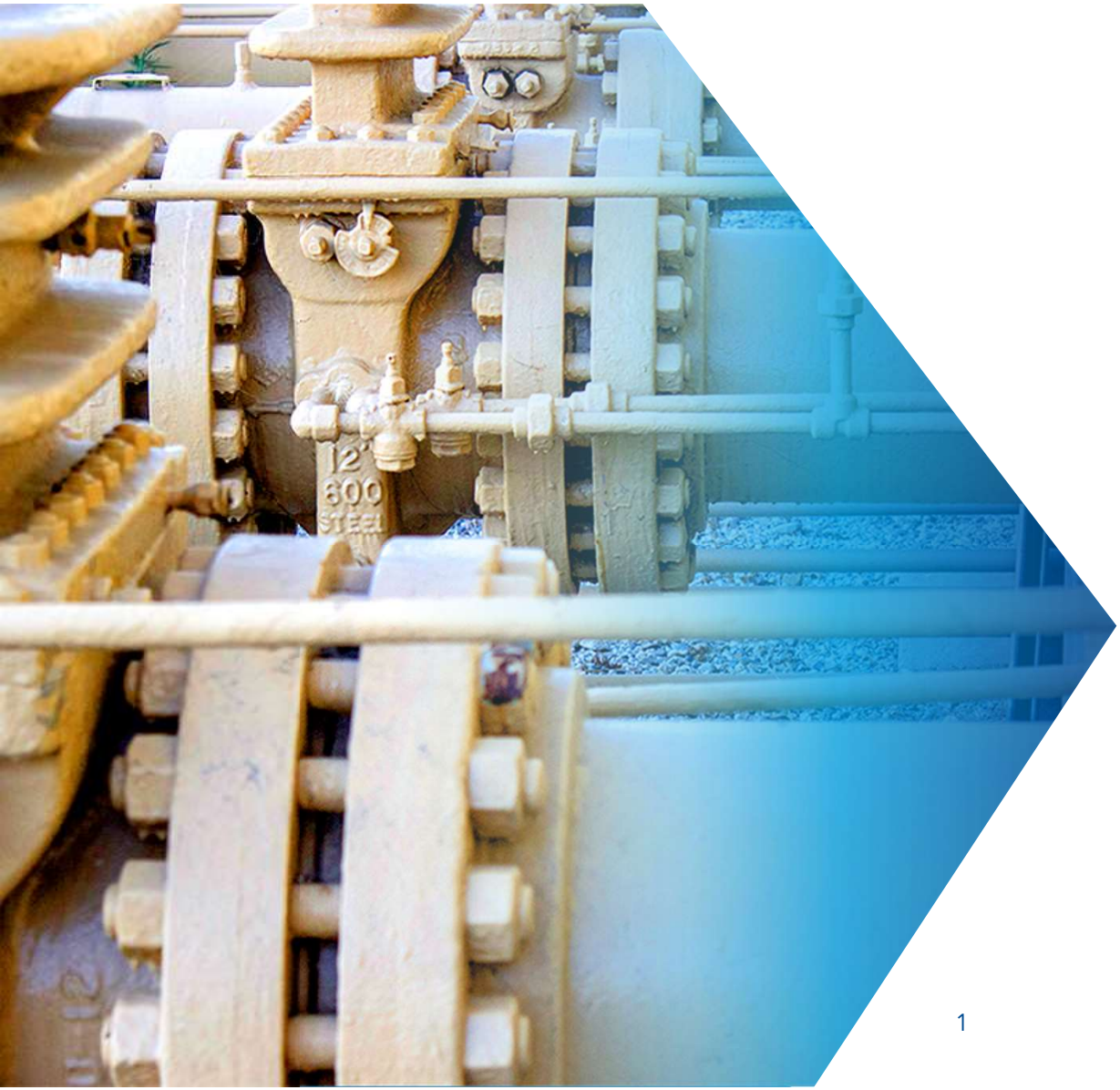


INTRODUCTION TO GAS METERING

SoCalGas™

Why do we meter?

