO vessel operations by measuring hydrocarbons, water, and gas at multiple points in the process. Moreover, the V-Cone can be an **integral addition to an FPSO** by reducing costs usually associated with installing and maintaining a flow measurement device.



0 - 3 **diameters** upstream and downstream

+/- 0.5% **accuracy** and +/-0.1% **repeatability** over a 10:1 turndown

Standard **25+ year operating life** with generally no need for maintenance



Application: Steam

Flow Measurement Projects for Steam

Steam measurement is always a challenge, as the traditional pitot tubes and orifice plates offer low accuracy, low rangeability, and the ID of the process tube is usually unknown. Straight-run pipe requirements can be difficult to meet, making steam applications a challenge not many flow measurement devices can handle. There is a need to measure high turndowns because facilities such as campuses and hospitals have large flow ranges. Significantly more steam is used in winter compared to summer months and swapping a flow meter during every seasonal change carries a very high cost.



Typical Applications for Flow Meters

- Facilities
- Power plants
- University campuses

Challenges of the Application



Accurate Measurements | Reliability | Low Flow Cutoff | Straight-run Requirements | Disturbances

V-Cone as a Solution

The V-Cone typically reduces plant real estate needs, piping material, associated pipe support structure and installation labor by **50 percent** or more. The bigger the line size, the bigger the savings with the V-Cone.



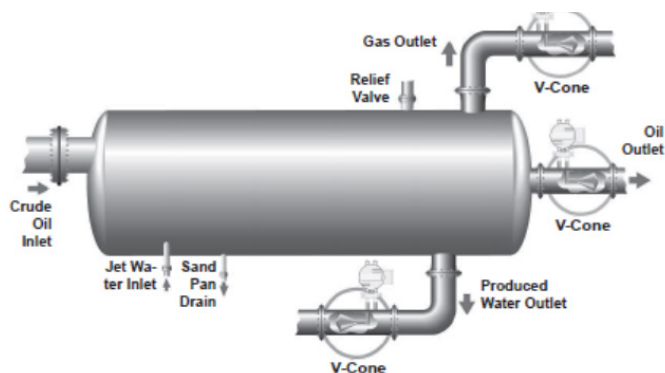
The **ExactSteam™** system is factory configured for energy metering or mass flow. Enabling the lowest permanent pressure loss, the ExactSteam unit maximizes plant efficiency. It boasts a 50:1 turndown, and can measure saturated (dry) steam, superheated, and unsaturated (wet) steam.



Application: Process Separators

Flow Measurement Projects for Process Separators

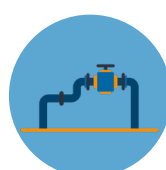
Process separators are typically used when more than one well and field deliver fluid to the platform at the same time. It is important to continuously monitor the oil, condensate, water, and gas being delivered to the platform from each well. Often, there are multiple meters in a very small amount of real estate, each measuring a different media of the separating fluid.



Typical Applications for Flow Meters

- Wet and dry gases
- Flow for anti-surge control
- Output from separators (single-phase gas, oil, and water)
- Flow to gas injection systems
- Produced water

Challenges of the Application



Space Constraints | Accuracy | Repeatability | Turndown | Maintenance | Wet Gas Scenarios

V-Cone as a Solution

The V-Cone is an ideal **retrofit solution** for separators, due to its ease of installation and straight-run requirements. Without the need for major construction, the V-Cone is a drop-in meter that lasts, on average boasting a **25+ year lifespan**.



- Low headloss
- $\pm 0.5\%$ accuracy
- $\pm 0.1\%$ repeatability



Application: Liquid Natural Gas (LNG)

Flow Measurement Projects for Liquid Natural Gas

With the continuous increase in demand for energy worldwide, the popularity of clean-burning natural gas has grown rapidly over the past decades. LNG's relatively abundant supply, along with new high-efficiency production technologies and lower carbon dioxide (CO₂) emission footprint have led it to become a cost-effective, environmentally-friendly choice for a variety of applications. Plants dedicated to turning raw natural gas into liquid natural gas and later back into gas for distribution are either on-stream, under construction, or planned all over the globe.



