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# COUNCIL DIRECTIVE

## of 5 April 1977

## on the approximation of the laws of the Member States relating to measuring systems for liquids other than water

(77/313/EEC)

(OJ L 105, 28.4.1977, p. 18)

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# COUNCIL DIRECTIVE

## of 5 April 1977

## on the approximation of the laws of the Member States relating to measuring systems for liquids other than water

(77/313/EEC)

THE COUNCIL OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Economic Community, and in particular Article 100 thereof,

Having regard to the proposal from the Commission,

Having regard to the opinion of the European Parliament [1],

Having regard to the opinion of the Economic and Social Committee [2],

Whereas in each Member State the construction and methods of control of measuring systems for liquids are subject to mandatory provisions which differ from one Member State to another and consequently hinder trade in such systems; whereas it is therefore necessary to approximate these provisions;

Whereas Council Directive 71/316/EEC of 26 July 1971 on the approximation of the laws of the Member States relating to common provisions for both measuring instruments and methods of metrological control [3], as last amended by Directive 72/427/EEC [4], has laid down the EEC pattern approval and EEC initial verification procedure for measuring instruments; whereas, in accordance with that Directive, the technical requirements for the design and functioning of measuring systems for liquids other than water should be laid down;

Whereas Council Directive 71/319/EEC of 26 July 1971 on the approximation of the laws of the Member States relating to meters for liquids other than water [5] and Council Directive 71/348/EEC of 12 October 1971 on the approximation of the laws of the Member States relating to ancillary equipment for meters for liquids other than water [6] have already laid down the technical design and operational requirements which such meters must satisfy; whereas it is specified in Directive 71/319/EEC that measuring systems including one or more meters for liquids other than water must be the subject of a separate Directive,

HAS ADOPTED THIS DIRECTIVE:

*Article 1*

This Directive shall apply to measuring systems for liquids other than water incorporating volumetric meters in which the liquid causes the movement of mobile walls of measuring chambers.

*Article 2*

Those measuring systems which may bear EEC signs and marks are described in the Annex hereto. They shall be subject to EEC pattern approval if the provisions of the Annex so require and shall undergo EEC initial verification under the conditions laid down in the Annex hereto.

Under the conditions laid down in the Annex, EEC pattern approval may also be granted to measuring system components and sub-assemblies.

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[1] OJ No C 125, 8. 6. 1976, p. 43.
[2] OJ No C 131, 12. 6. 1976, p. 53.
[3] OJ No L 202, 6. 9. 1971, p. 1.
[4] OJ No L 291, 28. 12. 1972, p. 156.
[5] OJ No L 202, 6. 9. 1971, p. 32.
[6] OJ No L 239, 25. 10. 1971, p. 9.

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*Article 3*

No Member State may, on the grounds of their metrological properties, refuse, prohibit or restrict the placing on the market or the use of measuring systems for liquids other than water bearing the signs and marks provided for in this Directive as specified by Directive 71/316/EEC.

No Member State may, on grounds of their metrological properties, refuse, prohibit or restrict the placing on the market of measuring system components and sub-assemblies bearing the EEC pattern approval sign.

*Article 4*

1. Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive within 18 months of its notification and shall forthwith inform the Commission thereof.

2. Member States shall communicate to the Commission the text of the provisions of national law which they adopt in the field covered by this Directive.

*Article 5*

This Directive is addressed to the Member States.

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*ANNEX*

1. GENERAL REQUIREMENTS FOR MEASURING SYSTEMS

1.1. **Definitions**

1.1.1. *Measuring system*

A measuring system for liquids other than water comprises, in addition to the meter itself conforming to Directive 71/319/EEC and the ancillary equipment conforming to Directive 71/348/EEC which may be associated with it, all the equipment to ensure correct measuring or intended to facilitate the operation and all other equipment which can affect measuring in any possible way.

If several meters intended for separate measuring operations operate in conjunction with common components, each meter shall be considered as comprising, with the common components, a measuring system.

If several meters are intended for a single measuring operation, the meters are considered as forming a single measuring system.

1.1.2. *Minimum delivery*

The minimum delivery of a measuring system is determined in conformity with the requirements of Directives 71/319/EEC and 71/348/EEC, having regard to the provisions of this Directive.

In measuring systems intended to measure liquid received into the system, the smallest volume of liquid for which measurement shall be authorized is called minimum reception. The preceding requirement relating to minimum delivery applies, by analogy, to minimum reception.

1.1.3. *Gas separator*

A gas separator is an apparatus for continuously separating and removing by an appropriate device any air or gases contained in the liquid.

The gas evacuation device is, in principle, automatic in operation. However, this requirement shall be waived if there is a mechanism which automatically stops the flow of liquid if there is a risk of air or gas entering the meter. In this case, resumption of measurement shall be possible only when the air or gas has been removed, either automatically or manually.

1.1.4. *Gas extractor*

A gas extractor is an apparatus designed to extract air or gases accumulated in the pipework upstream of the meter in the form of pockets no more than slightly mixed with the liquid.

The above requirements concerning the gas evacuation device for the gas separator shall also apply to that of the gas extractor.

1.1.5. *Special gas extractor*

A special gas extractor is an apparatus which, like the gas separator but under less stringent operating conditions, continuously separates any air or gases contained in the liquid, and 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.

1.1.6. *Condenser tray*

A condenser tray is a closed tank designed to collect, in pressurized liquefied gas measuring systems, the gases contained in the liquid to be measured and to condense them before measuring.

1.1.7. *Gas indicator*

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

1.1.8. *Sight-glass*

A sight-glass is a device for checking that all or part of the measuring system is completely full of liquid.

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1.2. **Scope**

The general requirements of section 1 shall apply to all types of measuring systems unless otherwise specified in section 2.

1.3. **Meters, flowrate limits**

Meters incorporated in a measuring system, including any ancillary equipment, shall be of an EEC pattern approved for measuring the liquid concerned under normal operating conditions.

These meters shall be subject to separate EEC pattern approval or to approval included in the EEC pattern approval of the measuring system in which they are incorporated. The flowrate limits (maximum and minimum flowrates) of a measuring system may differ from those of the meter fitted to it. In such cases it should be checked that the maximum and minimum flowrates of the measuring system are compatible with those of the meter. Even where a meter has been approved as a component incorporated in a measuring system, it must in all instances comply with the requirements of Directive 71/319/EEC. Where a number of meters are mounted in parallel on a single measuring system, the sum of the maximum and minimum flowrates of the various meters shall, with the exception of the specific instances laid down in this Annex, be taken into account in determining the flowrate limits of the measuring system. The maximum flowrate of the measuring system must be at least twice the total minimum flowrate of its meter or meters.

1.4. **Point of transfer**

1.4.1. Measuring systems shall incorporate a point defining the quantity of liquid delivered or received and called the point of transfer. This point of transfer is situated downstream of the meter in delivery systems, upstream of the meter in receiving systems.

1.4.2. Measuring systems may be of two types: ‘empty-hose’ systems and ‘full-hose’ systems; the term ‘hose’ includes rigid pipework.

1.4.2.1. Empty-hose systems are, in the case of delivery equipment, measuring systems in which the point of transfer is situated upstream of a delivery hose. This point of transfer takes the form of either a weir-type sight-glass or a closing device, combined, in both cases, with a system which ensures the emptying of the delivery hose after each measuring operation.

1.4.2.2. Full-hose measuring systems are, in the case of delivery equipment, measuring systems whose point of transfer consists of a closing device situated in the delivery pipework. Where the pipework has a free end, the closing device shall be situated as close as possible to this end.

1.4.2.3. In the case of receiving equipment, the same requirements apply by analogy to the reception pipework upstream of the meter.

1.5. **Filters**

Measuring systems shall incorporate a device upstream of the meters, intended to collect solid impurities from the liquids (filter). Filters shall as far as possible be so arranged as to be easily accessible.

1.6. **Elimination of air or gases**

1.6.1. *General requirement*

Measuring systems shall be installed in such a way that they do not normally produce, upstream of the meter, entry of air or release of gas into the liquid. If there is a risk that this requirement might not be met, measuring systems shall incorporate gas-eliminating equipment permitting the proper elimination of any air or undissolved gases which may be contained in the liquid before it passes through the meter.

The gas-eliminating equipment shall be suitable for the supply conditions and be arranged in such a way that the additional error due to the influence of the air and gases on the measuring results shall not exceed:

— 0·5% of the quantity measured for liquids other than potable liquids of a viscosity not exceeding 1 mPa·s,

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— 1% of the quantity measured for potable liquids and those whose viscosity exceeds 1 mPa·s.

However, there shall be no need for the error to be less than 1% of the minimum delivery.

1.6.2. *Pumped flow*

1.6.2.1. Subject to 1.6.6, when the pressure at the pump intake may, even momentarily, fall below atmospheric pressure or the saturated vapour pressure of the liquid, a gas separator shall be provided.

1.6.2.1.1. A gas separator intended to operate at a maximum flowrate not exceeding 100 $m^3$ /h may be subject either to separate EEC pattern approval or to approval included in the EEC pattern approval of the measuring system of which it forms part, where this Annex provides for approval of such a system. However, as regards gas separators designed to operate at a maximum flowrate exceeding 100 $m^3$ /h, pattern approval may be granted by analogy with an approved pattern of the same design and smaller dimensions. Gas separators which have received separate EEC pattern approval may be used in measuring systems without gas indicators.

1.6.2.1.2. The gas separator shall in principle be installed downstream of the pump. It may, however, be combined with the pump.

It shall always be positioned as close as possible to the meter so that the pressure drop due to the flow of liquid between the two components is negligible.

1.6.2.1.3. The operational limits of a gas separator shall be as follows:

(a) the maximum flowrate or flowrates for one or more specified liquids;

(b) the maximum and minimum pressure limits compatible with proper functioning of the gas eliminating device.

1.6.2.1.4. Where a gas separator intended to operate at a maximum flowrate not exceeding 100 $m^3$ /h is covered by a separate EEC pattern approval, it shall, within the error limits laid down in 1.6.1, ensure the elimination of air or gases mixed with the liquid to be measured, under the following test conditions:

(a) the measuring system shall operate at its maximum flowrate and the minimum pressure laid down for the gas separator;

(b) any proportion by volume of air or gases relative to the liquid is permissible if the gas separator is designed for a maximum flowrate lower than or equal to 20 $m^3$ /h; it shall be limited to 30% if the gas separator is designed for a maximum flowrate higher than20 $m^3$/h.(Air or gases shall be measured at atmospheric pressure to determine their percentage.)

In addition, the automatic gas removal device shall continue to operate properly at the maximum pressure laid down for gas separators.

