

NORSOK STANDARD
COMMON REQUIREMENTS
FISCAL MEASUREMENT SYSTEMS

I-CR-100

Rev. 1, January 1995

1 FOREWORD

This standard has been developed by the NORSOK standardisation work group and agreed by the Norwegian industry for the widest possible national and international application.

ANNEX A is normative. ANNEX B is informative.

2 SCOPE

This standard provides criteria for selection of fiscal flow measurement systems and sampling/analysis equipment for fiscal purposes. Further the standard provides general and technical requirements for such systems or main components thereof.

3 NORMATIVE REFERENCES

AGA 7	Measurement of gas by turbine meters - Transmission Measurement Committee Report No. 7.
AGA 8	Natural Gas density and compressibility factor executable program and Fortran code. Committee Report No. 8.
API MPMS	Ch. 4, 5, also ch. 11-13, if applicable.
API MPMS	clause 8.2 Automatic sampling of petroleum and petroleum products.
API MPMS	clause 10.9 (corresponds to IP 386/90)
ASTM-D-4928-89	(corresponds to IP 386/90)
CEN/TC 234-WG5 N40	Draft "Functional requirements for gas metering systems for natural gas"
IEC 751	Industrial Platinum Resistance Thermometer sensors
IP 386/90	Water in crude oil by Coulometric Karl Fischer titration.
IP PMP No. 2	Guidelines for users of Petroleum Measurement Tables
IP PMM Part VII	Continuous Density Measurement
ISO 1000	SI units and recommendations for use of their multiples and of certain other units.
ISO 3170:	Petroleum Liquids - Manual Sampling
ISO 3171:	Petroleum Liquids - Automatic pipeline sampling.
ISO 5024	Measurement - Standard reference conditions
ISO 6978:	"Calculation of heating value and reference density".
ISO 5167	"Measurement of fluid flow by means of orifice plates, nozzles and venturi tubes inserted in circular cross-section conduits running full"
ISO 6551	Petroleum Liquids and Gases - Fidelity and Security of Dynamic Measurement - Cabled Transmissions of Electric and/or Electric Pulsed Data.
ISO 7278 Part 3	Liquid hydrocarbons - Dynamic measurement - Proving systems for volumetric meters"
ISO DP 9857	Continuous Density Measurement
ISO DIS 9951	Measurement of gas flow in closed conduits - Turbine meters
ISO/CD 10715	"Natural Gas - Sampling Guidelines".

NORSOK standards:

I-SR-100	Automatic oil sampler
I-SR-101	Automatic gas sampler
I-SR-102	Fuel gas measurement
I-SR-103	Flare gas measurement
I-SR-104	Fiscal metering system for gas
I-SR-105	Fiscal metering system for crude oil and condensate.

4 DEFINITIONS AND ABBREVIATIONS

4.1 Definitions

Fiscal quantity	Measured quantity of hydrocarbons used for sale, custody transfer, ownership allocation or calculation of royalty or tax. Note: The term "fiscal " refers to the function of the measurement system, not its level of measurement uncertainty.
Allocation	Distribution of sold/produced quantities of hydrocarbons between licensees and owner companies.
Quantity	Measure of the hydrocarbon medium, by volume, mass or energy.

4.2 Abbreviations

AGA	American Gas Association
CEN/TC	The European Committee for Standardization/ Technical Committee
IP PMP	Institute of Petroleum, Petroleum Measurement Paper
IP PMM	Institute of Petroleum, Petroleum Measurement Manual
ISO	The International Organization of Standardization
IEC	International Electrotechnical Commission
NPD	Norwegian Petroleum Directorate
PD meter	Positive Displacement meter
VDU	Visual Display Unit

5 GENERAL REQUIREMENTS

Fiscal measurement systems include all systems for:

- Fiscal metering of gas and crude oil/condensate.
- Measurement of fuel and flare gas.
- Automatic sampling of gas and crude oil/condensate.

This standard is based on the standards listed in clause 3.

All systems shall give readings in SI-units according to ISO 1000.

The reference conditions shall be 15.0C, 1.011325 bar abs, ref. ISO 5024.

Algorithms and uncertainty analyses for the systems shall be either:

- based on international standards,
- as recommended by manufacturer, or.
- as specified by end user.

Ref.: Relevant Norsok I-SR standards.

Uncertainty:

Table 1 below specifies normally applied uncertainty limits.

