Natural Gas Sub-metering Presentation for AEE Seminar at Boston College

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What makes a meter revenue Grade?
Accuracy. 1-2% error . Varies by Utility.
Acceptable total readings.

Historically are Diaphragm Style (ANSI Spec B109.1) 1.25 " or smaller Badge with Flowrate and DP across meter
-40 to 140 range.
Mechanical temp compensated
Bellows, Positive Displacement , linkages with Bimetal element and adjust.

NIST Traceable Provers - 3rd party witnessed.
Bell Prover or Sonic nozzle. Run gas.

4 inch meter is 400 lbs.

Both B109.1 and B109.2 define diaphragm-type gas meter capacity as that volume of 0.60 specific gravity gas at an absolute pressure of 14.73 PSIA that will result in an average pressure drop through the meter of 0.5 inch of water column, using specified inlet and outlet connections. This capacity rating is not to be construed as a maximum capacity but as a common capacity rating base. Within the B109.1, meters are divided up into several classes:

Class Capacity (ft^3/hr)

Minimum Maximum

50 50 174

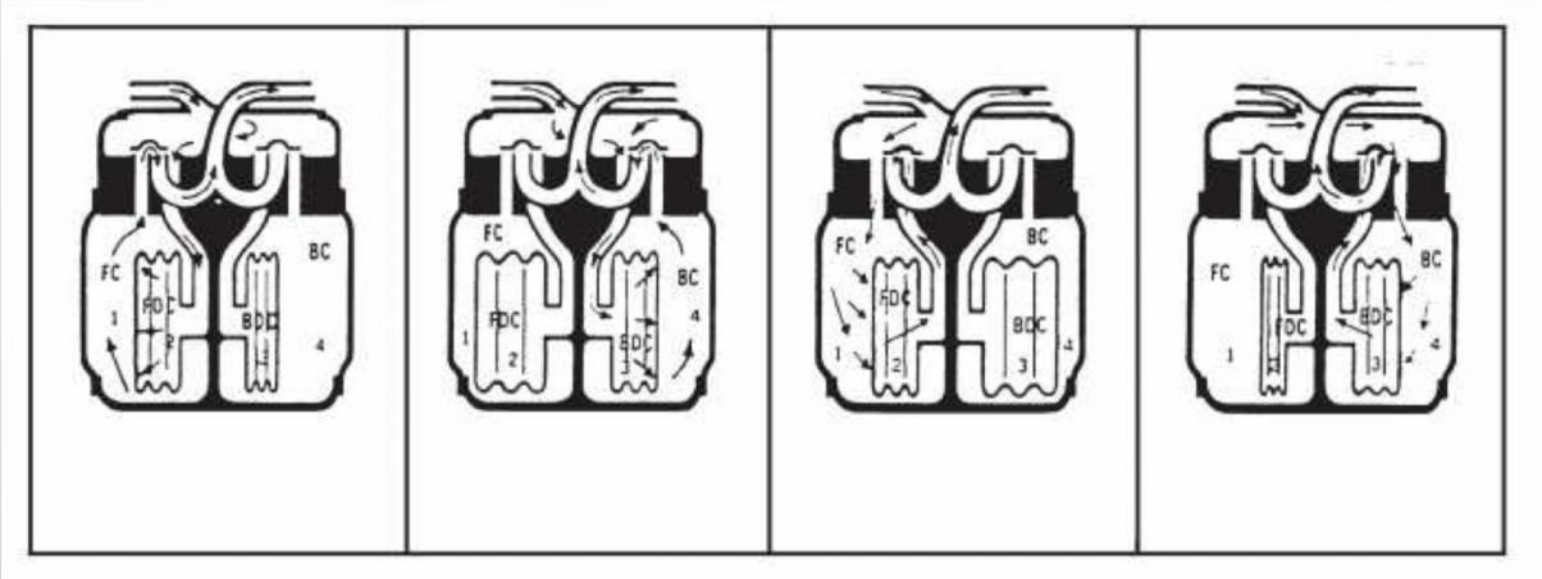
174 175 249

250 250 399

400 400 499

This standard calls for new meters to be $\pm$1.0% accurate and $\pm$2.0% after accelerated life tests. (See Figure 4. for small meter test apparatus.)

