Australian Government
National Measurement Institute

NMI R 105

Direct Mass Flow Measuring Systems for Quantities of Liquids

(OIML R 105:1993(E), IDT and OIML R 105 — Annex C:1995(E), IDT)

The English versions of international standards:

- OIML R 105:1993 *Direct Mass Flow Measuring Systems for Quantities of Liquids*, and
- OIML R 105 — Annex C:1995 — *Test Report Format*

are adopted as the identical national standard with the reference number NMI R 105

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1. SCOPE

NMI R 105 provides the metrological and technical requirements, the test procedures and a test report format for the pattern approval of direct mass flow measuring systems for quantities of liquids used for trade in Australia. NMI R 105 also specifies the tests required for verification/certification and reverification.

2. CONTENTS

NMI R 105 is comprised of the following international recommendations published by the International Organisation of Legal Metrology (OIML):

- *OIML R 105. Direct Mass Flow Measuring Systems for Quantities of Liquids* (1993); and
- *OIML R 105 — Annex C. Direct Mass Flow Measuring Systems for Quantities of Liquids. Annex C — Test Report Format* (1995).

3. VARIATIONS AND INTERPRETATIONS

The following variations and interpretations apply:

- The metrological authority for pattern approval is the National Measurement Institute.
- The metrological authorities for verification are the State/Territory verifying/certifying authorities.
- For references to 'initial verification' substitute 'verification/certification' and for 'in-service' substitute 'reverification'.
- Publications of the International Electrotechnical Commission (IEC) now have numbers based on a 60000 series, e.g. the 68 series is now 60068. Also please note that the 801 series is now 61000-4.

IEC 60068-1 (1988) Basic Environmental Testing Procedures. Part 1: General and Guidance. Also refer to amendment IEC 60068-1-am1 (1992). The equivalent Australian standard is AS 1099.1–1989.

IEC 60068-2-1 (1990) Basic Environmental Testing Procedures. Part 2: Tests. Test A: Cold. Section 3 — Test Ad: Cold for Heat-dissipating Specimen with Gradual Change of Temperature. Also refer to amendments IEC 60068-2-1-am1 (1993) and IEC 60068-2-1-am2 (1994).

IEC 60068-2-2 (1974) Basic Environmental Testing Procedures. Part 2: Tests. Test B: Dry Heat. Section 4 — Test Bd: Dry Heat for Heat-dissipating Specimen with Gradual Change of Temperature. Also refer to amendments IEC 60068-2-2-am1 (1993) and IEC 60068-2-2-am2 (1994).

IEC 60068-2-6 (1995) Basic Environmental Testing Procedures. Part 2: Test. Test Fc: Vibration (Sinusoidal).

IEC 60068-2-28 (1990) replaced by IEC 60068-3-4 (2001) Environmental Testing — Part 3 –4: Supporting Documentation and Guidance — Damp Heat Tests.

IEC 60068-2-30 (1980) Basic Environmental Testing Procedures. Part 2: Tests. Guidance for Damp Heat Tests. Test Dd and Guidance: Damp Heat, Cyclic (12 + 12-hour Cycle). Also refer to amendment IEC 60068-2-30-am1 (1985).

IEC 60068-3-1 (1974) Basic Environmental Testing Procedures. Part 3: Background Information. Section 1 — Cold and Dry Heat Tests. Also refer to first supplement IEC 60068-3-1A (1978).

IEC 61000-4-2 (2001) Electromagnetic Compatibility (EMC). Part 4: Testing and Measurement Techniques. Section 2 — Electrostatic Discharge Immunity Test.

IEC 61000-4-3 (2002) Electromagnetic Compatibility (EMC). Part 4: Testing and Measurement Techniques. Section 3 — Radiated, Radio-frequency, Electromagnetic Field Immunity Test.

IEC 61000-4-4 (1995) Electromagnetic Compatibility (EMC). Part 4: Testing and Measurement Techniques. Section 4 — Electrical Fast Transient/Burst Immunity Test. Also refer to amendments IEC 61000-4-4-am1 (2000) and IEC 61000-4-4-am2 (2001).

ORGANISATION INTERNATIONALE
DE MÉTROLOGIE LÉGALE

INTERNATIONAL RECOMMENDATION

Direct mass flow measuring systems for quantities of liquids

Ensembles de mesurage massiques directs de quantités de liquides

OIML R 105

Edition 1993 (E)

CONTENTS

FOREWORD

The International Organization of Legal Metrology (OIML) is a worldwide, intergovernmental organization whose primary aim is to harmonize the regulations and metrological controls applied by the national metrological services, or related organizations, of its Member States.

The two main categories of OIML publications are:

1) **International Recommendations (OIML R),** which are model regulations that establish the metrological characteristics required of certain measuring instruments and which specify methods and equipment for checking their conformity; the OIML Member States shall implement these Recommendations to the greatest possible extent;

2) **International Documents (OIML D),** which are informative in nature and intended to improve the work of the metrological services.

OIML Draft Recommendations and Documents are developed by technical committees or subcommittees which are formed by the Member States. Certain international and regional institutions also participate on a consultation basis.

Cooperative agreements are established between OIML and certain institutions, such as ISO and IEC, with the objective of avoiding contradictory requirements; consequently, manufacturers and users of measuring instruments, test laboratories, etc. may apply simultaneously OIML publications and those of other institutions.

International Recommendations and International Documents are published in French (F) and English (E) and are subject to periodic revision.

OIML publications may be obtained from the Organization's headquarters:

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This publication - reference OIML R 105, edition 1993 (E) - was developed by the OIML working groups SP 5D-Sr 10 "Mass flow assemblies for measuring quantities of liquids" and SP 5D "Dynamic measurement of quantities of liquids". It was sanctioned by the International Conference of Legal Metrology in 1992.

TERMINOLOGY
(terms and definitions)

The terminology used in this Recommendation conforms to the "Vocabulary of Basic and General Terms in Metrology" (VIM - 1984 edition) and the "Vocabulary of Legal Metrology (VML - 1978 edition). In addition, for the purposes of this Recommendation, the following definitions apply:

T.1 Direct mass flow instrument

A measuring instrument that determines the mass of a quantity of flowing liquid without the use of any auxiliary device or data on the physical properties of the liquid.

T.2 Master meter

A working standard, traceable to national standards, used for the verification of a direct mass flow instrument.

T.3 Measuring system

A direct mass flow instrument and other apparatus assembled to carry out a specified measurement operation [VIM 4.05].

T.4 Motor fuel dispenser

A measuring system intended for filling the tanks of motor vehicles authorized for road traffic, pleasure boats, and small aircraft with liquid fuel.

T.5 Direct sale

A measuring transaction during which both the buyer and the seller (or their agents) are present when the quantity is being determined.

T.6 Minimum measured quantity

The smallest quantity for which the measurement is metrologically acceptable for the system.

T.7 Presetting device

The means used to select a quantity to be delivered and which automatically stops the flow of the liquid after the measurement and delivery of the selected quantity.

T.8 Dry hose type

A system in which the discharge hose is completely drained following the mechanical operation involved in each delivery.

T.9 Wet hose type

A system in which the discharge hose remains full of liquid prior to and after the completion of a measurement and delivery.

T.10 Maximum flow rate

The highest flow rate at which the measuring system is required to meet the applicable maximum permissible errors.

T.11 Minimum flow rate

The lowest flow rate at which the measuring system is required to meet the applicable maximum permissible errors.

T.12 Electronic measuring system

A measuring system equipped with electronic devices.

T.13 Electronic device

A device employing electronic subassemblies and performing a specific function. Electronic devices are usually manufactured as a separate unit and are capable of being independently tested.

Note: An electronic device, as defined above, may be a complete measuring system or part of measuring system, such as:

T.13.1 Measuring transducer

A device that transforms the flow of the liquid to be measured into signals aimed at the calculator. It may be either autonomous or use an external power source.

T.13.2 Calculator

A device that receives the output quantity from the transducer(s), checks and transforms it and, if appropriate, memorizes the results until they are used. In addition, the calculator may be capable of communicating both ways with peripheral equipment.

T.13.3 Indicating device

A device that displays the data transmitted from the calculator.

T.13.4 Power supply

A device that provides the electronic devices with the required electrical energy, using one or several sources of D.C. or A.C.

T.13.5 Peripheral equipment

Auxiliary devices such as:

– repeating indicating devices
– ticket printers
– daily report printers
– devices to read key cards, magnetic cards or bank-notes
– self-service equipment, etc.

T.14 Electronic subassembly

A part of an electronic device employing electronic components that has a recognizable function of its own.

T.15 Electronic component

The smallest physical entity that uses electron or hole conduction in semiconductors, gases or in a vacuum.

T.16 Error (of indication)

The indication of a measuring system minus the (conventional) true value of the measure [VIM 5.24].

