

Ultrasonic Meters for Residential and Commercial Applications



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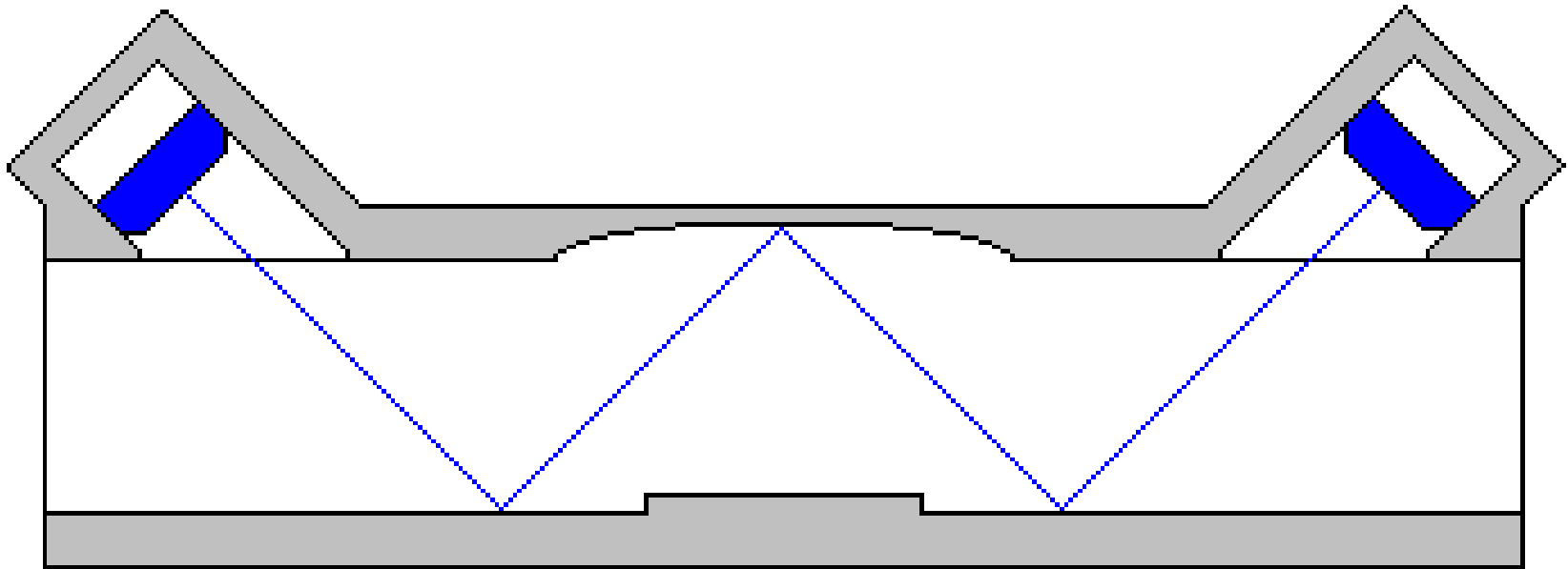
PAUL HONCHAR
SENSUS
Sr. Product Manager