Table 1. System uncertainty limits.

SYSTEM	MAX UNCERTAINTY (95 % conf. level)
Fiscal oil metering	± 0.30 % of standard volume
Fiscal gas metering	± 1.0 % of standard volume
Fuel metering	± 1.8 % of standard volume
Flare metering	± 5.0 % of standard volume

Other uncertainty limits may be applicable for fiscal metering stations if validated by a cost-benefit analysis (see clause 6).

For system concepts with no system specific requirements in NORSOK standards, the design shall to the greatest possible extent, be based on (in order of priority):

- international standards, preferably CEN/ISO or ISO.
- the manufacturer's recommendations.

6 SYSTEM SELECTION CRITERIA

6.1 General

The measurement system with the lowest life cycle cost shall be selected.

6.2 Cost/benefit analysis of alternative metering concepts

The cost of using a concept with high accuracy (class A) may be unreasonable in relation to the monetary value of the additional measurement uncertainty of a less accurate/less expensive concept (class B). The selection of metering concept shall be based on an alternative cost analysis as outlined below.

An analysis shall be performed to quantify:

1. Monetary value of 1 % reduction in measurement uncertainty for oil and gas. (Owners will use 0.5 NOK max to reduce measurement uncertainty by 1.0 NOK)
2. Uncertainty of well-test concept for oil and gas (No measurement). For metering systems on marginal field tied into existing platforms such monetary value shall be based on difference in ownership between marginal field owners and existing fields owners .
3. A matrix (table) showing the monetary value of reducing uncertainty of well-test concept towards 0 % uncertainty for oil and gas.

The key parameter is this analysis for decision making is the value of the total cost of using a metering system with a specified uncertainty compared to potential monetary value of corresponding reduction in uncertainty for oil and gas.

All monetary values above shall be calculated as net present values.

6.3 Special consideration for fuel gas system

Orifice meter should be preferred to gas turbine meter unless the cost of long upstream meter run lengths of the orifice meter outweighs:

- Cost of annual flow calibrations at operating conditions of the gas turbine meter, and.
- cost of one spare gas turbine meter (in stores).

Also, a gas turbine meter shall be preferred if the flow range of the fuel stream requires frequent changes of orifice plates during regular operation.

For very small fuel gas streams, in particular non-fuel streams withdrawn from the fuel distribution system downstream of the main fuel metering system, the following methods should be considered:

- For gas streams withdrawn manually at intervals: No meter, just an estimation.
- For continuous streams smaller than specified by ISO 5167 and AGA 7, one of the following methods shall be used;
 - Small, fullbore, gas turbine meters, designed to manufacturer's standard (minimum 6 mm).
 - Integral orifice meters (Smaller than 12 mm).
 - Other suitable type of small flowmeter with equivalent accuracy.

6.4 Special consideration for fiscal sampling system

If it can be documented by a cost-benefit analysis (ref. clause 6.2), the sampling concept shall be in order of priority:

- no sampling equipment (e.g. usage of other analysis).
- manual sampling point.
- automatic sampling system.

6.5 Alternatives to sampling equipment

For determination of water content in oil, a continuous water-in-oil monitor shall be considered as alternative to automatic sampling and subsequent lab. analysis.

On-line gas chromatograph shall only be used if they are found to be more cost-effective than sampling and subsequent lab. analysis, and if required by any agreement.

7 TECHNICAL REQUIREMENTS

7.1 Fiscal metering system, oil and gas

7.1.1 General

The requirements below are only relevant if the specified component is part of the metering concept.

It is indicated in the headings below if the subsequent text is applicable only for oil or gas metering systems.

7.1.2 Mechanical part (oil)

7.1.2.1 Sizing

A sufficient number of meter runs shall be installed, each sufficiently equipped to determine the quantity of oil or gas for all expected flow rates, with required accuracy, reliability and regularity.

7.1.2.2 Meter runs

Design	According to API MPMS Ch. 5
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7.1.2.3 Flow meters design

Turbine meters	Ref. API MPMS Ch. 5.3. Robust design with rotor shaft supported upstream and downstream of rotor.
PD meters	Ref. API MPMS Ch. 5.2.

There shall be dual pulse train for turbine & PD meter, with direct transmission of flow meter pulses to the computer part. The pulse integrity shall be to ISO 6551, grade A, or equivalent.