Typical Applications for Flow Meters

- Production and processing
- Storage and transportation
- Distribution
- Fuel gas
- Burners
- LNG plants
- Cold box

Challenges of the Application



Durability | Accuracy | Ease of Installation | High Operating Costs

V-Cone as a Solution

The V-Cone's proprietary **self-conditioning** technology and lack of moving parts allows for a highly reliable measurement solution for liquid natural gas applications. Its innovative design is ideal for harsh operating conditions where precision is absolutely necessary.



- 0.5" to 120" line sizes
- Flanged, threaded, hub, or weld-end standard fittings
- Up to 20,000 psi



Application: Subsea

Flow Measurement Projects for Subsea

Flow measurement in subsea production systems, modules, and templates is a challenge for flow meters. Several pipe lines join below the surface and will eventually extend to a fixed platform, Floating Production Storage and Offloading Vessel (FPSO), or perhaps a pipeline running to a land-based operation.



Typical Applications for Flow Meters

- Well head flows
- Gas lift
- Produced gas and water
- Gas and water injection
- MEG injection
- Compressor surge control

Challenges of the Application



Accuracy | Turndown | Underwater Installation | Space Constraints | Lifespan and Maintenance

V-Cone as a Solution

The V-Cone reduces installation real estate and allows for flexible layouts, due to its **self-conditioning design** and little to no straight-run requirements. The quality of craftsmanship and 25+ year operating lifespan make it an ideal solution for subsea applications.



- Can withstand 15,000 psi subsea
- 50:1 turndown
- 2" through 16" line size



Application: Enhanced Oil Recovery

Flow Measurement Projects for Enhanced Oil Recovery (EOR)

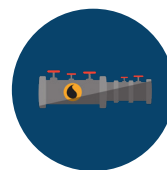
Maximizing oil recovery in offshore fields can require a myriad of enhanced oil recovery techniques which can add complexity at subsea depths. Whether it's water injection, gas injection, or CO₂ injection, measurement of the media at the injection site and the oil at the production wellhead is required. In the case of water injection, production water often has corrosive materials, necessitating flow meters made of durable, oftentimes exotic materials, able to withstand high pressure in a harsh environment.



Typical Applications for Flow Meters

- Hydrocarbon gas injection
- CO₂ injection, meeting carbon footprint (including supercritical CO₂)
- Water injection
- Production wellhead

Challenges of the Application



Accurate CO₂ Measurement | Repeatability | Space Constraints | Durability & Custom Material Options

V-Cone as a Solution

Enhanced oil recovery often needs a flow meter that can **reduce the operation's carbon footprint**, and provide accurate measurement for a super critical system like CO₂ injection. The V-Cone performs in demanding environments with the added benefit of little to no straight run needed, reducing weight in offshore applications. The custom materials that V-Cones offer allow for durability in high-pressure applications.



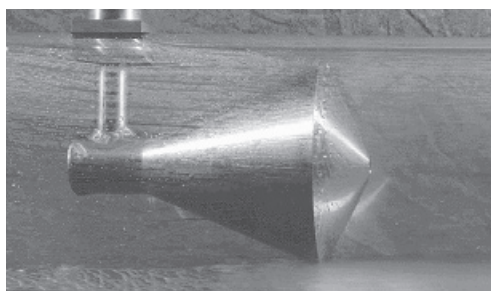
- $\pm 0.5\%$ accuracy
- $\pm 0.1\%$ repeatability
- Calibrated for customer application
- Durable for harsh environments



Application: Wet Gas

Flow Measurement Projects for Wet Gas

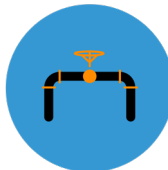
Wet gas is a commonly seen form of fluid that occurs in many large-scale industries like oil and gas. It can be classified as a natural gas with some form of liquid. The presence of liquid in the gas makes it very difficult to measure since it is no longer considered a single-phase fluid. Produced gas output from test and production separator units is often wet and needs to be metered; the liquid fraction in gas causes all flow meters to read in error, making it difficult for accurate allocation metering, mass balance, and correct chemical injection.