In The Beginning

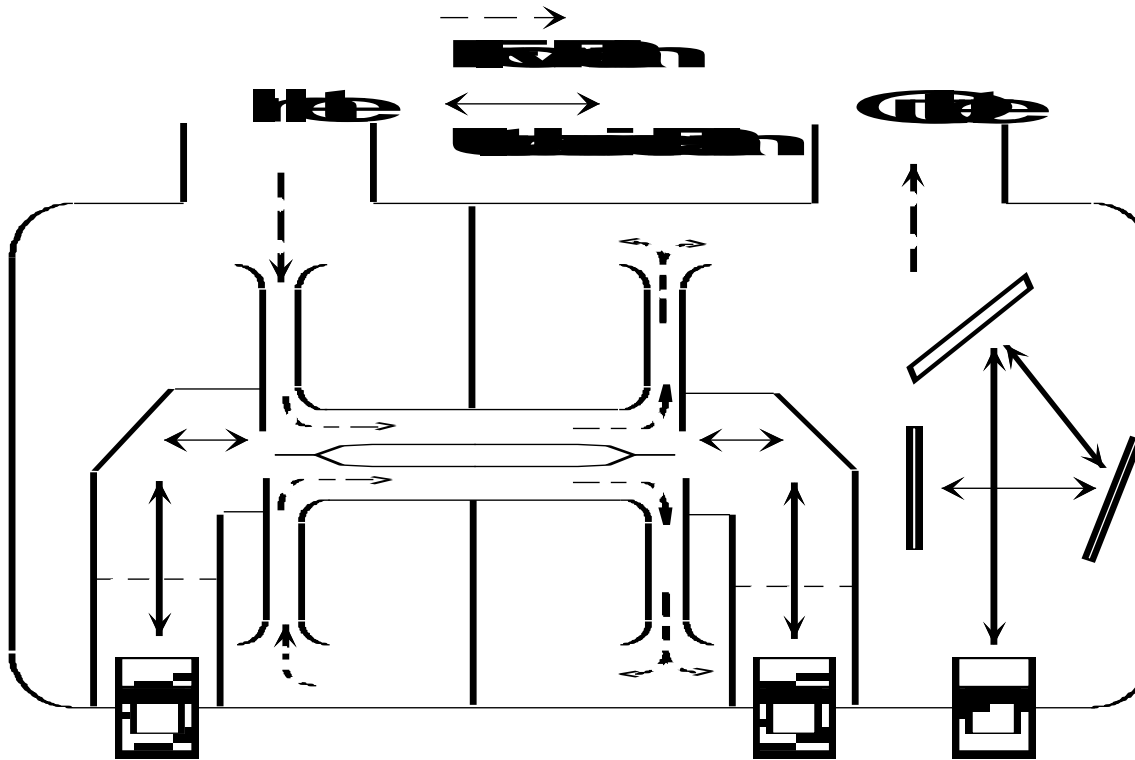
In early 1987, British Gas announced a “competition”

- Design proposals due in September 1987
- 21 proposals received
- 4 were selected for further development
 - 2 ultrasonic
 - 1 fluidic
 - 1 silicon beams

Basic Design: Siemens



Basic Design: Gill R&D

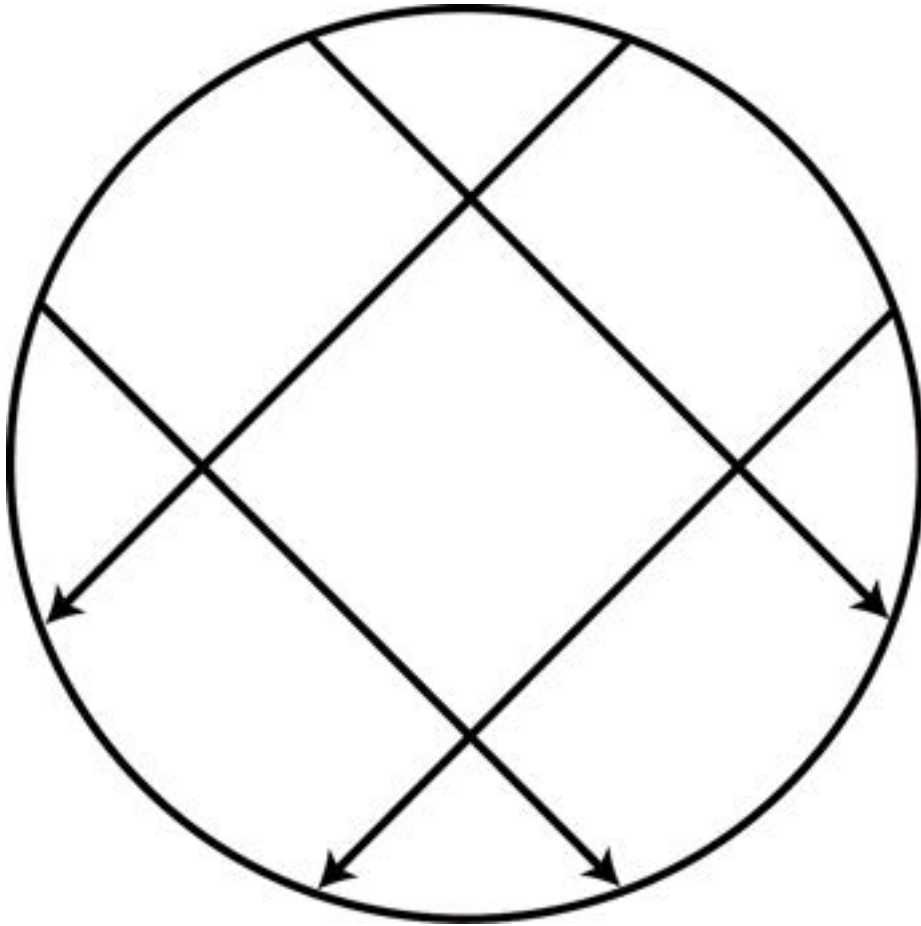


Ultrasonic: Basics

Sound waves

- Acoustic (audible sound)
 - 20 Hz to 20,000 Hz
- Ultrasonic
 - Generally above 20,000 Hz
- Time of Flight
 - Velocity is determined based upon transit time of sound waves

