Commercial Meter Set Design

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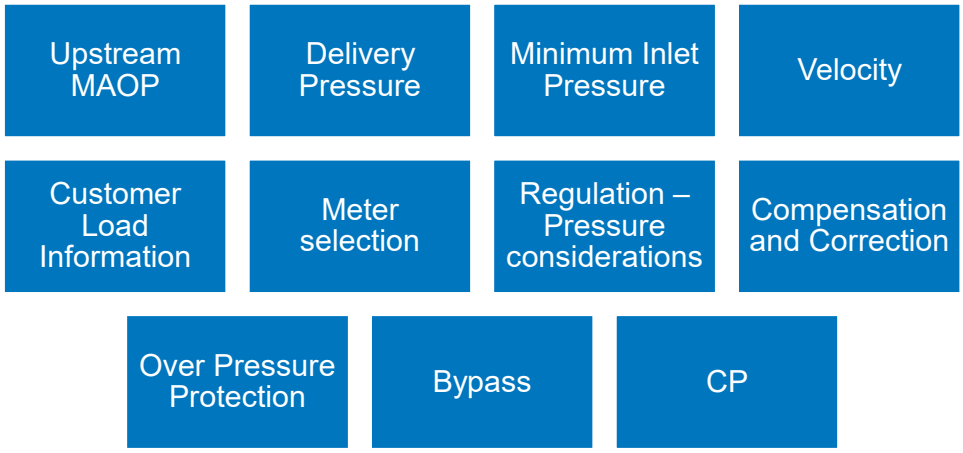
Introduction and Welcome.

Distinctives of Commercial Meter Sets

- Higher Loads – higher capacity meters and regulators
- Higher service pressures – often 2 psig and up.
- Redundancy and maintenance requirements
- Future Load Growth
- Custom Solutions

What sets Commercial meter sets apart? What is important about them? They are the cash register for the utility but often there is a custom aspect to their design. Often times a customer may have specific and unique equipment or process parameters that require the design of a meter set tailored to the customer's needs.

Design Considerations



There are many interrelated items that go into the design of a natural gas meter set. These will be the focus of this presentation.

Briefly discuss those shown on screen.

Codes and Standards

- 49 CFR Part 192
- NFPA 54 / ANSI Z2231 - National Fuel Gas Code
- ANSI/AGA B109.2, B109.3, B109.5 – large diaphragm meters, rotary meters and higher-capacity regulators commonly used in commercial service.
- Utility Design Standards

There are many codes that govern the design and operation of natural gas systems. This includes the meter set. Understanding how codes, standards, and specifications are practically applied to meter set design is critical.

Typical Components

- Service Line
- Inlet valve
- Regulator/Regulation
- Filter/Strainer
- Meter
- Bypass
- Vent
- Relief

Most commercial meter sets have similar components but may differ in configuration.

This one is out back at the facility where I work so it gets used as a learning example for the new engineers.

Explain and point out components going from inlet riser to outlet pipe.

Riser
Tracer wire – indicative of a poly service
Bypass and valve off anodeless riser
Shutoff valve
Strainer
Regulator – 2” – yellow cap
Pipe Support
Loop of pipe
Rotary meter
Proving port

Butterfly valve
Bypass valve
Pipe Support
Reducer
Takeoff of gas to generator
Larger diameter pipe to building equipment

Regulation

Some examples of various regulation types. It really depends on your pressure cut, etc.

Briefly discuss different versions.

Special pressure
HP to IP

Regulation

- The process of reducing and controlling pressure.
- Inlet Pressure
- Delivery pressure
- Upstream MAOP
- Overpressure protection (monitor reg, relief valve, shut-off valve).

What meets these parameters that your utility uses?
Regulation is a key part of the meter set design. There are many different scenarios related to the pressures on a system.
Determine what the Regulation needs to do:
Are you reducing the pressure from intermediate to a service pressure (7" w.c.)? Is it a higher service pressure that a customer wants delivered (2 psig, 5 psig)?

Do you need to reduce the pressure from high pressure down to service pressure? Do you need and intermediate step in there?

How will the regulator provide protection from and over pressure event? (monitor reg, relief valve, shut-off valve). Separate relief valve, internal relief?

The selection of regulation is an important one. Often the inlet pressure and the delivery pressure that the customer has requested end up playing significantly into the regulator type(s) that is selected.

Inlet/delivery conditions.