1.6.2.1.5. Where a gas separator is approved as a component incorporated in an approved measuring system, the requirements of 1.6.2.1.4 may be applied to it. In this case, a gas indicator is not necessary.

Where the measuring system incorporates a gas indicator conforming to the definition in 1.1.7, the gas separator shall, within the error limits laid down in 1.6.1, ensure the elimination of air or gases mixed with the liquid to be measured, under the following conditions:

(a) the measuring system shall operate at its maximum flowrate and minimum pressure;

(b) the proportion by volume of air or gases relative to the liquid shall not exceed:

— 20% for liquids other than potable liquids of a viscosity not exceeding 1 mPa·s,

— 10% for potable liquids and for other liquids of a viscosity which is in excess of 1 mPa·s ([1]).

([1]) Experience shows that the requirement referred to in subparagraphs (a) and (b) is generally met by a properly built separator if its effective volume is at least equal to 8% of the volume delivered in one minute at the maximum flowrate indicated on the plate of the measuring system.

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Where the proportion by volume of air or gases relative to the liquid exceeds the above percentages and the gas separator fails to meet the requirements in respect of maximum permissible errors, gas or air bubbles must be clearly visible in the gas indicator.

1.6.2.2. When the pressure at the pump inlet is constantly greater than the atmospheric pressure and the saturated vapour pressure of the liquid, and there is no gas separator, a gas extractor or special gas extractor shall be necessary if gaseous formations are liable to occur between the pump and the meter during non-flow periods or if air pockets can be introduced into the pipework (e.g. when the supply tank is completely empty) in such a manner as to produce a specific error in excess of 1 % of the minimum delivery.

1.6.2.2.1. The gas extractor or special gas extractor intended to operate at a maximum flowrate not exceeding 100 $m^3$ /h may be subject either to separate EEC pattern approval or approval included in the EEC pattern approval of the measuring system of which it forms part, if the present Annex makes provision for approval of the system.

However, as regards gas extractors intended to operate at a maximum flowrate in excess of 100 $m^3$ /h, pattern approval may be granted by analogy with an approved pattern of the same design and with smaller dimensions.

Gas extractors and special gas extractors which have been granted separate EEC pattern approval may be used in measuring systems without gas indicators.

1.6.2.2.2. The gas extractor or special gas extractor shall in principle be installed downstream of the pump. However, it may also be combined with the pump.

In both cases, it shall normally be installed at the highest point in the pipework, as close as possible to the meter and upstream of it. If it is installed below the level of the meter, a non-return device, fitted if necessary with a pressure limiting valve, shall be incorporated to prevent the pipes between the valve and the meter from emptying.

If the pipework upstream of the meter incorporates several high points, several gas extractors may be required.

1.6.2.2.3. The limits of operation of a gas extractor or special gas extractor are as defined for gas separators in 1.6.2.1.3 including the minimum delivery for which such devices are provided.

1.6.2.2.4. A gas extractor or special gas extractor shall, at the maximum flowrate of the measuring system, ensure the elimination of a gas or air pocket, measured under atmospheric pressure, of a volume at least equal to the minimum delivery without an additional error greater than 1% of the minimum delivery. Moreover, a special gas extractor shall also be capable of separating continuously a volume of gas or air equal to 5% of the volume of the liquid delivered at the maximum flowrate without the resulting additional error exceeding the limits fixed in 1.6.1.

1.6.2.3. The requirements of 1.6.2.1 and 1.6.2.2 shall not prohibit the existence of manual or automatic extraction devices in fixed installations of large dimensions.

1.6.2.4. If the supply of the liquid is so arranged that, whatever the conditions of use, no gas or air can form in or penetrate into the reception pipework upstream of the meter during measurement, no gas elimination device is required, provided that any gaseous formation liable to occur during non-flow periods does not cause a specific error in excess of 1% of the minimum delivery.

1.6.3. *Non-pumped flow*

1.6.3.1. In cases where the meter is supplied by gravity, without use of a pump, if the pressure of the liquid in all parts of the pipework upstream of the meter and in the meter itself is greater than the saturated vapour pressure and atmospheric pressure, a gas eliminator shall not be necessary. However, after the measuring system has been put into service, an arrangement is required to ensure that it remains correctly filled.

1.6.3.2. If the pressure of the liquid is likely to be less than atmospheric pressure while remaining greater than the saturated vapour pressure, the introduction of air into the meter shall be prevented by means of an appropriate device.

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1.6.3.3. Where the meter is supplied under gas pressure, the entry of gas into the meter shall be prevented by means of an appropriate device.

1.6.3.4. In all circumstances the pressure of the liquid between the meter and the point of transfer shall be higher than the saturated vapour pressure of the liquid.

1.6.4. *Gas removal*

The gas removal pipe of a gas eliminator shall not include a manually controlled valve if closure of this valve prevents the operation of the gas eliminator. If, however, a closing device of this kind is required for safety reasons, it must be possible to ensure its maintenance in the open position by means of a sealing device.

1.6.5. *Anti-swirl device*

If it is intended as a general rule that the supply tank of a measuring system be completely emptied, the outlet orifice of the tank shall be provided with an anti-swirl device, except where the system incorporates a gas separator.

1.6.6. *Viscous liquid*

As the effectiveness of gas separators and gas extractors decreases with an increase in the viscosity of the liquid, these devices need not be fitted in the case of liquids with a dynamic viscosity of more than 20 mPa·s at 20 ºC. The pump shall be so arranged that the inlet pressure is always greater than the atmospheric pressure. If this condition is unlikely to be fulfilled on ali occasions, a device shall be fitted to stop the flow of the liquid automatically as soon as the inlet pressure falls below the atmospheric pressure. A manometer shall be used to monitor this pressure. These conditions are not necessary if the measuring system incorporates devices ensuring that no air can be introduced through the joints in the sections of pipework subjected to reduced pressure.

When the measuring system is not in use, the pipework shall be kept full of liquid up to the point of transfer.

1.7. **Gas indicator**

1.7.1. Measuring systems may be fitted with a gas indicator. Such devices may be made mandatory in the cases specified in section 2.

1.7.2. The gas indicator shall be so designed as to provide a satisfactory indication of the presence of gas or air in the liquid.

1.7.3. The gas indicator shall be installed downstream of the meter.

1.7.4. In empty-hose measuring systems the gas indicator may take the form of a weir-type sight-glass and may also be used as a point of transfer.

1.7.5. The gas indicator may be provided with a bleed screw or some other blow-off device when it forms a high point in the pipework. No pipe shall be connected to the blow-off device. Flow indicators (e.g. spinners) may be incorporated in the gas indicator, provided that such devices do not prevent any gaseous formations which may be present in the liquid from being visible.

1.8. **Complete filling of the measuring system**

1.8.1. The meter and the pipework from the meter to the point of transfer shall automatically be kept full of liquid during the measuring operation and when the system is not in use.

If this condition is not fulfilled, particularly in cases where the installation is fixed, it must be possible for the complete filling of the measuring system up to the point of transfer to be effected manually and monitored during measurement, and when the system is not being used. To ensure the complete elimination of air and gas from the measuring system, blow-off devices, if possible with small windows, shall be placed at appropriate positions.

1.8.2. The pipework between the meter and the point of transfer shall not, in general, by variations in temperature, induce additional errors of more than 1% of the minimum delivery.

Section 2 shall specify the technical conditions to be fulfilled in certain special cases in order that this requirement may be met.

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1.8.3. If necessary, a pressure maintaining device shall be installed downstream of the meter to ensure that the pressure in the gas eliminators and in the meter is always greater than the atmospheric pressure and the saturated vapour pressure of the liquid.

1.8.4. Measuring systems in which there is a possibility of the liquid flowing in the direction opposite to that of normal flow when the pump has stopped, shall be provided with a non-return valve, fitted with a pressure-limiting device if necessary.

1.8.5. In empty-hose measuring systems the pipework downstream from the meter and, if necessary, the pipework upstream of the meter shall have a high point so that all parts of the measuring systems remain constantly filled. Draining of the delivery hose referred to in 1.4.2.1 shall be assured by an air vent. In certain cases this air vent may be replaced by special devices such as an auxiliary pump or a compressed-gas injector. In measuring systems designed for minimum deliveries of less than 10 $m^3$, such devices shall operate automatically.

1.8.6. In full-hose measuring systems the free end of the hose shall incorporate a device to ensure that the hose cannot be emptied during periods when the system is not used. This requirement need not apply to liquefied gas.

When a closing device is placed downstream of this device, the volume of the space between them shall be as small as possible and in any case less than the maximum permissible error for the minimum delivery of the measuring system.

In the case of systems intended for measuring viscous liquids, the end of the nozzle shall be so designed that it cannot retain a quantity of liquid exceeding 0·4 times the maximum permissible error for the minimum delivery of the measuring system.

1.8.7. If the hose comprises several components, these shall be assembled either by means of a special connector to keep the hose full or by a connection system which is either sealed or ensures that the components are virtually impossible to separate without a special tool.

1.9. **Variation of internal volume of full hoses**

In the case of full hoses in a measuring system provided with a hose reel, the increase in internal volume due to the change from the coiled position, when not subjected to pressure, to the uncoiled position, when subjected to pressure without any flow of liquid, shall not be more than twice the maximum permissible error for the minimum delivery.

If the measuring system is not provided with a hose reel, the internal volume increase shall not exceed the maximum permissible error for the minimum delivery.

1.10. **Branches**

1.10.1. In measuring systems which are intended to deliver liquids, branches downstream of the meter shall only be permitted if they are so arranged as to ensure that the liquid is discharged from a single outlet at a time. In measuring systems intended to receive liquids, branches upstream of the meter are permitted only if they are so arranged that the intake of liquid is effected through a single pipe at a time.

Departures from these requirements may only be approved in the case of delivery systems which are specifically installed to supply only one user at a time, and receiving systems which cannot operate for more than one supplier at a time.

1.10.2. In measuring systems operating either with an empty hose or a full hose and having flexible pipes, a non-return valve shall if necessary be incorporated in the rigid pipework leading to the full hose immediately downstream from the selector valve. In addition the selector valve shall not in any position permit connection of the discharge hose, operating as an empty hose, to the pipework leading to the full hose.

1.11. **By-passes**

Any connections intended for by-passing the meter shall be closed by means of blanking flanges. However, if the operating requirements

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make such a by-pass necessary, it shall be closed either by means of a closing disc or by means of a double closing device with a monitoring valve in-between. It must be possible to ensure closure by means of seals.

1.12. **Valves and control mechanisms**

1.12.1. If there is a risk that the supply conditions might lead to the meter becoming overloaded, a flow-limiting device shall be provided. This device shall be placed downstream of the meter if it causes a pressure loss. It must be possible to seal it.

