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MASTER METER METHOD

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MASTER METER METHOD

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ABSTRACT

This paper was presented at the NEL, in London, on the dec., 11th, 1996. It reports the experience of FAURE HERMAN with master-meter prover and centralised calibration method, based on the use of the true helical bladed turbine meter, HELIFLU ™ TZN. This practice was originated on french pipelines networks, for products and crude oil, in the sixties.

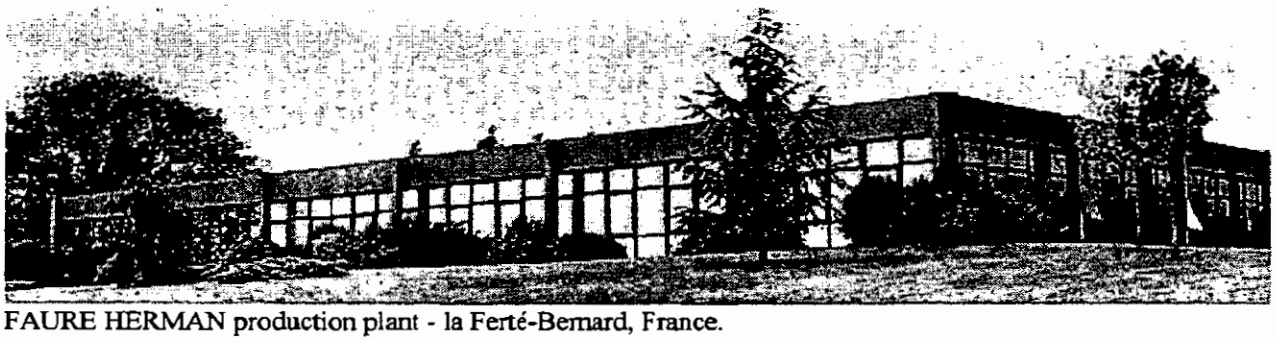
FAURE HERMAN, FLUIDS MEASUREMENT

FAURE HERMAN is the manufacturer of the true helical bladed turbine meter, specialising in precision turbine meters for fiscal and high integrity applications.

We have considerable experience in the Oil and Gas industries, from exploration and production, transportation and refining. Most of the Major Oil Companies in the world have an item of our equipment on either export or allocation metering.

FAURE HERMAN is a medium-sized company and a division of the INTERTECHNIQUE group of France, with offices in UK, USA and Italy. The company conforms to ISO 9001 and is accredited by several international bureaus.

The main plant is in la Ferté-Bernard approximately 150 km south-west of Paris. It includes 3 fully certified and traceable pipe provers with the ability to attain up to 3,000 m^3/h on liquid, 2,500 m^3/h on gas. All the calibration for liquids are performed on hydrocarbons to cover viscosity ranges (0.6 - 400 cSt).

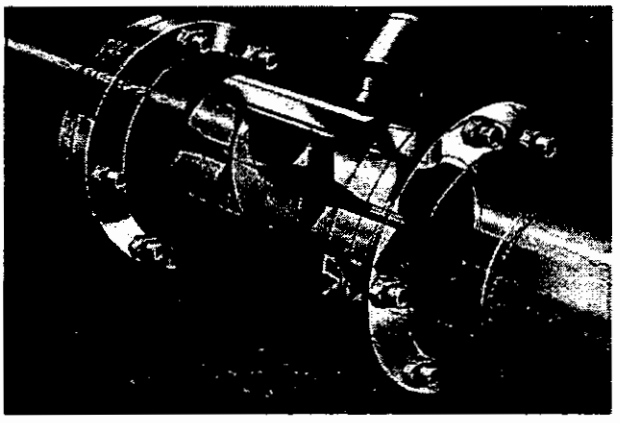


FAURE HERMAN production plant - la Ferté-Bernard, France.

MASTERY OF THE DUAL-BLADED TURBINE METER

The heart of FAURE HERMAN' success is the mastery of design and application of the helical bladed rotor, which is found in every FAURE HERMAN meter since 1953. The original concept was to provide a generic type of flowmeter, which was less effected by all usual influences, such as : changes in viscosity, temperature and pressure.