Selection scenarios:
Intermediate Pressure to Service Pressure
High Pressure to Service Pressure
Each Reg system must have overpressure protection (monitor reg, relief valve, shut-off valve).
Regs sized to handle the upstream pressure
Internal relief?

Over Pressure Protection

- Design limits and MAOP controls
- Pressure regulation and limiting devices
- Relief and Venting requirements
- Customer meter and service regulator protections
- Operational safeguards

"Each pressure limiting or pressure regulating station must be designed to prevent the downstream pressure from exceeding the safe limits of the distribution system." 49 CFR 192.195b

Don't let your relief outlet piping introduce a "restriction" because length adds more restriction than the valve or reg can take to open on over pressure..

Make sure you know what the customer's MAOP is and what equipment they may have downstream.

Meter Types

- Diaphragm
- Rotary
- Turbine
- Ultrasonic
- Coriolis





There are a variety of meter types that show up in the Commercial meter category. I often include industrial sets in with these. I will briefly discuss Turbines, ultrasonics and Corilois meters now, I was asked to focus more on Diaphragm and Rotary types.

Turbine: Large loads, accurate but has limited rangeability. Often you can swap our cartridges to increase meter capacity. Mechanical.

Ultrasonics: These are more expensive than many of the other types of commercial meters but they are very accurate across a wide range of flows and pressures. They use the speed of sound in a gas in a known volume to determine the flow rate through the meter. They require very little maintenance and can measure across a wide range of flows.

Coriolis: These are not seen in the utility space quite as often as the other types mentioned here. They are a true mass flowrate meter. They do not have the requirements for inlet and outlet flow conditions that other meter types do. That allows them to be used in a variety of locations and configurations. They also are available in higher pressure class ratings. They should be installed with the “U” upside down. They can be “clocked” with the bolt pattern but verify with the manufacturer

before doing so.

Diaphragm

Diaphragms have been a workhorse for many utilities. The bigger the diaphragm meter, the higher the pressure the meter can typically handle. They are simple and easy to maintain. Some sizes are no longer manufactured. We are phasing out AL-5000's and later will do that with 2300's as well. They are very effective for many applications, especially when we are dealing with IP post regulation (7" w.c., 2 psig, 5 psig).