1.12.2. The various positions for the operating components of multi-way valves shall be easily visible and located by notches, stops or other fixing devices. Departures from this requirement are permissible whenever the adjacent positions of the operating handle form an angle of 90º or over.

1.12.3. Retaining valves and closure mechanisms not used to define the quantity measured must, if necessary, have relief valves in order to dissipate any abnormally high pressures which may arise in the measuring system.

1.13. **Layout of measuring systems**

Measuring systems shall be installed in such a manner that the indicating device is clearly visible under normal conditions of use. The indicating device and, if present, the gas indicator of the gas separator shall as far as possible be observable from one position. Sealing devices shall be easily accessible, plates shall be fixed irremovably and the statutory markings shall be clearly legible and indelible.

1.14. **On-site verification devices**

Verification of the installation, as provided for in 3.2 shall be possible. If necessary, pipework shall be provided to return the measured liquid to a storage tank. The installation shall, as necessary, be equipped with temperature and pressure tappings, especially when the operation or testing of the measuring systems requires a knowledge of these factors.

1.15. **Characteristics of a measuring system**

The characteristics of a measuring system are as follows:

— maximum and minimum flowrates,

— maximum operating pressure,

— if necessary, minimum operating pressure,

— the liquid or liquids to be measured and the limits of viscosity, kinematic or dynamic, where an indication of the nature of the liquids alone is not sufficient to determine their viscosity,

— minimum delivery,

— the temperature range in the case where the liquid can be measured at a temperature below −10 ºC or above + 50 ºC.

1.16. **Markings**

A measuring system, component or sub-assembly which has been granted pattern approval must carry, in a legible and indelible manner, either on the dial of the indicating mechanism or on a special descriptive plate, the following information:

(a) the EEC pattern approval sign;

(b) the identification mark or name of the manufacturer;

(c) the manufacturer's designation, if any;

(d) the serial number and year of manufacture;

(e) the characteristics of the measuring system as defined in 1.15;

(f) any supplementary information specified in the pattern approval certificate.

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

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The markings on the dial of the indicating mechanism of the meter forming part of the measuring system must not contradict those on the descriptive plate of the measuring system.

If the measuring system can be transported without being dismantled the markings for each part may also be combined on a single plate.

1.17. **Seals**

Sealing shall preferably be carried out by lead stamping. However, certain seals applied with pincers shall be permitted on fragile instruments or where such seals are sufficiently protected against any danger of accidental breakage.

Seals must in all cases be easily accessible.

Sealing devices shall be provided on all parts of measuring systems which cannot be protected in any other way against operations which might affect accuracy of measurement. However, sealing devices need not be provided on connections which can only be dismantled by means of a tool.

The sealing devices shall be so designed as to enable the EEC partial initial verification mark to be affixed.

It shall be possible to seal the stamping-plate referred to in 3.3.2.1 of Annex II to Directive 71/316/EEC to a support of the measuring system. It may be combined with the descriptive plate on the measuring system referred to in 1.16.

In the case of a measuring system used for potable liquids, the seals shall not be affixed, so that the system can be dismantled for the purposes of cleaning.

2. SPECIAL REQUIREMENTS FOR DIFFERENT TYPES OF MEASURING SYSTEMS

2.1. **Liquid-fuel measuring systems** [1]

2.1.1. Liquid-fuel measuring systems are measuring systems intended for the delivery of liquid fuel into the fuel tanks of road vehicles.

Measuring systems used for refuelling pleasure boats and small aircraft with liquid fuel shall be treated as liquid-fuel measuring systems.

They may include their own supply arrangement or be designed for installation in a central supply system.

The ratio between the maximum and minimum flowrates of these systems shall be at least 10: 1.

2.1.2. Where the measuring system has its own supply arrangement, a gas separator shall, if possible, be installed immediately upstream of the meter inlet.

This gas separator shall meet the requirements of 1.6.2.1.4 or 1.6.2.1.5 [2].

In this latter case, no blow-off device as referred to in 1.7.5 shall be permitted.

2.1.3. Where the measuring system is designed for installation in a central supply system or for refuelling at a distance, the general rules of 1.6 shall be applied.

2.1.4. Liquid-fuel measuring systems shall be fitted with a device for resetting the volume indicator to zero in accordance with 1.1, 1.2, 1.3 and

[1] Additional provisions will be added later concerning liquid-fuel measuring systems incorporating:
— motor-fuel blending meters,
— motor-fuel and lubricant blending meters,
— electric or electronic indicators and ancillary devices,
— self-service devices, and
— measuring systems intended for the supply of liquefied gas.

[2] In the case of separators which comply with 1.6.2.1.5. experience shows that the requirement is generally met if the effective volume of the separator is at least 5% of the volume supplied in one minute at the maximum flowrate indicated on the meter plate.

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1.5 of the Annex to Directive 71/348/EEC, as well as a volume totalizer.

Where these systems also incorporate a price indicator, the indicator shall be fitted with a device for resetting it to zero.

Devices for resetting the price indicator and volume indicator to zero shall be incorporated in such a way that the resetting of either of these indicators to zero automatically resets the other to zero.

2.1.5. Where the liquid-fuel measuring system has its own supply arrangement operated by an electric motor, a device shall be fitted which, after the motor has stopped, prevents any further delivery of the liquid until the indicator has been reset to zero.

Under no circumstances shall resetting to zero be possible during delivery.

2.1.6. The non-return device referred to in 1.8.4 shall be mandatory. It shall be installed between the gas eliminator and the meter. However it may be placed immediately downstream of the meter if the gas eliminator is installed above the level of the meter. In this case, it may be combined with the device provided for in 1.8.3. Where the non-return device is installed between the gas eliminator and the meter, the resulting pressure loss must be low enough to be considered negligible.

2.1.7. The hoses on full-hose measuring systems shall incorporate a manual closure mechanism which meets the requirements of 1.8.6. An automatic closure mechanism may also be incorporated.

Full-hose measuring systems supplied solely by means of a hand-operated pump, need only incorporate the closure mechanism referred to in 1.8.6.

2.1.8. Measuring systems with a maximum flowrate of 60 litres/minute or less must have a minimum delivery not exceeding five litres.

2.1.9. Where the meter is fitted with a ticket-printer, the ticket-printing device must be connected to the device which resets the volume indicator to zero. This arrangement must enable the ticket to be checked after printing by comparison with the indication shown.

2.1.10. In accordance with 3.2, initial verification of liquid-fuel measuring systems shall be carried out in one or two stages depending on whether or not they have their own supply system.

2.2. **Measuring systems fitted to road tankers for the transport and delivery of liquids with low viscosity (viscosity ≤ 20 mPa·s) stored at atmospheric pressure, except for potable liquids**

2.2.1. The requirements of 2.2 shall apply to measuring systems fitted to road tankers or transportable tanks.

Measuring systems may be installed on road tankers containing one or more compartments, in which case each compartment shall be fitted with its own closure valve (manual or automatic).

2.2.2. In accordance with national rules on use, if any, each measuring system shall be used for a specified product or for a category of products for which the meter has been granted EEC pattern approval.

The pipework shall be so designed that the mixing of products in the measuring system is easily prevented.

2.2.3. Where tanks are fitted to trailers or semi-trailers, the measuring systems may be affixed either to the tractor or to the trailer or semi-trailer.

2.2.4. A measuring system fitted to a road tanker may be of the empty-hose or full-hose type. It may also have either one empty hose and one full hose or two full hoses of different dimensions arranged so as to operate alternately.

Change-over shall not be possible during a measuring operation.

2.2.5. Where the meter is fitted with a ticket-printer, the printing of the ticket shall be coupled with the resetting to zero of the volume indicator.

2.2.6. A measuring system fitted to a road tanker may be designed to operate solely by pump, solely by gravity, either by pump or by gravity, or by gas pressure.

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2.2.6.1. Measuring systems supplied solely by pump may operate as full-hose or as empty-hose systems.

2.2.6.1.1. If there is a risk that the condition in 1.6.2.4 may not be met, the meter shall be preceded by a gas eliminator such as:

(a) a suitable gas separator, which shall meet the requirements of 1.6.2.1.4 or 1.6.2.1.5 [1];

(b) a gas extractor;

(c) a special gas extractor.

Where the meter outlet pressure in the measuring system may fall below the atmospheric pressure but remain higher than the saturated vapour pressure of the liquid measured, these devices shall be combined with an automatic mechanism to slow down and stop the flow, in order to prevent any air passing into the meter.

If there is no risk of the meter outlet-pressure falling below the atmospheric pressure (which is the case, in particular, with systems operating only on full-hose) automatic mechanisms to slow down and stop the flow shall not be required.

2.2.6.1.2. The special gas extractor with an automatic stop device shall be fitted with a sight-glass in accordance with 1.1.8.

2.2.6.1.3. The compartments in road tankers shall be fitted with an anti-swirl device, except where the measuring system has a gas separator conforming to the requirements of 1.6.2.1.4.

2.2.6.2. Measuring systems operating solely by gravity shall meet the following requirements:

2.2.6.2.1. The equipment shall be so designed that the total content of the compartment or compartments can be measured at a flowrate greater than or equal to the minimum flowrate through the measuring system.

2.2.6.2.2. If there are links with the gas phase in the tank, appropriate devices shall prevent any gas from entering the meter.

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2.2.6.2.3. The compartments of the tank shall be fitted with an anti-swirl device, except where the measuring system has a gas separator in conformity with item 1.6.2.1.4.

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2.2.6.2.4. The requirements of 1.6.3.1, 1.6.3.2 and 1.6.3.4 shall apply. An accelerating pump may be used downstream of the point of transfer if the foregoing conditions are satisfied. Such a pump shall not allow any drop in pressure in the meter.

2.2.6.2.5. In some measuring systems, particularly those having a special gas extractor with an automatic stop device and those having a permanent venting communication with the atmosphere immediately downstream of the point of transfer, a gas indicator shall not be required.

However, in measuring systems with a manual air-vent immediately downstream of the point of transfer, a gas indicator shall be mandatory except in systems where the pressure may not fall below atmospheric pressure.

2.2.6.3. Measuring systems which can operate either by pump or by gravity shall satisfy the requirements of 2.2.6.1 and 2.2.6.2.

2.2.6.4. Measuring systems fed by means of gas pressure may operate as empty-hose or as full-hose systems. The pipework linking the device to prevent gas entering the meter, as specified in 1.6.3.3, and the meter itself, shall not incorporate any constriction or component likely to cause a pressure loss which generates gaseous formation by releasing the gas dissolved in the liquid.

Such systems shall incorporate a manometer which indicates the pressure inside the tank. The zone of permissible pressures shall be shown on the dial of the manometer.