Typical Applications for Flow Meters

- Offshore platforms
- Natural gas wells
- Digester gas
- Gas lift systems
- Production well heads

Challenges of the Application



Meter Overreading | Oil:Liquid Determination | Blocked Ports | Possible Liquid Damming

V-Cone as a Solution

In side-by-side tests with other differential pressure meters, the V-Cone flow meter provided the **most accurate** measurement of challenging wet gas flow regimes. The V-Cone is available for wet gas applications in line sizes of 2" to 12". V-Cones are less prone to corrosion, making the 25 year lifespan of the meter highly desirable.



- Accuracy of $\pm 2\%$, dependent on process conditions
- Turndowns of 10:1 and greater, without loss of accuracy
- Virtually no need for maintenance
- Low installation costs



Application: Municipal Water Treatment

Flow Measurement Projects for Municipal Water Treatment

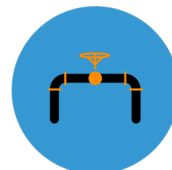
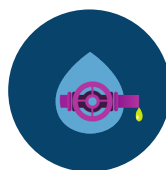
Water treatment facilities have a task of providing clean water to their surrounding communities. These facilities will measure the effluent flow from their plants, going through a standard treatment process where it is crucial to measure the fluid accurately prior to each stage. Oftentimes, due to tight piping locations with many flow disturbers near filter beds and pumps, viable metering technologies are limited. Flow meters are used to measure flow volume between wells, treatment filter beds, during backwashing processes, and more.



Typical Applications for Flow Meters

- Water treatment facilities
- Water wells
- Chemical injection
- Reclaimed water
- Finished water effluent
- Back wash

Challenges of the Application



Space Constraints | High Flow Turbulance | Requires Custom Meter Cleaning | Accuracy

V-Cone as a Solution

V-Cone is a great alternative to other differential pressure meters, as it is less prone to internal corrosion within the flow element tube, and provides accurate readings despite installation near flow disturbers. Its **long-term lifespan** prevents the need to dismantle piping or shut down water production to perform meter maintenance and repairs.



- $\pm 0.5\%$ accuracy
- $\pm 0.1\%$ repeatability
- Little to no straight-run requirements
- Provides oxygen cleaning services



Application: Digester Gas

Flow Measurement Projects for Digester Gas

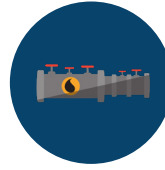
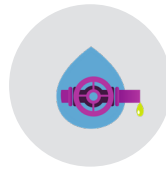
With the ever-lasting demand for an alternative to fuel, digester gas has been a common application where biofuels are produced. A biofuel often used as an energy source, digester gas is found as an application in wastewater municipal plants, but can also be found on farms, and in breweries and distilleries. Due to varied compositions of digester gas, build-up can occur and cause issues in the pipeline. Flow measurement is used to monitor this energy source's performance and to comply with environmental regulations which may require greenhouse gas emissions reports.



Typical Applications for Flow Meters

- Sanitation
- Power generations/cogen
- Biofuels

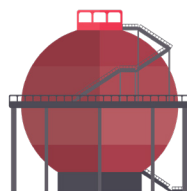
Challenges of the Application



Corrosive and Wet Media | Accuracy Issues | Potentially Hazardous Application | Low Pressure & Low Flow Rates

V-Cone as a Solution

Built to endure harsh operating conditions, the V-Cone is well-suited to the varying temperature, turndown, and pressure that digester gas applications are known for. The varying materials that the V-Cone can be constructed from make the V-Cone highly customizable, and **resistant to corrosion** and build-up.



- $\pm 0.5\%$ accuracy
- $\pm 0.1\%$ repeatability
- Little to no straight-run requirements
- Wide variety of materials