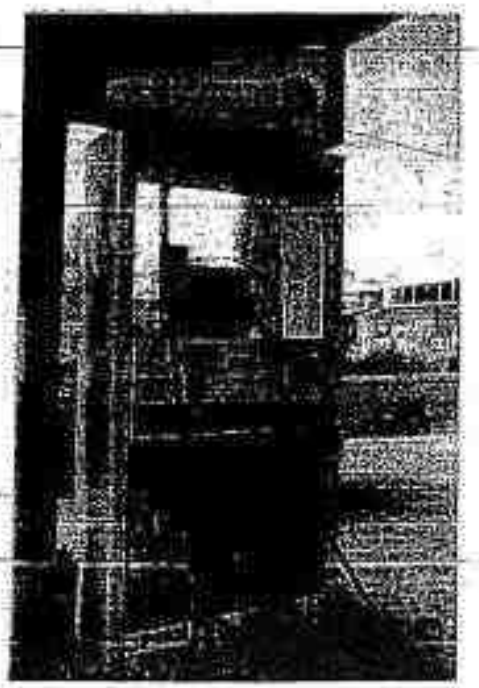
INDIAN INSTITUTE OF LEGAL METROLOGY



NOTES ON

MEASURING SYSTEM FOR LIQUIDS OTHER THAN WATER

(FUEL DISPENSER AND LPG DISPENSER FOR MOTOR VEHICLES)

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Introduction

Measuring systems for liquids other than water was first introduced vide GSR No dated the 4th March, 2009.It follows the OIML Recommendations made under R-117: Edition 1995 (E) and is in force since 5th June, 2009.

Terminology

Meter for volumes of liquids

An instrument intended to measure continuously, memorize and display the volume of liquid passing through the measurement transducer at metering conditions.

Note: A meter includes at least a measurement transducer, a calculator (including adjustment or correction devices if present) and an indicating device

Measurement transducer

A part of the meter which transforms the flow or the volume of the liquid to be measured into signals which are passed to the calculator. It may be autonomous or use an external power source.

Note: For the purposes of this specification, the measurement transducer includes the flow or volume sensor.

Calculator

A part of the meter that receives the output signals from the transducer(s) and, possibly, from associated measuring instruments, transforms them and, if appropriate, stores in memory the results until they are used. In addition, the calculator may be capable of communicating both ways with peripheral equipment.

Indicating device

A part of the meter which displays continuously the measurement results.

Note: A printing device which provides an indication at the end of the measurement is not an indicating device.

Ancillary device

A device intended to perform a particular function, directly involved in elaborating, transmitting or displaying measurement results.

Main ancillary devices are:—

(i) zero setting device;
(ii) repeating indicating device;
(iii) printing device;
(iv) memory device;
(v) price indicating device;
(vi) totalizing indicating device;
(vii) conversion device;
(viii) pre-setting device; and
(ix) self-service device.

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- Ancillary devices may be a part of the calculator or of the meter, or may be peripheral equipment, connected through an interface to the calculator.
- In addition these devices shall bear a legend which is clearly visible to the user to indicate that they are not controlled when they display a measurement result visible to the user. Such a legend will be present on each print out likely to be made available to the consumer.

Additional device

A part or a device, other than an ancillary device, required to ensure correct measurement or intended to facilitate the measuring operations, or which could in any way affect the measurement.

Main additional devices are:—

(i) gas elimination device;
(ii) gas indicator;
(iii) sight glass;
(iv) filter, pump;
(v) device used for the transfer point;
(vi) anti-swirl device;
(vii) branches or bypasses; and
(viii) valves, hoses.

Measuring system

A system which comprises the meter itself and all the ancillary devices and additional devices.

Constituents of a measuring system

A meter itself is not a measuring system. The smallest possible measuring system includes—

(i) a meter,
(ii) a transfer point,
(iii) a hydraulic circuit with particular characteristics which must be taken into account,
(iv) a gas elimination device,
(v) a filter device,
(vi) a pumping device,
(vii) correction devices related to temperature, viscosity, etc.

The measuring system may be provided with other ancillary and additional devices.

If several meters are intended for a single measuring operation, the meters are considered to form a single measuring system.

If several meters intended for separate measuring operations have common elements (calculator, filter, gas elimination device, conversion devices, etc.) each meter is considered to form, with the common elements, a measuring system.

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Pre-setting device

A device which permits the selection of the quantity to be measured and which automatically stops the flow of the liquid at the end of the measurement of the selected quantity.

Note : The pre-set quantity may be the volume, the mass or the related price to pay.

Adjustment device

A device incorporated in the meter that only allows shifting of the error curve generally parallel to itself, with a view to bringing errors within the maximum permissible errors.

Associated measuring instruments

Instruments connected to the calculator, the correction device or the conversion device, for measuring certain quantities which are characteristics of the liquid, with a view to making a correction or a conversion or both.

Correction device

(i) A device connected to or incorporated in the meter for automatically correcting the volume at metering conditions, by taking into account the flow rate or the characteristics of the liquid to be measured (viscosity, temperature and pressure) and the pre-established calibration curves or both.

(ii) The characteristics of the liquid may either be measured using associated measuring instruments, or stored in a memory in the instrument.

Conversion device

(i) A device which automatically converts the volume measured at metering conditions into a volume at base conditions, or into a mass, by taking account of the characteristics of the liquid (temperature, pressure, density, relative density.....) measured using associated measuring instruments, or stored in a memory.

(ii) The quotient of the volume at base conditions, or of the mass, to the volume at metering conditions is referred to as "conversion factor".

Metering conditions

The conditions of the liquid of which the volume is to be measured, at the point of measurement (example: temperature and pressure of the measured liquid).

Base conditions

The specified conditions to which the measured volume of liquid is converted (example: base temperature and base pressure).

Notes (i) Metering and base conditions (which refer only to the volume of liquid to be measured or indicated) should not be confused with the "rated operating conditions" and "reference conditions" which apply to influence quantities.

(ii) The values chosen as base conditions should preferably be 15°C or 20°C, and 101 325 Pa.

Transfer point

A point at which the liquid is defined as being delivered or received.

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Gas separator

A device used for continuously separating, and removing, any air or gases contained in the liquid.

Note: In general, devices defined from paragraphs 1(16) to 1(19) are called gas elimination devices.

Gas extractor

A device used to extract air or gases accumulated in the supply line of the meter in the form of pockets that are no more than slightly mixed with the liquid.

Special gas extractor

A device which, like the gas separator but under less stringent operating conditions, continuously separates any air or gases contained in the liquid, and which automatically stops the flow of liquid if there is a risk of air or gases, accumulated in the form of pockets no more than slightly mixed with the liquid, entering the meter.

Condenser tank

In pressurized liquefied gas measuring systems, a closed tank used to collect the gases contained in the liquid to be measured and to condense them before measuring.

Gas indicator

A device allowing easy detection of any air or gas bubbles which may be present in the liquid flow.

Sight glass

A device for checking, before start-up and after shut-down, that all or part of the measuring system is filled completely with liquid.

Basic working principle of fuel dispenser.

The basic working principle of fuel dispenser can be illustrated by the following chart , the line with arrow presenting flow direction of oil, line denoting the transmission direction of mechanical or electric sign.