[1] In the case of separators which comply with 1.6.2.1.5, experience shows that the requirement is generally met if the effective volume of the separator is at least 5% of the volume supplied, in one minute at the maximum flowrate of the measuring system.

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2.3. **Reception measuring systems for the unloading of marine, rail and road tankers**

2.3.1. Measuring systems designed to measure the volume of liquids unloaded from marine, rail and road tankers shall incorporate an intermediate tank in which the level of the liquid determines the point of transfer.

This intermediate tank may be designed to deal with gas elimination.

2.3.1.1. In the case of road and rail tankers, the intermediate tank shall automatically maintain a constant level which is visible or otherwise detectable at the start and on completion of the measuring operation. The permissible variations in the constant level shall correspond to a volume of no more than the maximum permissible error for the minimum reception.

2.3.1.2. In the case of marine tankers, provision for automatic maintenance of a constant level shall not be necessary; if no such provision is made, the variations in the content shall be measurable.

If the marine tanker is emptied by pumps located in the bottom of the tanker, the intermediate tank need only be used at the beginning and end of reception.

2.3.1.3. In the two cases referred to in 2.3.1.1 and 2.3.1.2, the cross-section of the intermediate tank shall be such that a quantity equal to the maximum permissible error for the minimum reception corresponds to a difference in level of at least 2 mm.

2.4. **Measuring systems, whether stationary or fitted to road tankers, for the measuring of pressurized liquefied gas** ***(excluding cryogenic liquids)***

2.4.1. There shall be a permanent link along rigid pipework between these measuring systems and their feed tanks. A non-return valve shall be fitted between the feed tanks and the meter.

2.4.2. A pressure maintenance device located downstream of the meter shall ensure that the product is in a liquid state inside the meter during the measuring process. The required pressure may be maintained either at a fixed value or at a value adjusted to suit measurement conditions.

2.4.2.1. If the pressure is maintained at a fixed value, that value shall be at least equal to the vapour pressure of the product at a temperature 15 ºC higher than the highest possible in-service temperature. It shall be possible to seal the setting of the pressure maintenance device.

2.4.2.2. Where the pressure is adjusted to suit measurement conditions, it shall exceed the vapour pressure of the liquid by at least 100 kPa (1 bar) during measurement. This function shall be automatic.

2.4.2.3. In the case of stationary measuring systems for industrial use, the competent metrology service may authorize the use of manually adjustable pressure maintenance devices, in which case the pressure at the meter outlet shall not be less than the vapour pressure of the product at a temperature 15 ºC above the temperature of the liquid during measurement. A diagram shall be affixed to the measuring system to show the vapour pressure of the product measured as a function of its temperature. If it is anticipated that these measuring systems may have to operate unsupervised for long periods, the temperature and pressure shall be registered continuously by recording equipment.

2.4.3. A gas-elimination device shall be provided upstream of the meter consisting of either a gas separator or a condenser tray.

2.4.3.1. The gas separator shall satisfy the general requirements laid down in section 1 for either the liquefied gas itself or for a liquid of greater viscosity.

However, because of the difficulty of verification, it is permissible for a gas separator to be approved if its effective volume is not less than 1·5% of the volume delivered in one minute at maximum flowrate in cases where the pipe connecting the meter to the storage tank is not more than 25 m long. If it exceeds 25 m in length, the effective volume of the gas separator shall be not less than 3% of the volume delivered in one minute at maximum flowrate.

It shall not be necessary to fit either a gas indicator or a sight-glass to liquefied gas measuring systems.

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The gas-evacuation pipe may be connected to the space containing the gas phase in the feed tank or to a self-contained pressure maintenance device set at a pressure 50 to 100 kPa (0·5 to 1 bar) below the pressure at the meter outlet. This pipe may incorporate a shut-off valve, but it must not be possible to close this valve during the measuring process.

2.4.3.2. The volume of the condenser tray shall depend on the volume of the pipework between the supply tank valve and the pressure maintenance value downstream of the meter. It shall not be less than twice the decrease in volume of the liquid liable to occur if the temperature drops by a value conventionally fixed at 10 ºC for pipework exposed to the atmosphere and 2 ºC for buried or thermally insulated pipework. For the evaluation of the volume, coefficients of thermal expansion of $3 \cdot 10^{-3}$ per degree Celsius for propane and propylene and $2 \cdot 10^{-3}$ per degree Celsius for butane and butadiene shall be used instead of the exact values. For other products with a high vapour pressure, the values of the coefficient to be adopted shall be fixed by the competent metrology service.

The condenser tray shall be fitted with a manually operated blow-off device.

In a measuring system, the condenser tray shall be located at the highest point in the pipework.

The volume calculated by the foregoing method may be spread over several condenser trays located at the highest points in the pipework.

2.4.4. A thermowell shall be provided in the immediate vicinity of the meter. The thermometer used shall have a scale interval not exceeding 0·5 ºC and shall be verified.

A manometer shall be fitted between the meter and the pressure maintenance valve.

For measuring systems incorporated in road tankers, a manometer socket shall be adequate.

2.4.5. Where the measuring process is carried out on a system fitted to a road tanker, there shall be no connection between the gas phases in the supply tank and the reception tank.

2.4.6. Safety valves may be incorporated into measuring systems for the purpose of preventing abnormally high pressure. If these valves are located downstream of the meter, they shall open into the atmosphere or be connected to the reception tank.

Under no circumstances shall the safety valves located upstream of the meter be connected by piping which by-passes the meter to the valves located downstream.

2.4.7. If operating conditions necessitate the use of detachable hoses, the hoses shall remain full if their volume is greater than the maximum permissible error for the minimum delivery.

Detachable full hoses shall be equipped with special ‘coupler’ connections for full hoses. Manual blow-off devices shall be provided, if necessary, at the ends of these hoses.

2.4.8. The monitoring valve of the double closing device specified in 1.11 for any pipework by-passing the meter must be capable of being shut off for safety reasons. In such cases, a manometer fitted between the two shut-off valves or any other equivalent system shall monitor any leakages.

2.5. **Measuring systems for milk**

2.5.1. The requirements of 2.5 shall apply to portable measuring systems used to monitor the reception of milk by collecting tankers, to fixed measuring systems used for reception and to portable or fixed measuring systems used for the delivery of milk.

2.5.2. In reception equipment, the point of transfer shall consist of a constant level in a tank located upstream from the meter. This constant level shall be visible before and after each measuring operation, and shall be automatically re-established.

2.5.2.1. Where the meter is supplied by a pump, the constant-level tank may be installed before the pump or between the pump and the meter.

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2.5.2.1.1. In the first case the tank may itself be supplied by gravity, by the emptying of churns, or with the aid of an auxiliary pump or vacuum system.

If the milk is delivered into the tank with the aid of a pump or a vacuum system, a gas eliminator shall be necessary; this eliminator may be combined with the constant-level tank.

2.5.2.1.2. In the second case, the constant-level tank shall act as a gas eliminator.

2.5.2.2. Notwithstanding the requirements of 1.8.3, the meter may function with the aid of a vacuum system. In this case, since the pressure inside the pipework between the constant-level tank and the meter is lower than atmospheric pressure, the pipework connections must be perfectly leak-tight. It must be possible to check this tightness.

2.5.2.3. In all cases of reception, the pipework upstream of the constant level must be completely emptied by an automatic mechanism under usual operating conditions.

2.5.2.4. The constant level shall be monitored by means of a sight-glass or level indicator. The level will be regarded as constant when it settles within a zone lying between two lines corresponding to a difference in volume of not more than twice the maximum permissible error on minimum delivery. The distance between the two lines must be at least 15 mm.

2.5.2.5. .If, to meet the requirement of 2.5.2.4, decelerating mechanisms are incorporated in the measuring system, the flowrate during the decelerating period must not descend below the minimum flowrate of the meter.

2.5.2.6. If, in reception equipment, the liquid measured is conveyed at a level lower than that of the meter, an automatic mechanism shall ensure a pressure higher than atmospheric pressure at the meter outlet.

2.5.3. Measuring systems used for the delivery of milk shall meet the requirements of section 1.

2.5.4. Notwithstanding the general requirements of section 1 regarding the elimination of air or gas, gas elimination equipment shall meet the requirements of 1.6.1 under operating conditions only, i.e. when air enters at the beginning and end of each measuring operation.

For reception equipment, the user shall be able to ascertain the leak-tightness of the connections so that no air may enter upstream of the meter during measuring. For delivery equipment, the system shall be assembled so that the liquid pressure in the connecting pipes running from the supply tank is always positive.

## 3. EEC PATTERN APPROVAL AND EEC INITIAL VERIFICATION

### 3.1. **EEC pattern approval**

3.1.1. *The following systems shall be subject to EEC pattern approval:*

— liquid-fuel measuring systems, referred to in 2.1. When such systems are designed for installation in a central supply system, the pattern approval certificate shall be accompanied by one or more specimen drawings showing the conditions for assembly at the place of use,

— measuring systems fitted to road tankers for the transport and delivery of liquids of low viscosity (viscosity $\leq$ 20 mPa·s) stored at atmospheric pressure (except potable liquids), referred to in 2.2,

— pressurized liquefied-gas measuring systems fitted to road tankers, referred to in 2.4,

— measuring systems for the reception of milk, referred to in 2.5.

3.1.2. *Tests*

3.1.2.1. In the execution of the tests, working standards and their use shall be determined in such a way that the measuring inaccuracy of the calibration method does not exceed one-fifth of the maximum permissible error for the measuring system under examination.

3.1.2.2. Meter test

It is first necessary to determine the curve of errors as a function of flowrate, using a sufficiently large number of measuring points between the minimum and maximum flowrates. It is necessary to

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verify in particular the width of the range of errors of the meter in the zone; the position of the error curve in relation to the zero line is of lesser importance.

It may also be necessary to carry out tests beyond the permitted flow-rate limits.

Tests must also be carried out as far as possible at the operational limits, i.e. for the maximum and minimum temperatures and viscosities specified and for minimum delivery.

Except in the case of tests for minimum delivery, the test volume shall be selected so as to be large enough to ensure that the value of the scale of the indicator is never greater than one-third of the maximum permissible error.

Where EEC pattern approval has already been granted in respect of the meter and its ancillary equipment, it is necessary to verify whether the characteristics of the meter and of the measuring system are sufficiently compatible. If so, the meter need not be submitted to further tests, but the minimum delivery of the measuring system must be determined in accordance with 4.2 of Chapter I of the Annex to Directive 71/319/EEC.