The main requirements are stability, durability and, above all, reliability in service. FAURE HERMAN now have over 8,000 units in service around the world on fiscal metering systems.



There has been extensive R & D over the years and we now have several designs of flowmeters suitable for most applications. Our current and most famous design is the HELIFLU ™ TZN.

The HELIFLU ™ TZN is an industrial version and is specifically aimed at the fiscal metering of hydrocarbon fluids, such as crude oils, condensates, refined products and LPG's..

The meter is designed to operate at extreme conditions and provides an alternative to traditional metering techniques.

The meter features :

- ⇒ High accuracy (better than ± 0.15%)
- ⇒ Repeatability (better than ± 0.02%)
- ⇒ Wide viscosity range (0.1 to 300 cSt +)
- ⇒ Long-term stability
- ⇒ Low pressure drop
- ⇒ Compact, low weight

Over the years, we have been asked to supply flowmeters for key monitoring points on various installation, where confidence had to be at the highest level. We have also provided alternative cost-effective solutions to traditional methods of metering, such as proving i.e. using our knowledge of the helical bladed devices as reference meters.

We have found that our HELIFLU ™ TZN unit out perform most turbine flowmeters currently available and that, in some cases, can perform as well as a traditional prover, i.e. returning linearity of better than ± 0.1% and repeatability better than ± 0.01%. This fact is most demonstrable on larger units.

FAURE HERMAN have been involved in numerous projects around the world, to provide alternative means of proving on metering systems. There are examples where master-meter provers have been employed to overcome some fundamental problems such as: cost, available space, location and level of local technical backup.

A direct comparison between master-meter provers using a HELIFLU ™ TZN and pipe provers is significant.

Typically :

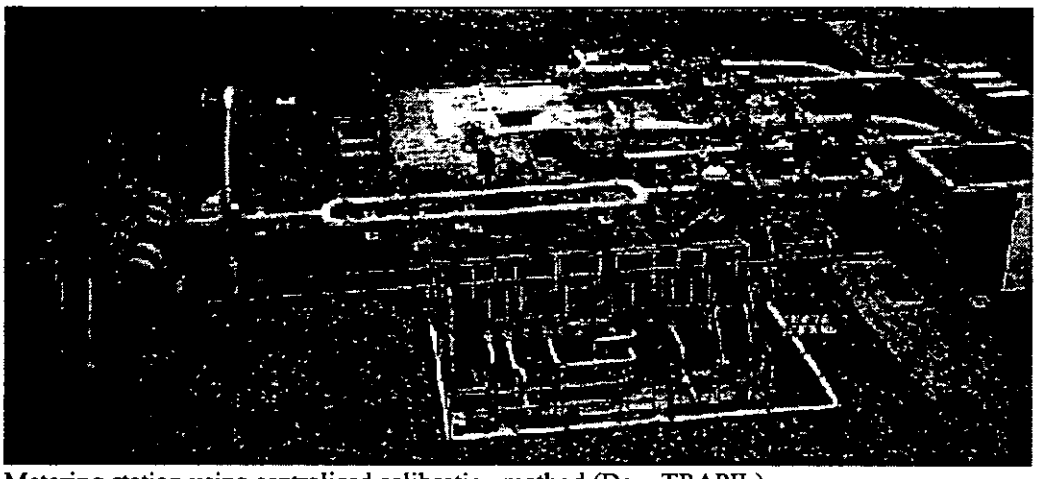
⇒ a master meter prover costs approximately 40% less
⇒ the actual footprint tends to be at least half that of a pipe prover
⇒ it can be transported as a skid with greater ease, due to size
⇒ a system using HELIFLU ™ TZN meters can be re-sized
⇒ a master-meter prover tends to be more reliable, less to go wrong
⇒ proving time is reduced, can prove on line
⇒ the maintenance of the primary measuring element is extremely simple

EXPERIENCE OF METERING ONSHORE

In 1966, FAURE HERMAN embarked on a joint project with the Metrology Authorities of France, the major pipelines and oil company operating throughout the country. The aim was to install major pipelines, and generally to help the logistic of crude and refined hydrocarbons.