Fuel is sucked from underground tank, enter measurement transducer via vapor separator, and flow out nozzle through solenoid valve. The position movement value of axis generated by transducer is converted into relevant electric pulse sign by sensor, the indicator of electric counter display accumulative volume refueled. If in mechanical fuel dispenser, the volume refueled can be presented by the indicator device of mechanical counter by measuring the position movement of output axis of converter. The pump of submersible fuel dispenser is installed in oil in tank, which can delivery fuel to several measurement transducers, and flow out nozzle. Its counter device is similar to pump built-in fuel dispenser. The current fuel dispenser is operated simply, putting down nozzle to start system, and nozzle automatically closed when tank is full. Other operation can be conducted on the operating keyboard, such as presetting, starting,

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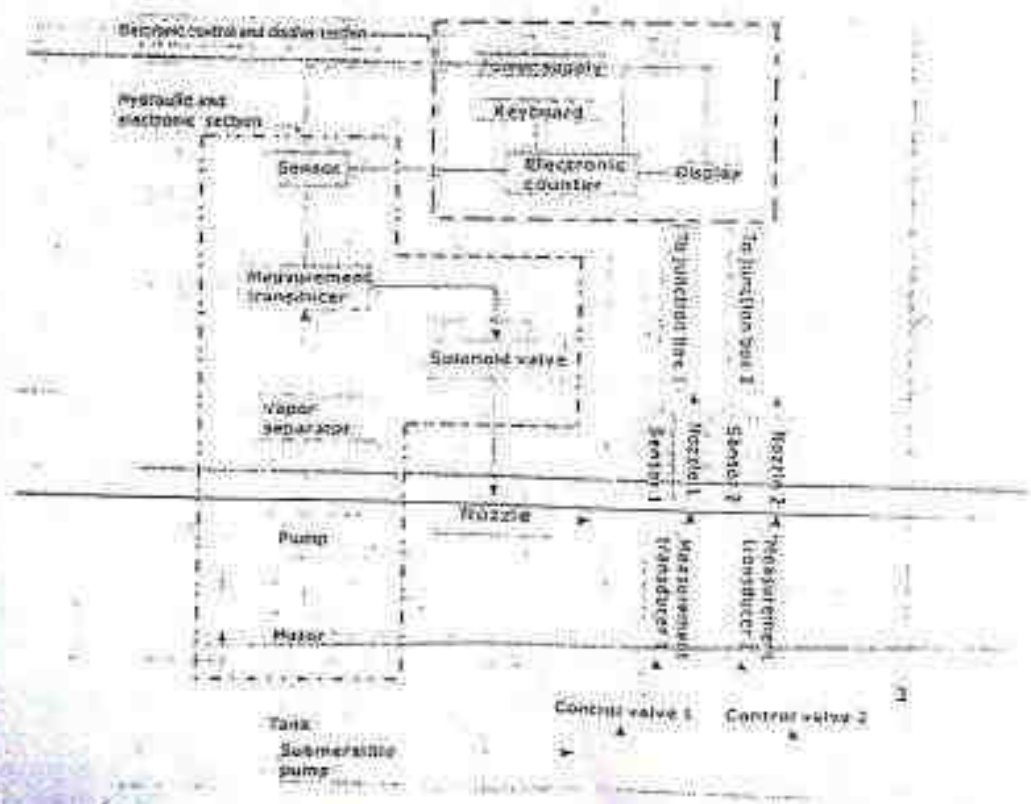
close, inquiry and various denotations. When the fuel dispenser's starting component work (e.g. take off nozzle or push starting button) motor is operated and drive pump. The oil is sucked into pump chamber from underground tank, being be pressured in pump body, and flow into oil-air separator in where air was segregated from oil. The air-free oil flow into measurement transducer and impel the calculating piston move, the position movement of output axis sign corresponding to fuel filled was transmitted and converted into electric pulse sign through sensor. The pulse sign transmit to electrical counter device that record and display the volume of present and total filing (either volume or sale). Finally, the oil was measured and flowed out of nozzle via solenoid valve and oil indicator.

The operator conducts the starting, close and control flow-rate; oil indicator is device used for air and foam check through eyes. Solenoid valve is mounted for preventing in presetting fuel from affecting accuracy due to the inertial of fuel.

Fuel dispenser with submersible pump to delivery oil together, its motor and pump is operated by the nozzle or starting key. Submersible pump delivers pressured oil to many fuel dispensers, in this kind of fuel dispenser delivered through positive pressure dot need to install built-in oil – air separator, pump and motor, but the rest of components is similar to suction pump fuel dispenser



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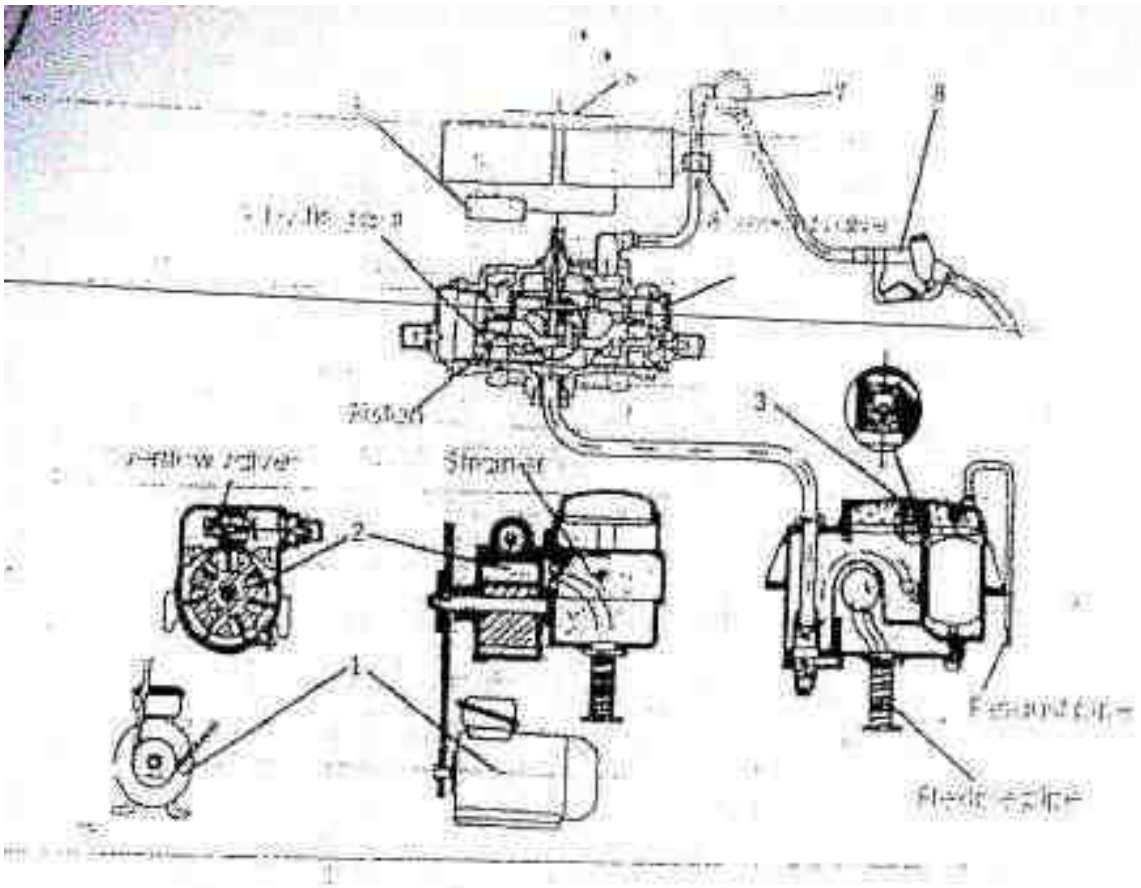

1-Motor 2-Pump 3-Vappor separator 4-Measurement transducer 5-Sensor 6-Mechanicle/electronic counter device 7-Oil indicator 8-Nozzle

Hydraulic part of a dispenser

When a dispenser is switched on, the electric motor is activated, and begins draw fuel from its outlet. This displacement of the liquid creates a partial vacuum at the pump inlet. When the discharge nozzle remains closed, the vacuum is relieved by fuel circulating continuously through the unit. But when the nozzle is opened, suction pressure is transferred instantaneously from the pump inlet to the storage tank through the pipe line. There, atmospheric pressure forces the fuel to flow through a check valve toward the dispenser.

Before entering the pumping unit, it passes through a strainer or filter, which removes any solid particles. Small quantities of trapped air and fuel vapor are also removed from the fuel through an air separator chamber.

Then the fuel, free of air and vapor, passes to the automatic control valve which permits fuel to flow only in the direction of the meter, never back to the pump. Now-a-days, the control valve is replaced by a solenoid and pilot valve.

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The Metering and the Registering part

Metering Unit

Metering devices mostly use piston meters and are positive-displacement. A piston moving through a cylinder filled with liquid will displace a quantity of liquid which will be determined by the bore of the cylinder and the stroke of the piston. Usually four cylinders are used. The pistons operate may operate in a horizontal plane or in a vertical plane and convert their to reciprocating action to a rotary shaft output to drive either the pulser or the mechanical computer.

The metering units are calibrated at the factory. Normally, the calibration is of high accuracy and reliable. However, meters may need adjustment after period of usage or deliberate mal-adjustment to cross the MPE limit.

