

# Utilizing Coriolis Meters for L.A.C.T. Measurement

By

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## Introduction

The Crude Oil gathering and transportation industries continue to undergo a period of change in business relationships. New technologies are gaining a significant impact on the manner in which hydrocarbon liquids are measured. The introduction of new types of flow meters has driven the industry to evaluate its' present methods of precision measurement. This paper will address and summarize the History, Theory, Performance, Installation and Calibration of Coriolis Meters for use in L.A.C.T. service.

## History

The driving force for the use of Coriolis technology is the requirement of the industry to reduce the cost of maintenance of traditional flow meters such as Rotary Vane Positive Displacement Meters. The challenge to displace Rotary Vane meters is the ability to provide equal to accuracy with no significant changes to calibration methods or procedures. Both challenges have been successfully overcome by utilizing the non intrusive design of Coriolis flow meters.

## Theory

“Coriolis force flow meters operate on the principle that inertial forces are

generated whenever a particle in rotating body moves relative to that body in a direction towards or away from the axis of rotation of that body”<sup>1</sup>

*In simplest terms, mass flow rate causes the vibrating tubes to twist. The twist of the tubes is proportional to mass flow.*

Coriolis force flow meters also utilize vibrating element technology to arrive at density. Once Mass and density are known, volume is calculated.

- Principle of operation ...see figure 1,

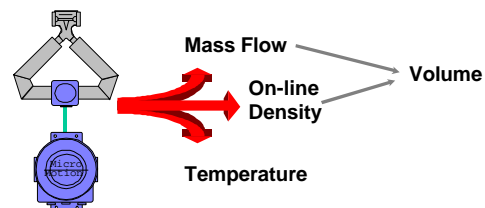


Figure 1

There exists over a dozen manufactures of Coriolis Flow Meters, these manufactures differ in product offering in sizes and flow rate capability, mounting configurations, how you support the meter, location of other devices, factory testing, published accuracy, field experience.

- Product Configuration ...see figure 2

## Performance

Typical Performance of Coriolis meters should not be accepted below .15 %

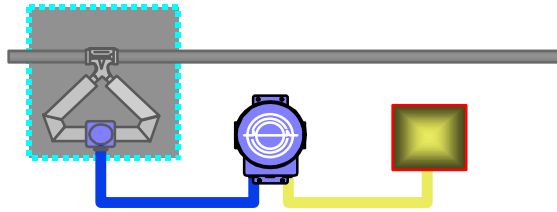


Figure 2

accuracy and 20: 1 turndown.

- Why Coriolis?
  1. Multi Variable
    - Mass
    - Volume
    - Density
    - Temperature
  2. Non – Intrusive
    - No mechanical wear
    - Not damaged by air slugs
  3. Simple installation
  4. Accuracy
    - High turndown
    - Less effects caused by
      - Oil Characteristics
      - Operational systems
      - Equipment conditions
      - Weather
      - Other<sup>ii</sup>

## Installation

Many Coriolis flow meters can readily be adapted to replace existing Rotary Vane meters by simply using a “kit” consisting of welding four elbows and the Coriolis meters mounted in vertical position and a spool piece. Consideration needs to be given to manufactures recommendation on the orientation of the Coriolis.

See figure3

In new piping configurations, it is recommend that the Coriolis meter be mounted in the same orientation as a Positive Displacement Meter, typically downstream of a three way divert valve.

See figure.....4

## Calibration

It is important to note that for volume measurement Coriolis the calibration procedures should mirror that used on Rotary Vane Positive Displacement Meters.

“Regardless of the prover type or meter type, the same basic proving principle applies”<sup>iii</sup>

$$\frac{\text{Known Volume}}{\text{Unknown Volume}} = \text{Meter Factor}$$

Meter factor, temperature correction, S&W factor are typically applied in other peripheral devices to calculate gross volume @ standard temperature or net volume.

## Conclusion

It is very important to properly apply Coriolis technology to L.A.C.T. design and operation. Proper consideration for good measurement techniques should always take precedence. The technology has proven to be very sound and becomes very attractive when a complete cost of ownership is used in the evaluation of Coriolis vs. Rotary Vane meters as the custody transfer device.

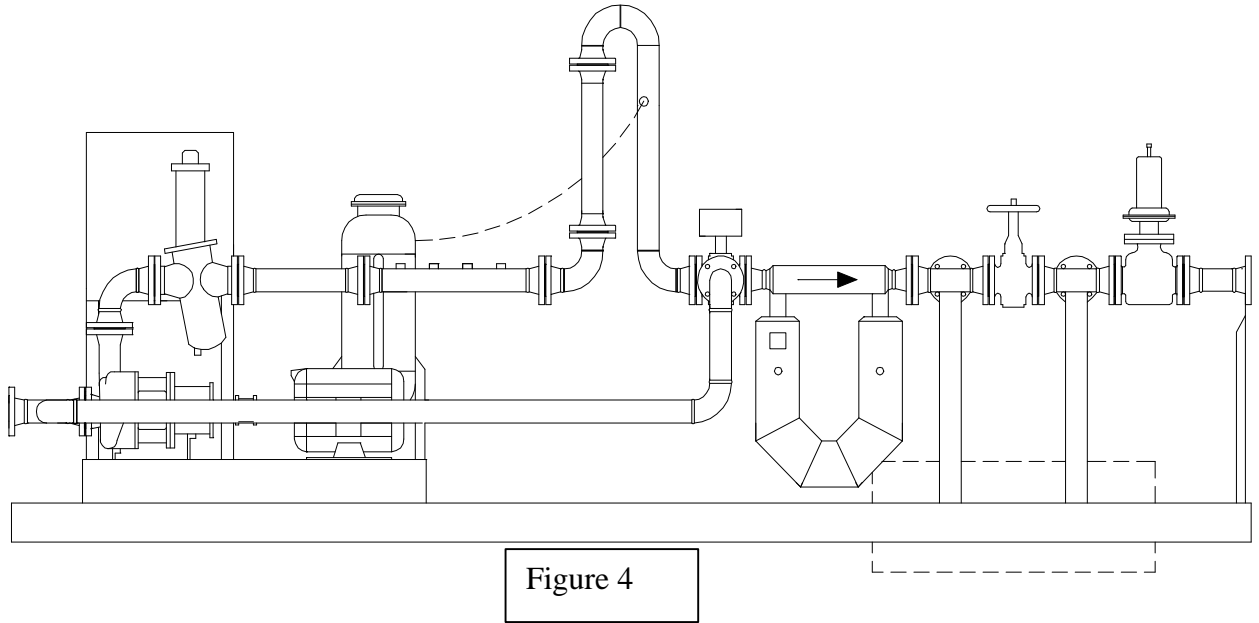


Figure 4

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- <sup>i</sup> American Petroleum Institute Measurement of Liquids by Coriolis Force Flowmeters
  - <sup>ii</sup> Do you know what would happen if ...Frank Carpenter Lake Charles Instrument, Inc.
  - <sup>iii</sup> Fundamentals of Meter Proving, Larry Suchy, Mark Vandiver, Meter Check, Inc.