Fundamentals of Ultrasonic Measurement



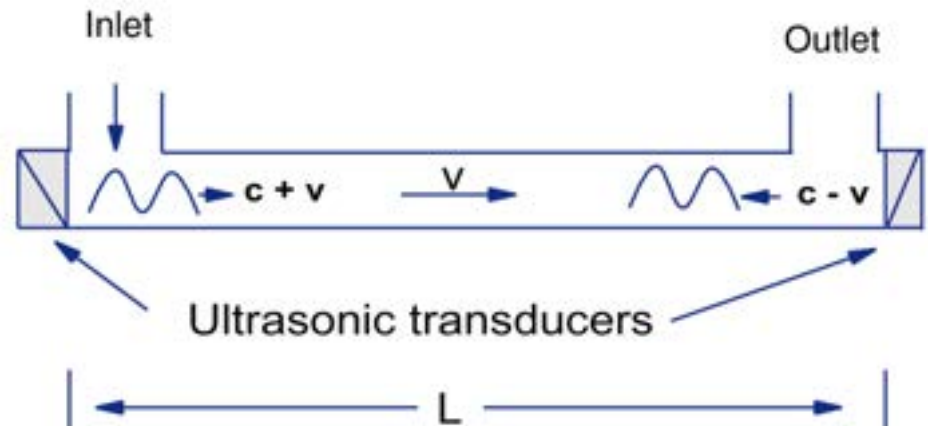
Multi Path – High Flow

- Larger flowing diameter
- Profile of gas can change shape
- Average gas velocity requires multiple path measurements

Fundamentals of Ultrasonic Measurement

Single Path – Low Flow

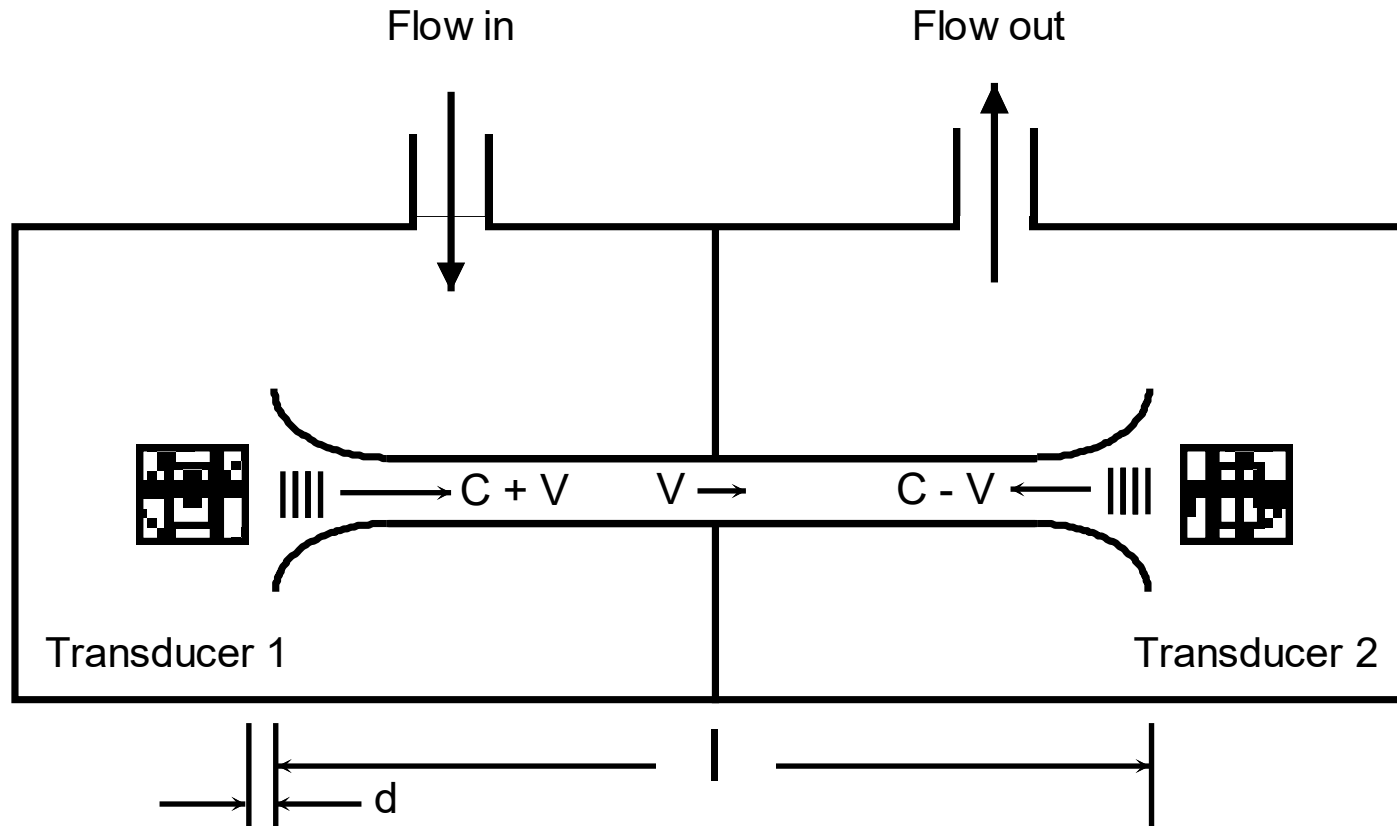
- Pulses are produced with – and against – the gas stream.
- Pulses flowing with the gas velocity speed up
- Pulses flowing against the gas velocity slow down
- Difference = gas speed within the known area