These adjustments can be made in very small quantity as little as 3/10,000 part of volume. The adjusting mechanism may be located on the top of the meter or on one of the piston caps. It may be a knurled knob, keyed disk, or calibrated wheel or have some other but immediately identifiable design. The disc or wheel or any other adjusting device must have locking pins or fixed perforated screws for sealing.

The Registering Unit

The rotary shaft output of the metering unit drives a registering unit, which may be old fashioned mechanical computer, or a sensor or pulser in electrical installations. In mechanical registers the display is analog. It has two panels of computing and display. The lower panel indicates the volume delivered with 1/10th divisions of a litre, in an operation. The display has to be reset to zero before the next operation can begin.
the upper panel known as totalizer, registers the total volume dispensed by the unit. The indication must be ir-reversible and is sealed to prevent any change in display.

Such registering units are still found in small towns and mainly in the rural areas.

In semi-mechanical registering units, a sensor is used to convert the mechanical energy of the meter shaft to convert it into electrical signal. The output of the sensor is sent to the digital display panel. The panel shows both the volume displayed in an operation and also the total volume dispensed by the unit. Here again, the volume indicator is set to zero before the next operation can begin and the totalizer is ir-reversible. The sensor box is need to be sealed to prevent any unauthorized adjustment.

Such type of units are found in semi-urban or rural areas and are known as Z-series pumps because of their design.

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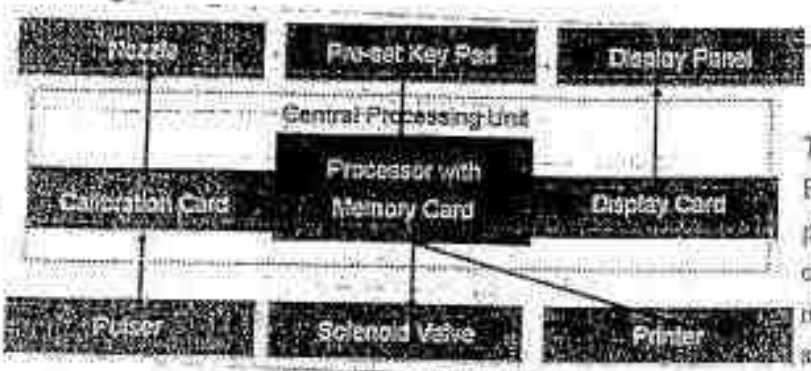
Working Principle of Electronic Multiple Product Dispensers

Electronic Multiple Product Dispensers (MPD) devices used for measuring and transferring a specified volume of a number of liquid fuels from a single equipment. Apart from the introduction of solenoid valve, which is controlled by the micro-processor, rest of the hydraulic section is more or less the same as those in older mechanical units.



The Electronic System

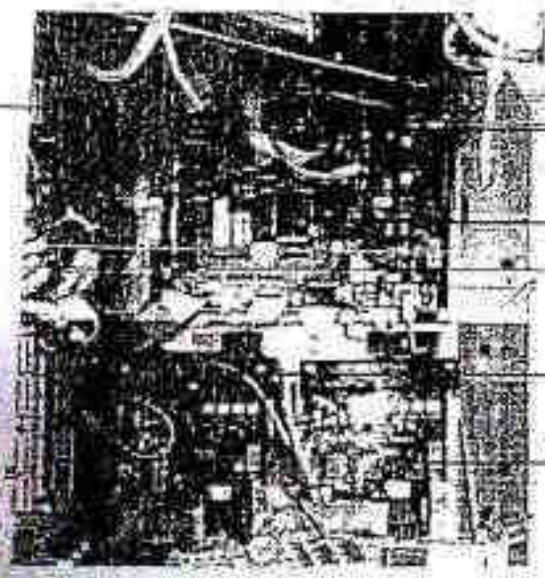
The electronic Device

The heart of the system is the Central Processing Unit (CPU), a micro-processor with an in-built memory chip. It controls the entire set of measuring, display, delivery and associated devices of preset keypad, receipt printer etc.

An MPD, being an electronic device uses a transducer, generally called a pulser, which is coupled directly to the meter shaft. The pulser converts the mechanical force of the rotating shaft into discreet electrical pulses. These pulses are transmitted as input to the CPU. The CPU recognizes not only pulse signals but electrical signals from other input devise - zero reset, price adjustment, preset mechanism etc. After all the information are processed, the CPU sends appropriate signal to the display panel (through the display card), to the printer, if connected and also to the solenoid valve to control rate of flow of liquid through the meter. The rate increases in the beginning, remains steady in the middle and slows down towards the end of delivery.

The pre-set key pad is used to transmit the pre-set the quantities or total price of fuel to be delivered and also credit card details.

The display panel normal bears the following information - price per litre, quantity delivered and price. There is also a totalizer to register total quantity of fuel deliver from the unit.



Upper Chamber

The Upper Chamber holds the electronic part of the unit. It contains the main mother board of the processor along with memory chip, connected to all input devices and output devices. The all important DIP switch Box, also known as Black Box, used for electronic calibration, is located here. Other major

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components are Calibration Card, Display Card and Unit and Totalizer. Calculating device - Preset Keyboard and Printing Device are also connected to the mother board.

Components of this chamber which require sealing are - Dip Switch Box, Display Unit and the Totalizer.

In a chamber there may be as many as four units, two in each side, one unit each for 4 types of fuels - High Speed Diesel, Super Diesel, Un-leaded Petrol and normal Petrol.

Specific types of measuring systems

(1) **Fuel dispenser**

A measuring system intended for the refuelling of motor vehicles, small boats and small aircraft.

(2) **Measuring system on a pipeline**

A measuring system which in principle is installed on a fixed pipeline connecting two or more fixed tanks.

Note : This pipeline is characterized by a flowrate of the liquid to be measured which, in general, either does not change or changes little during a prolonged period.

(3) **Aircraft refuelling tanker measuring system**

A tanker mounted measuring system intended for refuelling aircraft, supplied from a tank mounted on the vehicle.

(4) **Aircraft hydrant measuring system**

A mobile measuring system intended for refuelling aircraft, supplied from hydrant pits.

(5)**Blend dispenser**

A fuel dispenser providing mixtures of various grades of gasoline (multigrade-dispenser) or mixtures of gasoline and lubricating oil (gasoline-oil-dispenser) through a single nozzle.

(6) **Self-service arrangement**

An arrangement that allows the customer to use a measuring system for the purpose of obtaining liquid for his own purchase.

(7) **Self-service device**

A specific device that is part of a self-service arrangement and which allows one or more measuring systems to perform in this self-service arrangement.

Note : The self-service device includes all the elements and constituents that are mandatory so that a measuring system performs in a self-service arrangement.

(8) **Attended service mode**

An operating mode of a self-service arrangement in which the supplier is present and controls the authorization for the delivery.

Notes: (i) In attended service mode, the settlement of the transaction takes place before the customer leaves the site of the delivery.

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(ii) A transaction is settled when the parties interested in the transaction have made their agreement known (explicitly or implicitly) as regards the amount of the transaction. This may be a payment, signing a credit card voucher, signing a delivery order, etc.

(iii) The parties interested in a transaction may be the parties themselves or their representatives (for example: the employee in a filling station, the driver of a truck).

(iv) In attended service mode the measurement operation ends at the moment settlement of the transaction takes place.

(9) **Unattended service mode**

An operating mode of a self-service arrangement in which the self-service arrangement controls the authorization for the delivery, based on an action of the customer.

Note : In unattended service mode, the end of the measurement operation is the end of the registration (printing or memorizing) of information concerning the measurement operation.

(10) **Pre-payment**

A type of payment in attended or unattended service mode requiring payment for a quantity of liquid before the delivery commences.

(11) **Attended post-payment (or post-payment)**

A type of payment in attended service mode requiring payment for the delivered quantity after the delivery but before the customer leaves the site of the delivery.

(12) **Unattended post-payment (or delayed payment)**

A type of payment in unattended service mode in which payment for the delivered quantity is required after the delivery, but in which the transaction is not settled when the customer leaves the site, following an implicit agreement with the supplier.

(13) **Authorization of a measuring system**

An operation that brings the measuring system into a condition suitable for the commencement of the delivery.