T.17 Intrinsic error

The error of a measuring system used under reference conditions [VIM 5.27].

T.18 Initial intrinsic error

The intrinsic error of a measuring system as determined prior to performance tests and durability evaluations.

T.19 Fault

The difference between the error of indication and the intrinsic error of a measuring system.

T.20 Significant fault

For masses equal to or greater than the minimum measured quantity, a fault greater than one-fifth of the absolute value of the maximum permissible error for the measured quantity.

The following are not considered as significant faults:

– faults arising from simultaneous and mutually independent causes in the measuring instrument itself or in its checking facilities,

– transitory faults being momentary variations in the indication, which cannot be interpreted, memorized or transmitted as a measurement result,

– faults implying the impossibility to perform any measurement.

T.21 Durability error

The difference between the intrinsic error over a period of use and the initial intrinsic error of a measuring system.

T.22 Significant durability error

For masses equal to or greater than the minimum measured quantity, a durability error greater than one-fifth of the absolute value of the maximum permissible error for the measured quantity.

Durability errors are not considered as significant when:

– the indication cannot be interpreted, memorized or transmitted as a measurement result,

– the indication is such that it is impossible to perform any measurement.

T.23 Interruptible/noninterruptible measuring system

A measuring system is considered as interruptible/noninterruptible when the liquid flow can/cannot be stopped, easily and rapidly.

T.24 Influence quantity

A quantity that is not the subject of the measurement but which influences the value of the measurand or the indication of the measuring system [VIM 2.10].

T.24.1 Influence factor

An influence quantity having a value within the rated operating conditions of the measuring system, as specified in this Recommendation.

T.24.2 Disturbance

An influence quantity having a value within the limits specified hereafter in this Recommendation, but outside the specified rated operating conditions of the measuring system.

Note: An influence quantity is a disturbance if, for that influence quantity, the rated operating conditions are not specified.

T.25 Rated operating conditions

Conditions of use, specifying the range of values of influence quantities for which the metrological characteristics are intended to lie within the maximum permissible errors [adapted from VIM 5.05].

T.26 Reference conditions

A set of specified values of influence factors fixed to ensure valid intercomparison of results of measurements [adapted from VIM 5.07].

T.27 Performance

The capability of the measuring system to accomplish the intended functions.

T.28 Durability

The capability of the measuring system to maintain its performance characteristics over a period of use.

T.29 Checking facility

A facility that is incorporated in a measuring system and enables significant faults to be detected and acted upon.

Note: The checking of a transmission device aims at verifying that all information that is transmitted (and only that information) is fully received by the receiving equipment.

T.30 Automatic checking facility

A checking facility operating without the intervention of an operator.

T.30.1 Permanent automatic checking facility (type P)

An automatic checking facility operating during all the measurement operation.

T.30.2 Intermittent automatic checking facility (type I)

An automatic checking facility that operates at least once at the beginning of each measurement operation.

T.31 Nonautomatic checking facility (type N)

A checking facility that requires intervention of an operator.

T.32 Durability protection feature

A feature that is incorporated in a measuring system and that enables the detection of, and acting upon significant durability errors.

The same classification for types P, I or N applies to durability protection features. Certain devices may be employed simultaneously, for checking and for durability protection.

T.33 Performance test

A test intended to verify whether the measuring system being tested (equipment under test or EUT) is capable of accomplishing its intended functions.

T.34 Durability test

A test intended to verify whether the EUT is capable of maintaining its performance characteristics over a period of use.

DIRECT MASS FLOW MEASURING SYSTEMS for QUANTITIES of LIQUIDS

Section I

GENERAL

1 Scope, application and terminology

1.1 This Recommendation specifies the metrological and technical requirements for direct mass flow measuring systems (hereafter referred to as "systems") that are designed to measure the mass of flowing liquids in closed conduits. It also specifies the relevant examination and tests that are to be conducted during pattern evaluation and verification.

It does not apply to measuring systems for cryogenic liquids, for which refer to the OIML International Recommendation R81.

1.2 The terminology given in pages 5-9 shall be considered as a part of this Recommendation.

Section II

METROLOGICAL REQUIREMENTS

2 Rated operating conditions

The manufacturer shall specify the rated operating conditions for which the system is intended to perform within the maximum permissible errors. The rated operating conditions shall include the various liquids, or the density and viscosity ranges (including any specific product limitations) of the liquids to be measured, and the ranges of liquid flow rates, temperatures and pressures.

The ratio of the maximum to minimum flow rates for the measuring system shall be:

a) ten or greater for systems in general,

b) five or greater for systems for liquified gases.

3 Maximum permissible errors

3.1 Pattern evaluation

During pattern evaluation the maximum permissible errors on all quantities equal to or greater than two times the minimum measured quantity shall be:

a) ± 0.3 % of the measured quantity under the following conditions:

– with any one liquid within the range of liquids,

– at any one liquid temperature and pressure within their respective ranges,

and

– at all flow rates within the range of flow rates.

The system shall be adjusted for the liquid, temperature, and pressure prior to conducting the tests.

b) ± 0.5 % of the measured quantity under the following conditions:

– with all liquids within the range of liquids,

– at all liquid temperatures and pressures within their respective ranges,

– at all flow rates within the range of flow rates.

After an initial adjustment of the system, the various tests shall be conducted without further adjustment. It is recommended that the initial adjustments be made at or near mid-range of the rated operating conditions when practical. If the instrument is relocated during the testing, a consistent instrument installation that does not affect the performance of the instrument shall be maintained.

3.2 Verification

The maximum permissible errors on verification shall be ± 0.5 % on all quantities equal to or greater than the minimum measured quantity under the following conditions:

– any one liquid, temperature, and pressure, and

– at any flow rate within the ranges specified for the system in the pattern approval.

3.3 Small quantities

The maximum permissible error (mpe) applied to any quantity over the range from the minimum measured quantity up to two times the minimum measured quantity shall be plus or minus the absolute value of the maximum permissible error at two times the minimum measured quantity.

3.4 Repeatability

The repeatability error of the instrument shall be not greater than 0.2 % of the measured quantity.

Note: The repeatability error is considered to be the difference between the largest and smallest results obtained during tests conducted under the same conditions.

3.5 Liquified gases

The maximum permissible errors shall be two times the maximum permissible errors specified in 3.1, 3.2, 3.3, and 3.4 when used to measure liquified gases.

4 Adjustment means

A system shall be provided with means to change the ratio between the quantity indicated and the actual quantity of liquid that has passed through the system. A by-pass shall not be used to this end.

4.1 Discontinuous adjusting means

When the adjusting means changes the ratio in a discontinuous manner, the consecutive values of the ratio shall not differ by more than 0.1 %.

4.2 Sealing

Provisions shall be made for applying a security seal to the adjustment means.

5 Minimum measured quantity

The minimum measured quantity of the system shall be specified by the manufacturer.

Section III

TECHNICAL REQUIREMENTS

6 Indicators

A measuring system shall include an indicator. Indications shall be clear, definite, accurate, and easy to read under normal conditions of operation of the instrument.

6.1 Units of measurement

The indicated and recorded units for measuring systems shall be the gramme, the kilogramme, or the tonne.

6.2 Numerical value of scale interval

The numerical value of a scale interval shall be equal to 1, 2, or 5, or a decimal multiple or submultiple of 1, 2, or 5.

6.3 Maximum value of scale interval

The scale interval shall be not greater than 0.5 % of the minimum measured quantity.

6.4 Values defined

Indicated values shall be adequately defined by a sufficient number of figures, words, symbols, or combinations thereof. A display of "zero" shall be a zero digit for all displayed digits to the right of the decimal mark and at least one to the left. Any remaining spaces to the left shall either be all "zeros" or all blank.

6.5 Return to zero

Except for a noninterruptible measuring system, one indicator shall be provided with a means for returning the indication to zero either automatically or manually.

6.5.1 Resettable method of operation

The resettable means shall not be operable during a delivery. Once the zeroing operation has begun, it shall not be possible to indicate a value other than the latest measurement, or "zeros" when the zeroing operation has been completed.

6.6 Nonresettable indicator

An instrument may also be equipped with a nonresettable indicator if the indicated values cannot be construed to be the indicated values of the resettable indicator for a delivered quantity.

6.7 Presetting device

An instrument may be provided with means to select the quantity to be delivered. The scale interval of the presetting device shall not be less than the scale interval of the indicator.

7 Printer

When a system is equipped with means for printing the measured quantity, the following conditions apply:

- the scale interval of the printer shall be the same as that of the indicator,
- the value of the printed quantity shall be the same value as the indicated quantity,
- the printer cannot record a quantity for a delivery (other than an initial reference value) until the measurement and delivery have been completed,
- the printer is returned to zero when the resettable indicator is returned to zero, and
- the printed values shall meet the requirements applicable to the indicated values.