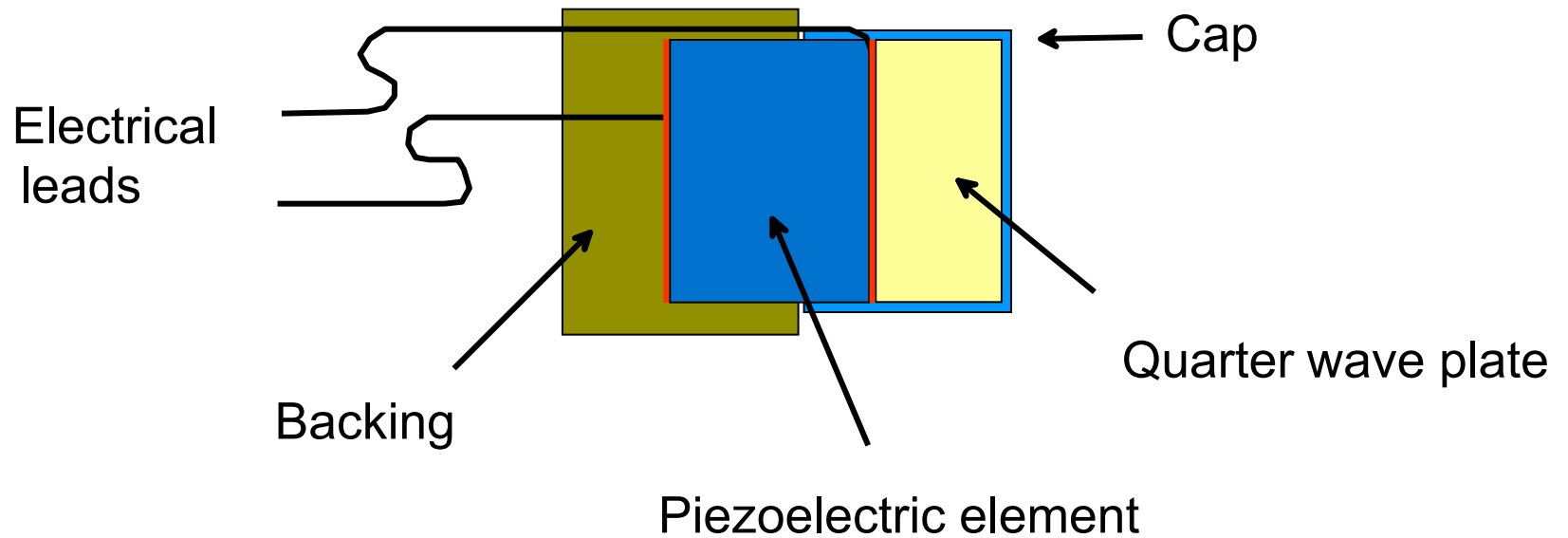
Time of Flight Principles

- Piezoelectric transducers generate and detect waves
- Waves travel at the speed of sound of the moving fluid
- Velocity of gas is determined from the transit time of generated sound waves
- Sampling system: Spot measurement repeated at intervals averaging two seconds
- Volume (ft³) = **Velocity** (fps) x cross-sectional **Area** of flow tube (ft²) x sample **Time** (s)