(14) **Direct selling to the public**

A transaction (selling or buying) of quantities of liquids whose settlement is associated with indications provided by a measuring system, any of the parties having access to the place of measurement and one of them being a consumer.

Notes : (i) The consumer can be any person. Generally the consumer is the buyer but he can also be the seller.

(ii) Main measuring systems used for direct selling to the public are:

- fuel dispensers,
- measuring systems on road tankers for the transport and delivery of domestic fuel oil.

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Metrological characteristics

(1) **Primary indication**

An indication (displayed, printed or memorized) which is subject to legal metrology control.

Note : Indications other than primary indications are commonly referred to as secondary indications.

(2) **Absolute error of measurement**

The result of a measurement minus the (conventional) true value of the measurand.

(3) **Relative error**

The absolute error of measurement divided by the (conventional) true value of the measurand.

(4) **Maximum permissible errors**

The extreme values permitted by the specification for an error.

Notes : (i) Maximum permissible errors are stated as relative errors or absolute errors.

(ii) Where the comparison of a volume (for instance: difference between a result obtained at some specified conditions and a result obtained at reference conditions) with maximum permissible error is involved then, it is obvious that it is the absolute maximum permissible error, associated with the relative maximum permissible error, which applies.

Imp (5) **Minimum measured quantity of a measuring system**

- The smallest volume of liquid for which the measurement is metrologically acceptable for that system.
- The minimum measured quantity of a measuring system shall have the form 1×10^n, 2×10^n or 5×10^n authorized units of volume, where n is a positive or negative whole number, or zero.
- The minimum measured quantity shall satisfy the conditions of use of the measuring system; except in exceptional cases, the measuring system shall not be used for measuring quantities less than this minimum measured quantity.
- The minimum measured quantity of a measuring system shall be not less than the largest minimum measured quantity of any one of its constituent elements (meter(s), gas extractor(s), special gas extractor(s), etc.). However, for gas elimination devices this provision does not need to be fulfilled if it is demonstrated (including tests) that it is not necessary.

(6) **Minimum specified volume deviation**

The absolute value of the maximum permissible error for the minimum measured quantity of a measuring system.

The minimum specified volume deviation shall be equal to or greater than the following value:—

(i) for continuous indicating devices, the volume corresponding to 2 mm on the scale or to one-fifth of the scale interval (of the first element for mechanical indicating devices), whichever is greater,

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(ii) for discontinuous indicating device, the volume corresponding to two scale intervals.

(7) **Minimum specified price deviation**

The price to pay corresponding to the minimum specified volume deviation.

(8) **Repeatability error**

For the purposes of this Recommendation, the difference between the largest and the smallest results of successive measurements of the same quantity carried out under the same conditions.

(9) **Intrinsic error**

The error of a measuring system used under reference conditions.

(10) **Initial intrinsic error**

The intrinsic error of a measuring system as determined prior to all performance tests.

(11) **Fault**

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

(12) **Significant fault**

A fault the magnitude of which is greater than the larger of these two values:—

(i) one-fifth of the magnitude of the maximum permissible error for the measured volume;

(ii) the minimum specified volume deviation.

The following are not considered to be significant faults, namely:—

(i) faults arising from simultaneous and mutually independent causes in the measuring instrument itself or in its checking facilities;

(ii) transitory faults being momentary variations in the indication, which cannot be interpreted, memorized or transmitted as a measurement result; and

(iii) faults implying the impossibility of performing any measurement.

Field of application

(1) **Scope**

This Specification provides the metrological and technical requirements applicable to dynamic measuring systems for quantities of liquids other than water subject to legal metrology controls. It also provides requirements for the approval of parts of the measuring systems (meter, etc.).

In principle, this Specification applies to all measuring systems fitted with a meter as defined under paragraph 1(1) of Part 1- Terminology (continuous measurement), whatever be the measuring principle of the meters or their application, except—

(i) drum meters for alcohol;

(ii) measuring systems for cryogenic liquids;

(iii) direct mass measuring systems,

the provisions of paragraph 4 shall apply to electronic measuring systems for alcohol and for cryogenic liquids. This Specification also applies to systems in which volume measurements are converted to mass indication.

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Moreover, specific provisions could be developed for measuring systems equipped with e.g. ultrasonic or vortex meters. It will then be appropriate to decide whether such meters should be included in the scope of this Specification.

This Specification is not intended to prevent the development of new technologies.

(2) **Liquids to be measured**

Measuring systems that are covered by this Specification may be used for the following liquids, namely:—

(i) **liquid petroleum and related products**: crude oil, liquid hydrocarbons, liquefied petroleum gas (LPG), liquid fuel, lubricants, industrial oils, etc.;

(ii) **liquid food:** dairy products (milk, cream, etc.), beer and brewer's wort, wine and musts (cider, etc.), alcoholic beverages (liquor, whisky, etc.) non-alcoholic carbonated and not carbonated beverages, juices and concentrates, vegetable oils (soya-bean-oil, palm-oil, etc.);

(iii) **alcohol:** pure ethanol (ethyl alcohol) and mixtures of only ethanol and water (except drum meters for alcohol);

(iv) **chemical products in liquid state:** HCl, H_2SO_4, ammonia water etc; and

(v) **other liquids**: all other liquids except cold potable water and hot water; examples: distilled water and deionized water, liquids used for calibration of tanks.

General Requirement

Accuracy classes

Taking into consideration their field of application, measuring systems are classified into four accuracy classes according to Table 1.

TABLE 1

Class	Field of application
0.3	Measuring systems on pipeline
	All measuring systems if not differently stated elsewhere in this table, in particular
	Fuel dispenser for motor vehicles (other than LPG dispenser)
0.5	Measuring systems on road tankers for liquids of low viscosity
	Measuring system for the unloading of ship tanks and rail and road tankers

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> Measuring systems for milk

> Measuring systems for loading ships

> Measuring system for refueling aircraft

> Measuring systems (other than LPG dispenser) for liquefied gases under pressure measured at a temperature equal to or above -10 C

LPG dispenser for motor vehicles

Measuring systems normally in class 0.3 or 0.5 but used for liquids

Whose temperature is less than -10 C or greter than 50 C,or

Whose dynamic viscosity is higher than 1000 MPa.s,or

Whose maximum volumetric flowrate is not higher than 20l/h

Measuring systems (other than LPG dispenser) for liquefied gases under pressure measured at a temperature below -10 C

(ii) For volumes smaller than two litres, and without prejudice to paragraph 2.(5)(iii), the maximum permissible errors, positive or negative, on volume indications are specified in Table 3.

class-1 → 0.3 or 0.5

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Maximum permissible errors

(i) For volumes not smaller than two litres, and without prejudice to paragraph 2(5)(iii) the maximum permissible relative errors, positive or negative, on volume indications are specified in Table 2.

TABLE 2

	Accuracy classes			
	0.3	0.5	1.0	1.5
A	0.3%	0.5%	1.0%	1.5%
B	0.2%	0.3%	0.6%	1.0%

Note:- 1. As per Paragraph 2(6)(i)

Maximum permissible errors in line A of Table 2 apply to complete measuring systems, for all liquids, all temperatures and all pressures of the liquids, and all flow rates for which the system is intended to be, or has been approved, without any adjustment between the various tests, for:

(a) pattern approval,

(b) initial verification in one stage or the second stage of a two-stage initial verification,

(c) Subsequent verifications.

2. As per Paragraph 3(1) (ii)

(a) The maximum permissible errors for a meter, within its field of operation, are equal to those specified in line B of Table 2.

(b) For any quantity equal to or greater than five times the minimum measured quantity, the repeatability error of the meter shall not be higher than two-fifths of the value specified in line A of Table 2.

(c) For a given liquid within their fields of operation, meters shall present a magnitude of the difference between the initial intrinsic error and the error after the endurance test equal to or less than the value specified in line B in Table 2.

TABLE 3

Measured quantity	Maximum permissible errors
From 1 to 2 L	☐ Value fixed in Table 2, applied to 2 L
From 0.4 to 1 L	☐ Twice the value fixed in Table 2
0.2 to 0.4 L	☐ twice the value fixed in Table 2, applied to 0.4 L
From 0.1 to 0.2 L	☐ quadruple the value fixed in Table 2
Less than 0.1 L	☐ quadruple the value fixed in Table 2, applied to 0.1 L

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Paragraph 2. (5)(iii), Imp

(iii) However, whatever the measured quantity may be, the magnitude of the maximum permissible error is given by the greater of the following two values:

(a) absolute value of the maximum permissible error given in Table 2 or Table 3,

(b) minimum specified volume deviation.