- Alternatives to metering
  - Subscription to water heating, home heating, etc
  - Flat rate for gas service

- Reasons for metering
  - "Gas Company's cash register"
  - Charge the customer only for the energy used
  - Verify proper operation and safety of the distribution system

Meter Types and Applications

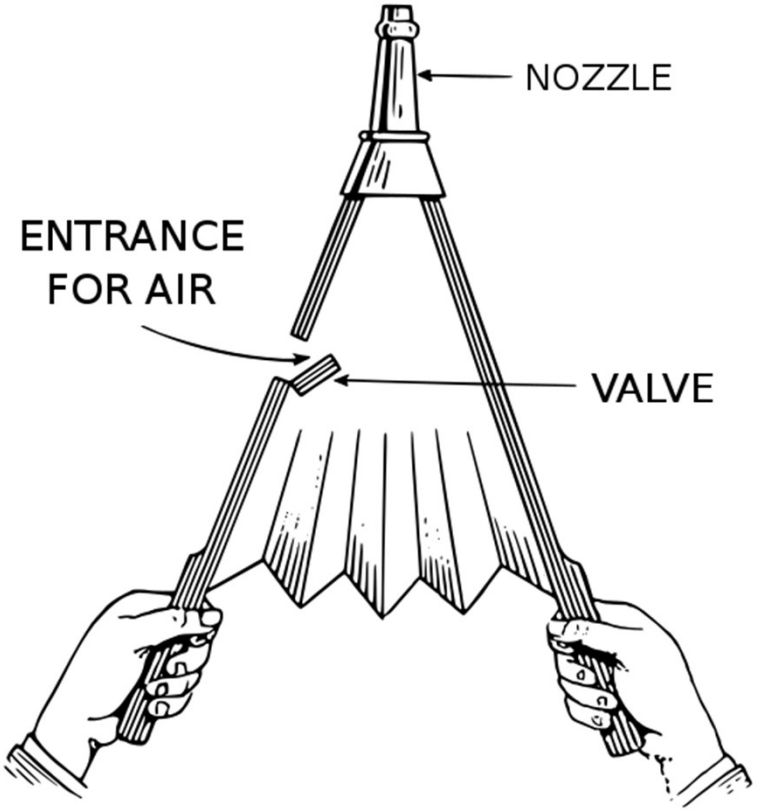
- Custody Transfer
  - Where gas is bought or sold
  - Meters at these locations are governed by industry standards
- Non-custody Transfer
  - Also known as Process Metering
  - Used for system monitoring and control

Custody Transfer Metering

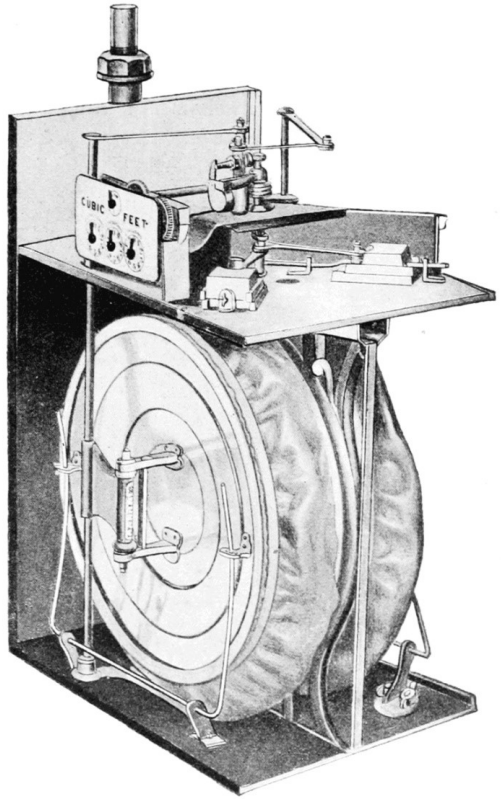
- Diaphragm
  - Most numerous meter type
  - Design well over 100yrs old

Custody Transfer Metering - Diaphragm

- Theory of Operation
  - Positive displacement meter
  - Basically operate like a set of blacksmith's bellows – gas flows into the known-volume measuring chamber until it is full, then valves shift positions and the chamber empties to the meter outlet