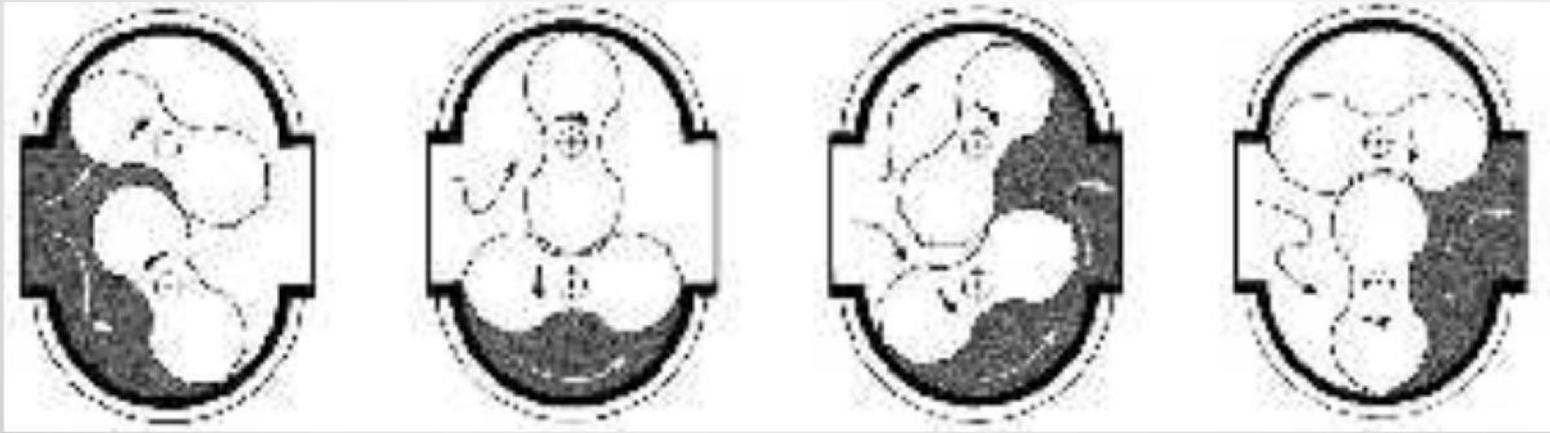
Diaphragm meter Cutaway



Rotary meters

- Rotary meters - 18 lbs
- External- Pressure & Temperature compensation -
- 2 inch meter in 60 psig line, 5 x more gas than the badge.

Rotary Meter Cutaway



Pressure Effect on Gas Flow

Boyle's Law

$$\frac{\text{Gauge Pressure + Atmospheric Pressure}}{14.73 \text{ psia}}$$

Rule of Thumb: Every 15 psig results in Doubling of initial Gas Flow

STP = 1x Flow
15 PSIG = 2x Flow
30 PSIG = 3x Flow
45 PSIG = 4x Flow

Difference between ACFM and SCFM

Temperature Effects on Gas Measurement

Charles Law

$$F_t = \text{Temperature Correction Factor} = \frac{520^\circ R}{460^\circ R + \text{Gas Temperature}}$$

Rule Thumb: Every 5 degrees = 1% error.

80 deg – 60 deg = 4% error

Correction Factors applied to Rotary meter

Applying the Basic Gas Laws, the following formula may be used to size a rotary meter:

$$Q_s = Q_d \times F_p \times F_t$$

Where:

Q_s = Standard or corrected volume

Q_d = Displaced or uncorrected volume

F_p = Pressure correction factor =

Flowmeters for Gas

Diaphragm - Small diameter <1.5 inch (Total Only)

Rotary- Large diameter > 1.5 inch (Total Only)

Thermal Mass – >1/4" inch (Rate and Total, Low DP, T&P Comp)

Turbine – ¼" inch + , (Rate and Total, High DP, T&P Comp opt)

Vortex - ¼" inch + , (Rate and Total, High DP, T&P Comp opt)

Orifice, Venturi, Pitot – (only power plants and Transmission)

Ultrasonic In-line - (2 inch + , (Rate and Total, Low DP, T&P Comp opt, Very Expensive , Custody Transfer)

Ultrasonic Clamp-on - ¼" inch + , (Rate and Total, NO DP, T&P Comp)

Coriollis – Power Plant only, High DP, High Cost, Large Size

Some Conclusions

- Walk through Prior to installation for Straight Run and Obstacles
- Temperature Compensation
- Pressure Compensation
- Low Flow capability and Sized Correctly
- Factory Calibrated
- Field Reference
- Field Commissioning