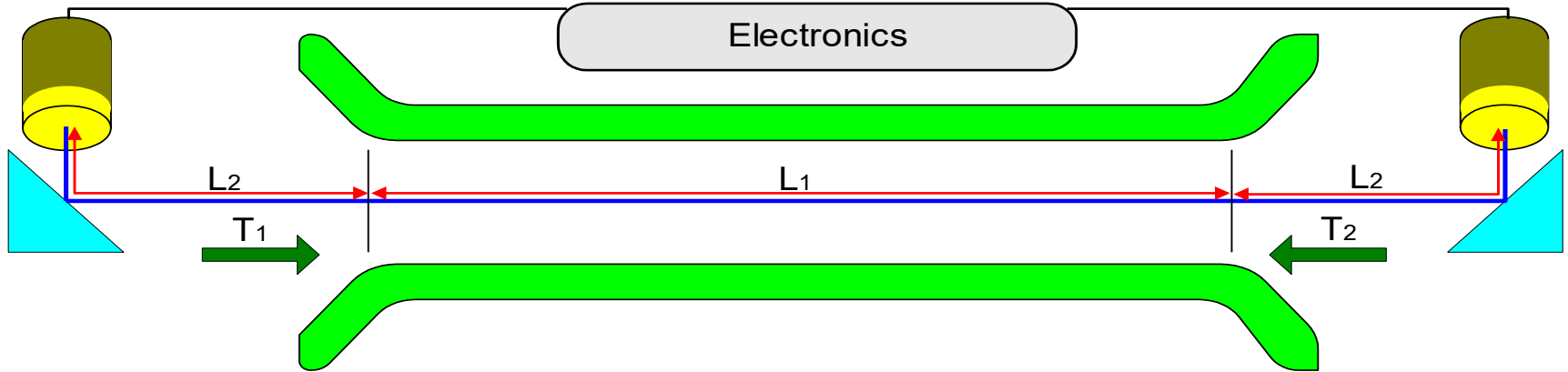
Ultrasonic Meter Schematic



Transducer Schematic



Velocity Determination



$$T_1 = \frac{L}{C+V} \quad T_2 = \frac{L}{C-V} \quad \text{so} \quad V = \frac{L}{2} \left(\frac{1}{T_2} - \frac{1}{T_1} \right)$$

$$V = \frac{L}{2} \left(\frac{T_1 - T_2}{T_1 T_2} \right)$$

T_2 = Time of upstream firing
 T_1 = Time of downstream firing

C = Speed of sound in gas
 V = Velocity of the gas

Timing

The meter has to measure the “time of flight” of the ultrasonic pulse in nanoseconds (10^{-9} sec) to achieve acceptable volume accuracy

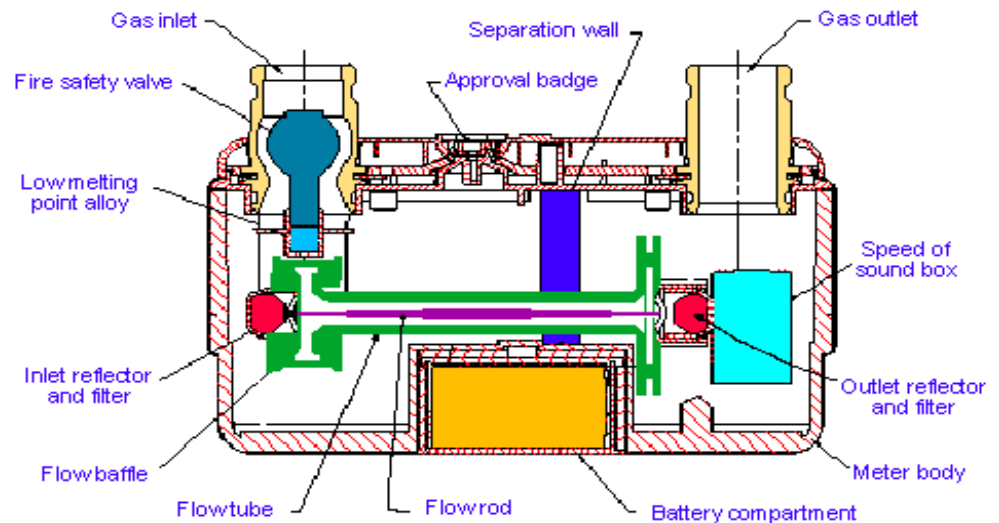
(0.000000001)



