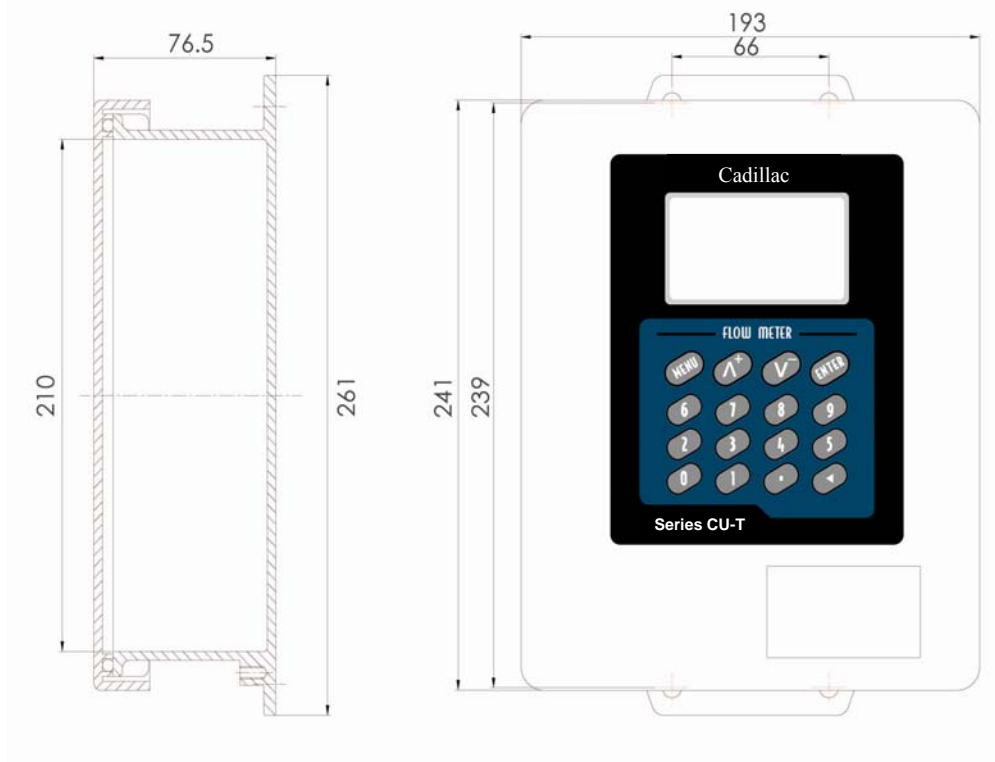


Cadillac[®] Ultrasonic Flow Meter

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 and energy measurements.
- Basis for internal cost distribution using campus-wide systems.
- Process monitoring from central control rooms.
- Thermal efficiency optimization.

FEATURES

- ◆ **ACCURACY:** +/- 1.0% of the reading for CU-T, +/- 2.0% of the reading for CU-E system *
* $\pm 0.5\%$ of velocity or ± 0.05 ft/s for Transit Time flow* $\pm 2.0\%$ of reading or better for Energy Measurement
- ◆ **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, **ONE SIZE FITS ALL!** One meter and transducer set works on fluids and piping of all nature and sizes. Operates on Pipe diameters from 1/2" to 200".

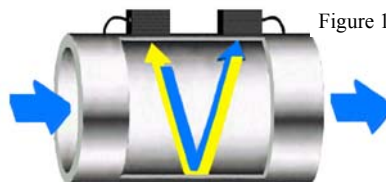
PRINCIPLE OF OPERATION

One main Ultrasonic technology is available from Central Station Steam Company®, which incorporate the use of ultrasonic energy to measure flow. This technology is Transit Time, which is based on time of flight. The proper application of this technology is dependent on fluid conditions and will be covered in **Meter Selection**.

Transit Time flow technology operates 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 or a rack assembly), allowing the ultrasonic energy from the transducer to be transferred through the pipe wall and into the moving fluid.

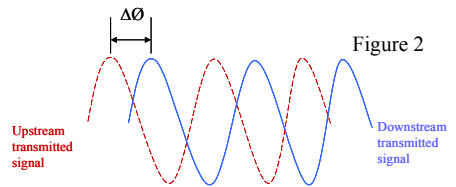
Transit Time is used on clean (low suspended solids) non aerated fluids by measuring the differ-

ence 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 con-



version made by the flow meters' digital signal processing (DSP) from the phase shift ($\Delta\theta$)

between the up and downstream pulsed sonic signals (Figure 2). Ideally the path length the signal must travel is maximized in order to generate the greatest (ΔT) possible providing the largest signal resolution possible.