For this to happen, new procedures had to be developped, as well as cost-effective solutions of monitoring product in transit. All input and output points had to conform to the requirements of the French Department of Metrology.

This was achieved by the technique of centralised calibration and proved to be very successful, in many respects. Now virtually all the main operators involved in hydrocarbon transit rely on master-meter provers, i.e. it is now a standard practice.



Metering station using centralised calibration method (Doc. TRAPIL)

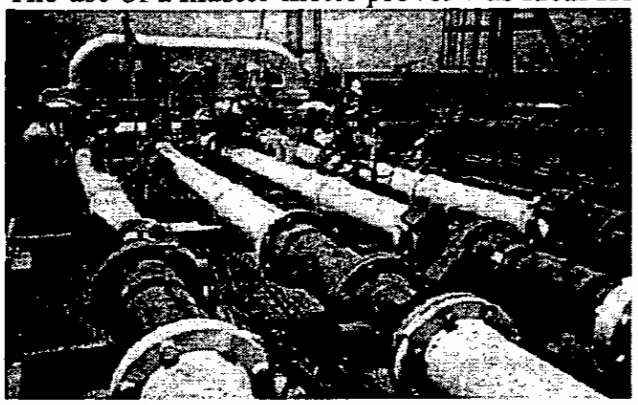
In 1996, FAURE HERMAN supplied 3 skids for the metering stations of products pipelines, coming from the LEUNA 2000 refinery in former East-Germany, including master-meter provers. Each system has a capacity of 600 m^3/h and was approved by the German Authorities (PTB) for fiscal measurement.

EXPERIENCE OF METERING OFFSHORE

Recently, FAURE HERMAN completed a project in South-Eat Asia, where a metering system including a master-meter prover was installed on a FPSO. The aim was to reduce to a minimum the amount of deck space taken by the metering package.

The throughput was to be in the region of 3,000 m^3/h of condensate.

The use of a master-meter prover was ideal for this application, as in order to verify a throuput of 3,000 m^3/h with a traditional solution would have been involved the use of very large prover indeed. In this case, the saving was about 10 tons.



Metering unit on a FPSO

The problems associated with a prover of that size would have been the overall size, the amount of reinforcement to prevent torsional movement when service.

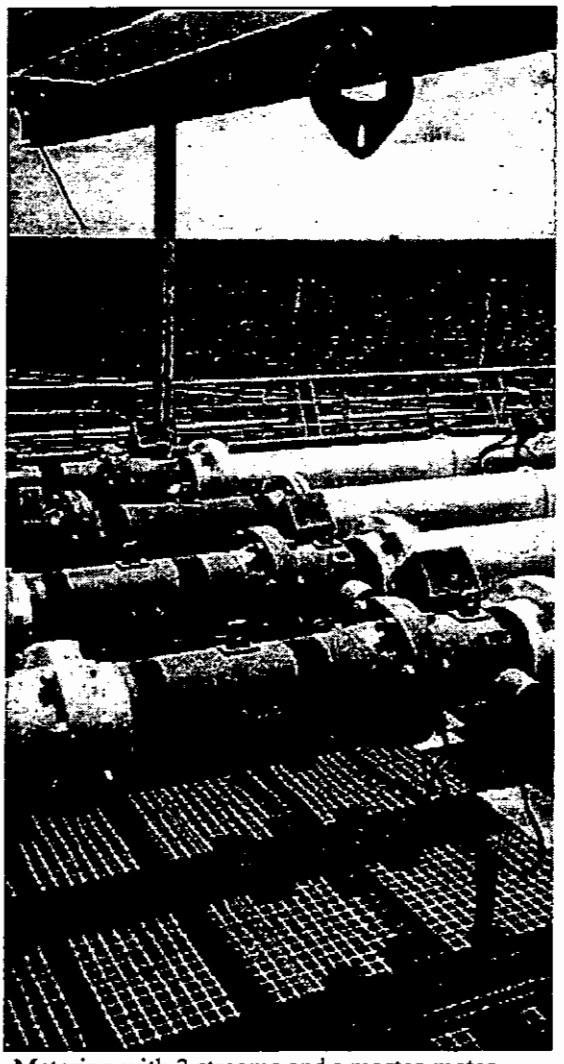
THE MASTER-METER PROVING METHOD

'' A master-meter is selected, maintained and operated to serve as a reference for the proving of another meter. A comparison of the two meter outputs is the basis of the master-meter proving method.''