Any delivered printed quantity shall also include an identification number, the time and date, and the name of the seller. This information may be printed by the device or preprinted on the ticket.

8 Measuring systems

8.1 Vapor elimination

An instrument or measuring system shall be equipped with an effective gas elimination device or other effective means, automatic in operation, to prevent the measurement of vapor and air that results in errors greater than the applicable maximum permissible error.

8.2 Maintenance of liquid state

An instrument shall be installed so that the product being measured will remain in a liquid state during passage through the instrument.

8.3 Provision for sealing

Adequate provision shall be made for applying security seals in such a manner that an adjustment cannot be made on any device that affects the measurement result without breaking the security seal.

9 Discharge lines and valves

9.1 Diversion of measured liquid

No means shall be provided by which any measured liquid can be diverted from the measuring instrument. However, two or more delivery outlets may be permanently installed and operated simultaneously provided that any diversion of flow to other than the intended receiving receptacle cannot be readily accomplished or is readily apparent. Such means include physical barriers, visible valves or indications that make it clear which outlets are in operation, and explanatory signs if necessary.

A manually controlled outlet that may be opened for purging or draining the measuring system may be permitted. Effective means shall be provided to prevent the passage of liquid through any such outlet during normal operation of the measuring system.

9.2 Directional flow valves

A valve or valves or other effective means, automatic in operation (and equipped with a pressure limiting device, if necessary), to prevent the reversal of flow shall be properly installed in the system if a reversal of flow could result in errors that exceed the maximum permissible errors.

9.3 Discharge valves

A discharge valve may be installed on a discharge line only if the system is a wet hose type. Any other shutoff valve on the discharge side of the instrument shall be of the automatic or semiautomatic predetermined-stop type or shall be operable only:

– by means of a tool (but not a pin) entirely separate from the device, or

– by means of a security seal with which the valve is sealed open.

9.4 Anti-drain means

In a wet hose type device, effective means shall be provided to prevent the drainage of the hose between transactions.

9.5 Other valves

Check valves and closing mechanisms that are not used to define the measured quantity shall have relief valves (if necessary), to dissipate any abnormally high pressure that may arise in the measuring system.

10 Markings

A measuring system shall be legibly and indelibly marked with the following information:

a) pattern approval mark

b) name and address of the manufacturer, or his trademark and, if required by Legal Metrology Services, the manufacturer's identification mark in addition to the trademark

c) designation selected by the manufacturer

d) serial number

e) maximum and minimum flow rates

f) maximum working pressure

g) range of temperature when that of the liquid whose mass is to be measured differs from the range of - 10 °C to + 50 °C

h) minimum measured quantity

i) product limitations, if applicable.

Section IV

REQUIREMENTS FOR ELECTRONIC MEASURING SYSTEMS

11 General requirements for electronic measuring systems

11.1 Electronic measuring systems shall be designed and manufactured such that their errors do not exceed the maximum permissible errors under rated operating conditions.

11.2 Electronic measuring systems shall be designed and manufactured such that, when they are exposed to disturbances:

– either significant faults do not occur, or

– significant faults are detected and acted upon by means of checking facilities.

This requirement may apply separately to:

– each individual cause of significant fault, and/or

– each part of the measuring system.

11.2.1 Noninterruptible measuring systems shall be designed and manufactured in such a way that a significant fault does not occur when they are exposed to disturbances.

11.2.2 It is the responsibility of the manufacturer to decide whether a given pattern of measuring system is interruptible or not, taking into account the applicable rules of security.

A motor fuel dispenser shall be interruptible.

When, at the time of pattern approval, it is not possible to specify the future utilization of the instrument, requirements in 11.2.1 apply (see 14.1).

11.3 The requirements in 11.1 and 11.2 shall be met durably, in accordance with the following requirements:

11.3.1 Electronic measuring systems shall be provided with the durability protection features specified in 13.

11.3.2 Electronic measuring systems shall be designed and manufactured such that significant durability errors resulting from causes arising in the electronic devices themselves:

– either do not occur, or

– shall be detected and acted upon by means of the durability protection features.

11.4 A pattern of measuring system is presumed to comply with the requirements in 11.1, 11.2 and 11.3 if it passes the examination and tests specified in 14.2.

12 Requirements specific to certain electronic devices

12.1 Measuring transducer

All the signals emitted by the sensor, and only those signals, shall be transmitted securely to the calculator, for example, in the form of two similar signals, a signal with redundant information, or a signal that is verifiable by the calculator.

12.2 Calculator

All the parameters that are necessary for the elaboration of indications that are subject to legal metrology control, such as unit price calculation table or correction polynomial shall be present in the calculator at the beginning of the measurement operation.

The calculator may be provided with an interface permitting the coupling of peripheral equipment. When the external equipment is connected, the instrument shall continue to function correctly and its metrological functions shall not be affected.

12.3 Indicating device

12.3.1 The unit price may be changed either on the instrument directly or through peripheral equipment. However, the instrument shall be designed such that the unit price can only be changed when the instrument is not operating. In addition, a time of at least five seconds shall elapse before the next delivery starts (starting of the pump).

In the case of a direct sale, the time that elapses before an actual value appears on the indicating device shall not exceed 0.5 seconds.

12.3.2 When zeroing may be carried out before a transaction is concluded, the data relating to this transaction shall be recorded or printed on a device subject to metrological control (e.g. using a controlled memory or a secure peripheral printer or an indicator specially reserved to this end). It shall be possible to recall this data in a way that differentiates it from results of a transaction being made.

In a direct sale, no more than one transaction (in addition to the transaction being made) can be memorized for one measuring system.

12.4 Power supply

When conducting an accuracy test to determine compliance with the requirements below, add to the maximum permissible error for the quantity indicated, 5 % of the minimum measured quantity.

12.4.1 Noninterruptible measuring systems

In the case where the flow is not interrupted during the failure of the principal power supply, the measuring system shall be provided with an emergency power supply to safeguard all measuring functions occurring during that failure.

12.4.2 Interruptible measuring systems

12.4.2.1 Motor fuel dispensers

Either the provisions in 12.4.1 shall be met, or the information contained at the moment of the failure shall be saved and displayable on an indicating device subject to legal metrology control as follows:

– either 15 minutes continuously and automatically after the failure, or
– 5 minutes, in one or several periods manually controlled by an appropriate device, during at least one hour after the failure.

Note: This requirement is applicable when the instrument has been supplied normally with electrical power for the 12 hours that preceded the power failure.

A motor fuel dispenser shall be designed such that an interrupted delivery cannot be continued after the power supply has been reestablished if the power failure has lasted more than 15 seconds.

12.4.2.2 Other measuring systems

Either the provisions in 12.4.1 shall be met, or the information contained at the moment of the failure shall be saved and displayable on an indicating device subject to legal metrology control when the power is returned.

12.5 Peripheral equipment

Any peripheral device for which the main function is not to provide a definite indication for a transaction need not be submitted to control, provided it does not influence the measurement result. In such a case, a clear and unambiguous indication of this fact shall appear in the immediate vicinity of the device or on each ticket emitted.

13 Checking facilities and durability protection features

Checking facilities and durability protection features are all subject to the same requirements. For ease of reading, such facilities or features are designated as checking features in this chapter.

13.1 Action of checking features

The detection of significant faults or of significant durability errors by the checking features shall result in the following action, according to the type.

13.1.1 Checking feature of type N

A visible or audible alarm for the attention of the operator.

13.1.2 Checking feature of types I or P

a) For interruptible measuring systems, in particular motor fuel dispensers:

– automatic correction of the fault or error, or
– stopping only the faulty device when the measuring system without that device continues to comply with the regulations, or
– stopping the measuring system.

b) For noninterruptible measuring systems:

– automatic correction of the fault or error, or
– stopping only the faulty device when the measuring system without that device continues to comply with the regulation, or
– a visible or audible alarm for the operator and blocking (or if possible, obliterating) the indications.

This alarme shall continue until the cause of the alarm is suppressed. In addition, when the measuring system transmits data to peripheral equipment, the transmission shall be stopped or accompanied by a message indicating the presence of a fault.

In addition, when an instrument is not used for a direct sale it may be provided with devices to estimate the amount of liquid having passed through the installation during the occurence of the fault or error. The result of this estimate shall not be mistaken for an indication subject to legal metrology control.

c) Measuring systems shall be provided with a device permitting the retrieval of the information relating to the totalized quantity that is contained in the instrument when the significant fault or significant durability error occurred.

13.1.3 Checking feature for the indicating device (applicable for checking as defined in 13.4.2.b)

a) For motor fuel dispensers, a sequential display, for at least one second each, of all the elements ("eights" test), then blanking of all the elements ("blank" test), followed by a display of "zeros"

b) For all other measuring systems, the test sequence as described under (a) or any other automatic test cycle that indicates all possible values for every element of the display.