Gold vs Silver is measured in hundredths of seconds (10^{-2} sec)
(0.01)

First Generation - Europe

Beginning in 1993, 1.3 million residential single path ultrasonic meters installed in Europe



First Generation – North America

Starting in 2000, residential single path ultrasonic meters emerged onto the North American market



Next Generation Residential

Today, there are several single path ultrasonic meters being offered in the North American market



Sensus



Itron



Pietro
Fiorentini



Honeywell



Landis + Gyr

Next Generation 400 Class

Today, commercial and industrial single path ultrasonic meters are expanding in the North American markets, with more to come



Sensus
SonixIQ 425



Itron
Intelis 425



Pietro Fiorentini
iCON 400

Commercial and Industrial Applications

In 2002, commercial and industrial single path ultrasonic meters started to take their places in North American markets



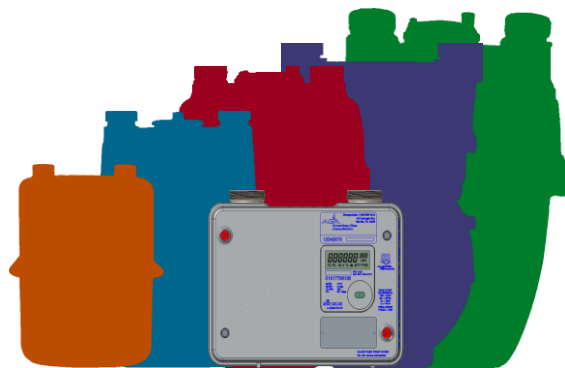
Sensus Sonix600/880/2000

Ultrasonic Meter Benefits

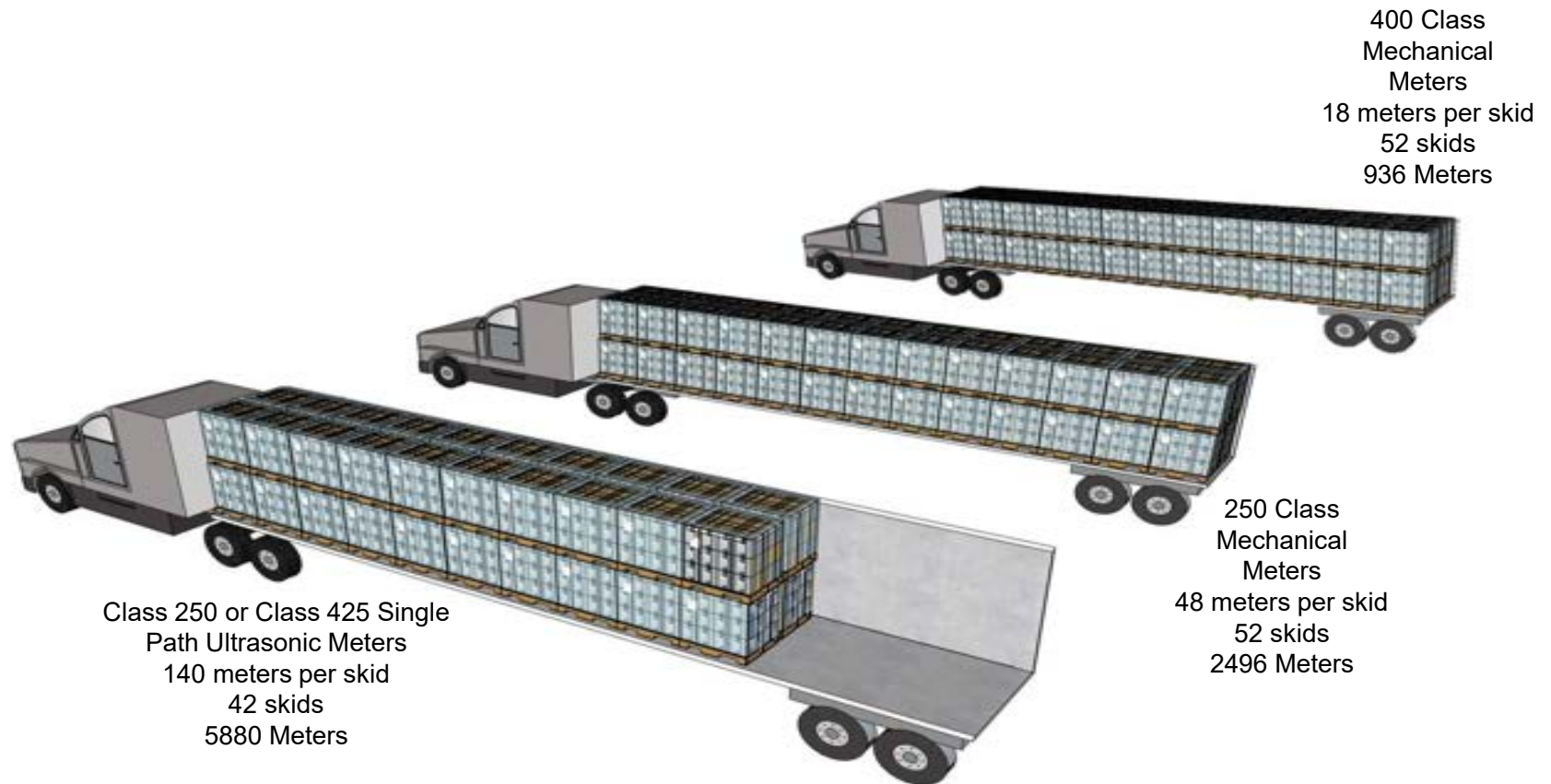
- Initial and retained metrology accuracy
- No moving parts
- Integrated radio for two-way communication
- Integrated valve, pressure, temperature and other sensors
- Scrolling LCD display with detailed information
- Data log and alarm log history
- Built-in theft and tamper detection
- Measurement and environment health checks
- Enhanced security
- Edge intelligence
- Scalable pulse outputs
- Laser etched information