For minimum measured quantities greater than or equal to two litres, the minimum specified volume deviation (E_{min}) is given by the formula:

$E_{min} = (2\ V_{min}) \times (A/100)$

where

V_{min} is the minimum measured quantity,

A is the numerical value specified in line A of Table 2 for the relevant accuracy class.

For minimum measured quantities less than two litres, the minimum specified volume deviation is twice the value specified in Table 3, and related to line A of Table 2.

Note - The minimum specified volume deviation is an absolute maximum permissible error.

Example for calculation of M.PE.

Case 1:- When minimum measured quantity is not smaller than 2 litre Imp

Let a fuel dispenser (Petrol), having minimum measured quantity as 5 litre, and if the delivered quantity is also 5l, then M.P.E. on delivered quantity shall be calculated as follows:-

Minimum specified volume deviation is given by the formula

$E_{min} = (2\ V_{min})\ (A/100)$

$E_{min} = 2 \times 5 \times 1000 \times (0.5/100) = 50ml$

As per table 2, line A, M.PE.= (0.5/100) x 5x1000 = 25ml

From the above calculation, minimum specified volume deviation is 50ml while calculated M.P.E as per table 2, line A is 25ml which shows that 50ml is more than the 25ml so ,M.P.E for 5l delivery taken for the fuel dispenser having minimum measured quantity as 5l shall be 50 ml.

Case 2:- When minimum measured quantity is smaller than 2 litre

Let a fuel dispenser (Petrol), having minimum measured quantity as 10ml, and if the delivered quantity is also 5l, then M.P.E. on delivered quantity shall be calculated as follows:-

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In this case,Minimum specified volume deviation(E_{min}) = twice the value specified in table 3(for 10ml)

$$= 4 \times 10 \times (0.5/100)$$

$$= 0.2 \text{ ml}$$

As per table 2, line A, M.P.E.= (0.5/100) x 5x1000 = 25ml

From the above calculation , minimum specified volume deviation is 0.2ml while calculated M.P.E as per table 2 ;line A is 25ml which shows that 0.2ml is less than the 25ml so ,M.P.E for 5l delivery taken for the fuel dispenser having minimum measured quantity as 10ml shall be 25 ml.

Conditions for applying maximum permissible errors

Provisions in this sub-clause apply to volume indications at metering conditions (see Paragraph 2(7) for converted indications).

(i) Maximum permissible errors in line A of Table 2 apply to complete measuring systems, for all liquids, all temperatures and all pressures of the liquids, and all flow rates for which the system is intended to be, or has been approved, without any adjustment between the various tests, for:

(a) pattern approval,

(b) initial verification in one stage or the second stage of a two-stage initial verification,

(c) Subsequent verifications.

(ii) *Explanation*: An adjustment is allowed for each liquid, but in this case the pattern approval certificate provides information on the capability of the meter to measure all the liquids without particular precautions. For example, the meter may be allowed only for measuring one liquid in normal use, or an automatic device that provides an adaptation to each liquid may be necessary.

(iii) When stated in the pattern approval certificate, a one-stage initial verification or the second stage of a two-stage initial verification of a measuring system intended to measure two or more liquids may be carried out with one liquid only or with a liquid different from the intended liquids. In this case and if necessary, the pattern approval certificate provides a smaller range or a shift for maximum permissible errors, so that Paragraph 2(6)(i) is fulfilled by the measuring system for all intended liquids.

When stated in the pattern approval certificate, the initial verification of a meter of a measuring system intended to measure two or more liquids may be carried out with one liquid only or with a liquid different from the intended liquids. In this case and if necessary, the pattern approval certificate provides a smaller range or a shift for maximum permissible errors, so that Paragraph 2(6)(ii) is fulfilled by the meter for all intended liquids.

The above considerations may be extended to the case of a measuring system or a meter intended to measure only one liquid but verified with another liquid.

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Provisions for converted indications

(i) **Maximum permissible errors on conversion devices**

When a conversion device for converting into a volume at base conditions or into a mass (including all its components and associated measuring instruments) is verified separately, maximum permissible errors on converted indications due to the conversion device, positive or negative, are equal to ± (A - B), A and B being the values specified in Table 2. However, the magnitude of the maximum permissible error shall not be less than the greater of the two following values:—

(a) one-half scale interval of the indicating device for converted indications.

(b) half of the value corresponding to the minimum specified volume deviation.

(ii) **Accuracy of associated measuring instruments**

When verified separately, associated measuring instruments shall exhibit an accuracy at least as good as the values in Table 4.

These values apply to the indications of associated measuring instruments taken into account for the calculation of the converted quantity (they include errors mentioned in Paragraph 2(7)(iii).

TABLE 4

Maximum permissible errors on measuring:	Accuracy classes of the measuring system			
	0.3	0.5	1.0	1.5
Temperature	±0.3°C	±0.5°C	±0.5°C	±0.5°C
Pressure	less than 1 MPa : ± 50 kPa between 1 and 4 MPa : ± 5% more than 4 MPa : ± 200 kPa			
Density	± 1 kg/m^3	± 1 kg/m^3	±2 kg/m^3	±2 kg/m^3

(iii) **Accuracy for calculation of characteristic quantities of the liquid**

When the calculating function of a conversion device is verified separately, the maximum permissible error for the calculation of each characteristic quantity of the liquid, positive or negative, is equal to two-fifths of the value fixed in paragraph 2(7)(ii). However, the magnitude of the maximum permissible error shall not be less than one-half scale interval of the indicating device for converted indications.

(iv) **Direct verification of a converted mass indication**

When a conversion device is only associated with (or included in) a meter and when the converted mass indication is verified directly by comparison to mass standards (e.g. using a weighing machine) the maximum permissible errors

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(MPE) on the converted indication, positive or negative, are given by the formula:

$$MPE = \pm [B^2 + (A - B)^2]^{1/2}$$

where A and B are the values specified in Table 2.

When a conversion device is included in a measuring system, maximum permissible errors of line A of Table 2 apply to the converted mass indication. However, in any case, the magnitude of maximum permissible errors shall not be less than the mass corresponding to the minimum specified volume deviation.

(v) **Direct verification of a converted volume indication**

Standards delivering directly the true value of converted volume indications are not available for general uses. Such standards only exist for a given liquid or for very similar liquids. When such standards are available, provisions in paragraph 2(7)(iv) can be applied by analogy.

Indications

(i) The volume indication shall be made in **cubic centimetres or millilitres, in cubic decimetres or litres, or in cubic metres**. The symbol or the name of the unit shall appear in the immediate vicinity of the indication.

Mass may only be indicated in **tonnes, kilograms or grams**. The symbol or the name of the unit shall appear in the immediate vicinity of the indication.

(ii) Measuring systems shall be provided with an indicating device giving the volume of liquid measured at metering conditions.

Without prejudice to the provisions in paragraph 2(9)(iii) when a measuring system is fitted with a conversion device, it shall be fitted (in addition to the device indicating volumes at metering conditions) with a device indicating the volume at base conditions or the mass.

Provisions applicable to devices which indicate the volume at metering conditions apply to devices which indicate the volume at base conditions and by analogy to devices which indicate the mass.

(iii) The use of the same display for the indications of volume at metering conditions and of volume at base conditions or of mass is authorized provided that the nature of the displayed quantity is clear and that these indications are available on request.

(iv) A measuring system may have several devices indicating the same quantity. Each shall meet the requirements of this specification. The scale intervals of the various indications may be different.

(v) For any measured quantity relating to the same measurement, the indications provided by various devices shall not deviate one from another by more than one scale interval or the greatest of the two scale intervals if they differ, except otherwise provided in clause 5 (see paragraph 5 (10)(i)(c)).

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(vi) Subject to specific provisions for certain types of measuring systems, use of the same indicating device for the indications of several measuring systems (which then have a common indicating device) is authorized provided that one of the following conditions is met:

(a) it is impossible to use any two of these measuring systems simultaneously,

(b) the indications relating to a given measuring system are accompanied by a clear identification of that measuring system and the user may obtain the indication corresponding to any of the measuring systems concerned, using a simple command.