These introductory words from the API (MPMS chapter 4, section 5), referring to the methodology, summarises briefly its basis, but do not provide complete answers. Some details rely on a site experience, validated or even amended by the local Metrology Authorities.

Therefore, FAURE HERMAN takes an active part in the API works, which should specify some elements. This is especially thecase for the definition of the number of test runs, the required accuracy, etc.

The procedure FAURE HERMAN is putting forward relies on draft proposals (MPMS chapter 12, section 2, part 4).



Metering with 3 streams and a master-meter.

THE ESSENTIALS OF THE METHOD

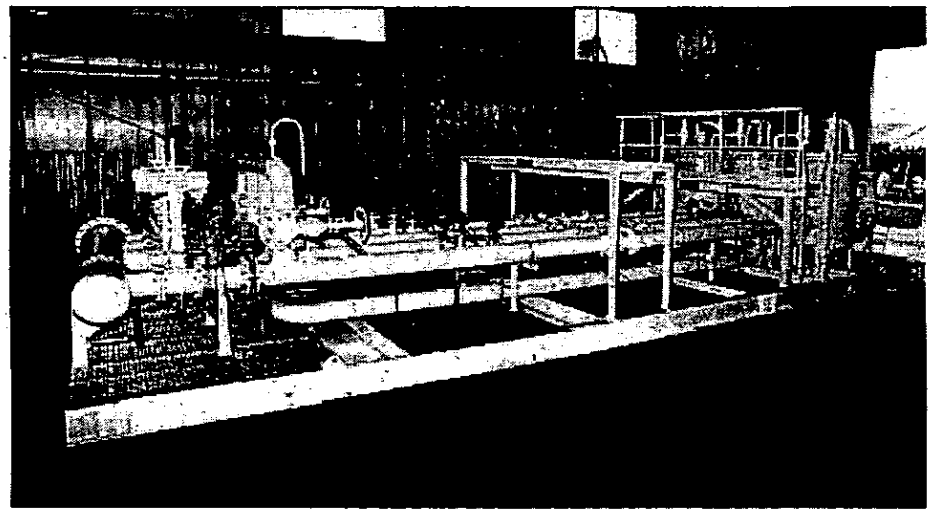
The use of the master-meter proving method requires :

⇒ accuracy and long-term repeatability of the HELIFLU ™ TZN turbine meter.

⇒ insensitivity of master-meter to viscosity and density variation.

⇒ re-calibration of the master-meter on proving facility (if a local station exists) or on the FAURE HERMAN calibration facilities, upto 3,000 m^3/h.

Nevertheless, the use of a centralised calibration method requires the availability of a spare meter during meter calibration and also the use of ''shuttle'' containers provided for transporting the meter in good conditions.



TECHNICAL OVERVIEW

Basic principle : pulse comparison

The method consists in installing in line a turbine flowmeter with a master turbine meter. When the liquid flows, the pulse counters of both meters are simultaneously triggered. When the last meter reaches a selected pulse amount, data are recorded.

To perform a prove with a sufficient accuracy, a high pulse number is used (API recommends a minimum of 10,000). To perform quickly the prove, the pulse interpolation method by double chronometry, in compliance with API requirements (chapter 4, section 6) may be used.

This basic principle shall be of course automated and carried out with a prove report. This report shall be validated by the local Metrology Authorities.

Prove report (to API)

A minimum of 5 tests are successively performed with the same meter. The system starts and stops automatically as soon as the pulse counter of one of the meters reaches 10,000 pulses. The data logging system stores all the values.

Then, the system checks :

⇒ if the repeatability of the Meter Factor calculated between line meter and master-meter is better than 0.02%.

