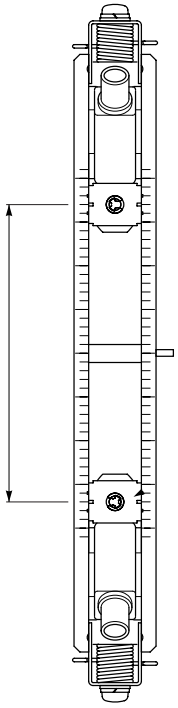
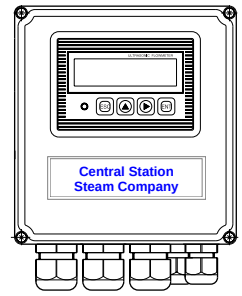
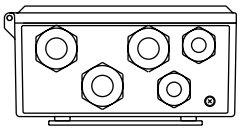
Cadillac® Ultrasonic Flow Meter

Central Station Steam Co.®

GENERAL INFORMATION







Central Station Steam Co.®
CADILLAC® METERS
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THE LIQUID FLOW METER OF CHOICE

The Cadillac® Ultrasonic Flow Meters are rate and totalizing meters which are capable of measuring liquids, of all types, non-intrusively. Due to its universal (one size fits all) design and ease of installation, it is particularly suitable for Hot and Chilled water measurements. In any Hot or Chilled water system the Cadillac Ultrasonic Flow Meters are fast becoming the technology choice, due to Cadillac's accuracy, reliability, rangeability and non intrusive (Clamp-on) mounting.

THE NEW INDUSTRY STANDARD

Integrating Digital Signal Processing (DSP) with advanced correlation detection methods, the flow meter features exceptional performance and flexibility. Combined with the ease of installation (pipe clamp-on), high accuracy, and no moving parts, Ultrasonic flow meters have become the fastest growing liquid flow technology in the world today. As a result Customers choose Cadillac Ultrasonic Flow Meters because of:

- **Non Intrusive Mounting, High Accuracy, Low Maintenance, Rangeability, No Pressure Drop**

APPLICATIONS

- Data Source for energy management system, DCS, district-wide systems.
- Energy-Customer Billing from accurately totalized flow measurements.
- Basis for internal cost distribution using campus-wide systems.
- Process monitoring from central control rooms.
- Thermal efficiency optimization.

FEATURES

- **ACCURACY: +/-0.5% of the reading***
  * ± 0.5% of velocity or ± 0.05 ft/s for Transit Time * ±2.0% of velocity or better for Doppler
- **RANGEABILITY: Minimum 50 to 1 turndown**
  Allows accurate flow measurement over wide variations encountered during peak and off-peak (low flow) periods.
- **LONGEVITY: No moving parts and ease of service**
  With no moving parts, failure rates are all but eliminated. In the event service or sensor replacement is required, ease of removal can be achieved without process interruption.
- **UNIVERSAL METER: meeting the challenges of the next millennium**
  No sizing required, **TWO METERS FITS ALL**! Two meters and six transducer mounting assemblies work on fluids and piping of all nature and sizes. Operates on Pipe diameters from 1/2" to 200".

PRINCIPLE OF OPERATION

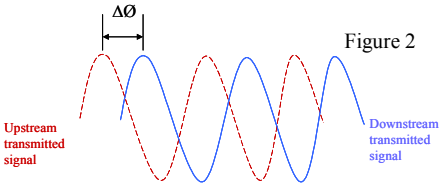
Two technologies are available from Central Station Steam Company®, which incorporate the use of ultrasonic energy to measure flow. Transit Time is based on time of flight, and Doppler, measures frequency shift of the generated signal. The proper application of each technology is dependent on fluid conditions and will be covered in **Meter Selection.**

Both flow technologies (Transit Time & Doppler) operate by generating ultrasonic energy via piezoelectric crystals imbedded in two separate resin blocks, called transducers. The transducers are attached to the outside pipe wall using a sonic coupling compound (typically a silicon based grease) and retaining system (typically pipe straps), allowing the ultrasonic energy from the transducer to be transferred through the pipe wall and into the moving fluid. From this point on, the two technologies differ in their mode of operation and will be addressed separately.

Transit Time is used on clean (low suspended solids) non aerated fluids by measuring the difference in time (ΔT) it takes the pulsed ultrasonic energy to move from the upstream transducer to the downstream transducer and vice versa (Figure 1). The difference in time of flight is directly proportional to the velocity of the moving liquid. Thus the higher the fluid velocity the greater the (ΔT), which is a conversion made by the flow meters' digital signal processing (DSP) from the phase shift (ΔØ) between the up and downstream pulsed sonic signals (Figure 2).

Figure 1

Figure 2



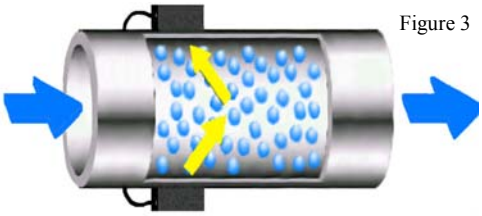
Volumetric flow rate is then calculated by taking the measured velocity and multiplying it by the effective internal cross sectional area of the process piping, which must programmed into the meter prior to transducer installation.