Should the characteristics of the meter not be compatible with those of the measuring system, or should no EEC pattern approval have been granted in respect of the meter (and its ancillary equipment), the entire measuring system must be tested in accordance with this Directive and with Directives 71/319/EEC and 71/348/EEC.

3.1.2.3. Tests for air or gas elimination

The tests must show that the air or gas elimination equipment meets the requirements of 1.6.2.1.4, 1.6.2.1.5 and 1.6.2.2.4.

Where gas separators and special gas extractors are fitted, continuous elimination shall be checked by comparison of the measurement results of a suitable volumetric meter inserted downstream of the separator (special extractor) with and without the addition of air or gas.

Where special extractors are fitted, it is also necessary to test for the complete emptying of the tank. If possible, the tests should be carried out with the least favourable liquid. In tests on mock-ups or models on a different scale from the actual equipment, account shall be taken of the laws of similarity concerning viscosity (Reynolds), gravity (Froude) and surface tension (Weber). As a general rule tests on models shall only be carried out where justified.

3.1.2.4. Tests on special measuring systems.

3.1.2.4.1. Liquid-fuel measuring systems.

The tests shall comprise:

(a) checking of the meter, checking of ancillary equipment and determination of the influence of such equipment (price indicator, printer, presetting device, etc.);

(b) checking of the gas eliminator;

(c) checking of the constancy of the volume of the hose;

(d) a special check to verify regular advance of the price indicator (irregular advance may be induced in the first component of the price indicator by sudden closing of the delivery valve).

3.1.2.4.2. Liquefied gas measuring systems.

The examination shall comprise:

(a) verification from drawings of the efficiency range and the design of gas separators;

(b) an operating test on the gas eliminator (level regulator), which may be incorporated in the gas separator.

The pressure maintenance device shall also be verified on the drawing. A model test may possibly be required in special cases by the inspection authority.

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3.1.3. In the case of the measuring systems referred to in 2.2 and 2.4, EEC pattern approval may be granted on the basis of drawings and diagrams, provided that they comply with the provisions of section 4.

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3.2. **EEC initial verification**

3.2.1. *General*

3.2.1.1. EEC initial verification of measuring systems may be carried out in one or two stages.

3.2.1.1.1. It shall be carried out in one stage when the system is entirely manufactured by a single manufacturer, can be transported without being dismantled and when it is verified under the conditions in which it is intended to be operated.

3.2.1.1.2. It shall be carried out in two stages in all other cases.

The first stage concerns the meter only or the meter fitted with any ancillary equipment which must be associated with it, whether or not incorporated in a sub-assembly.

The first-stage tests may be carried out on a test bench (possibly in the manufacturer's factory) or on the installed measuring system. At this stage, the metrological examinations may be carried out with liquids other than those for which the system is intended.

The second stage concerns the measuring system under actual operating conditions. This shall be carried out at the place of installation, under operating conditions, and with the liquid for which the system is intended.

However, the second stage may be carried out in a place selected by the metrology service concerned when the measuring systems can be transported without being dismantled and the tests can be carried out under the conditions in which the measuring system is intended to be operated.

3.2.2. *Tests*

3.2.2.1. When EEC initial verification is carried out in one stage, all the tests referred to in 3.2.2.2 must be performed.

3.2.2.2. When the tests are carried out in two stages:

The first stage shall consist of:

— an examination of the conformity of the meter, including any ancillary equipment (conformity to the respective patterns),

— a metrological examination of the meter, including built-in ancillary equipment.

The second stage shall consist of:

— an examination of the conformity of the measuring system, including the meter and ancillary equipment,

— a metrological examination of the meter and ancillary equipment in the measuring system,

— an operating test on the gas eliminator, if fitted; it shall not be necessary to check whether the maximum permissible errors for this device as provided for in 1.6 have been exceeded,

— inspection of the adjustment of the required pressure maintenance devices,

— verification of variations in the internal volume of hoses in full-hose systems,

— determination of residual quantities in empty-hose systems.

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4. MEASURING SYSTEMS FITTED TO ROAD TANKERS

4.1. **General requirements**

The measuring systems fitted to road tankers referred to in items 2.2 and 2.4 may obtain EEC pattern approval solely on the basis of an examination of the documents produced, if the latter are in conformity with one of the standard schemes referred to in item 4.2 and meet the requirements set out below:

4.1.1. Indication of the standard scheme adopted must be added to the markings specified in item 1.16.

4.1.2. The components of the measuring system must have received EEC pattern approval when such approval is specified either in Directive 71/319/EEC of 26 July 1971 relating to meters for liquids other than

▼M1

water, Directive 71/348/EEC of 12 October 1971 relating to ancillary equipment for meters for liquids other than water or in this Directive.

4.1.3. If a tank has several compartments, the outlet pipes from the compartments may be connected to a measuring system separately or through a manifold, unless otherwise specified in the relevant standard scheme. The provisions of the second paragraph of item 2.2.1 shall apply in all cases.

Where a measuring system is connected to several compartments through a manifold, there shall be a device for preventing several compartments from communicating with the measuring system simultaneously. This requirement does not, however, apply if the measuring system has a gas separator in conformity with item 1.6.2.1.4.

4.1.4. If a road tanker has two measuring systems which can be connected as required to one or more specific compartments, the pipes and valves must be arranged so that the two measuring systems cannot be connected to the same compartments simultaneously. In addition, the connections between compartments and measuring systems must be clearly marked so as to prevent a compartment being mistakenly connected to a measuring system not designed to measure the product which it contains.

4.1.5. If an anti-swirl device is specified requirement, it may be combined with the valve in the bottom of the compartment.

4.1.6. The pipework, valves and taps between compartments and measuring systems must be arranged in such a way that it is impossible to connect a measuring system to a tank separate from the road tanker.

4.1.7. The filter normally provided immediately upstream of the meter or the degassing equipment may be incorporated in the latter.

4.1.8. It must be possible to seal devices which allow delivery without passing through the meter in order to comply with any national requirements.

4.1.9. Where measuring systems include two-way valves, the latter must be so designed as to render simultaneous communication between the three orifices impossible.

4.2. **Standard schemes**

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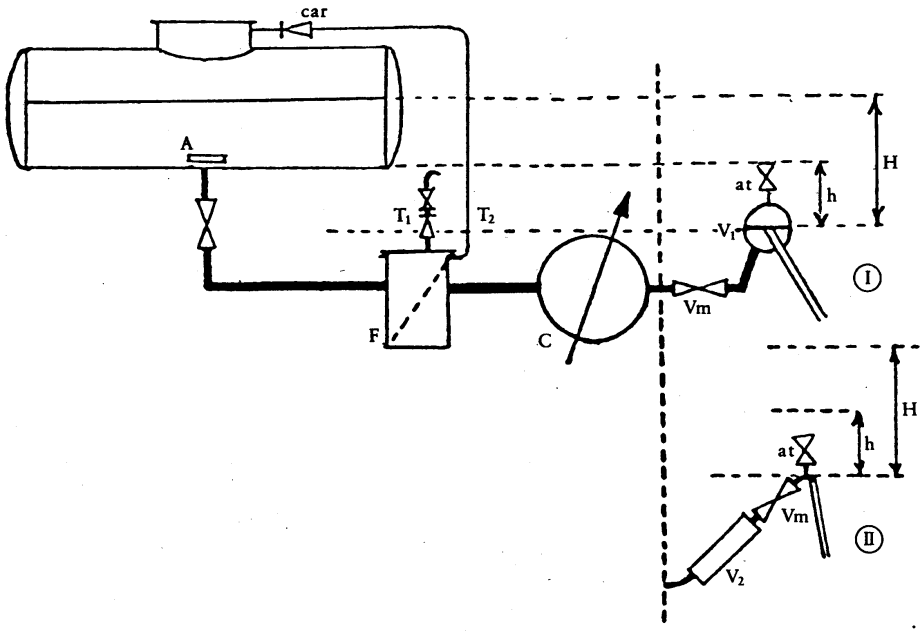
*Standard scheme S 1*

**Operation by gravity with permanent vent at point of transfer**

*Allows:* metered delivery only (empty hose).



▼**M1**

*Key to standard scheme S 1*

If the tank has several compartments, the measuring system must be directly and permanently connected to a specific compartment without a manifold.

A: Anti-swirl device.

F: Filter. The filter must be designed and installed in such a way that it can be cleaned without emptying the meter or the sight-glass ($V_1$ or $V_2$ respectively).

The whole of the filter must be situated below the level of the point of transfer.

$T_1$, $T_2$: Variants authorized for gas evacuation.

$T_1$: blow-off valve and non-return valve to prevent admission of gas into the measuring system.

$T_2$: return to the gaseous phase in the tank compartment.

car: Non-return valve to prevent gas flow in the event of thermal overpressure in the tank.

C: Meter.

Vm: Operating valve.

I and II: Variants of the empty-hose delivery system.

$V_1$: Weir-type sight glass.

$V_2$: Sight glass as defined in item 1.1.8, also serving as a gas indicator.

at: Permanent air vent of sufficient cross-section to ensure that pressure in the meter is at least equal to atmospheric pressure.

Permanent venting may be provided by a vertical tube without a valve. If this tube is connected to the top of the tank, the ‘car’ non-return valve is not needed.

H: Head of liquid.

h: Height of bottom of tank above point of transfer. This must be sufficient to ensure a flow rate at least equal to the meter's minimum flow rate until the tank is completely empty.