13.2 Checking features for the measuring transducer

The object of this checking feature is to verify the presence of the transducer, its correct operation and the correctness of data transmission.

This checking feature shall be of type P and the checking shall occur at time intervals not exceeding the duration of the measurement of an amount of liquid equal to the absolute value of the maximum permissible error on the minimum measured quantity.

During initial verification it must be possible to check that this checking feature functions correctly by such means as:

– disconnecting the transducer
– disconnecting any of the transducer's signal lines
– interrupting one of the sensor's pulse generators
– interrupting the electrical supply of the transducer.

13.3 Checking features for the calculator

The object of these checking features is to verify that the calculator system functions correctly and to ensure the validity of the calculations made. There are no special means required for showing that these checking features function correctly.

13.3.1 The checking of the functioning of the calculation system shall be of types P or I. In the latter case, the checking shall occur at least every five minutes for measuring systems other than motor fuel dispensers, and at least at each delivery for motor fuel dispensers.

The object of the checking is to verify that:

a) the values of all permanently memorized instructions and data are correct, by such means as:

– summing all instruction and data codes and comparing the sum with a fixed value
– line and column parity bits (LRC and VRC)
– cyclic redundancy check (CRC 16)
– double storage of data
– storage of data in "safe coding", for example protected by check sum, line and column parity bits

b) the storage of data relevant to the measurement result is performed correctly, by such means as:

– write-read routine
– conversion and reconversion of codes
– use of "safe coding" (check sum, parity bit)
– double storage.

13.3.2 The checking of the validity of calculations shall be of type P

This check consists of assessing the correct value of all the data relating to the measurement whenever these data are internally stored or transmitted to peripheral equipment through an interface; this check shall be effected by such means as parity bit, check sum or double storage.

In addition, the calculation system shall be provided with a means to control the continuity of the calculation program.

13.4 Checking feature for the indicating device

The object of this checking feature is to verify that the indications subject to legal metrology controls are displayed, and that the indications displayed correspond to the data provided by the calculator. In addition, it verifies the presence of indicating devices when they are removable.

These checking features shall have either the form as defined in 13.4.1 or the form as defined in 13.4.2.

13.4.1 This checking feature shall be of type P, except that it may be of type I if the indication subject to legal metrology control is duplicated on the measuring system, or if it may be easily found from other indications subject to legal metrology control. For example, in the case of a motor fuel dispenser, it is possible to find the price-to-pay from the quantity and the unit price or, in other cases, when a second indication on a secure printer subject to legal metrology control may be used.

The means used for checking may be:

– measuring the current in the filaments, for displays using incandescent filaments or LED's

– measuring the grid voltage, for displays using fluorescent tubes

– checking the impact of shutters, for displays using electro-magnetic shutters

– output checking of the control voltage of segment lines and of common electrodes to detect any disconnection or short-circuit between control circuits, for displays using multi-plex liquid-crystals.

13.4.2 The checking feature of the indicating device shall include:

a) a type I or type P checking of the electronic circuits (except the driving circuits of the display itself) controlling the indicating device. This checking shall meet the requirements in 13.1.2, and

b) a visual checking of the display. This checking shall meet the requirements in 13.1.3 ("eights" test).

This checking feature shall be of type I for the motor fuel dispensers and of type N for other measuring systems.

13.4.3 It shall be possible during verification to show that the checking facility of the indicating device is working, either:

– by disconnecting all or a part of the indicating device, or

– by an action that simulates a failure in the display, such as using a test-button.

13.5 Checking features for peripheral equipment

Any peripheral equipment with indications subject to legal metrology control shall include a checking feature of type I or P. The object of this checking facility is to verify the presence of the ancillary device and to validate the data transmitted by the calculator.

In particular, the checking of a printer aims at ensuring that the printing controls correspond to the data transmitted by the calculator.

At least the following shall be checked:

– presence of paper, and

– the electronic control circuits (except the driving circuits of the printing mechanism itself).

It shall be possible during verification to show that this checking facility of the printer is working by an action simulating a printing fault, such as using a test-button.

14 Pattern approval

14.1 Documentation

The request for pattern approval shall include the following:

– a functional description of the operation of the measuring instrument or system

– a functional description of the various electronic devices

– a flow diagram of the logic, showing the functions of the electronic devices.

Because of rapidly developing technology, a list of electronic subsystems and components as well as program listings can be given only as an indication. Replacement of electronic subassemblies or components shall not cause the performance of the electronic measuring system to deteriorate.

Furthermore, the application shall be accompanied by any document or evidence that supports the assumption that the design and construction of the electronic measuring system complies with the requirements of this Recommendation, in particular clause 13.

14.2 General requirements

Patterns shall normally be evaluated using one unit that is representative of the final pattern. The electronic measuring system shall be subjected to the following inspections and tests.

14.2.1 Design inspection

The examination of documents aims at verifying that the design of electronic devices and their checking features complies with the provisions in 11.3.1, 12 and 13. It includes:

a) an examination of the mode of construction and of the electronic subassemblies and components used, to verify the appropriateness for the intended use,

b) considering faults that are likely to occur, to verify that in all cases these devices comply with the provisions in 13, and

c) verification of the presence and effectiveness of the test device(s) for the checking features.

14.2.2 Performance tests

These tests (specified in Annexes A and B) aim at verifying that the measuring system complies with the provisions in 11.1 and 11.2 for influence quantities.

When subjected to the effect of an influence factor, the equipment shall continue operating correctly and shall not exceed the applicable maximum permissible errors.

When subjected to an external disturbance, the equipment shall either continue operating correctly or detect and indicate the presence of any significant fault. A significant fault shall not occur on a noninterruptible measuring system.

14.2.3 Durability examination

This examination aims at verifying that the measuring system complies with the provisions in 11.3.2 as regards failures of an electronic subassembly, component, device, or connection.

When subjected to a simulated failure of an electronic subassembly, component, device, or connection, the device shall either continue to operate without a significant durability error, or detect and signal the presence of a significant durability error.

The requirements in 11.3.1 and 11.3.2 provide sufficient assurance of durability and there is no need to carry out any durability test.

14.3 Equipment under test (EUT)

Tests are carried out on a complete measuring system where size and configuration permit. Otherwise, electronic devices shall be submitted separately to tests in the form of equipment comprising the following devices:

– measuring transducer

– calculator

– indicating device

– power supply.

This equipment shall be included in a simulation setup representative of the normal operation of the measuring system. For example, the movement of the liquid may be simulated by an appropriate device.

The calculator shall be in its final housing.

In all cases, peripheral equipment may be tested separately.

14.4 Pattern approval certificate

The following information shall appear on the pattern approval certificate:

– name and address of the recipient of the certificate

– name and address of the manufacturer if other than the recipient

– type and/or commercial designation

– principle metrological and technical characteristics

– pattern approval mark

– period of validity

– environmental classification, if applicable (see Annex B)

– location of marks for pattern approval, initial verification, and sealing

– list of documents that accompany the pattern approval certificate

– any other specific remarks considered necessary.

15 Initial verification

The initial verification of an electronic measuring system shall include a procedure to verify the presence and correct functioning of checking features by the use of test devices, as specified in 13.

ANNEX A

TEST PROCEDURES: PERFORMANCE TESTS - GENERAL

These tests should be applied uniformly by the legal metrology services and are intended to ensure that the instruments can perform and function as intended in the environment and under rated conditions of use.

When the effect of one factor is being evaluated, all other factors are to be held relatively constant at a value close to normal. Relatively constant or stable test conditions for each of the factors is as follows:

temperature : ± 5 °C

pressure : ± 20 % not to exceed 200 kPa (2 bar)

flow rate : ± 5 %

Air buoyancy corrections shall be made as appropriate according to the equation as follows:

$$m = f \times w$$

where:

m = mass

f = correction factor

w = weight indicated by the weighing instrument

The equation for determining the correction factor is as follows:

$$f = \frac{1 - \rho_a/\rho_r}{1 - \rho_v/\rho}$$

where:

ρ_a = density of air when calibrating the weighing instrument

ρ_r = reference density (8 000 kg/m^3)

ρ_v = density of gas or vapor displaced when tank is filled

ρ = density of liquid

Note: In a closed tank (e.g. LPG), $\rho_v = 0$ as no vapor is displaced.

Table 1 provides guidelines for these corrections at standard conditions.

The instrument should be tested with the liquid to be commercially measured or with a liquid of the same general physical characteristics.

A.1 Pattern approval tests

The gravimetric test method is recommended; other suitable methods may be used provided that the requirements in A.1.1 are met.