Custody Transfer Metering - Diaphragm

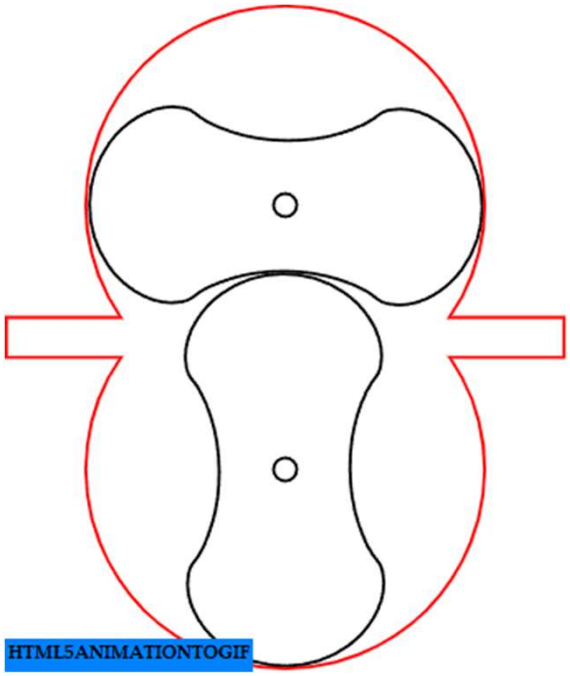


- Advantages
  - Fully mechanical – no outside power needed
  - Affordable and low maintenance requirement
- Disadvantages
  - Mechanical – moving surfaces wear over time
  - Potential for improperly cured diaphragm material to change size

Custody Transfer Metering

- Rotary
  - Common meter type for businesses ranging from restaurants to large industrial customers

Custody Transfer Metering - Rotary

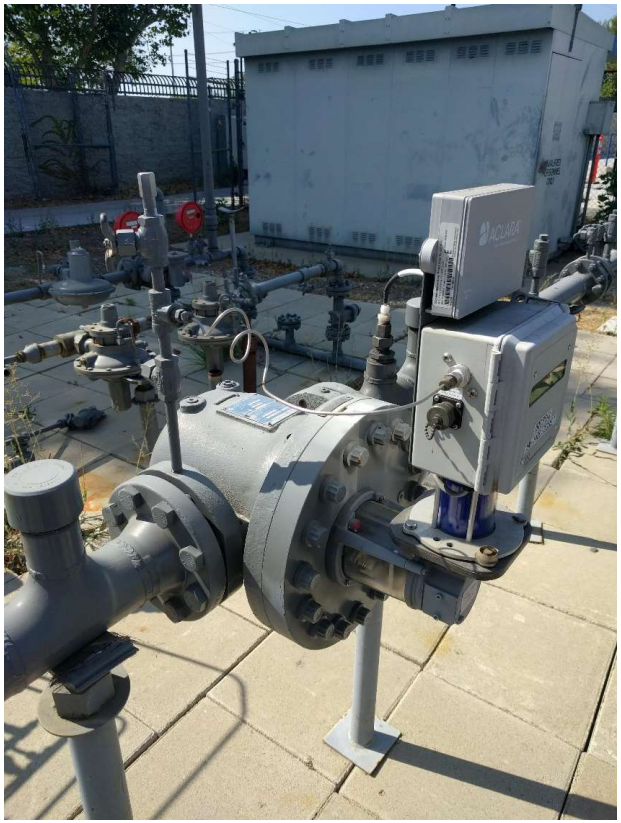


- Theory of Operation
  - Positive displacement meter
  - Essentially the inverse of a roots blower in the automotive world
  - As the intermeshed rotors turn, the form known-volume chambers against the inside surface of the body

- https://upload.wikimedia.org/wikipedia/commons/2/20/RootsBlowerAnimation.svg

Custody Transfer Metering - Rotary

- Advantages
  - Accuracy is machined into the meter
  - Small air gaps between sealing surfaces result in little to no wear
  - Affordable in comparison to other large volume meters
- Disadvantages
  - Debris in the gas flow can get between rotors and jam the meter
  - Improper installation can deform the meter body, also jamming the meter



Custody Transfer Metering

- Turbine
  - Commonly used for high consumption customers including large industrial facilities and fleet NGV fueling installations

Custody Transfer Metering - Turbine

- Theory of Operation
  - Inferential meter – instead of directly measuring volume, we measure gas velocity
  - Much like the back end of a jet engine or the exhaust side of a turbocharger, flowing gas pushes on a set of fan blades, causing them to spin. The speed of this spin is proportional to the speed of the gas, as well as the volume