(Continued on page 3)

(Continued from page 2)

Doppler is used on dirty (high suspended solids) or aerated fluids by measuring the frequency shift of the ultrasound as it reflects or bounces off particles or bubbles in the flow stream. One transducer acts as the source or frequency generator and the other as the frequency receiver. As the sound waves bounce off objects in the flow stream it causes a shift in frequency which is dependent on particle velocity (Figure 3). The greater the velocity the more frequency shift experienced. Caution should be exercised when applying Doppler since this is essentially an inferred measurement and is made on the premise that the particles or aeration, in the flow stream, are moving at the same velocity as the liquid. In certain applications this premise cannot be made and velocities measured can actually be unrepresentative of the actual liquid flow stream (typically reading low in liquids with high solids or slurries). Please consult Central Station Steam Company® engineering for application review in these cases.

Figure 3



METER SELECTION

As outlined in the "Principal of Operation" descriptions, Transit Time is suitable for reasonably clean liquids while Doppler is more suitable for dirty or aerated liquids. Both require a fully developed flow profile to assure that an average liquid velocity can be measured. Overly turbulent applications will struggle with low signal strength and signal noise. In order to assure that the acoustic energy can properly penetrate the pipe and process fluid, the pipe wall surfaces should be free of rust and/or debris. Significant coating, on the inside of the pipe, could also be a problem. Pipe liners should not be an issue, as long as they are properly bonded to the pipe wall. Since both Transit Time and Doppler ultrasonic technology measure fluid velocity to compute flow, it is essential for the pipe to be full. If an application is questionable, it is possible and even desirable to prove the application, of this technology, with a portable instrument. If the measurement location is readily accessible, this can be accomplished in a matter of minutes. Please call Cadillac® engineering for more information on portable meter.

METER INSTALLATION

Meter installation is critical to proper operation and flow measurement for Doppler and Transit Time flow technologies. Since process piping is both the flow containment and measurement spool piece, care must be taken in location selection , mounting orientation and mounting method.

TRANSDUCER LOCATION SELECTION

With regard to location selection and mounting orientation, care must be exercised to establish a point in the piping system that meets the following criteria:

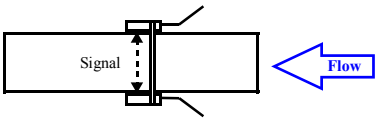
- Choose a section of pipe that is always full.
- Site should meet straight run requirements of at least 10 diameters upstream and 5 diameters downstream.
- After a pump, control valve or double piping bend, up to 30 diameters of straight run may be required.
- On horizontal pipe, mount transducers in the 3 and or 9 o'clock position (see mounting method). This avoids sediment that may collect on the bottom of the piping and bubbles or air pockets along the top of the piping, which can cause signal loss
- Ensure pipe skin temperature is within transducer temperature rating. (see specifications)
- If possible select a section of pipe where inside and outside are free from excessive scaling or corrosion.

If any or all of the above guidelines cannot be followed completely, it is still possible to obtain meaningful flow measurements, often with little or no loss of accuracy

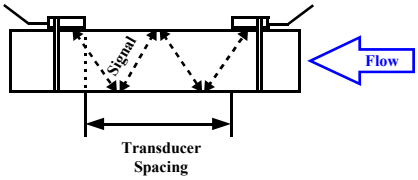
TRANSDUCER MOUNTING METHOD

With regard to mounting method selection there are four configurations. One for Doppler and three for Transit Time. Each will be discussed and illustrated separately.

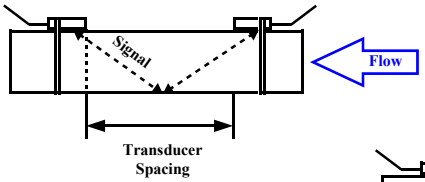
Figure "A"



"W" Method **Figure "B"**



"V" Method **Figure "C"**



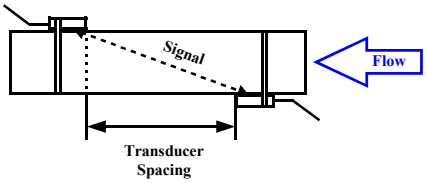
DOPPLER MOUNTING

Doppler has one mounting method which has the transducer mounted directly across (180°) from each other on the piping. (**Figure A**)

TRANSIT TIME MOUNTING

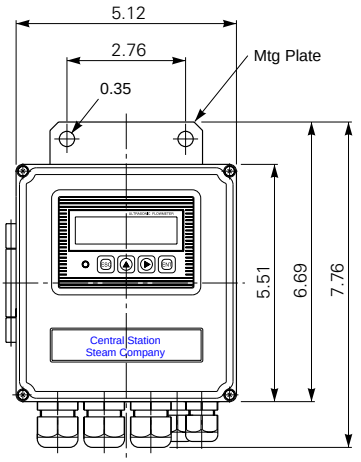
Transit Time has three mounting methods that are typically chosen on the basis of the piping diameter. Diameters from (1/2"-1") use the "W" method (**Figure B**). Diameters from (1"-16") use the "V" Method (**Figure C**). Diameters from (16"+) use the "Z" method (**Figure D**).