A.1.1 Uncertainty

The uncertainty (at a 95 % confidence level) in determining the error of the EUT shall not exceed 1/5 of the maximum permissible error to be applied.

A.1.2 Quantities

Any test quantity shall be equal to or greater than the minimum measured quantity.

A.1.3 Repeatability

Tests conducted to determine compliance with 3.4 shall be conducted with quantities equal to or greater than five times the minimum measured quantity.

A.1.4 Liquids

The EUT should be tested with sufficient liquid or liquids with similar characteristics over the range of liquids for which the manufacturer has requested approval.

A.1.5 Flow rates

The EUT shall be tested at the maximum and minimum flow rates and at least four intermediate flow rates. At least three tests should be conducted at each flow rate.

A.1.6 Temperatures

If temperature tests are conducted, the EUT should be tested at the maximum, minimum, and at a midpoint temperature. However, the temperatures may vary from those points as follows: maximum - 10 °C, minimum + 15 °C, and midpoint ± 5 °C.

A.1.7 Durability

A durability test shall be conducted as follows:

– an accuracy test shall be conducted prior to the durability test,
– the durability test shall be conducted for 100 hours in one or several periods at a flow rate from 80 % Q_{max} to Q_{max},
– after the 100 hour test, an accuracy test shall be conducted with the same quantity as above. The test results shall not vary from the first test by more than 0.3 % of the measured quantity, without any adjustment or correction.

A.1.8 Motor fuel dispensers

If the EUT is intended for use as a motor fuel dispenser, an accuracy test shall be conducted with five stops and starts during a delivery at maximum flow rate.

A.2 Initial and subsequent verification tests

The verification of the instrument may be conducted by the gravimetric or volumetric method, or with a master meter.

A.2.1 Uncertainty

The uncertainty (at a 95 % confidence level) in determining the error of the EUT shall not exceed one-third of the maximum permissible error to be applied.

A.2.2 Quantities

Any test quantity shall be equal to or greater than the minimum measured quantity.

A.2.3 Flow rates

The EUT shall be tested at the maximum flow rate achievable under the conditions of installation, the minimum flow rate marked on the instrument, and at at least one intermediate flow rate. At least one test shall be conducted at each flow rate.

A.2.4 Motor fuel dispensers

If the EUT is intended for use as a motor fuel dispenser, an accuracy test shall be conducted with five stops and starts during a delivery at maximum flow rate.

Table 1
Air buoyancy correction

Product density (kg/m^3)			Factor (f)
501.1	to	522.8	1.0022
522.9		546.5	1.0021
546.6		572.5	1.0020
572.6		601.1	1.0019
601.2		632.6	1.0018
632.7		667.7	1.0017
667.8		706.9	1.0016
707.0		751.0	1.0015
751.1		801.0	1.0014
801.1		858.2	1.0013
858.3		924.1	1.0012
924.2		1 001.0	1.0011
1 001.1		1 091.9	1.0010
1 092.0		1 201.0	1.0009
1 201.1		1 334.3	1.0008
1 334.4		1 500.9	1.0007
1 501.0		1 715.2	1.0006
1 715.3		2 000.9	1.0005

ANNEX B

TEST PROCEDURES: PERFORMANCE TESTS APPLICABLE TO ELECTRONIC EQUIPMENT

B.1 General

This Annex specifies the tests intended to ensure that electronic measuring systems perform and function as intended in a specified environment and under specified conditions. Where appropriate, each test indicates the reference conditions under which the intrinsic error is determined.

These tests supplement those in Annex A.

When the effect of one influence quantity is being evaluated, all other influence quantities are to be held relatively constant, at values close to reference conditions.

When the effect of a disturbance is being evaluated, no other dirsturbance shall be present and all influence quantities shall be held relatively constant, at values close to reference conditions.

B.2 Severity levels (see OIML International Document D11)

Typical test conditions are indicated for each performance test; these conditions correspond to the climatic and mechanical environment conditions to which measuring systems are usually exposed.

Measuring systems are divided into three classes according to the climatic and mechanical environment conditions:

– Class B, for a fixed instrument installed in a building.

– Class C, for a fixed instrument installed outdoors.

– Class I, for a mobile instrument, especially that which is mounted on a truck.

However, in relation to the future use of the equipment, the applicant for pattern approval may define specific environmental conditions in the documentation supplied to the metrology service. In this case, the metrology service carries out the tests at severity levels corresponding to the specific environmental conditions. If pattern approval is granted, the data plate shall indicate the corresponding limits of use, and manufacturers shall inform users of the conditions of use for which the instrument is approved. Finally, the metrology service shall verify that the conditions of use are met.

B.3 Reference conditions

Ambient temperature:	15 °C to 25 °C
Relative humidity:	45 % to 75 %
Atmospheric pressure:	86 kPa to 106 kPa
Power voltage:	Nominal voltage
Power frequency:	Nominal frequency

During each test, the temperature and relative humidity shall not vary by more than 5 °C and 10 % respectively within the reference ranges.

B.4 Performance tests

TEST	NATURE OF THE INFLUENCE QUANTITY	SEVERITY LEVEL (reference to OIML D11)		
		B	C	I
B.4.1 Dry heat	Influence factor	2	3	3
B.4.2 Cold	Influence factor	2	3	3
B.4.3 Damp heat (cyclic)	Influence factor	1	2	2
B.4.4 Vibration (sinusoidal)	Influence factor	–	–	3
B.4.5 Power voltage variations	Influence factor	1	1	1
B.4.6 Short time power reductions	Disturbance	1a & 1b	1a & 1b	1a & 1b
B.4.7 Bursts	Disturbance	2	2	2
B.4.8 Electrostatic discharge	Disturbance	1	1	1
B.4.9 Electromagnetic susceptibility	Disturbance	2 5 8	2 5 8	2 5 8

Notes: Simulated tests

Except for B.4.3 and B.4.4 (nonoperational tests), the tests may be conducted by simulating the flow without any actual product passing through the measuring system if it can be shown that the flow sensor is not affected by the test conditions.

Note 1: Simulated flow must produce an output or outputs from the measuring system corresponding to an actual flow rate between the minimum and maximum flow rates for the system.

Note 2: While flow is being simulated, it must be possible to ascertain that the flow measurement capabilities of the system are fully operational.

B.4.1 Dry heat

Test method: Dry heat (non condensing)

Object of test: To verify compliance with the provisions in 11.1 under conditions of high temperature.

References: IEC Publications 68-2-2, fourth edition, 1974 , basic environmental testing procedures, Part 2: Tests, Test Bd: Dry heat, for heat dissipating equipment under test EUT with gradual change temperature.

Background information concerning dry heat tests is given in IEC Publication 68-3-1, first edition, 1974, and first supplement 68-3-1A, 1978, Part 3: background information, section one: Cold and dry heat test. General background information on basic environmental testing procedures is given in IEC Publication 68-1, fourth edition, 1978.

Test procedure in brief: The test consists of exposure of the EUT to a temperature of 55 °C (classes C or I) or 40 °C (class B) under "free air" conditions for a two-hour period after the EUT has reached temperature stability. The EUT shall be tested at at least one flow rate (or simulated flow rate):

- at the reference temperature of 20 °C following conditioning,
- at the temperature of 55 °C or 40 °C, two hours following temperature stabilization, and
- after recovery of the EUT at the reference temperature of 20 °C.

Test severity:

1) Temperature: severity level 2: 40 °C
   severity level 3: 55 °C
2) Duration: two hours.

Number of test cycles: One cycle.

Maximum allowable variations: All functions shall operate as designed.

All indications shall satisfy the requirements concerning the maximum permissible errors.

B.4.2 Cold

Test method: Cold.

Object of test: To verify compliance with the provisions in 11.1 under conditions of low temperature.

References: IEC Publications 68-2-2, fourth edition, 1974, Basic environmental testing procedures, Part 2: Tests, test Ad: Cold, for heat dissipating EUT with gradual change of temperature.

Background information concerning cold tests is given in IEC Publication 68-3-1, first edition 1974 and first supplement 68-3-1A, 1978 Part 3: Background information, section one: Cold and dry heat tests. General background information on basic environmental testing procedures is given IEC Publication 68-1, fourth edition, 1978.

Test procedure in brief: The test consists of exposure of EUT to a temperature of - 25 °C (classes C or I) or - 10 °C (class B) under "free air" conditions for a two-hour period after the EUT has reached temperature stability. The EUT shall be tested at at least one flow rate (or simulated flow rate):

– at the reference temperature of 20 °C following conditioning,

– at a temperature of - 25 °C or - 10 °C, two hours following temperature stabilization, and

– after recovery of the EUT at the reference temperature of 20 °C.

Test severity: 1) Temperature: severity level 2: - 10 °C
severity level 3: - 25 °C

2) Duration: two hours.

Number of test cycles: One cycle.