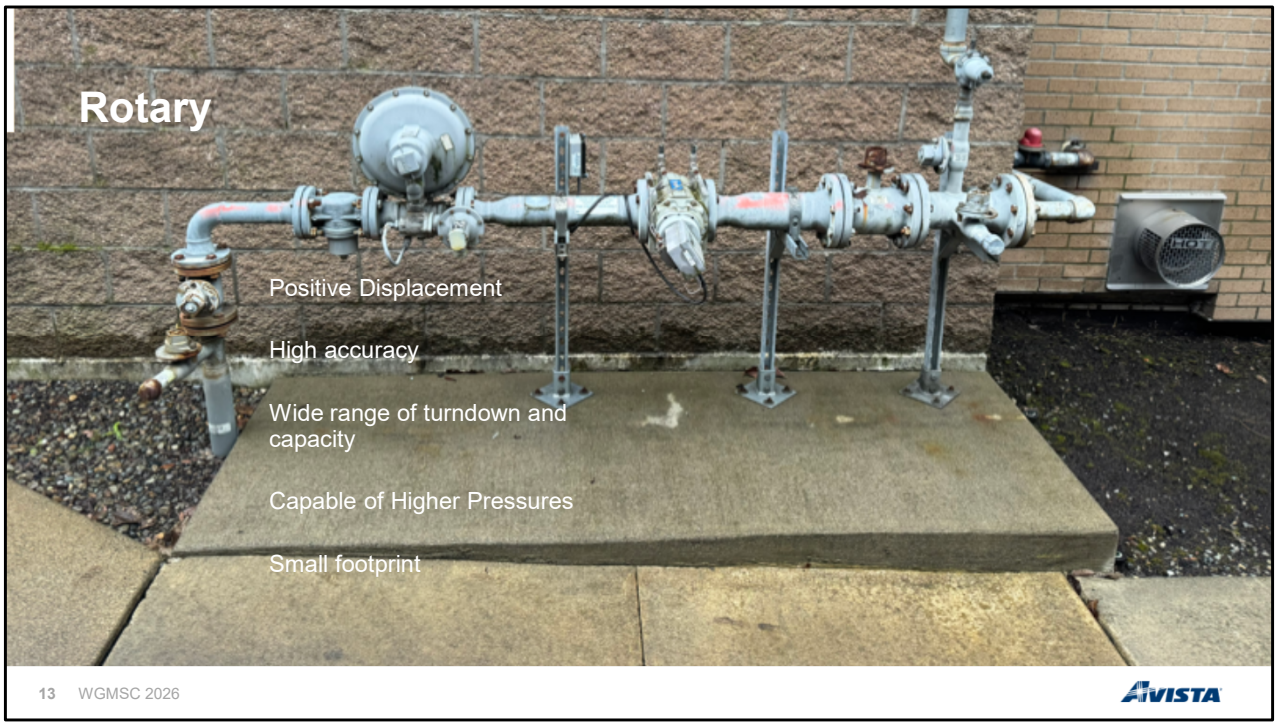
Diaphragm

- Positive Displacement
- High accuracy
- High Turndown rate
- Affordable
- Ideal for low to medium capacity loads – pilot metering
- Simple to install and maintain

This is an AL-5000. Note the Vic couplings on the inlet and outlet of the meter. These can be great to have in service as the require little maintenance, but many are getting old. They require a truck mounted crane to move them. Note the MINI-AT. That is a type of volume corrector we are phasing out as well.

Rotary

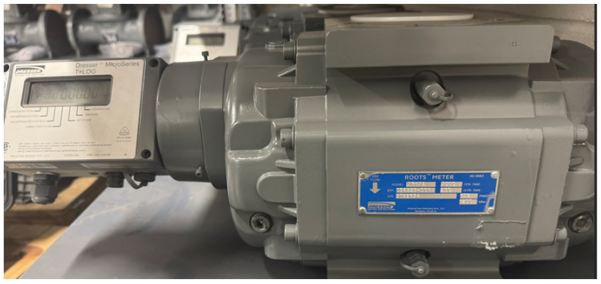
The classic. Note the vertical installation. This is what is recommended in the manufacturer's installation instructions. It allows for any dirt or debris to fall through the meter, instead of becoming caught in the meter body. That is what they described. Note the corrector that is attached. This one is on AMI and the corrector sends a pulse out to the ERT – note the wire out of the corrector.



This is another example. Note the dP getting pulled off the upstream and downstream of the meter. This one has the ERT mounted to a piece of Unistrut. Get some paint on that.