Ultrasonic Meter Benefits

- Compact footprint - fits in those tight closets, sub metering, multi-tenant applications
- Integral radio results in one asset to manage over the meter/radio's life
- Less space and less weight
 - Savings in fuel for transportation
 - Less chance of injury while handling or transporting
 - Less warehouse space for staging
- Go green with less than half the packaging and pallets to dispose



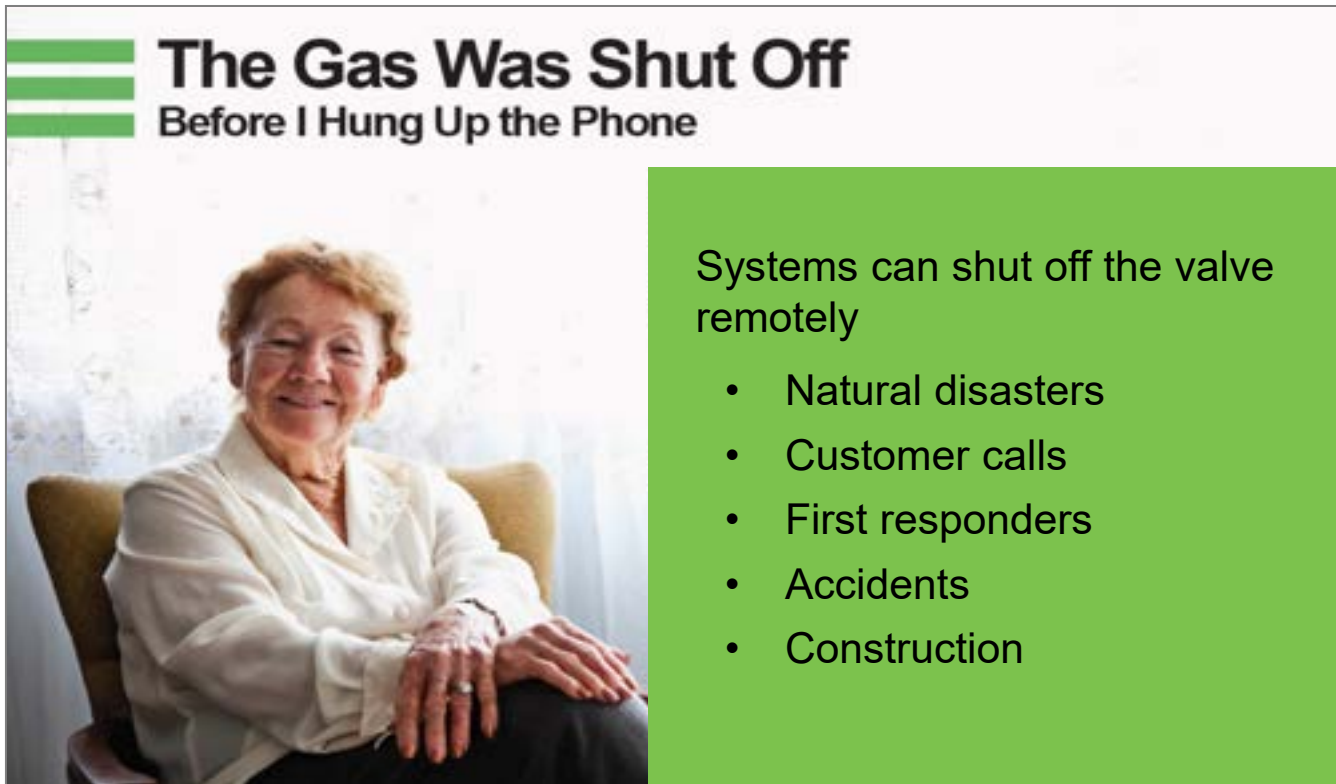
Shipping Benefits – Trailer Layouts



Typically, the number of residential ultrasonic meters is limited by trailer weight, not volume

Remote Communication - Shutoff

Customer Safety – Faster Response Time




The Gas Was Shut Off
Before I Hung Up the Phone

Systems can shut off the valve remotely

- Natural disasters
- Customer calls
- First responders
- Accidents
- Construction

Automatic Shutoff

Mitigation of Life & Property Loss



The First Responder to the Fire
Wasn't Called First

Internal monitoring can shut off the valve

- High pressure
- Low Pressure
- High temperature
- Air in meter
- Reverse flow
- Excess flow
- Other events

Automatic Shutoff

High Pressure Low Pressure Alarm and Shutoff

1 PSIG Pressure Transducer

User selectable between 0.03 and 1 PSIG

5 PSIG Pressure Transducer

User selectable between 0.15 and 5 PSIG

Alarm is set equal to or lower than shutoff limit

Low Pressure limits are set lower than High Pressure shutoffs



Automatic Shutoff

High Temperature Alarm and Shutoff



High Temperature Alarm

User selectable at 130F or 150F

High Temperature Shutoff

Fixed at 160F

Automatic Shutoff

Air in Meter Alarm and Shutoff



Meter must be in Natural Gas for 120 consecutive seconds before Air in Meter Alarm is enabled

After alarm is enabled, must be in Air for 300 consecutive seconds to alarm or shutoff.

Automatic Shutoff

Reverse Flow Alarm and Shutoff



Meter will measure Reverse Flow in Air or Natural Gas

Must be -3.5 CFH or greater for 128 consecutive readings (approximately 256 seconds) to alarm or shutoff.

LCD/Billing Index will not increment during reverse flow. A separate reverse flow index is available.

Automatic Shutoff

Excess Flow Alarm and Shutoff