Vesn-1) Markings

(i) Each measuring system, component or sub-system for which pattern approval has been granted shall bear, placed together legibly and indelibly either on the dial of the indicating device or on a special data plate, the following information:—

(a) pattern approval sign

(b) manufacturer's identification mark or trademark

(c) designation selected by the manufacturer, if appropriate

(d) serial number and year of manufacture

(e) characteristics as defined in paragraphs 2(3)(i), 3(1)(i)(a), 2(10)(vii)(b), or 3(1)(vii)(a),

(f) accuracy class, if other than 0.5

Paragraph 2(3)(i):-

(a) minimum measured quantity,

(b) measuring range limited by the minimum flowrate, Q_{min}, and the maximum flowrate, Q_{max},

(c) maximum pressure of the liquid, P_{max},

(d) minimum pressure of the liquid P_{min},

(e) nature of the liquid(s) to be measured and the limits of kinematic or dynamic viscosity when an indication of the nature of the liquids alone is not sufficient to characterize their viscosity,

(f) maximum temperature of the liquid, T_{max},

(g) minimum temperature of the liquid, T_{min}, and

(h) environmental class.

Note: The indicated characteristics should be the actual characteristics of use, if they are known when the plate is affixed. When they are not known, the indicated characteristics are those allowed by the pattern approval certificate. However, the minimum and the maximum temperatures of the liquids shall appear on the data plate only when they differ from 10°C and + 50°C respectively.

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The minimum measured quantity of the measuring system shall in all cases be clearly visible on the dial of any indicating device visible to the user during the measurement.

If several meters operate in a single system using common components, the marking required for each part of the system may be combined on a single plate.

When a measuring system can be transported without being dismantled, the markings required for each component may also be combined on a single plate.

(ii) Any information, markings or diagrams specified by this Recommendation or possibly by the pattern approval certificate, shall be clearly visible on the dial of the indicating device or within proximity to it.

The markings on the dial of the indicating device of a meter forming a part of a measuring system shall not contravene those on the data plate of the measuring system.

(iii) When volume at base conditions is indicated, these base conditions shall be clearly mentioned in the vicinity of the result of measurement, in the form:

T_b = ..., °C (or K)

P_b = ... MPa (or kPa or Pa or bar)

Sealing devices and stamping plate

Sealing is preferably carried out by means of lead seals. However, other types of sealing are permitted on fragile instruments or when these seals provide sufficient integrity, electronic seals for instance.

The seals shall, in all cases, be easily accessible.

Sealing should be provided on all parts of the measuring system which cannot be materially protected in any other way against operations liable to affect the measurement accuracy.

It must be prohibited to change parameters which participate in the determination of the results of measurement (parameters for correction and conversion in particular) by means of sealing devices.

Except for direct selling to the public, it may be acceptable that the nature of the measured liquid or its viscosity be manually entered into the calculator at the beginning of the measurement operation (see paragraph 3(1)(v)), even when this datum participates in the correction. This datum and a note explaining that this quantity has been entered manually shall then be printed at the same time as the measurement results.

A plate, referred to as the stamping plate, aimed at receiving the control marks, shall be sealed or permanently attached on a support of the measuring system. It may be combined with the data plate of the measuring system referred to in paragraph 2(19).

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In the case of a measuring system used for potable liquids, sealing shall be applied such that the equipment may be dismantled for cleaning purposes.

(ii) Electronic sealing devices

(a) When access to parameters that participate in the determination of results of measurement is not protected by mechanical sealing devices, the protection shall fulfil the following provisions (except in cases related to the 5th paragraph of paragraph 2(20)(i):—

(aa) access shall only be allowed to authorized people, e.g. by means of a code (key word) or of a special device (hard key, etc.); the code must be changeable;(access by means of only a code is not allowed in the case of direct selling to the public)

(bb) it shall be possible for at least the last intervention to be memorized; the record shall include the date and a characteristic element identifying the authorized person making the intervention (see (a) above); the traceability of the last intervention shall be assured for at least two years, if it is not over-written on the occasion of a further intervention; if it is possible to memorize more than one intervention, and if deletion of a previous intervention must occur to permit a new record, the oldest record shall be deleted.

(b) For measuring systems with parts which may be disconnected one from another by the user and which are interchangeable, the following provisions shall be fulfilled:—

(aa) it shall not be possible to access parameters that participate in the determination of results of measurements through disconnected points unless the provisions in 2(20)(ii)(a) are fulfilled;

(bb) interposing any device which may influence the accuracy shall be prevented by means of electronic and data processing securities or, if not possible, by mechanical means.

(c) For measuring systems with parts which may be disconnected one from another by the user and which are not interchangeable, the provisions in 2.20.2.2 apply. Moreover, these measuring systems shall be provided with devices which do not allow them to operate if the various parts are not associated according to the manufacturer's configuration.

Note : Disconnections which are not allowed to the user may be prevented, for example by means of a device that prevents any measurement after disconnecting and reconnecting.

Requirements specific to certain types of measuring systems

(1) Fuel dispensers

Except where otherwise specified, the requirements in this sub-clause do not apply to LPG dispensers.

(i) By design, the ratio between the maximum flowrate and the minimum flowrate for these systems shall be at least ten; on site, this ratio may be smaller provided that it is **not less than five.**

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(ii) When the measuring system includes its own pump, a gas elimination device shall be installed, immediately upstream of the meter inlet. Where a gas indicator is fitted, it shall not have a venting device as mentioned in paragraph 2(11).

(iii) When the measuring system is intended for installation in a centrally pumped system, or for a remote pump, the general provisions in paragraph 2(10) shall be applied.

If it is not intended to install a gas elimination device the manufacturer or installer has to prove that there is no risk for air intake or gas release. In this case the minimum level in the storage tank must be automatically secured and any leakage shall be checked

(iv) Fuel dispensers shall be equipped with a device for resetting the volume indicating device to zero.

The minimum height for the figures of the resettable volume indicator is 10 mm.

If these systems also include a price indicating device, this indicating device shall be fitted with a zero resetting device. The minimum height for the price indicator remains 4 mm

(v) When only one nozzle can be used during a delivery, and after the nozzle has been replaced, the next delivery shall be inhibited until the indicating device has been reset to zero.

When two or more nozzles can be used simultaneously or alternately, and after the utilized nozzles have been replaced, the next delivery shall be inhibited until the indicating device has been reset to zero. Moreover, by design, the provisions in the first paragraph of paragraph 2(16)(i) shall be fulfilled.

The above requirements do not apply when an auxiliary hand pump is used.

(vi) Measuring systems having a **maximum flowrate not greater than 3.6 m^3/h shall have a minimum delivery not exceeding 5 L.**

(vii) When the measuring system is fitted with a ticket printing device which is subject to control, this printing device shall comply with the relevant requirements in 3.4. In addition, any printing operation shall prevent the continuation of the delivery until a reset to zero has been performed. However, the printing operation shall not change the quantity indicated on the indicating device.

(viii) Fuel dispensers shall be interruptible.

(ix) In addition to requirements in paragraph 4(2)(ii), electronic fuel dispensers shall be such that the minimum duration of operation of the display shall be either—

(a) at least 15 min continuously and automatically after the failure of the principal electrical supply, or

(b) a total of at least 5 min in one or several periods controlled manually during one hour after the failure.

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Note : If a test during pattern approval is necessary to verify that the fuel dispenser fulfills this requirement, the instrument has to be supplied with electric power normally for the 72 hours which preceded the test. Before this supply the battery (if provided) may be unloaded.

In addition, fuel dispensers shall be designed so that an interrupted delivery cannot be continued after the power supply device has been re-established if the power failure has lasted more than 15 s.

(x) Electronic fuel dispensers shall be such that the delay time between the measurement value and the corresponding indicated value shall not exceed 500 ms.

Several fuel dispensers may have a common indicating device if and only if the first provision in paragraph 2(9)(vi) is met.

(xii) It is not required to display volumes, and prices if applicable, that correspond to a small number of scale intervals at the beginning of the delivery, and to start the display with that volume and the corresponding price.

