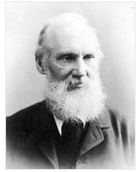
Flow Meter Selection Strategies and Best Practices

"If you cannot measure it, you cannot improve it." — Lord Kelvin, scientist



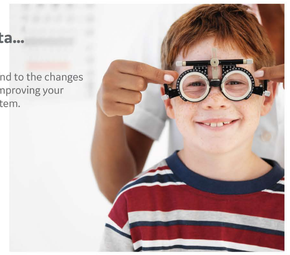
Flow measurement provides critical data required for reducing energy and water usage in district energy or combined heat and power systems.

This presentation covers fundamentals for getting a quality flow measurement, including:

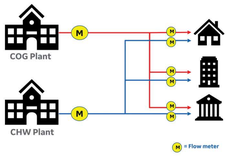
- Meter types
- Installation locations
- Process and environmental parameters
- Data transmission and collection

With data...

...you aren't blind to the changes you need for improving your process or system.



You need flow meters to measure water, chilled/hot water and steam usage.



Flow meters help optimize and control plant utilities and buildings.

True usage	Seasonal	Daily	Long term
Building #1 / Building #2 — Energy use	Energy use	Energy use	Year #1 / Year #5 — Energy use
Understand true energy use per building versus using only the building's area to bill and to direct energy usage and drive energy efficiencies	Account for and optimize energy use seasonally from extreme low flow to maximum design flow	Measure day and night use for both ambient temperature effects and direct building requirements	Measure current and long term energy use to baseline existing energy use to help determine project improvement savings and to control any future variations

Many factors affect the flow meter you pick.

Process

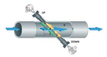
Environmental

Site and installation

Communications

Maintenance

Measurement technology



Process

Flow rate

Minimum and maximum flow rate is required, not just nominal. Critical data will either be missed or not measured accurately if the flow meter is not sized properly for the application.

Process temperature

Minimum and maximum process temperature range is required for selecting the proper flow meter elements. Temperature may be required mass flow conversion based on technology.

Process pressure

Minimum and maximum pressure range is required for selecting the proper pressure elements. Pressure may be required mass flow conversion based on technology, for steam as an example.

Viscosity

Changes in fluid viscosity from the specified value may cause an error in flow measurement if not accounted for properly, based on flow meter technology.

Conductivity

Certain technologies are affected by the conductivity of the fluid and significant changes in this property.

Flow direction

Some technologies only measure in one direction, which can cause batch measurement errors if not properly accounted for.

Environmental

Ambient temperature

Ambient temperature is critical for flow meters since internal and external components must be rated for extreme temperatures.

Humidity

High humidity environments may cause damage to electrical and mechanical components. High humidity applications must be accounted for by flow meter design.

Installation location

Installation location either indoors or outdoors must be considered. The equipment should meet weatherproof NEMA or IP ratings of the installation location and be compliant to local design codes.

Site and installation

Pipe size

Most flow meters cost significantly more with increase in pipe size while others, like clamp-on meters, have a minimal cost increase with size.

Wall thickness

Most flow meters measure standard schedule pipes by matching inner diameter. However, some flow meters have issues with either very thin or very thick wall pipes.

Pipe liner

Some flow measurement technologies can not be used with pipe liners. Alternatively, they must use an expensive alternative material of construction to satisfy fluid media compatibility.

Pipe insulation

When pipe insulation is required, it must be well maintained around and at the flow measurement location. Improper insulation can cause phase changes in the flowing media and lead to problems with flow measurement.

Flow measurement location

Most technologies require straight run before and after the flow meter to obtain a uniform flow profile. If meters are not installed per the manufacturer's installation requirements, additional inaccuracies may occur.

Installation

Most technologies require the pipe to be empty during installation. Some allow "hot tap" installation during process. Clamp-on meters are installed on the outside of the pipe with no affect to the process. Each method introduces a different labor effort and cost.

Communications

Display only

With a display only, the end user only receives live instantaneous flow measurements when at the flow meter or a summary totalized value over a specific amount of time. A display-only value is not ideal for optimizing a process, but is for general overall use.

Datalogging

Datalogging of measurement is for collecting data over a specific amount of time. A datalog is good for analyzing data for troubleshooting and understanding a new process, but is not ideal for optimizing a process over an extended amount of time.

Analog signal

An analog signal (typically 4-20 mA signal) is good for gathering instantaneous data over a long period of time and is well understood in the industry. However, the signal should be checked periodically for drifting and any associated changes.

Digital signal

A digital signal (such as Modbus, BACnet, Ethernet) is great for gathering instantaneous data over a long period of time. With a digital signal, there is no drifting and more than one process variable can be transmitted at the same time.

Maintenance

Calibration frequency

Some flow meters will require periodic calibration due to either electrical or mechanical drift. Therefore, they must calibrated on a periodic time basis to maintain accuracy and reliability.

Calibration method

With calibration frequency, some flow meters require different calibration methods. Some require testing and trimming the measurement element while others require a full fluid flow to validate performance.

Maintenance capabilities

Maintenance capabilities vary dramatically based on applications. Some meters require the pipe to be drained and removed completely for maintenance while other technologies can be serviced without process shutdown and draining and depressurizing the pipe.

Advanced diagnostics

Some flow technologies only provide a flow measurement value while other flow meter technologies provide advanced diagnostics. Diagnostics provide information about the health of the meter and the measurement quality for validation of the flow measurement.