User Selectable on 250 class meters between 251 and 400 cfh

User Selectable on 425 class meters between 426 and 630 cfh

Automatic Shutoff

Mitigation of Life & Property Loss



The First Responder to the Fire
Wasn't Called First

Internal monitoring can shut off the valve

- High pressure
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Local Communication - Shutoff

Employee Safety

**He's Watching Out for the Local Gas Man**
Are You?



Meters can have the valve shut off locally via short distance radio (handheld), or direct connect optical cable



Engineering Technical Note

Prepared by the AGA Operating Section
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Single-Path Ultrasonic Meters for Low Pressure Natural Gas Distribution Duties

A guide for use in distribution measurement systems

This technical note contains reference information for measuring natural gas using single-path ultrasonic flow meters, including principles of operation, technical issues, evaluation of measurement performance, error analysis, testing and calibration, references.

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SINGLE PATH ULTRASONIC GAS METERS

(Under 1400 Cubic Feet Per Hour Capacity)

Secretariat

400 North Capitol Street, NW – 4th Floor
Washington, DC 20001
U.S.A.
Catalog No. X62401

Complimentary Committee and Task Group Copy - DO NOT SHARE

Accuracy retention of single path ultrasonic meters have been awarded a 10 year Measurement Canada seal period, and can be statistically sampled.



Summary

Mechanical diaphragm meters are still a solid choice for basic measurement. They have been workhorses for gas measurement for nearly two centuries. However, they have limitations to their future application in smart gas networks.

Single path ultrasonic meters offer forward thinking utilities the opportunity to embrace the next generation of smart gas measurement. The solid-state digital platform already offers features and benefits well beyond traditional assets. This technology can provide solution to problems that we have yet to be encountered. The data analytics will reshape how the industry manages business.

It's your choice, choose wisely!