⇒ if the average of the Meter Factor is different from the previous one.

With this information, some decision would be taken either manually or automatically.

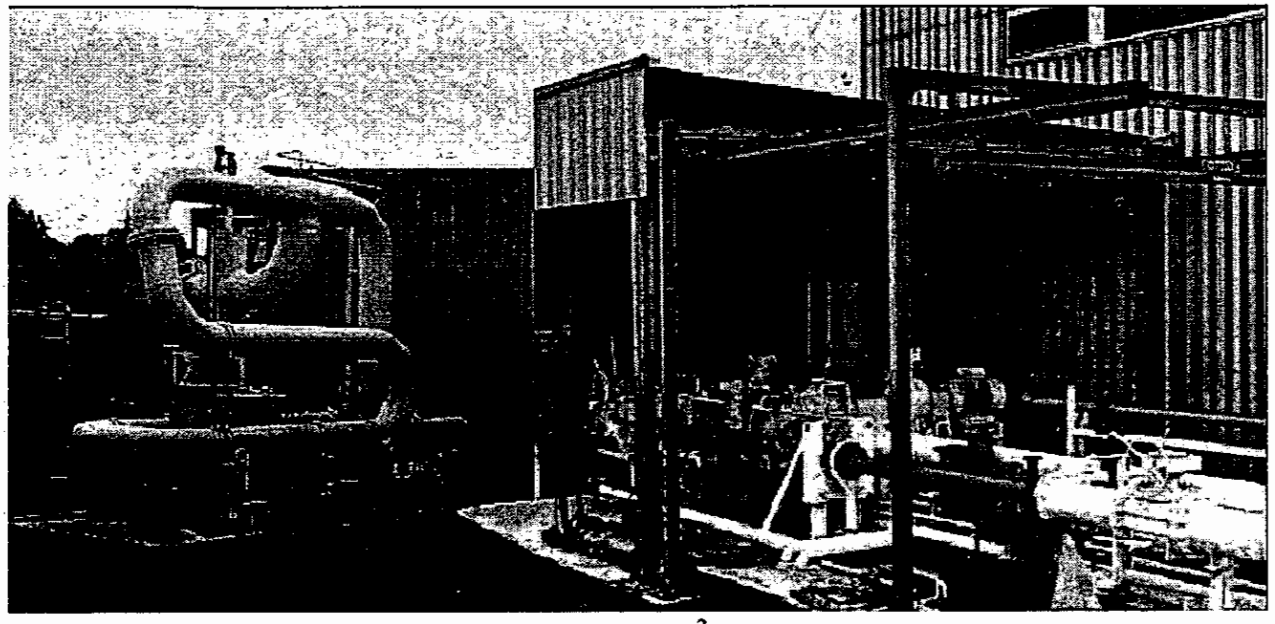
If Δ between old MF and new MF is < 0.25% (*)	The new MF is introduced in the flow computer. The computer may perform a retroactive calculation on the previous volume.
If Δ between old MF and new MF is < 0.10%	The old MF is still valid. No value will be changed.
If Δ between old MF and new MF is > 0.25% (*)	The line meter will be removed and sent back to the centralised proving station.

(*) These values are not under any regulation. The company shall define this value with the local Metrology Authority. API chapter 13, section 2, will be helpful to establish statistics.

FREQUENCY OF OPERATION

The calibration frequency is mostly defined by the local Authorities. Experience of such a system involves a proving frequency reduction.

The common practice is to perform a prove once a day at the beginning of operation. Some operators have reduced the frequency of such proves to once a week.. In France, users and generally Metrology Authorities recommend to return the master-meter in a centralised proving station once a year.



FAURE HERMAN multi-product proving station @ 1,000 m^3/h (medium size)

REFERENCES

1. Michel, C., Smith, P., Binet, P., ''Crude Oil Measurement on Floating Storage Vessel'', NEL, London, Dec. 11, 1996.

2. API, MPMS, chap. 4, section 5, 1988, reaffirmed oct. 1993 - ''Master Meter Prover''.