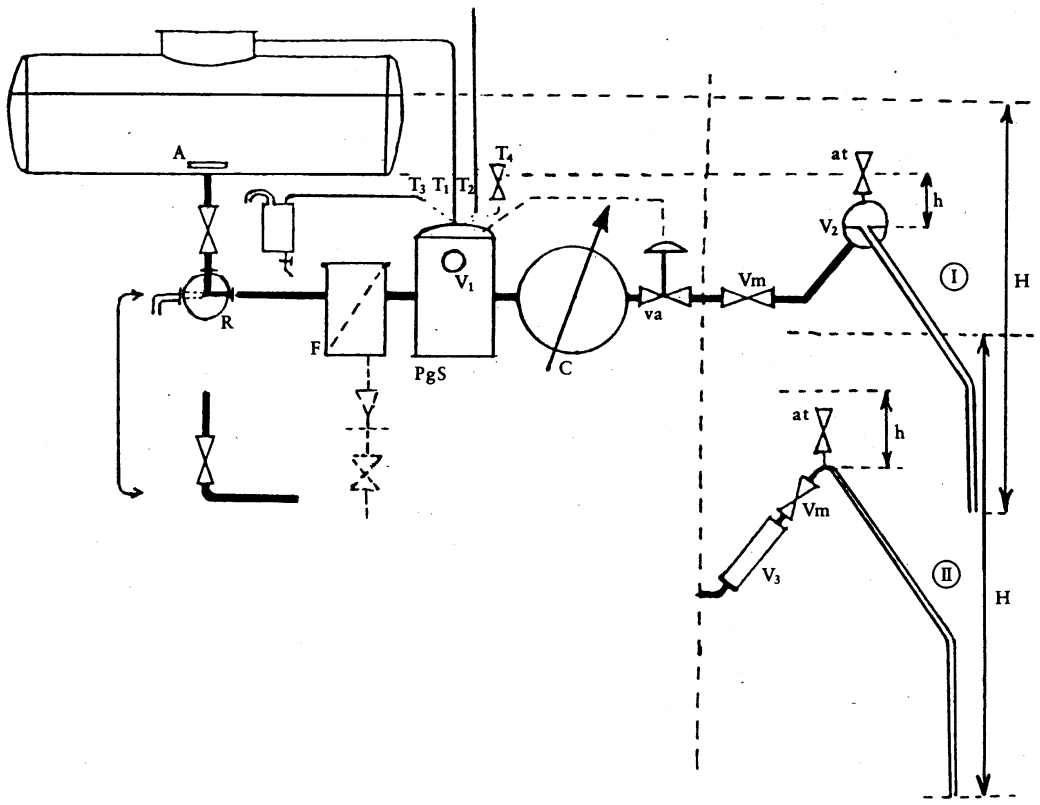
▼M1

*Standard scheme S 2*

**Operation by gravity without permanent vent at point of transfer during delivery**

*Allows:* (a) metered delivery (empty hose);

(b) direct unmetered delivery, emptying and filling of the tank without passing through the meter.



▼**M1**

*Key to standard scheme S 2*

The pipework between compartments and measuring systems must be such as to ensure permanent connections.

A: Anti-swirl device.

R: Two-way valve allowing metered delivery, unmetered delivery and emptying and filling of the tank without passing through the meter.

This valve is optional. It may be replaced by a direct connection.

F: Filter. A drain valve is authorized only if it includes a non-return valve preventing any admission of gas to the measuring system.

PgS: Special gas extractor as defined in item 1.1.5.

$V_1$: Sight glass of special gas extractor.

$T_1$, $T_2$, $T_3$ $T_4$: Variants authorized for the venting device.

$T_1$: return to tank.

$T_2$: vent to the atmosphere.

$T_3$: vessel to catch liquid particles entrained by the gases.

$T_4$: blow-off valve.

C: Meter.

va: Valve automatically closed by the special gas extractor when the pressure is insufficient to prevent vaporization in the meter or when a gas pocket accumulates in this special gas extractor. In addition, this valve must close in the event of a failure in its control system.

I and II: Variants of the empty-hose delivery system.

Variant I: weir-type sight glass $V_2$.

Variant II: sight glass as defined in item 1.1.8, also performing the function of a gas indicator $V_3$.

Vm: Operating valve.

The automatic valve va and the operating valve Vm may be combined in a special valve performing both functions. In that case, the two functions must be independent of each other.

In Variant II, this special valve must be placed after the sight glass $V_3$.

at: Manual vent. It may be automatic (e.g., automatically closed during the measuring operation and opened on completion thereof).

H: Head of liquid.

h: Height of bottom of tank above point of transfer. This must be sufficient to ensure a flow rate at least equal to the meter's minimum flow rate until the tank is completely empty.

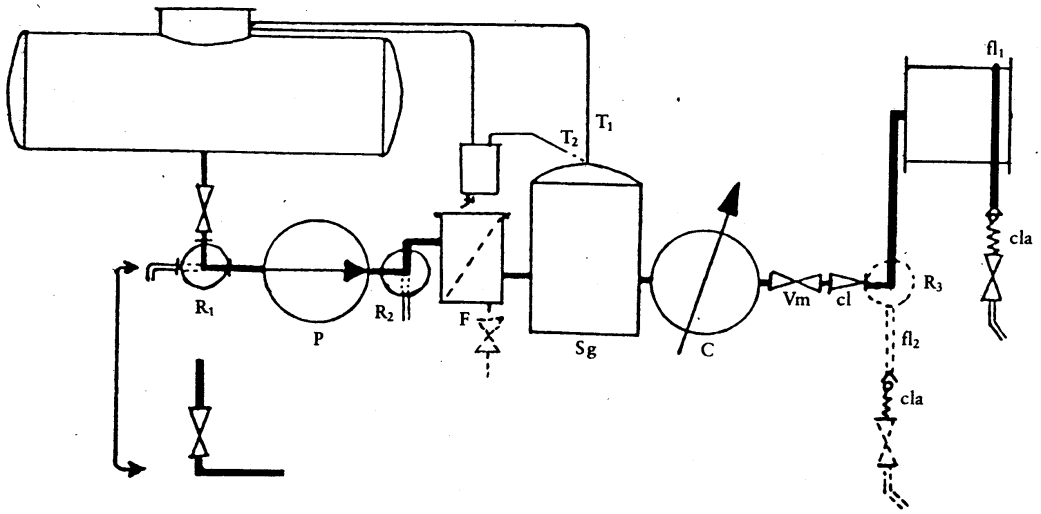
▼**M1**

*Standard scheme S 3*

The measuring system includes a pump, a gas separator and one or two full hoses.

*Allows:* (a) metered delivery by pump (full hose);

(b) direct unmetered delivery (with or without pump), emptying and filling of the tank without passing through the meter.



▼**M1**

*Key to standard scheme S 3*

$R_1$: Two-way valve allowing metered delivery, unmetered delivery and filling and emptying of the tank without passing through the meter.

This valve is optional. It may be replaced by a direct connection.

P: Pump. The pump may be reversible. In that case, a non-return valve must be added between the valve $R_2$ and the gas separator Sg.

$R_2$: Optional two-way valve, for direct unmetered delivery.

F: Filter. The filter may be fitted with a drain valve.

Sg: Gas separator as defined in item 1.6.2.1.4. The liquid level in the separator must be higher than that in the meter.

$T_1$, $T_2$: Variants authorized for the venting device.

$T_1$: direct return to the tank.

$T_2$: return to the tank via a vessel to catch liquid particles entrained by the gases.

C: Meter.

Vm: Operating valve.

cl: Non-return valve.

$fl_1$: Full hose on reel.

$fl_2$: Optional second full hose (very short) for delivery at high flow rates.

cla: Valve to prevent the full hose from emptying.

$R_3$: Device allowing deliveries to be made with either hose in a two-hose measuring system. This device must be in conformity with the first paragraph of item 1.10.1 and the second paragraph of item 2.2.4.

▼**M1**

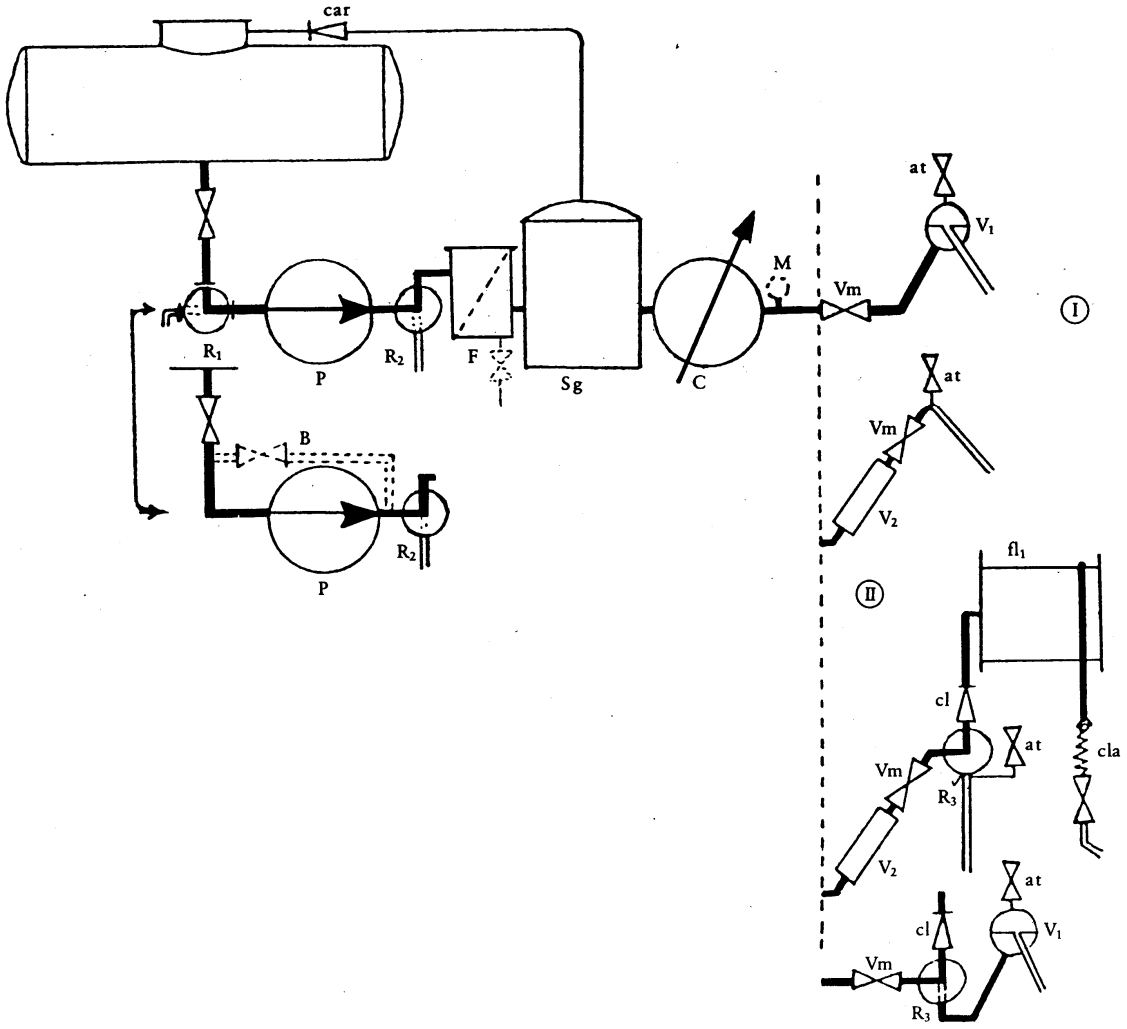
*Standard scheme S 4*

The measuring system has a pump, a gas separator, one empty hose or one full and one empty hose.

*Allows:* (a) metered delivery by pump (full or empty hose);

(b) metered gravity-feed delivery (empty hose);

(c) direct unmetered delivery (which or without pump), emptying and filling of the tank without passing through the meter.