Measurement technology

Differential pressure

- Differential pressure drop related to velocity caused by restriction in the line
- Pressure drop, restriction in flow path
- Periodic calibration is required
- A specific amount of straight run is required
- Higher cost of ownership

Turbine

- Flow measurement is proportional to frequency of revolutions
- Excellent repeatability
- Periodic calibration is required due to mechanical wear
- A specific amount of straight run is required
- Higher cost of ownership

Electromagnetic

- Based on Faraday's law of induction
- Flow velocity is proportional to the voltage
- No pressure drop or moving parts
- Fluid must be conductive
- A specific amount of straight run is required

Vortex

- Flow velocity is proportional to the vortex frequency
- No moving parts, large rangeability
- Pressure drop, restriction in flow path
- A specific amount of straight run is required

Ultrasonic transit time

- Ultrasonic transducers are installed across the pipe at an angle
- The difference in ultrasonic transmit times from both transducers is proportional to velocity
- No pressure drop or moving parts
- Clamp-on installation possible
- A specific amount of straight run is required
- Lower cost of ownership

Advantages of ultrasonic flow meters

No drifting, no periodic calibration required	No loss of process control, optimization of assets and efficiency, no downtime or expense from calibration
No pressure drop	No wasted energy from running a pump or purchase of a larger size pump
No restriction in the pipe	Contamination will not affect meter's measurement (drifting) or any damage to meter
No filters or strainers	No maintenance cost
Bi-directional measurement	No additional meters required
No moving parts	No loss of process control, optimization of assets and efficiency, no downtime or expense from calibration
Flow measurement independent of temperature, pressure, viscosity and conductivity	No impact to accuracy, which affects process control

Types of ultrasonic flow meters

Wetted

- Permanent installation
- Higher accuracy
- Liquid, gas and steam applications for district energy flow measurement

Clamp-on

- Installation at any time
- Permanent or portable installation
- Liquid and gas applications for district energy flow measurement

Advantages of clamp-on flow meters

Install on new or existing pipes	Save time and money not cutting into pipe, install in difficult locations, install anytime
Install on outside of pipe	Save time and money not cutting into pipe, no process shutdown, no process contamination
No welding, no extra parts	Save time and money
No leakage	No contamination
No required maintenance	Low cost of ownership

Examples of clamp-on meters

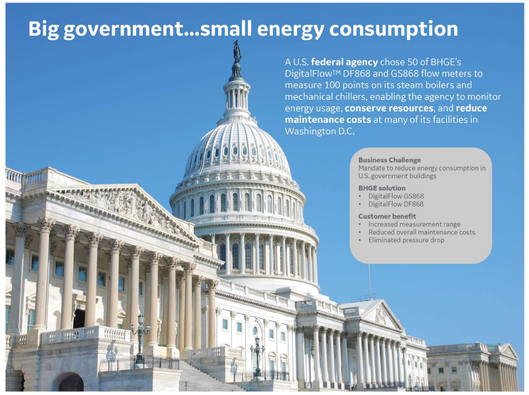
Permanent

- Clamp-on or wetted transducers
- Volumetric flow rate
- Energy rate with temperature inputs

Portable

- Clamp-on or wetted transducers
- Volumetric flow rate
- Energy rate with temperature inputs

Big government...small energy consumption



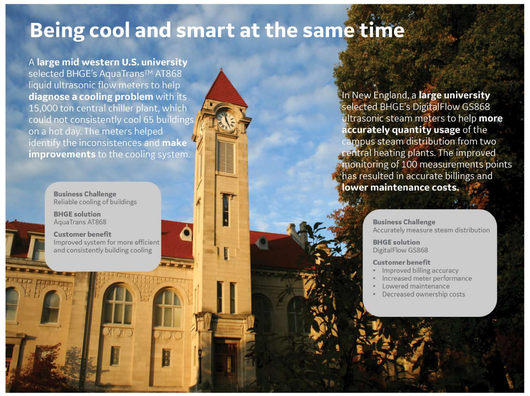
A U.S. **federal agency** chose 50 of BHGE's DigitalFlow™ DF868 and GS868 flow meters to measure 100 points on its steam boilers and mechanical chillers, enabling the agency to monitor energy usage, **conserve resources**, and **reduce maintenance costs** at many of its facilities in Washington D.C.

Business Challenge
Mandate to reduce energy consumption in U.S. government buildings

BHGE solution
- DigitalFlow GS868
- DigitalFlow DF868

Customer benefit
- Increased measurement range
- Reduced overall maintenance costs
- Eliminated pressure drop

Being cool and smart at the same time



A **large mid western U.S. university** selected BHGE's AquaTrans™ AT868 liquid ultrasonic flow meters to help **diagnose a cooling problem** with its 15,000 ton central chiller plant, which could not consistently cool 65 buildings on a hot day. The meters helped identify the inconsistences **and make improvements** to the cooling system.

Business Challenge
Reliable cooling of buildings

BHGE solution
AquaTrans AT868

Customer benefit
Improved system for more efficient and consistently building cooling

In New England, a **large university** selected BHGE's DigitalFlow GS868 ultrasonic steam meters to help **more accurately quantify usage** of the campus steam distribution from two central heating plants. The improved monitoring of 100 measurements points has resulted in accurate billings and **lower maintenance costs.**

Business Challenge
Accurately measure steam distribution

BHGE solution
DigitalFlow GS868

Customer benefit
- Improved billing accuracy
- Increased meter performance
- Lowered maintenance
- Decreased ownership costs

Prescription for cost savings

After a **major Canadian medical company** acquired a large campus, it selected BHGE's DigitalFlow GS868, DigitalFlow DF868, and AquaTrans AT868 to **track energy costs.** Since installing the ultrasonic flow meters to measure steam, chilled water and condensate, the company has **realized cost savings** and expected to achieve more savings for years to come.

Business Challenge
Track and obtain data on energy costs

BHGE solution
- DigitalFlow GS868
- DigitalFlow DF868
- AquaTrans AT868

Customer benefit
- Accurately recorded data

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a GE company