Maximum allowable variations: All functions shall operate as designed.

All indications shall satisfy the requirements concerning the maximum permissible errors.

B.4.3 Damp heat, cyclic

Test method: Damp heat, cyclic (condensing).

Object of test: To verify compliance with the provisions in 11.1 under conditions of high humidity when combined with cyclic temperature changes.

References: IEC Publication 68-2-30, second edition, 1980 Basic environmental testing procedures, Part 2: Tests, test Db: Damp heat, cyclic (12 h + 12 h cycle), test variant 2.

Background information concerning damp heat tests is given in IEC Publication 68-2-28, second edition, 1980: Guidance for damp heat tests.

Test procedure in brief: The test consists of exposure of the nonoperational EUT (power supplied and on) to cyclic temperature variations between 25 °C and the upper temperature of 55 °C (classes C or I) or 40 °C (class B), maintaining the relative humidity above 95 % during the temperature changes and during the phases at low temperature, and at 93 % at the upper temperature phases. Condensation should occur on the EUT during the temperature rise. The standard atmospheric stabilizing period before and recovery after the cyclic exposure are indicated in IEC Publication 68-2-30. After recovery, a performance test under reference conditions at at least one flow rate (or simulated flow rate) is conducted.

Test severity: 1) Upper temperature: severity level 1: - 40 °C
severity level 2: - 55 °C
2) Humidity: > 93 %.
3) Duration: 24 hours.

Number of test cycles: Two cycles.

Maximum allowable variations: All functions shall operate as designed.

All indications shall satisfy the requirements concerning the maximum permissible errors.

B.4.4 Vibration

Test method: Sinusoidal vibration.

Object of the test: To verify compliance with the provisions in 11.1 under conditions of sinusoidal vibration.

References: IEC Publication 68-2-6, fifth edition, 1982, Basic environmental testing procedures, Part 2: Test, test Fc: Vibration (sinusoidal).

Test procedure in brief: The nonoperational EUT shall be tested by sweeping the frequency in the specified frequency range, at 1 octave/minute, at the specified acceleration level with a specified number of sweep cycles per axis. The EUT shall be tested in its three, mutually perpendicular main axes, mounted on a rigid fixture by its normal mounting means. It shall normally be mounted so that the gravitational force acts in the same direction as it would in normal use. After the vibration test, a performance test under reference conditions at at least one flow rate is conducted.

Test severity: 1) Frequency range: 10 - 150 Hz
2) Max. acceleration level: 20 $m.s^{-2}$.

Number of test cycles: 20 sweep cycles per axis.

Maximum allowable variations: All functions shall operate as designed.

All indications shall satisfy the requirements concerning the maximum permissible errors.

B.4.5 Power voltage variation

B.4.5.1 AC power supply

Test Method: Variation in AC mains power supply (single phase).

Object of the test:	To verify compliance with the provisions in 11.1 under conditions of varying AC mains power supply.
Test procedure in brief:	The test consists of exposure of the EUT to power voltage variations, while the EUT is operating under normal atmospheric conditions. The EUT shall be tested at at least one flow rate (or simulated flow rate), at the upper and lower voltage limits.
Test severity:	1) Mains voltage: upper limit: U_{nom} + 10 % lower limit: U_{nom} - 15 %
Number of test cycles:	One cycle.
Maximum allowable variations:	All functions shall operate as designed. All indications shall satisfy the requirements concerning the maximum permissible errors.

B.4.5.2 DC power supply

Test Method:	Variation in DC power supply.
Object of the test:	To verify compliance with the provisions in 11.1 under conditions of varying DC power supply.
Test procedure in brief:	The test consists of exposure of the EUT to power voltage variations, while the EUT is operating under normal atmospheric conditions. The EUT shall be tested at at least one flow rate (or simulated flow rate), at the upper and lower voltage limits.
Test severity:	Mains voltage: upper limit: U_{nom} + 10 % lower limit: U_{nom} - 15 %
Number of test cycles:	One cycle.
Maximum allowable variations:	All functions shall operate as designed. All indications shall satisfy the requirements concerning the maximum permissible errors.

B.4.6 Short time power reduction

Test method:	Short time interruptions and reductions in mains voltage.
Object of test:	To verify compliance with the provisions in 11.2 under conditions of short time mains voltage interruptions and reductions.
References:	No reference to international standard can be given at the present time.

Test procedure in brief:	The test consists of subjecting the EUT to voltage interruptions from nominal voltage to zero voltage for a duration equal to 10 ms, and from nominal voltage to 50 % of nominal for a duration equal to 20 ms. The mains voltage interruptions and reductions shall be repeated ten times with a time interval of at least ten seconds. The EUT shall be tested at at least one flow rate (or simulated flow rate).
Test severity:	100 % voltage interruption for a period equal to 10 ms. 50 % voltage reduction for a period equal to 20 ms.
Number of test cycles:	Ten tests which a minimum of ten seconds between tests.
Maximum allowable variations:	a) For interruptible measuring systems, either the difference between the quantity indication during the test and the indication under reference conditions shall not exceed the values given in T.20 or the measuring system shall detect and act upon a significant fault, in compliance with 13.1. b) For noninterruptible measuring systems, the difference between the quantity indication during the test and the indication under reference conditions shall not exceed the values given in T.20.

B.4.7 Bursts

Test method:	Electrical bursts.
Object of test:	To verify compliance with the provisions in 11.2 under conditions where electrical bursts are superimposed on the mains voltage.
References to standard:	IEC Publication 801- 4 (1988).
Test procedure in brief:	The test consists of subjecting the EUT to bursts of double exponential wave-form transient voltages. Each spike shall have a rise time of 5 ns and a half amplitude duration of 50 ns. The burst length shall be 15 ms, the burst period (repetition time interval) shall be 300 ms. All these bursts shall be applied during the same measurement or simulated measurement.
Test severity:	Amplitude (peak value): 1 000 V.
Number of test cycles:	At least ten positive and ten negative randomly phased bursts shall be applied at 1 000 V.
Maximum allowable variations:	a) For interruptible measuring systems, either the difference between the quantity indication during the test and the indication under reference conditions shall not exceed the values given in T.20 or the measuring system shall detect and act upon a significant fault, in compliance with 13.1.

b) For noninterruptible measuring systems, the difference between the quantity indication during the test and the indication under reference conditions shall not exceed the values given in T.20.

B.4.8 Electrostatic discharge

Test method: Electrostatic discharge (ESD).

Object of the test: To verify compliance with the provisions in 11.2 under conditions of electrostatic discharges.

Reference to standard: IEC Publication 801-2, 1991.

Test procedure in brief: A capacitor of 150 pF is charged by a suitable DC voltage source. The capacitor is then discharged through the EUT by connecting one terminal to ground (chassis) and the other via 330 ohms to surfaces which are normally accessible to the operator.

In the contact discharge method, to be carried out on conductive surfaces, the electrode shall be in contact with the EUT and the discharge shall be actuated by the discharge switch of the generator.

In the air discharge method, on insulating surfaces, the electrode is approached to the EUT and the discharge occurs by the spark.

Test severity: Air discharge: up to and including 8 kV.

Contact discharge: up to and including 6 kV.

CAUTION: Do not use the paint penetration method.

Number of test cycles: At least ten discharges shall be applied at intervals of at least ten seconds between discharges, during the same measurement or simulated measurement.

Maximum allowable variations: a) For interruptible measuring systems, either the difference between the quantity indication during the test and the indication under reference conditions shall not exceed the values given in T.20 or the measuring system shall detect and act upon a significant fault, in compliance with 13.1.

b) For noninterruptible measuring systems, the difference between the quantity indication during the test and the indication under reference conditions shall not exceed the values given in T.20.

B.4.9 Electromagnetic susceptibility

Test method: Electromagnetic fields (radiated).

Object of the test: To verifiy compliance with the provisions in 11.2 under conditions of electromagnetic fields.

References: IEC Publication 801-3 (being revised: IEC draft 65A/77B (secretariat) 135/100, December 1992).

Test procedure in brief: The EUT shall be exposed to an electromagnetic field strenght as specified by the severity level during the same measurement or simulated measurement. The field strength can be generated in various ways (see IEC draft mentionned above).

The specified field strength is established prior to testing (without EUT in the field).

The field is generated in two orthogonal polarizations and the frequency range is scanned slowly.

If antennas with circular polarization (i.e. log-spiral or helical antennas) are used to generate the electromagnetic field, a change in the position of the antennas is not necessary.

When the test is carried out in a shielded enclosure to comply with international law prohibiting interference to radio communications, anechoic shielding may be necessary to reduce reflection from the walls.