"Z" Method **Figure "D"**



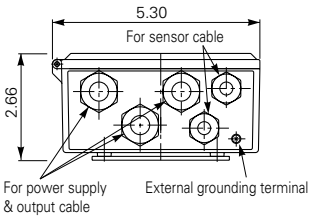
CADILLAC® ULTRASONIC FLOW METERS

Engineering Support @ Phone 888-556-3913

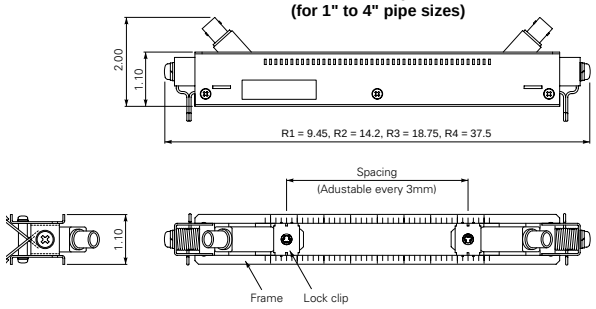


Transit Time Flow Meter as shown (used with R1 Rack assembly)

Unit: inches



R1 Rack assembly as shown (for 1" to 4" pipe sizes)



CADILLAC® ULTRASONIC FLOW METER GENERAL SPECIFICATIONS

- **Digital Correlation Transit Time**
  - Meter shall consist of remote electroincs and one pair of matched clamp-on transducers BNC style cable.
  - Meter available with analog (4-20 mA) and (2) digital outputs.
  - Two line 16 character LCD display providing both instantaneous and totalized flow.
  - Meter programmed via integral keypad.
  - Flow range ± 0.010 to 33 ft/s (± 0 to 10 m/s) bi-directional flow.
  - Accuracy Up to ± 0.5% of velocity, ± 1.0% rate typical on calibrated systems.
  - Repeatability: 0.5% or better.
  - Temperature Range: Standard Transducers - 4° to +212°F (- 20 to 100°C), Transmitter - 4° to +140°F (- 20 to 60°C)
  - Meter housing: NEMA 4X (IP65), ABS plastic (standard).
- **Digital Doppler**
  - Meter shall consist of remote electroincs and one pair of matched clamp-on transducers with integral cable.
  - Meter available with analog (4-20 mA) and digital relay outputs.
  - 32 character LCD display providing both instantaneous and totalized flow.
  - Meter programmed via integral keypad.
  - Flow range ± 0.05 to 50.0 ft/s (± 0.02 to 15.25 m/s) bi-directional flow.
  - Accuracy: Typically ± 2.0% of velocity (accuracy dependent on flow profile).
  - Repeatability: 0.1% of full scale.
  - Temperature Range: Transducers - 4° to +300°F (- 40 to 149°C), Transmitter - 4° to +130°F (- 20 to 60°C)
  - Meter housing: NEMA 4X (IP65), flame retardant, fiberglass-reinforced polyester (standard).

CADILLAC® ULTRASONIC METER MODEL NUMBER

CU												Cadillac Ultrasonic Flowmeter
	D											Digital Doppler
	T											Digital Correlation Transit Time
		A										100 to 120 Vac, 50/60 Hz
		B										200 to 240 Vac, 50/60 Hz
		C										20 to 30 V DC
			A									4-20 mA Output (Optically Isolated)
			B									4-20 mA & (2) Digital Outputs (Digital outputs not available for Portable)
				D								Dedicated (as shown above)
				P								Portable (not shown)
					A							General purpose area approvals
						1						NEMA 4X (IP65) Plastic ABS enclosure
							05					Transducers w/5 meters of cable (Standard)
							10					Transducers w/10 meters of cable
							15					Transducers w/15 meters of cable
							20					Transducers w/20 meters of cable
							30					Transducers w/30 meters of cable
								R1				Mounting Rack Assembly [3] - (1"-4") or (2"-9") pipe size (must specify)
								R2*				Mounting Rack Assembly - (3/4"-12") or (1/2"-4") pipe size (must specify)
								R3*				Mounting Rack Assembly [2] - (2"-72") pipe size
								R4*				Mounting Rack Assembly - (8"-200") pipe size
								R5				Not included (Only when using Doppler meter)

*Note: Transducer assembly reuires high gain transmitter

2 Note: High temperature sensors available for 2-16" pipe sizes (up to 392 F or 200 C) consult factory.

3 Note: Option not available for use when specifying Portable flow meter.

HEATING & COOLING ENERGY CALCULATOR

Central Station Steam Company® Energy Calculator is designed to measure energy consumed in hot water heating and chilled water cooling systems. Supplied with Temperature probes, the Calculator integrates with the Cadillac Ultrasonic Flow Meters to provide flexibility to meet all application needs. Modes of operation include: Heating, Cooling, Heating/Cooling and Charge/Discharge. For more information contact Central Station Steam Company®.