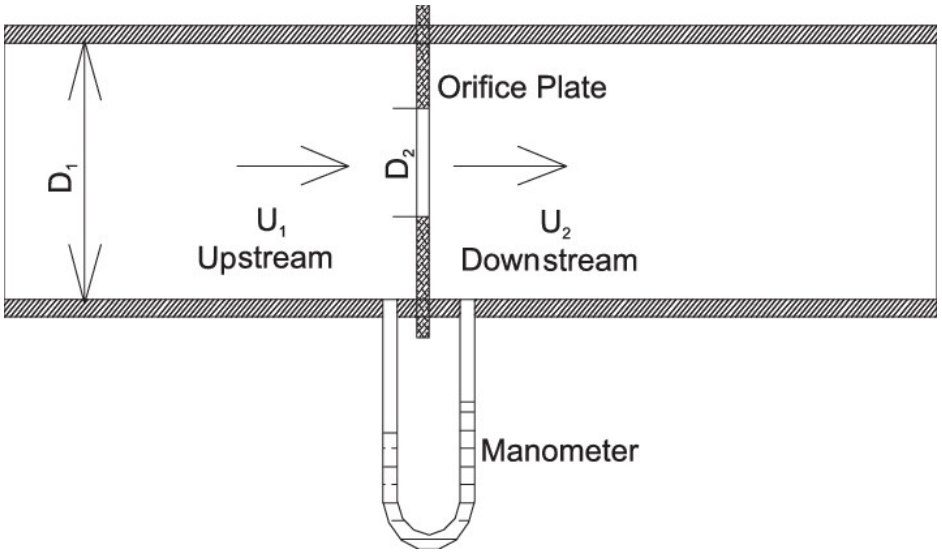
Custody Transfer Metering - Turbine

- Advantages
  - Capable of measuring very large, high pressure volumes of gas
  - Does not interrupt the flow of gas to the customer if the mechanism binds
- Disadvantages
  - Cost – meters themselves are expensive and require regular visits for lubrication
  - Straight pipe and flow conditioning requirements

Custody Transfer Metering

- Orifice
  - Used for very large consumption customers like oil refineries, power plants, or city-owned gas utilities

Custody Transfer Metering - Orifice



- Theory of Operation
  - Inferential meter – measures differential pressure across a restriction
  - This pressure differential, combined with the orifice plate parameters, pressure, and temperature are fed into a low computer to calculate the volume

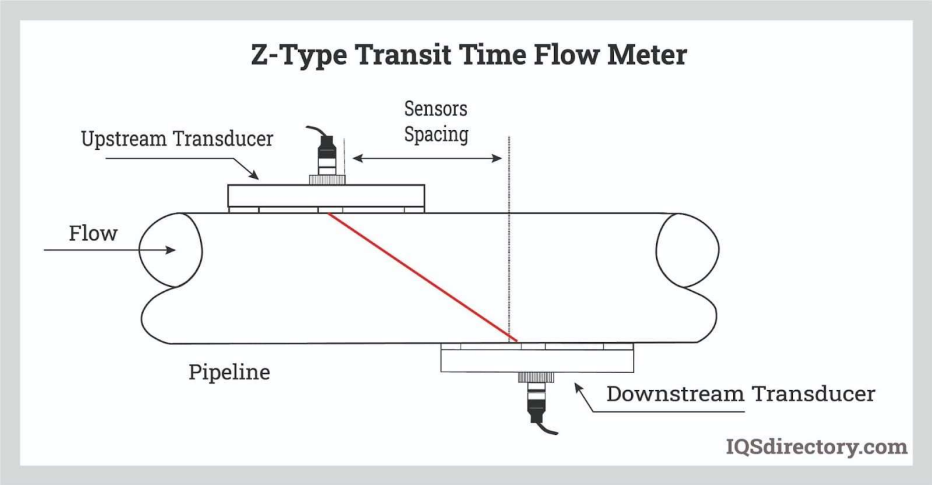
Custody Transfer Metering - Orifice

- Advantages
  - Gas flow to the customer continues if the meter malfunctions
  - Since the meter uses no moving parts, there is very little wear
- Disadvantages
  - Does not measure well outside the designed flowrate, particularly low flow
  - Requires straight pipe on both sides of the meter

Custody Transfer Metering

- Ultrasonic
  - Historically used for very large consumption customers and custody transfer points between distribution and transmission companies
  - In recent years, the technology has become cheaper and more compact, allowing for meters sized to replace rotaries and diaphragms

Custody Transfer Metering - Ultrasonic



- Theory of Operation
  - Inferential meter – measures gas velocity
  - The meter sends pulses of sound across the flow in both the upstream and downstream directions and records the time each takes
  - The difference in transit times combined with the path length gives the velocity of the gas

Custody Transfer Metering - Ultrasonic

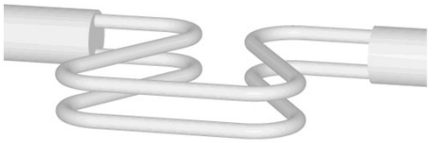
- Advantages
  - Meter can use its own data to internally troubleshoot
- Disadvantages
  - Meters require flow conditioning. On large meters, this means a straight pipe requirement, but on some smaller meters, flow conditioning is built into the meter itself
  - Meter requires power to measure, whether battery or line power