▼**M1**

*Key to standard scheme S 4*

$R_1$: Two-way valve for metered delivery, unmetered delivery and emptying and filling of the tank without passing through the meter.

This valve is optional. It may be replaced by a direct connection.

P: Pump. The pump may be reversible. In that case, a non-return valve must be added between valve $R_2$ and the gas separator Sg.

B: Optional bypass allowing metered gravity-feed delivery (empty hose). This bypass is authorized only if there is no valve $R_1$.

$R_2$: Optional two-way valve for direct unmetered delivery.

F: Filter. The filter may be fitted with a drain valve.

Sg: Gas separator as defined in item 1.6.2.1.4. The liquid level in the gas separator must be above that in the meter.

car: Non-return valve preventing gas flow (in the case of empty hose delivery).

C: Meter.

M: Pressure gauge take-off; this is only compulsory when there is a bypass B.

This take-off makes it possible to check, during initial verification, that the pressure in the meter is at least equal to atmospheric pressure during gravity-feed delivery.

at: Automatic or manual vent. When there is a bypass B, this vent must be automatic and of sufficient cross-section to ensure that the pressure in the meter is at least equal to atmospheric pressure.

Vm: Operating valve.

I and II: Variants of the delivery device:

Variant I: empty hose.

Variant II: combinations of one full and one empty hose.

cl: Non-return valve.

$V_1$: Weir-type sight glass.

$V_2$: Sight glass as defined in item 1.1.8, also serving as a gas indicator.

$fl_1$: Full hose on reel.

cla: Valve to prevent the full hose from emptying.

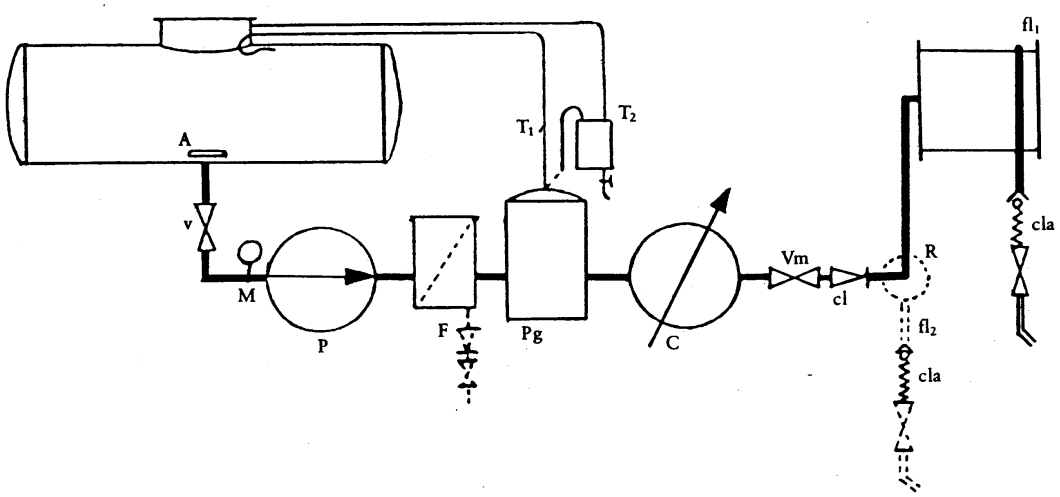
$R_3$: Device allowing deliveries to be made via either the full or empty hose. This device must be in conformity with the first paragraph of item 1.10.1 and the second paragraph of item 2.2.4.

▼M1

*Standard scheme S 5*

The measuring system includes a pump, a gas extractor and one or two full hoses.

It only allows metered deliveries by pump (full hose).



▼**M1**

*Key to standard scheme S 5*

If the tank has several compartments, the measuring system must be directly and permanently connected to a specific compartment without a manifold.

A: Anti-swirl device.

V:

'Open or closed'

type valve rendering any slowing-down at the pump intake practically impossible.

M: Pressure gauge to check that the pressure at the pump intake is never less than atmospheric pressure

P: Pump.

F: Filter.

A drain valve is authorized only if it includes a non-return valve preventing any admission of gas to the measuring system.

Pg: Gas extractor. Two variants, $T_1$ and $T_2$, and authorized for the venting device.

$T_1$: Direct link between the gas extractor and the tank. In this case the pipework must lead into the tank along the wall in order to facilitate separation of liquid particles and gases.

$T_2$: Gas extractor connected to the tank by a vessel to catch liquid particles entrained by the gases.

C: Meter.

Vm: Operating valve.

cl: Non-return valve.

$fl_1$: Full hose on reel.

$fl_2$: Optional full second hose (very short) for deliveries at high flow rates.

cla: Valve to prevent the full hose from emptying.

R: Device allowing deliveries to be made with either hose in a two-hose measuring system. The device must be in conformity with the first paragraph of item 1.10.1 and the second paragraph of item 2.2.4.

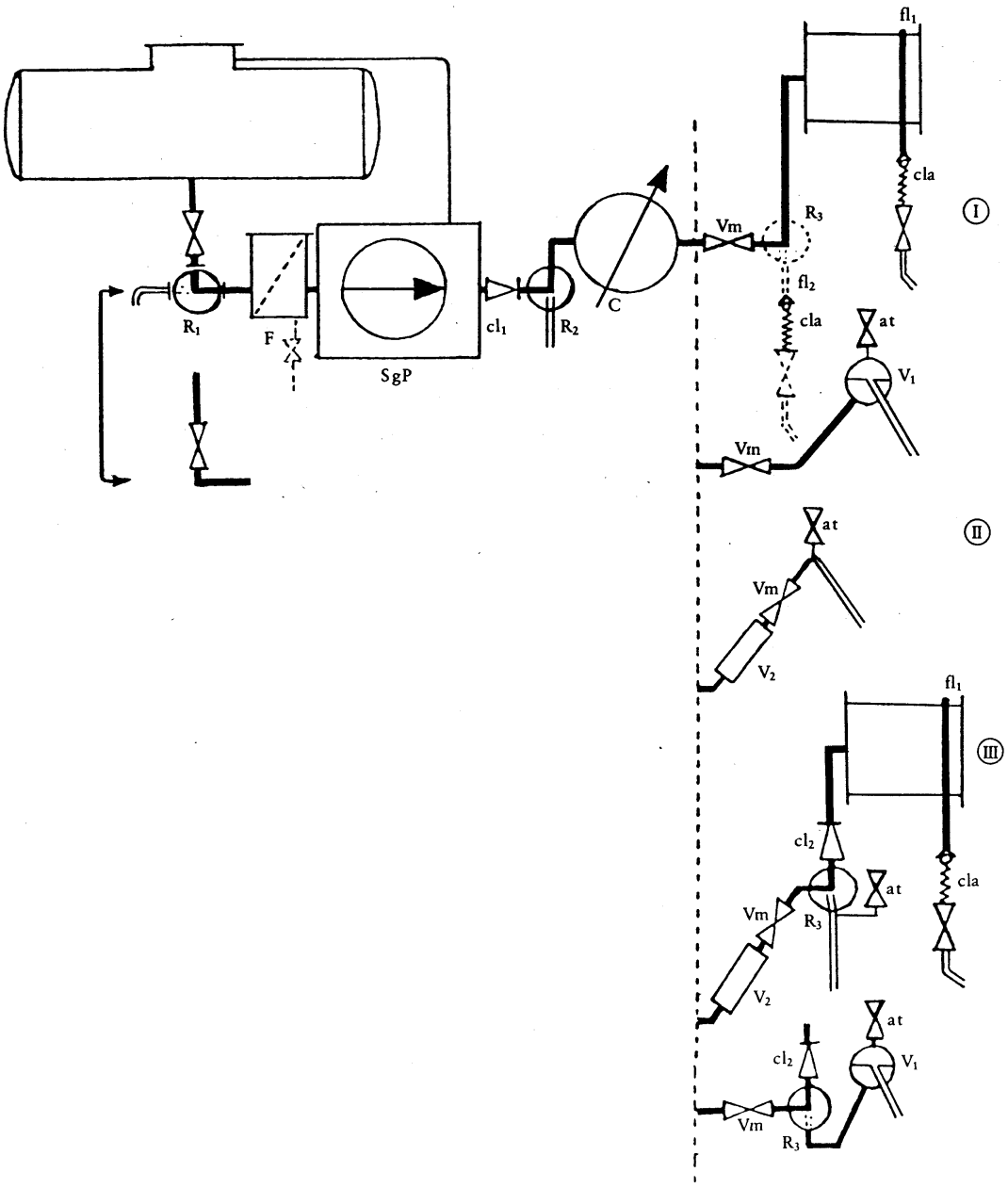
▼**M1**

*Standard scheme S 6*

The measuring system includes a gas separator combined with the supply pump, one or two full hoses, or one empty hose, or one full and one empty hose.

*Allows:* (a) metered delivery by pump (full or empty hose);

(b) direct delivery with or without pump, without passing through the meter, and emptying and filling of the tank without passing through the meter.



▼**M1**

*Key to standard scheme S 6*

$R_1$: Two-way valve allowing metered delivery, unmetered delivery and emptying and filling of the tank without passing through the meter.

This valve is optional. It may be replaced by a direct connection.

F: Filter. The filter may be fitted with a drain valve.

SgP: Gas separator combined with the supply pump as described in the first paragraph of item 1.6.2.1.2. This subassembly must satisfy the requirements laid down in item 1.6.2.1.4. It must have received EEC pattern approval.

$cl_1$: Non-return valve. This valve may be located downstream of the meter.

$R_2$: Optional two-way valve for direct unmetered delivery.

C: Meter.

I, II, III: Variants of the delivery device:

Variant I: one or two full hoses;

Variant II: empty hose;

Variant III: combinations of one full and one empty hose.

Vm: Operating valve.

$V_1$: Weir-type sight glass.

$V_2$: Sight glass as defined in item 1.1.8, also serving as a gas indicator.

$fl_1$: Full hose.

$fl_2$: Optional second full hose (very short) for deliveries at high flow rates.

cla: Valve to prevent the full hose from emptying.

$cl_2$: Non-return valve.

at: Automatic or manual air vent.

$R_3$: Device allowing deliveries to be made by either of two available delivery methods. This device must be in conformity with the first paragraph of item 1.10.1 and the second paragraph of item 2.2.4.