Test severity:

Frequency range	26 - 1 000 MHz
Field strength	3 V/m
Modulation	80 % AM, 1 kHz sine wave

Maximum allowable variations: a) For interruptible measuring systems, either the difference between the quantity indication during the test and the indication under reference conditions shall not exceed the values given in T.20 or the measuring system shall detect and act upon a significant fault, in compliance with 13.1.

b) For noninterruptible measuring systems, the difference between the quantity indication during the test and the indication under reference conditions shall not exceed the values given in T.20.

ORGANISATION INTERNATIONALE
DE MÉTROLOGIE LÉGALE

INTERNATIONAL RECOMMENDATION

Direct mass flow measuring systems for quantities of liquids
Annex C: Test report format

Ensembles de mesurage massiques directs de quantités de liquides
Annexe C: Format du rapport d'essai

OIML R 105
Annex C

Edition 1995 (E)

CONTENTS

FOREWORD

The International Organization of Legal Metrology (OIML) is a worldwide, intergovernmental organization whose primary aim is to harmonize the regulations and metrological controls applied by the national metrological services, or related organizations, of its Member States.

The two main categories of OIML publications are:

1) **International Recommendations (OIML R),** which are model regulations that establish the metrological characteristics required of certain measuring instruments and which specify methods and equipment for checking their conformity; the OIML Member States shall implement these Recommendations to the greatest possible extent;

2) **International Documents (OIML D),** which are informative in nature and intended to improve the work of the metrological services.

OIML Draft Recommendations and Documents are developed by technical committees or subcommittees which are formed by the Member States. Certain international and regional institutions also participate on a consultation basis.

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DIRECT MASS FLOW MEASURING SYSTEMS for QUANTITIES of LIQUIDS

ANNEX C

TEST REPORT FORMAT

Note: This Annex is informative with regard to implementation of OIML Recommendation R 105 in national regulations; however, use of the test report format is mandatory for application of the Recommendation within the OIML Certificate System.

General information concerning the pattern

Application N°: _____ Date: _____

Model designation: _____

Manufacturer: _____

Address: _____

_____

Applicant: _____

Address: _____

_____

Representative: _____

Telephone: _____ Fax: _____

Description of instruments or systems to be covered:

N°	Maximum flowrate	Minimum flowrate	Minimum measured quantity	Accuracy class	Application or use
1					
2					
3					
4					
5					
6					

Note: Please indicate which of the above has been submitted for test.

General information concerning the pattern (cont.)

Instrument technology: _____

Description of the system:

_____

_____

_____

_____

_____

_____

Method of operation:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Observer: _____

Report page N° _____ of _____

General information concerning test conditions

Model: _____ Serial N°: _____ Date: _____

Standards:

Weighing system - Description: _____

_____

_____

Accuracy and uncertainty: _____

Volumetric system - Description: _____

_____

_____

Accuracy and uncertainty: _____

Test liquid or liquids: _____

Environmental test equipment - Description:

Temperature: _____

_____

Humidity: _____

_____

Disturbance tests equipment: _____

_____

Test location: _____

_____

Observer: _____

Technical requirements: Checklist

Model: _____ Flowrate: _____ Serial N°: _____

Clause	Title	+	–	Remarks
6	Indicators			
6.1	Units of measurement			
6.2	Numerical value of scale interval			
6.3	Maximum value of scale interval			
6.4	Values defined			
6.5	Return to zero			
6.5.1	Resettable method of operation			
6.6	Nonresettable indicator			
6.7	Presetting device			
7	Printer			
8	Measuring systems			
8.1	Vapor elimination			
8.2	Maintenance of liquid state			
8.3	Provision for sealing			
9	Discharge lines and valves			
9.1	Diversion of measured liquid			
9.2	Directional flow valves			
9.3	Discharge valves			
9.4	Anti-drain means			
9.5	Other valves			

Note: + Complies, – Does not comply, / Not applicable

Remarks: _____

_____

_____

Observer: _____

Report page N° _____ of _____

Technical requirements: Checklist (cont.)

Marking requirements (clause 10) Date: _____

Model: _____ Flowrate: _____ Serial N°: _____

Clause 10	Information to be marked	+	–
a)	Pattern approval mark		
b)	Manufacturer's name and address or trademark		
c)	Manufacturer's designation		
d)	Serial number		
e)	Maximum and minimum flowrates		
f)	Maximum working pressure		
g)	Special limits of temperature		
h)	Minimum measured quantity		
i)	Product limitations		

Note: + Present, – Not present, / Not applicable

Remarks: _____

_____

_____

_____

_____

_____

Observer: _____

Requirements for electronic measuring systems: Checklist

Model: _____ Flowrate: _____ Serial N°: _____

Clause	Title	+	–	Remarks
12.1	Measuring transducer			
12.2	Calculator			
12.3.1	Indicating device - unit price			
12.3.2	Indicating device - zeroing			
12.4.1	Power supply - noninterruptible systems			
12.4.2.1	Motor fuel dispensers			
12.4.2.2	Other measuring systems			
12.5	Peripheral equipment			
13.1.1	Checking feature of type N			
13.1.2 a)	Type I or P - interruptible			
13.1.2 b)	Noninterruptible			
13.1.2 c)	Information retrieval - totalized quantity			
13.1.3 a)	Checking features - motor fuel dispensers			
13.1.3 b)	Checking features - other measuring system			
13.2	Checking features - measuring transducer			
13.3.1 a)	Checking features - calculator			
13.3.1 b)	Checking features - calculator			
13.3.2	Checking calculations type P			
13.4.1	Checking feature - indicating device			
13.4.2 a)	Checking feature - indicating device			
13.4.2 b)	Checking feature - indicating device			
13.4.3	Checking feature - indicating device: operation during verification			
13.5	Checking features - peripheral equipment			

Note: + Complies, – Does not comply, / Not applicable

Remarks: _____

_____

_____

Observer:

Report page N° _____ of _____

Summary of the tests

Application N°:_____ Date:_____

Model: _____ Flowrate: _____ Serial N°: _____

Certificate of conformity N°: _____ Date: _____

N°	Test description	+	–	Remarks
C.1	Flow test - A.1.4 Liquids			
	A.1.5 Flow Rates			
	A.1.6 Temperatures			
	A.1.8 Motor fuel dispensers			
C.2	Dry heat test (B.4.1)			
C.3	Cold test (B.4.2)			
C.4	Damp heat, cyclic test (B.4.3)			
C.5	Vibration test (B.4.4)			
C.6	Power supply test (B.4.5.1)			
C.7	Power reduction test (B.4.6)			
C.8	Bursts test (B.4.7)			
C.9	Electrostatic discharge test (B.4.8)			
C.10	Electromagnetic susceptibility test (B.4.9)			
C.11	Durability test (A.1.7)			
C.12	Repeatability test (A.1.3 - 3.4)			

Note: + Passed, – Failed, / Not applicable

Remarks: _____

_____

_____

Observer: _____

C.1 Flow test (A.1.4, A.1.5, A.1.6 and A.1.8 if applicable)

Model: _____ Serial N°: _____ Date: _____

Test liquid density (kg/m^3): _____ at _____°C Air buoyancy correction factor (f): _____

Ambient temperature:_____ Humidity: _____ Barometric pressure: _____

Test method: Gravimetric _____ or Volumetric _____

Flow rate nominal: (100 %) _____

	Test #1	Test #2	Test #3	Average
Flow rate				
Test quantity				– – –
Indication				
Error				
mpe				– – –
% error				
Liquid temperature*				
Pressure				
Repeatability (maximal difference between tests #1, #2 and #3: 0.2 %) (test quantity ≥ 5 x minimum measured quantity)				

Flow rate nominal: (80 %) _____

	Test #1	Test #2	Test #3	Average
Flow rate				
Test quantity				– – –
Indication				
Error				
mpe				– – –
% error				
Liquid temperature*				
Pressure				
Repeatability (maximal difference between tests #1, #2 and #3: 0.2 %) (test quantity ≥ 5 x minimum measured quantity)				

* Product temperature in test standard

Remarks: _____

_____

Observer: _____

Report page N° _____ of _____

C.1 Flow test (A.1.4, A.1.5, A.1.6 and A.1.8 if applicable) (cont.)

Model: _____ Serial N°: _____ Date: _____

Test liquid density (kg/m^3): _____ at _____°C Air buoyancy correction factor (f): _____

Ambient temperature:_____ Humidity: _____ Barometric pressure: _____

Test method: Gravimetric _____ or Volumetric _____

Flow rate nominal: (60 %) _____

	Test #1	Test #2	Test #3	Average
Flow rate				
Test quantity				– – –
Indication				
Error				
mpe				– – –
% error				
Liquid temperature*				
Pressure				
Repeatability (maximal difference between tests #1, #2 and #3: 0.2 %) (test quantity ≥ 5 x minimum measured quantity)				

Flow rate nominal: (40 %) _____

	Test #1	Test #2	Test #3	Average
Flow rate				
Test quantity				– – –
Indication				
Error				
mpe				– – –
% error				
Liquid temperature*				
Pressure				
Repeatability (maximal difference between tests #1, #2 and #3: 0.2 %) (test quantity ≥ 5 x minimum measured quantity)				

* Product temperature in test standard

Remarks: _____

_____

Observer: _____

C.1 Flow test (A.1.4, A.1.5, A.1.6 and A.1.8 if applicable) (cont.)