The volume thus hidden shall not be greater than two times the minimum specified volume deviation. The hidden price shall not be greater than the price corresponding to that volume.

(2)Fuel dispensers for liquefied gases under pressure (LPG dispensers)

(i) Requirements in paragraph 5(1)(i), 5(1)(iv)) and 5(1)(vii) to 5(1)(xii) are applicable to LPG dispensers for motor vehicles. However, the ratio between the maximum flowrate and the minimum flowrate shall be at least five by design.

Paragraph 5(1)(i):- By design, the ratio between the maximum flowrate and the minimum flowrate for these systems shall be at least ten on site, this ratio may be smaller provided that it is not less than five.

Paragraph 5(1)(iv):- Fuel dispensers shall be equipped with a device for resetting the volume indicating device to zero.

The minimum height for the figures of the resettable volume indicator is 10 mm.

If these systems also include a price indicating device, this indicating device shall be fitted with a zero resetting device. The minimum height for the price indicator remains 4 mm.

Paragraph 5(1)(vii):- When the measuring system is fitted with a ticket printing device which is subject to control, this printing device shall comply with the relevant requirements in 3.4. In addition, any printing operation sh[illegible] prevent the continuation of the delivery until a reset to zero has be[illegible] performed. However, the printing operation shall not change the quantity i[illegible]ated on the indicating device.

Paragraph 5(1)(viii):- Fuel dispensers shall be interruptible.

Paragraph 5(1)(ix):- In addition to requirements in paragraph 4(2)(ii), [illegible]onic fuel dispensers shall be such that the minimum duration of operatio[illegible] display shall be either—

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(a) at least 15 min continuously and automatically after the failure of the principal electrical supply, or

(b) a total of at least 5 min in one or several periods controlled manually during one hour after the failure.

Note : If a test during pattern approval is necessary to verify that the fuel dispenser fulfills this requirement, the instrument has to be supplied with electric power normally for the 12 hours which preceded the test. Before this supply the battery (if provided) may be unloaded.

Paragraph 5(1)(ix):- In addition, fuel dispensers shall be designed so that an interrupted delivery cannot be continued after the power supply device has been re-established if the power failure has lasted more than 15 s.

Paragraph 5(1)(x):- Electronic fuel dispensers shall be such that the delay time between the measurement value and the corresponding indicated value shall not exceed 500 ms.

Several fuel dispensers may have a common indicating device if and only if the first provision in paragraph 2(9)(vi) is met.

Paragraph 5(1)(xii):- It is not required to display volumes, and prices if applicable, that correspond to a small number of scale intervals at the beginning of the delivery, and to start the display with that volume and the corresponding price. The volume thus hidden shall not be greater than two times the minimum specified volume deviation. The hidden price shall not be greater than the price corresponding to that volume.

(ii) Requirements in paragraph 5(4)(i), 5(4)(ii), 5(4)(ii)(a), 5(4)(ii)(b), 5(4)(iii), 5(4)(iii)(a) and 5(4)(iii)(b) are applicable to LPG dispensers for motor vehicles.

Paragraph 5(4)(i): Only full hose measuring systems are authorized.

Paragraph 5(4)(ii)(a& b) : A pressure maintaining device, located downstream of the meter, shall ensure that the product in the meter remains in a liquid state during the measurement. The necessary pressure may be maintained either at a fixed value or at a value adjusted to suit the measurement conditions.

(a) When the pressure is maintained at a fixed value, this value shall be at least equal to the vapour pressure of the product at a temperature 15°C above the highest possible operating temperature. It shall be possible to protect the adjustment of the pressure maintaining device with a seal.

(b) When the pressure is adjusted to suit the measurement conditions, this pressure shall exceed the vapour pressure of the liquid during the measurement by at least 100 kPa (1 bar). This adjustment shall be automatic.

Paragraph 5(4)(iii)(a& b) : A gas elimination device shall be fitted upstream of the meter. However, if it is demonstrated that no vapour release will occur during measurements a gas elimination device is not mandatory. This demonstration shall include tests under the worse conditions.

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(a) The gas separator shall comply with the general requirements in paragraph 2(10)(i), either for the liquefied gas itself or for a liquid of higher viscosity.

However, because of the low viscosity of liquefied gases and due to the difficulty of control, it is accepted that when the length of the pipework linking the meter to the feed tank does not exceed 25 m, a gas separator may be approved if its useful volume is at least equal to 1.5% of the volume delivered in one minute at maximum flowrate. When the length of this pipework exceeds 25 m, the useful volume of the gas separator shall be at least equal to 3% of the volume delivered in one minute at maximum flowrate.

The gas outlet pipe of the separator may be connected to the space in the feed tank which contains the gaseous phase, or to an independent pressure maintaining device set to a pressure from 50 to 100 kPa (0.5 to 1 bar) lower than the pressure at the meter outlet. This pipe may incorporate a shut-off valve, which meets the requirements in paragraph 2(10)(v).

(b) The volume of the condenser tank depends on the volume of the pipework between the supply tank valve and the pressure maintaining valve, downstream of the meter. The volume of this condenser tank shall be at least equal to twice the reduction in volume of the liquid which is likely to occur between these valves if the temperature drops by a value conventionally fixed at 10°C for exposed pipes and 2°C for insulated or underground pipes.

To calculate the contraction, the coefficient of thermal expansion shall be rounded to 3×10^{-3} per degree Celsius for propane and propylene and 4×10^{-3} per degree Celsius for butane and butadiene. For other products with a high vapour pressure, the values of the coefficient to be adopted shall be specified by the competent metrology service.

The condenser tank shall be fitted with a manual blow off valve. It shall be fitted at the high point in the pipework of the measuring system of which it is part.

The volume resulting from the above calculation may be divided between several condenser tanks located at high points in the pipework.

(iii) The manufacturer or the owner of the measuring system shall provide a thermometer well or an equivalent means for measuring the temperature close to the meter. The thermometer used shall have a scale interval not exceeding 0.5°C and shall be verified.

(iv) Connection between the gas phases of the feed tank and of the vehicle's tank is prohibited.

(v) When only one nozzle can be used during a delivery, and after the nozzle has been replaced, the next delivery shall be inhibited until the indicating device has been reset to zero.

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When two or more nozzles can be used simultaneously or alternately, and after the utilized nozzles have been replaced, the next delivery shall be inhibited until the indicating device has been reset to zero. Moreover, by design, the provisions in the first paragraph of 2(16)(i) shall be fulfilled. Moreover, in both cases, when the flow is stopped by emergency means and a predetermined delay is exceeded, the current delivery shall be stopped and the next delivery shall be preceded by a reset to zero.

(vi) A non-return valve, located between the gas elimination device and the meter, is mandatory. The pressure loss caused by it shall be sufficiently low to be considered negligible.

(vii) Hoses shall be fitted with special connections for full hoses, so-called couplers or self-sealing valves.

(viii) Safety features shall not affect the metrological performance.

(ix) When the measuring system is provided with a conversion device, it shall be possible to verify separately the indications of volume at measuring conditions and associated measuring instruments.

(x) Closing valves in vapour return lines shall automatically result in stopping the delivery or preventing the start of the next delivery, unless these valves have been sealed in the open position.

(xi) The construction of the nozzle shall be such that, at the moment of coupling or uncoupling, the loss of liquid does not exceed the minimum specified volume deviation.

Initial verification

Initial verification of a measuring system is carried out in a single stage when the system can be transported without dismantling and when it is verified under the intended conditions of use; in all other cases, it is carried out in two stages.

The first stage concerns at least the measurement transducer, alone or fitted with associated ancillary devices, or possibly included in a sub-system. Tests of the first stage may be carried out on a test bench, possibly in the factory of the manufacturer, or on the installed measuring system. At this stage, the metrological examinations may be carried out with different liquids than those which the system is intended to measure.

The first stage also concerns the calculator and the density sensor. If necessary, the messurement transducer and the calculator can be verified separately.

The second stage concerns the measuring system in actual working condition. It is carried out at the place of installation under operating conditions and with the intended liquid of use. However, the second stage may be carried out in a place chosen by the verification body when the measuring system can be transported without dismantling and when the tests can be performed under the operating conditions intended for the measuring system.

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Initial verification of electronic systems shall include a procedure for verifying the presence and correct operation of checking facilities by the use of test devices as specified in paragraph 4(3).