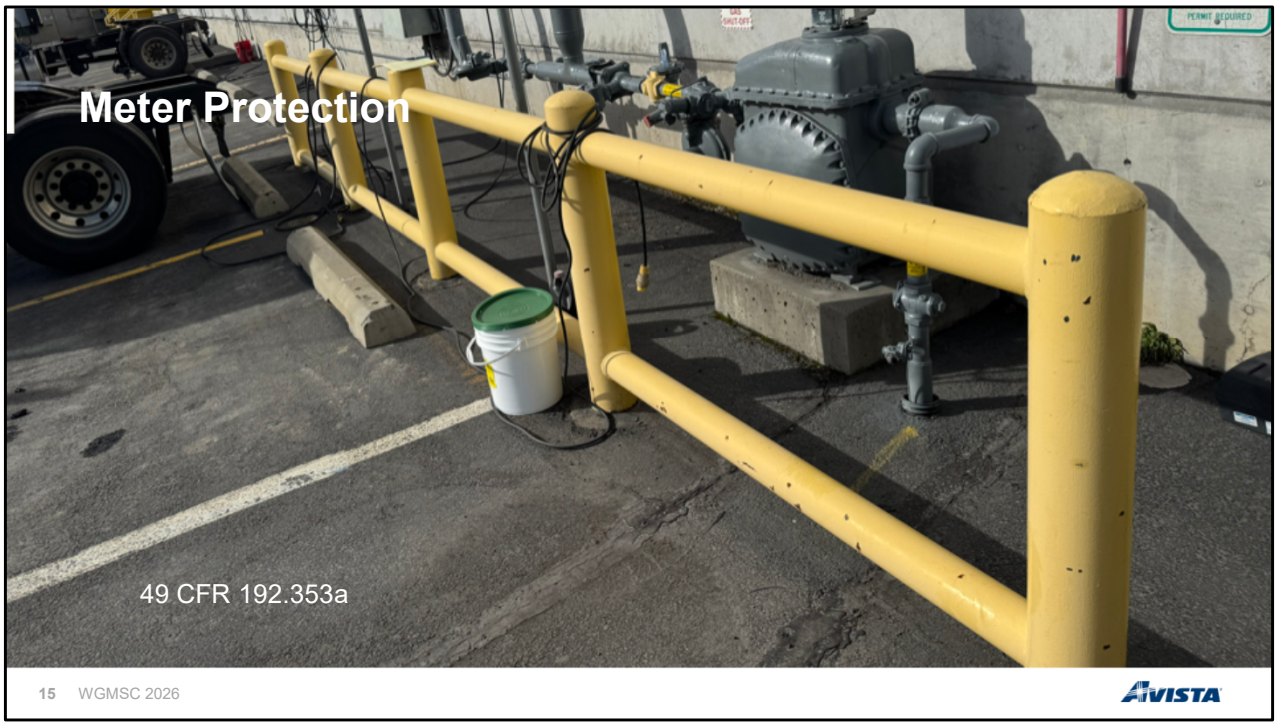
Compensation and Correction

- Temperature
- Pressure
- Elevation



Compensation:
Elevation – atmospheric pressure of the town where the meter is located divided by the base pressure.
Temperature – Many meters are temperature compensating. When they aren't, the meter will require a temperature factor be applied to the volume of flow.
Pressure – applied to adjust the volume of measured gas for meters that are measuring as at a pressure higher than atmospheric conditions.

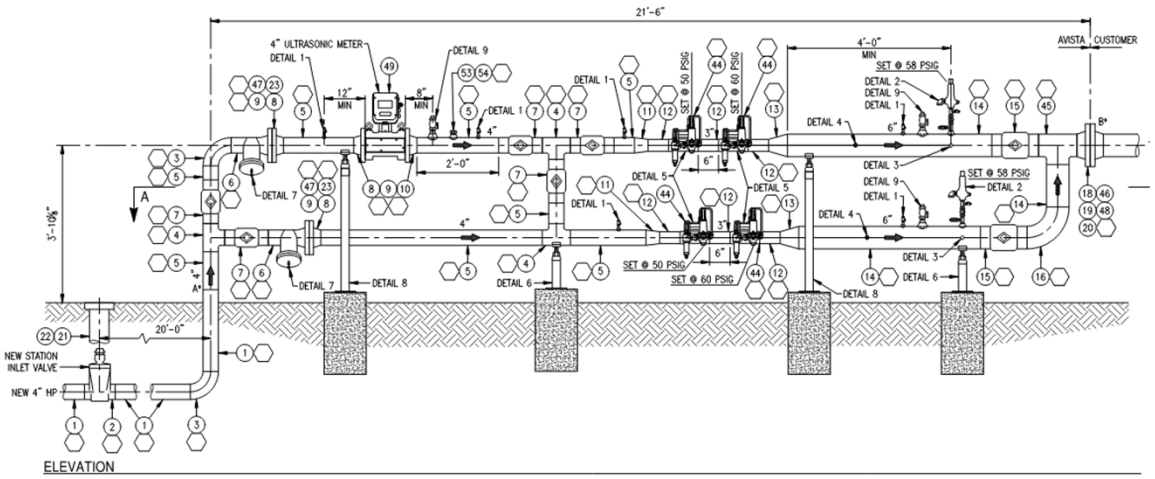
Correction: Gas volumes through meters that are non-temperature compensated must be corrected for the temperature effects on the volume. This is achieved by one of three methods: a temperature compensating meter, a correction device installed on the meter such as an electronic corrector (typically for large volume accounts), or by the correcting factor applied to the account through the billing system.



Determine the likely risk and plan accordingly. Some locations can be identified as needing physical protection installed with the addition of the meter. There are others where it needs to be added retroactively due to impacts or collisions. ASTM F3016 provide guidance for bollards. Focus is on accidental vehicle impacts. ASTM F3016 is a low-speed crash-testing standard that verifies whether bollards or barriers can stop everyday vehicle accidents before they reach people or buildings.