Model: _____ Serial N°: _____ Date: _____

Test liquid density (kg/m^3): _____ at _____ °C Air buoyancy correction factor (f): _____

Ambient temperature:_____ Humidity: _____ Barometric pressure: _____

Test method: Gravimetric _____ or Volumetric _____

Flow rate nominal: (25 %) _____

	Test #1	Test #2	Test #3	Average
Flow rate				
Test quantity				– – –
Indication				
Error				
mpe				– – –
% error				
Liquid temperature*				
Pressure				
Repeatability (maximal difference between tests #1, #2 and #3: 0.2 %) (test quantity ≥ 5 x minimum measured quantity)				

Flow rate nominal: (10 %) _____

	Test #1	Test #2	Test #3	Average
Flow rate				
Test quantity				– – –
Indication				
Error				
mpe				– – –
% error				
Liquid temperature*				
Pressure				
Repeatability (maximal difference between tests #1, #2 and #3: 0.2 %) (test quantity ≥ 5 x minimum measured quantity)				

* Product temperature in test standard

Remarks: _____

_____

Observer: _____

Report page N° _____ of _____

C.2 Dry heat test (B.4.1) - Maximum high temperature: 55 °C or 40 °C

Model: _____ Serial N°: _____ Date: _____

Test liquid density (kg/m^3): _____ at _____ °C Air buoyancy correction factor (f): _____

Simulated test: _____ or Operational test: _____

Test #1 (20 °C)					
Flow rate	Temperature*	Test quantity	Indication	Error	mpe

Test #2 (maximum high temperature: _____ °C)					
Flow rate	Temperature*	Test quantity	Indication	Error	mpe

Test #3 (20 °C)					
Flow rate	Temperature*	Test quantity	Indication	Error	mpe

C.3 Cold test (B.4.2) - Minimum low temperature: – 10 °C or – 25 °C

Test #1 (20 °C)					
Flow rate	Temperature*	Test quantity	Indication	Error	mpe

Test #2 (minimum low temperature: _____ °C)					
Flow rate	Temperature*	Test quantity	Indication	Error	mpe

Test #3 (20 °C)					
Flow rate	Temperature*	Test quantity	Indication	Error	mpe

* Chamber or ambient temperature

Observer: _____

C.4 Damp heat, cyclic test (B.4.3)

Model: _____ Serial N°: _____ Date: _____

Test liquid density (kg/m^3): _____ at _____ °C Air buoyancy correction factor (f): _____

Simulated test: _____ or Operational test: _____

Before damp heat test:

Test #1					
Flow rate	Temperature*	Test quantity	Indication	Error	mpe

After damp heat test:

Test #2					
Flow rate	Temperature*	Test quantity	Indication	Error	mpe

Observer: _____

C.5 Vibration test (B.4.4)

Model: _____ Serial N°: _____ Date: _____

Test liquid density (kg/m^3): _____ at _____ °C Air buoyancy correction factor (f): _____

Simulated test: _____ or Operational test: _____

Before vibration test:

Test #1					
Flow rate	Temperature*	Test quantity	Indication	Error	mpe

After vibration test:

Test #2					
Flow rate	Temperature*	Test quantity	Indication	Error	mpe

* Chamber or ambient temperature

Observer: _____

Report page N° _____ of _____

C.6 Power supply test (B.4.5.1)

Model: _____ Serial N°: _____ Date: _____

Test liquid density (kg/m³): _____ at _____ °C Air buoyancy correction factor (f): _____

Simulated test: _____ or Operational test: _____

Mains voltage (+ 10 %): _____

Test #1					
Flow rate	Temperature*	Test quantity	Indication	Error	mpe

Mains voltage (– 15 %): _____

Test #2					
Flow rate	Temperature*	Test quantity	Indication	Error	mpe

Observer: _____

C.7 Power reduction test (B.4.6)

Model: _____ Serial N°: _____ Date: _____

Test liquid density (kg/m³): _____ at _____ °C Air buoyancy correction factor (f): _____

Simulated test: _____ or Operational test: _____

100 % Reduction

Test #1						
Flow rate	Temperature*	Test Quantity	Indication	Error	Error at R/C	Diff. or S/F

50 % Reduction

Test #2						
Flow rate	Temperature*	Test Quantity	Indication	Error	Error at R/C	Diff. or S/F

* Chamber or ambient temperature
R/C = Reference condition; Diff. or S/F = difference or significant fault

Observer: _____

C.8 Bursts test (B.4.7)

Model: _____ Serial N°: _____ Date: _____

Test liquid density (kg/m^3): _____ at _____ °C Air buoyancy correction factor (f): _____

Simulated test: _____ or Operational test: _____

Power supply lines: test voltage 1 kV, duration of the test 1 minute at each polarity

Measured quantity	Connection			Result			
	L ↓ ground	N ↓ ground	PE ↓ ground	Polarity	Indication	Significant fault (T.20)	
						No	Yes (Remarks)
	without disturbance						
	X			pos			
				neg			
	without disturbance						
		X		pos			
				neg			
	without disturbance						
			X	pos			
				neg			
	without disturbance						
	X			pos			
				neg			
	without disturbance						
		X		pos			
				neg			
	without disturbance						
			X	pos			
				neg			

L = phase, N = neutral, PE = protective earth

Passed: _____ Failed: _____

Remarks: _____

_____

_____

Observer: _____

C.8 Bursts test (B.4.7) (cont.)

Model: _____ Serial N°: _____ Date: _____

Test liquid density (kg/m³): _____ at _____ °C Air buoyancy correction factor (f): _____

Simulated test: _____ or Operational test: _____

I/O signals, data and control lines: test voltage 0.5 kV, duration of test 1 minute at each polarity.

Measured quantity	cable interface			Result			
				Polarity	Indication	Significant fault (T.20)	
						No	Yes (remarks)
	without disturbance						
	X			pos			
				neg			
	without disturbance						
		X		pos			
				neg			
	without disturbance						
			X	pos			
				neg			
	without disturbance						
	X			pos			
				neg			
	without disturbance						
		X		pos			
				neg			
	without disturbance						
			X	pos			
				neg			

Passed: _____ Failed: _____

Remarks: _____

_____

_____

Observer: _____

C.9 Electrostatic discharge (B.4.8)

Model: _____ Serial N°: _____ Date: _____

Test liquid density (kg/m^3): _____ at _____ °C Air buoyancy correction factor (f): _____

Simulated test: _____ or Operational test: _____

☐ Contact discharges ☐ Paint penetration

☐ Air discharges Polarity (*): ☐ pos ☐ neg

Measured quantity	Discharges			Result		
	Test voltage (kV)	Number of discharges ≥ 10	Repetition interval(s)	Indication	Significant fault (>e)	
					No	Yes (remarks)
	without disturbance					
	2					
	4					
	6					
	8 (air discharges)					
	without disturbance					
	2					
	4					
	6					
	8 (air discharges)					

Passed: _____ Failed: _____

Remarks: _____

_____

_____

_____

_____

_____

Note: If the EUT fails, the test point at which this occurs shall be recorded.

Observer: _____

(*) IEC 801-2 specifies that the test shall be conducted with the most sensitive polarity.

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C.10 Electromagnetic susceptibility test (B.4.9)

Model: _____ Serial N°: _____ Date: _____

Test liquid density (kg/m^3): _____ at _____ °C Air buoyancy correction factor (f): _____

Simulated test: _____ or Operational test: _____

Test						
Flow rate	Temperature*	Test quantity	Indication	Error	Error at R/C	Diff. or S/F

* Chamber or ambient temperature

R/C = Reference condition; Diff. or S/F = difference or significant fault

Remarks: _____

_____

_____

_____

Observer: _____

C.11 Durability test (A.1.7)

Model: _____ Serial N°: _____ Date: _____

Test liquid density (kg/m^3): _____ at _____ °C Air buoyancy correction factor (f): _____

Before durability test:

Test #1					
Flow rate	Temperature*	Test quantity	Indication	Error	mpe

After durability test:

Test #2					
Flow rate	Temperature*	Test quantity	Indication	Error	mpe

* Chamber or ambient temperature

Observer: _____

C.12 Repeatability test (A.1.3.1 and 3.4)

The determination of compliance to this requirement can be made from the flow tests conducted under C.1.

Repeatability error (not greater than 0.2 %): _____

Observer: _____