Tests

When initial verification takes place in two stages, the first stage shall include—

- an examination for conformity of the meter, including the associated ancillary devices (conformity with the respective patterns),
- a metrological examination of the meter, including the associated ancillary devices.

The second stage shall include—

- an examination for conformity of the measuring system, including the meter and the ancillary and additional devices,
- a metrological examination of the measuring system; if possible, this examination is carried out within the limits of operating conditions for the system,
- an operational test of the gas elimination device, where appropriate, with no need to verify that the maximum errors applicable to this device and specified in 2.10 are met,
- an inspection of the adjustment of the prescribed pressure maintaining devices where appropriate,
- when necessary, a test of the variations of the internal volume of the hoses in full hose measuring systems, e.g. in the case of a hose reel,
- an operational test of the control valve preventing the emptying of the hose during non-operating periods, for full hose measuring systems,
- a determination of the residual quantities in empty hose measuring systems.

(b) When initial verification takes place in one stage, all tests in above paragraph shall be performed.

Subsequent verification

(i) Subsequent verification of a measuring system may be identical to initial verification.

(ii) The preliminary examination of the meter should only be repeated if the protective marks on the measuring element of the meter have been damaged. This examination may be replaced by a test of the measuring system if the conditions for the preliminary examination are met and if the measuring system can undergo testing with a volume of liquid corresponding to the minimum measured quantity. For the determination of the error curve, at least 60% of the maximum flowrate should be reached.

(iii) The ancillary devices shall be considered as having been subjected to the preliminary examination if the protective marks are not damaged. It is sufficient to carry out a reduced number of measurements during the simplified examination of the ancillary devices.

Some relevant portion of OIML R 117-1: 2007(E) is given below

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Test Procedure [as per **OIML R 118**- Edition 1995 (E)]

1. Determination of flow rate

The flow rate can be obtained under flying start/stop condition by the following procedure

a) Reset the volume indicator to zero. Insert the nozzle into a container of suitable capacity, or back into the supply tank

b) Start the pump, when the volume indication is at whole number of litres, start the stop watch. The volume indication at which the stop watch was started should be noted.

c) After at least 30 seconds, stop the stop watch when the volume indication is at a whole number of litres.

d) Calculate the flow rate Q from

$$Q = V_i \times (60/t)$$

Where V_i = the difference between the volume indication recorded at step (c) and the volume indication recorded at step (b) and t= the time elapsed from the stop-watch in step (c)

2. Accuracy Test

For mechanical counters, the test shall be performed at not less than two unit price which corresponds to the maximum and minimum torques. This is generally near the maximum and minimum unit prices.

For electronic counters, the test shall be performed at the maximum unit price.

For both mechanical and electronic counters, one of the accuracy test shall be performed at the maximum flowrate and maximum unit price stated in the application.

The test measure shall not be smaller than the minimum measured quantity.

a) Set the maximum unit price

b) Adjust and determine the flow rate Q

c) Wet and drain the test measure

d) Reset the indication of the dispenser

e) Fill the test measure at the fixed flowrate, without stopping if possible

f) Read Unit price (Pu), Volume indication of dispenser(Vi), Price indication(Pi),Volume indication of test measure(Vn)

g) Drain the test measure

h) Repeat the above step twice and calculate mean value of error (Ev)

$$Ev = [(Vi - Vn)]$$

i) Repeat above step at five other flow rates

Q L/min	Unit Price (Pu) Rs/L	Vi	Pi	Vn	Ev	Mpe	Ep Price

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Checking facility for electronic indicating device

The checking facility for an electronic indicating device shall provide visual checking of the entire display, which shall meet the following description (Part 2, clause 4.3.iv.b):

- displaying all the elements (eights test);
- blanking all the elements (blank test); and
- displaying zeros.
- Each step of the sequence shall last at least 0.75 second

This test can be carried out in conjunction with the test for zero setting.

1. Remove the nozzle from its hang-up position and check that the:
   display test is performed; and
   display segments are not faulty.

Zero Setting

- The zero-setting devices of the price-indicating device and of the volume-indicating device shall be designed in such a way that zeroing either indicating device automatically involves zeroing the other. Part 2, clause 3.3.v)
- The zero-setting device shall not permit any alteration of the measurement result shown by the price/volume-indicating device other than by making the result disappear and displaying zeros (Part 2, clause 3.2.iv. b)
- Once the zeroing operation has begun it shall be impossible for the price/volume-indicating device to show a result different from that of the measurement that has just been made, until the zeroing operation has been completed. The price/volume-indicating device shall not be capable of being reset to zero during measurement (Part 2, clause 3.2.iv.c)

Flow interruption Test

Object of the test:

- To determine the effect of sudden pressure variations on the accuracy of the volume

Test procedure:

- The interruption test shall be performed three times at the maximum flowrate.
- The test volume shall be at least the volume delivered in one minute at *Qmax*. *Using the* nozzle valve, the liquid flow is started and stopped abruptly five times during the same measurement. These stops shall be made at various intervals.

Adjust the flowrate to *Qmax*.

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Wet and drain the test measure.
Reset the indication of the dispenser.
Fill the test measure at *Qmax, with 5 stops.*
Read *Indication on the meter (V_i), Volume measured from test measure (V_n) and T*
Calculate $Ev = \frac{(V_i - V_n)}{V_n} \times 100$ E
Drain the test measure.
Repeat above step twice, and calculate the mean values *Ev*

Gas elimination device

Object of the test:

To determine the efficiency of the gas elimination device.

Test equipment:

Gas meter, valves, pressure gauge (where applicable) and a test measure with a capacity corresponding to at least the greater of:

- the volume delivered in one minute at the maximum flowrate,
- 1 000 times the scale interval, or
- the minimum measured quantity.

Test procedure:

Air is usually drawn into the dispenser through a special inlet, either upstream ofthe pump by suction, or downstream of the pump under pressure. In either case theair inlet should be fitted with a control valve, a stop valve and a non-return valve toprevent liquid from entering the inlet and draining out of the dispenser. Where the airis introduced under pressure, a pressure gauge shall be fitted as a means of measuring the air pressure in order to calculate the volume of air at atmospheric pressure.

The air inlet can be open during the test. If a non-return valve is not fitted upstream of the pump, ensure that the open end of the air pipe, the control valve and the gas meter are all positioned above the highest liquid level in the dispenser.

A gas meter, complying with the requirements of International Recommendations OIML R 6 and R 31 or R 32, may be provided to measure the volume of the air (*V*a). Complete a test at *Q*max without any air supply. Make at least six measurements with the control valve open in increasing amounts until the liquid flow from the pump stops. Draw an error curve as a function of supplied air.

The supplied air should be given as a relative value of the measured volume of liquid (*V*a/*V*n). The range of values of *V*a/*V*n is specified in Table 1. *V*a is the volume of air isothermallyconverted to the atmospheric pressure.

Viscosity of test liquid	With gas indicator	Without gas indicator
≤1 mPa.s	0 – 20 %	0 ~ a
> 1 mPa.s	0 – 10 %	

1 Adjust initially the entry of air at 0 % at maximum liquid flowrate.

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2 Wet and drain the test measure.

3 Run the dispenser for at least one minute to make sure the conditions are steady.

4 Do not switch off the dispenser. Read dispenser volume indication ($Vi1$) and gas meter indication ($Va1$).

5 Fill the test measure at the maximum attainable flowrate.

6 Note any air bubbles in the gas indicator if fitted.

7 Read dispenser volume indication ($Vi2$) and gas meter indication ($Va2$).

8 Calculate Vi (= $Vi2 - Vi1$) and Va (= $Va2 - Va1$), and read Vn and T.

9 Calculate Vnc, Ev and Va/Vn (or Va/Vnc if appropriate).

10 Drain the test measure.

11 Repeat steps 2 to 9 at least five times in case of systems with gas indicator or until liquid flow stops after having increased the entry of air for each cycle by 4 % for liquid with viscosities not exceeding 1 mPa.s.

Notes

(1) For fuel dispensers for diesel motor vehicles, this test shall be performed with diesel.

(2) This test on the gas elimination device shall be performed at the maximum flowrate attainable by the liquid in the gas elimination device. Therefore adaptations of the abovementioned procedure shall be made according to the configuration of the dispenser.

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