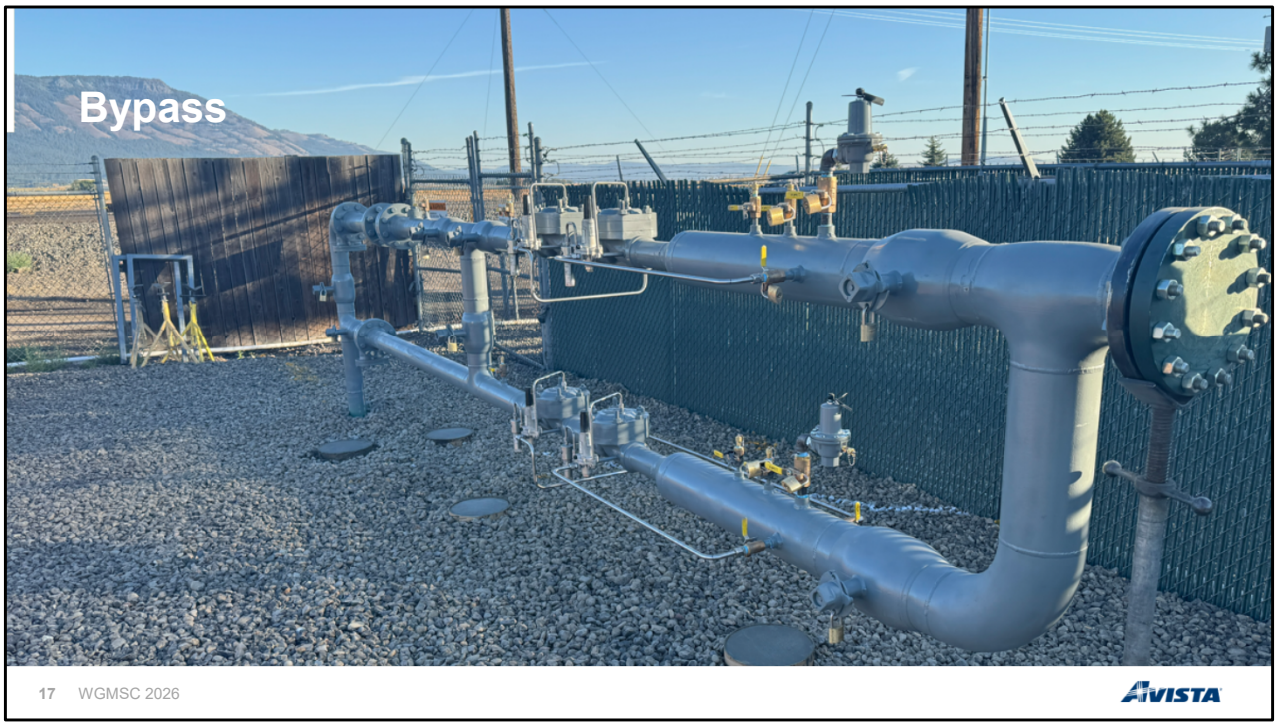
This location has vehicles parking right around the meter set, if protection was not installed it would be a matter of time until we had an incident of some sort.

Bypass



This is a meter set for a wood product factory upgrade. Note the bypass is redundant except for the meter. Note the options for flow through the meter set that can be selected by using the valves.

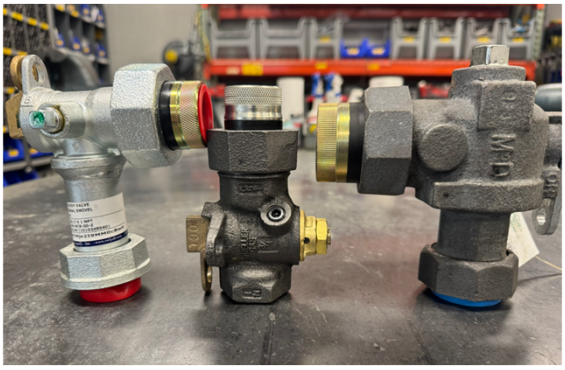
This set used a Flowsic 550. The cycle of demand on the meter showed a variation in the load profile – lots of peaks and valleys. This helped us select a USM meter vs. a turbine due to its increased rangeability and accuracy across the wide measurement range.



This is the meter set from the previous slide installed in the field and waiting connection to the customer's piping.

Cathodic Protection

- How to isolate the meter set and the customer piping from the utilities Cathodic Protection system?



It is important to isolate the Utilities cathodic protection system from the customers piping, etc. This can be accomplished a variety of ways. Some typical methods involve valves that have a non-conducting (insulating) portion. The use of flange isolation kits is also a method of electrical insulating flanges. These eliminate the electrical path through and across the flange. There are situations where the isolation/insulating device becomes shorted. This can impact the function of the Cathodic Protection system and associated diagnostic reads.

Questions?