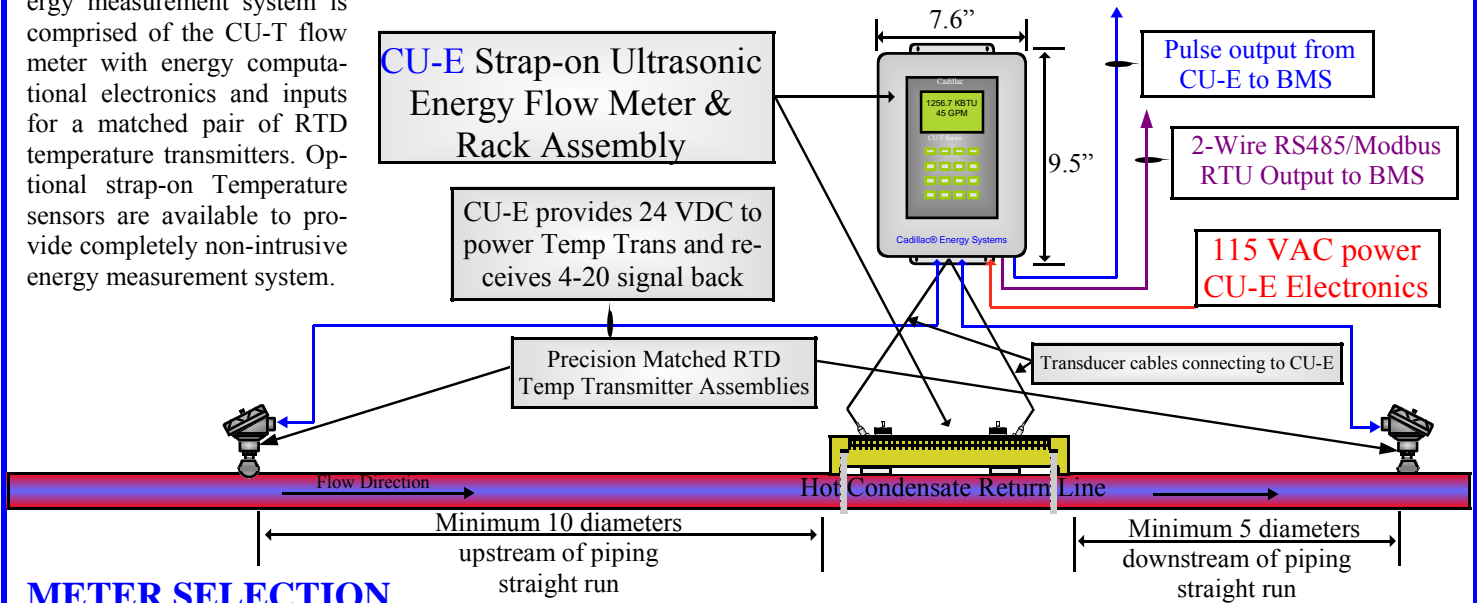
Volumetric flow rate is then calculated by taking the measured velocity and multiplying it by the effective internal cross sectional area of the process piping, which must be programmed into the meter prior to transducer installation.

ENERGY METER SYSTEM

CU-E WATER ENERGY SYSTEM

The Cadillac Ultrasonic energy measurement system is comprised of the CU-T flow meter with energy computational electronics and inputs for a matched pair of RTD temperature transmitters. Optional strap-on Temperature sensors are available to provide completely non-intrusive energy measurement system.

Layout schematic



METER SELECTION

As outlined in the "Principal of Operation" descriptions, Transit Time is suitable for all reasonably clean liquids. Transit Time requires 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 Transit Time ultrasonic technology measure fluid velocity to compute flow, it is essential for the pipe to be full

METER INSTALLATION

Meter installation is critical to proper operation and flow measurement for Transit Time flow technologies. Since process piping act as 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 three main configurations for Transit Time flow transducers, which are discussed below.

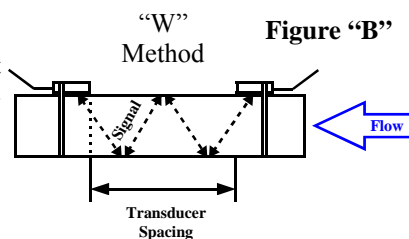


Figure "B"

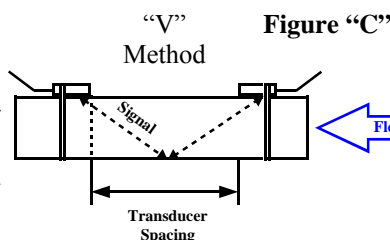


Figure "C"

TRANSIT TIME MOUNTING

Transit Time has three mounting methods that are typically chosen on the basis of the piping diameter. Diameters from (3/4"-4") use the "W" method (Figure B). Diameters from (4'-16") use the "V" Method (Figure C). Diameters from (16"+) use the "Z" method (Figure D).

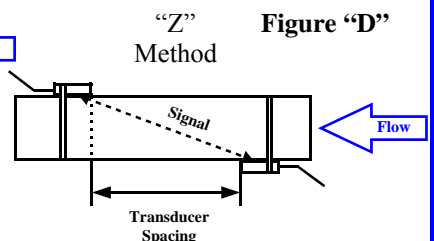


Figure "D"