Custody Transfer Metering

- Coriolis
  - Used in CNG applications, like as the billing meter in NGV fuel dispensers

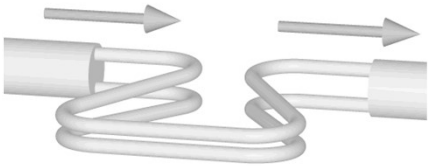
Custody Transfer Metering - Coriolis

- Theory of Operation
  - Mass flowmeter – volume can be calculated measured density
  - Gas flow is split into two parallel vibrating tubes, which causes the vibrational frequency to shift between the two tubes. This shift is used to calculate the mass flowrate



No Flow

https://commons.wikimedia.org/wiki/File:Coriolis_meter_vibrating_no-flow_512x512.gif



Flow

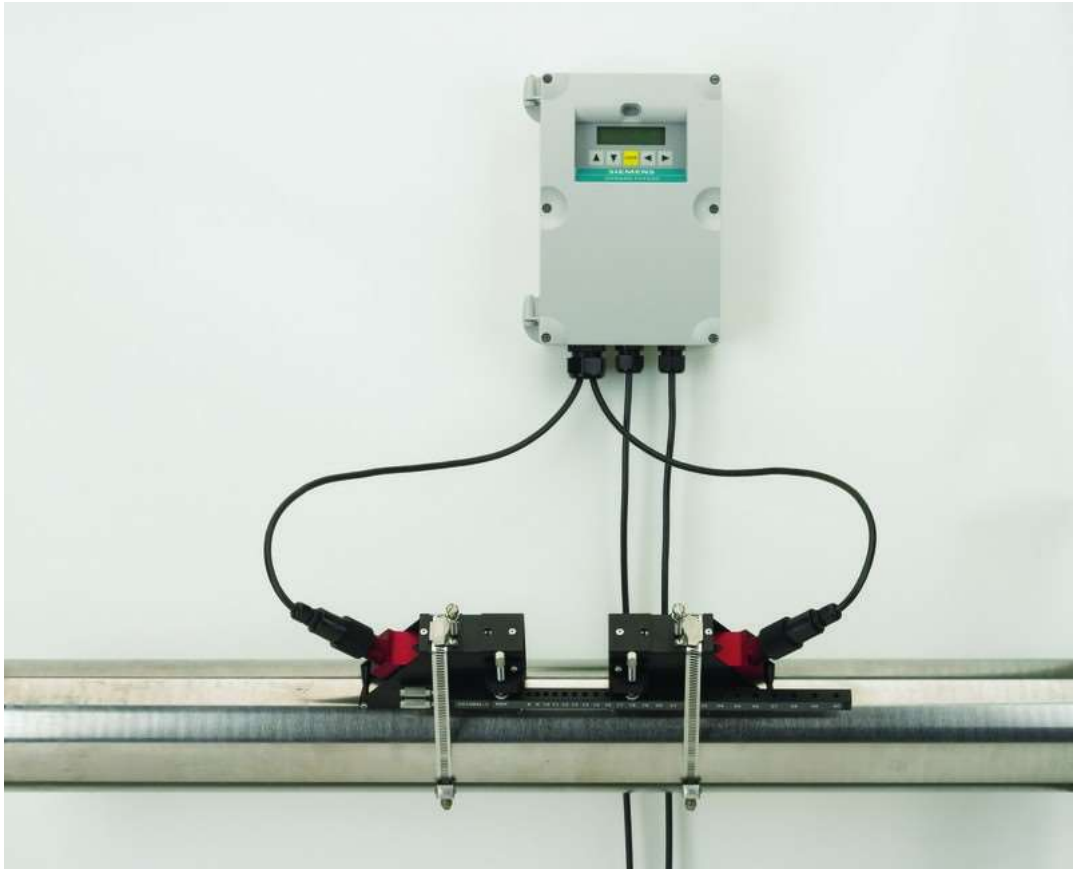
https://commons.wikimedia.org/wiki/File:Coriolis_meter_vibrating_flow_512x512.gif

Custody Transfer Metering - Coriolis

- Advantages
  - Operate at very high pressures
  - Very compact and don't have straight pipe requirements
- Disadvantages
  - Relatively expensive
  - Require power to operate

Non-Custody Transfer Metering

» Clamp-on Ultrasonic



Non-Custody Transfer Metering

» Pitot Tube/Annubar

Non-Custody Transfer Metering

» Conditioning Orifice Plate

Questions?