



New High Capacity Coriolis Flowmeters From Krohne (The March of the Titans!)

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There is an unrelenting pressure on Coriolis meter suppliers to continuously develop and adapt their product portfolio to the ever changing market needs.

One of these emerging markets is the general acceptance of Coriolis meters as a suitable technology for the oil and gas industry, endorsed by the API (American Petroleum Institute), the AGA (American Gas Association) and the Weights and Measures approvals organisations in many countries.

Recent updates to the OIML recommendations for OIML R-117-1 now incorporates the mass flow recommendations of R105 for liquids other than water. This recommendation is also used as the normative standard to which Coriolis meters are tested for Custody Transfer applications according to the European Measurement Instruments Directive (MID).

KROHNE has now entered this market segment with a range of meters specifically developed to meet the stringent requirements of the guidelines, and recommendations for this industry.

The Product

After extensive market research, a range of 3 Coriolis meters were developed to match the flow rates, pressure ratings and safety required by the industry. The three sizes range from 4" (DN100) to 10" (DN250) with the possibility of increasing the flange size by one step on every meter.

A standard operating pressure of 150 bar (2175 psi) has also been incorporated into the twin straight tube design. The requirements of NACE (National Association of Chemical Engineers) Standard MR0175-2000 for the material requirements relating to the general problems of Sulphite Stress Cracking (SSC) of metals in sour environments has also been taken care of. To this end an all Duplex SS (UNS S31803/DIN1.44462) is available.



Fig. 1 The OPTIMASS 2000

Design

The tried and tested straight tube technology (OPTIMASS 7000), now currently in its 7th year as a successful and growing product, has been used to develop the twin tube design of the OPTIMASS 2000. Time was spent during the development phase to optimise the signal size, and decouple the measurement and drive from the environment to ensure optimum performance. This has resulted in a meter that is capable of measuring to a turndown rate of 400:1. The flow rates for custody transfer applications have been restricted to 20:1 due to the limited velocities allowed in general, for the measurement of refined

hydrocarbon products. The accuracy measurement within this turndown of 20:1 still falls well within the requirements of accuracy class 0.3 for mass and volume flow as specified by R117-1.

The current trend by Coriolis suppliers is to specify very high maximum flow rates. In many cases these flow rates are very difficult to achieve without excessive cavitation due to the high velocities through the meter. The OPTIMASS 2000 uses a well designed and optimised flow splitter to minimise these effects.



Fig. 2 Flow splitter

Calibration

To accommodate the calibration requirements of such a large flow rate as specified for the OPTIMASS 2000, KROHNE had to make significant investments in additional flow calibration facilities. These were built during the course of 2007, tested and finally commissioned late 2007. Early 2008 the facility was accredited by UKAS to ISO 17025 with an uncertainty of 0.035% for mass and 0.038% for volume.

These calibration rigs are traceable to international standards and have the added benefit in the largest rig, of a KROHNE Ultosonic V meter (5 path Ultrasonic Flow meter) which can be used as a reference meter. The KROHNE Ultosonic V is also approved for use as a custody transfer meter. Normal calibration uses a gravimetric method against a calibrated and certified weigh scale.



Fig. 3 (calibration rigs)

Performance

The OPTIMASS 2000 provides unparalleled performance over a wide measurement turndown.

Extensive testing has been done to verify the specifications and the results have been very interesting. The OPTIMASS 2000 has 'best in class' zero stability which enables it to measure at low flow rates for volume and mass flow without significant loss of accuracy. This is illustrated in the graph below which shows excellent performance at around 5% of the flow rate.

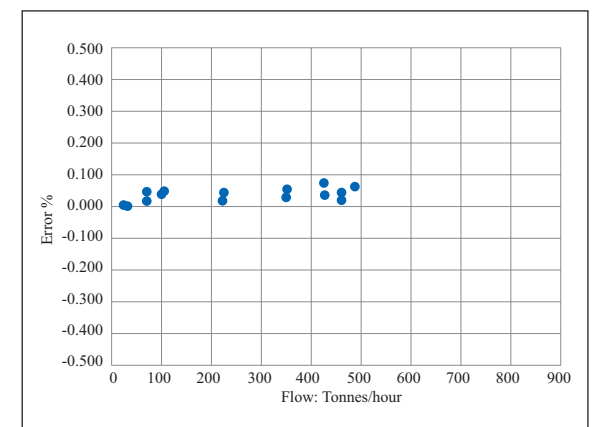


Fig. 4 Graph showing low flow performance

The volume flow accuracy is due to the innovative and patented pressure compensation used to correct the density, which is the weak point of many Coriolis meters. The principle reason for the need to compensate, is the changing stiffness of the measurement tubes due to pressure (150 bar maximum operating pressure!) The stiffness change of the measuring tubes alters the natural resonant frequency from which the density values are derived. This is even more pronounced in Coriolis meters with large bent tubes where the tendency of the tubes is to try to straighten out due to the Bourdon effect.

Conclusion

KROHNE are confident that they have developed an industry leading meter which will fulfil the requirements of this demanding industry.

It features:

- Innovative technology for inbuilt pressure compensation
- Wide measurement turndown (up to 400:1)
- High pressure rating
- Secondary containment with burst pressure in excess of 100 bar to prevent fugitive emissions
- Outstanding flow measurement performance and finally a small footprint when compared to the competitive Titans out there!