▼**M1**

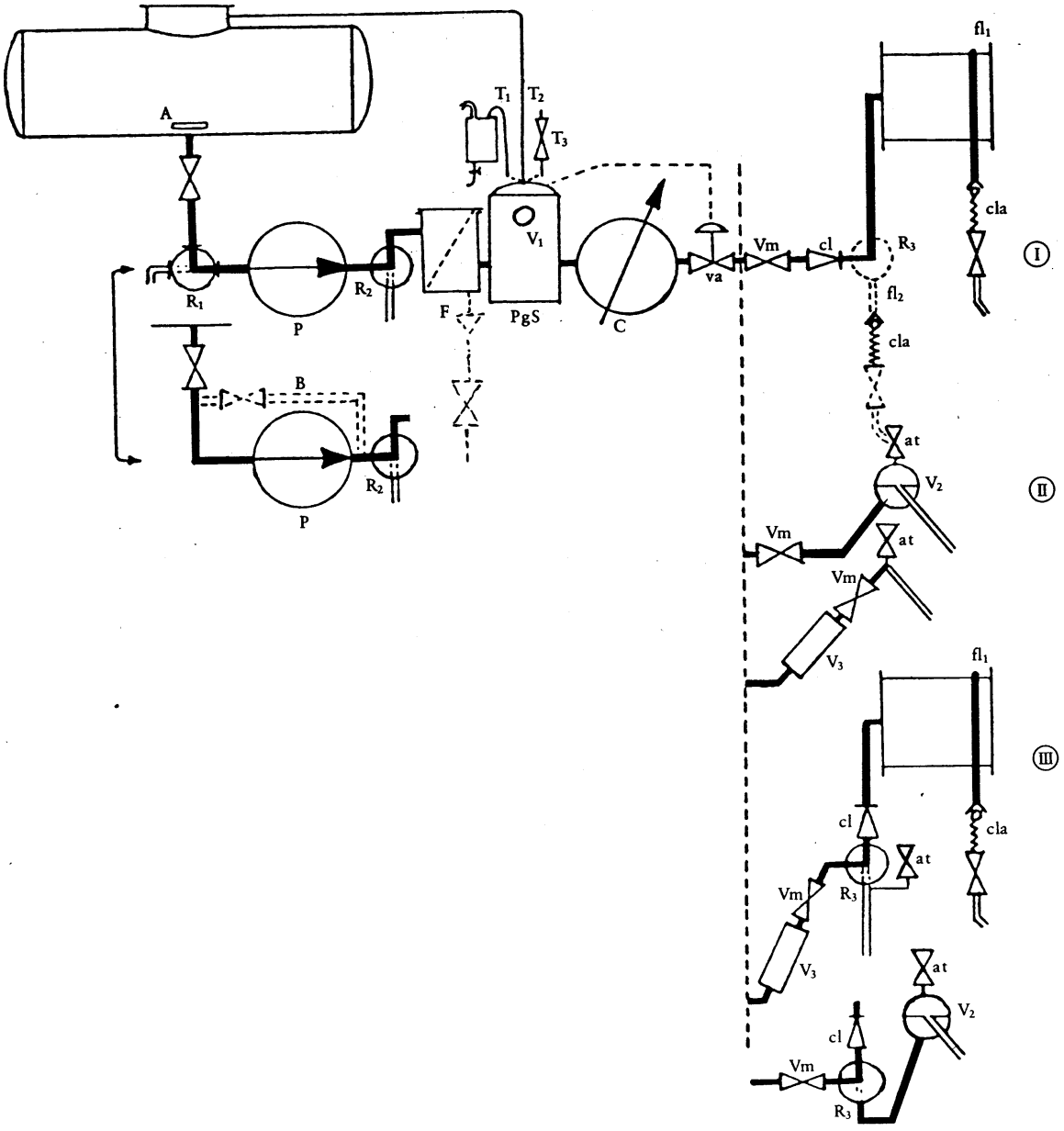
*Standard scheme S 7*

The measuring system includes a pump, a special gas extractor, one or two full hoses, or one empty hose or one full hose and one empty hose.

*Allows:* (a) metered delivery by pump (full or empty hose);

(b) metered gravity-feed delivery (empty hose);

(c) direct delivery with or without pump, without passing through the meter, and emptying and filling of the tank without passing through the meter.



▼**M1**

*Key to standard scheme S 7*

If the tank has several compartments and if it is possible to use a manifold, the valves in the bottom of the compartments and the valves on the intake pipe must be of the 'open or closed' type. Pipes between compartments and the measuring system must be permanently connected.

A: Anti-swirl device.

$R_1$: Two-way valve allowing metered delivery, unmetered delivery and emptying and filling of the tank without passing through the meter.

This valve is optional. It may be replaced by a direct connection.

P: Pump. The pump may be reversible. In that case, a non-return valve must be incorporated between the valve $R_2$ and the special gas extractor PgS.

B: Optional bypass allowing metered gravity-feed delivery (empty hose). This bypass is authorized only if there is no valve $R_1$.

$R_2$: Optional two-way valve for direct unmetered delivery.

F: Filter. A drain valve is authorized only if it includes a non-return valve preventing any admission of gas to the measuring system.

PgS: Special gas extractor as defined in item 1.1.5.

$V_1$: Sight glass of special gas extractor.

$T_1$, $T_2$, $T_3$: Variants authorized for the venting device.

$T_1$: vessel to catch liquid particles entrained by the gases.

$T_2$: return to the tank.

$T_2$: blow-off valve.

C: Meter.

va: Valve automatically closed by the special gas extractor when the pressure is insufficient to prevent vaporization in the meter or when a gas pocket accumulates in the extractor. In addition, this valve must close in the event of a failure in its control system.

I, II, III: Variants of the delivery device.

Variant I: one or two full hoses;

Variant II: empty hose;

Variant III: combinations of one full and one empty hose.

Vm: Operating valve.

The automatic valve va and the operating valve Vm may be combined in a special valve performing both functions. In that case, the two functions must be independent of each other. This special valve must be placed downstream of the sight glass $V_3$ in those variants (II and III) which include the latter.

cl: Non-return valve.

$V_2$: Weir-type sight glass.

$V_3$: Sight glass as defined in item 1.1.8, also serving as a gas indicator.

$fl_1$: Full hose on reel.

$fl_2$: Optional second full hose (very short) for delivery at high flow rates.

cla: Valve preventing the full hose from emptying.

at: Automatic or manual air vent.

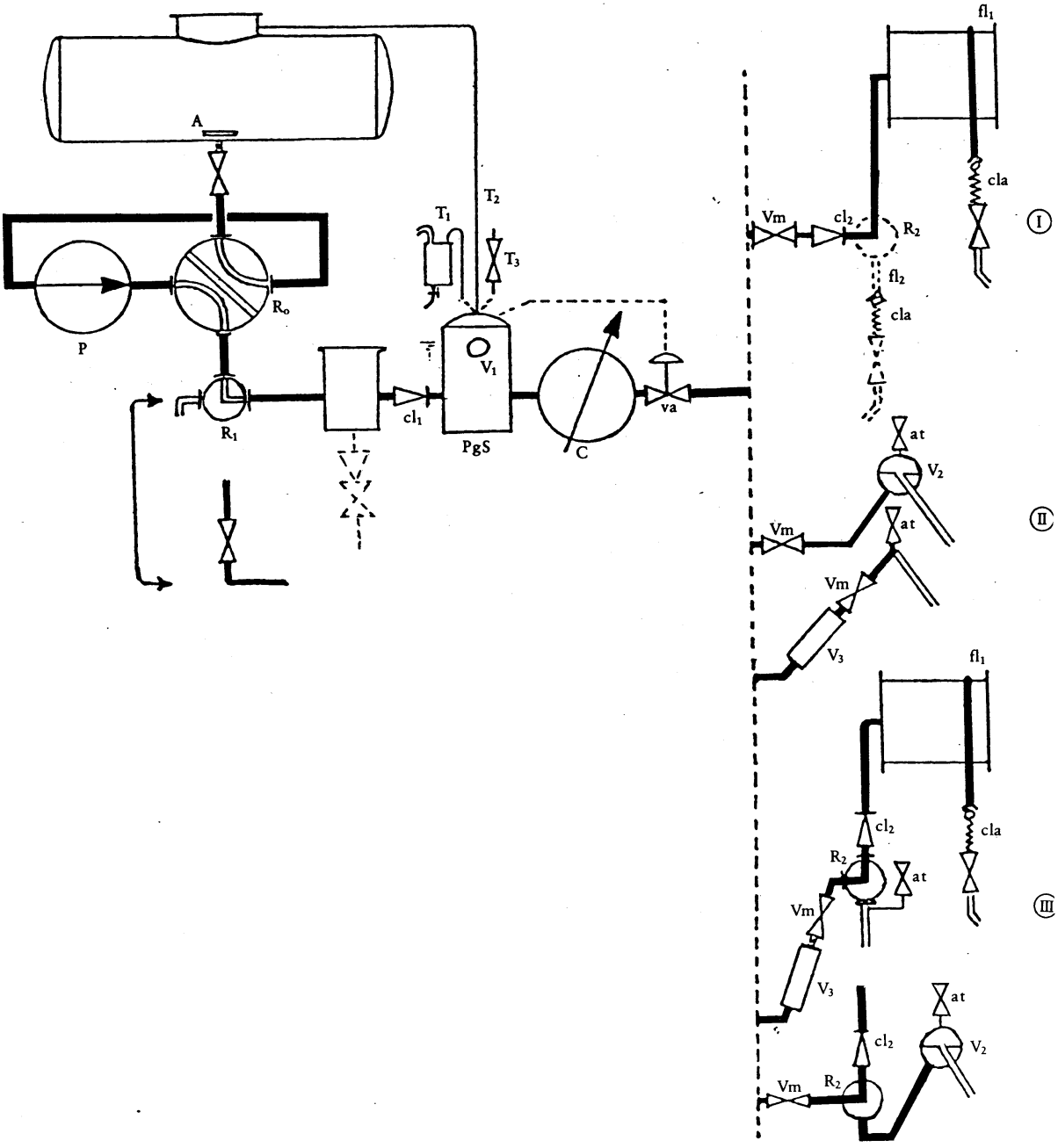
$R_3$: Device allowing deliveries to be made by either of two available delivery methods. This device must be in conformity with the first paragraph of item 1.10.1 and the second paragraph of item 2.2.4.

▼M1

*Standard scheme S 8*

The measuring system includes a pump, a three-way valve, a special gas extractor, one or two full hoses, or one empty hose or one full and one empty hose.

*Allows:*
(a) metered delivery by pump (full or empty hose);
(b) gravity-feed metered delivery (empty hose);
(c) direct delivery with or without pump, without passing through the meter, and emptying and filling of the tank without passing through the meter.



▼**M1**

*Key to standard scheme S 8*

If the tank has several compartments and if it is possible to use a manifold, the valves in the bottom of the compartments and the valves on the intake pipe must be of the 'open or closed' type. Pipes between compartments and the measuring system must be permanently connected.

A: Anti-swirl device.

P: Pump.

$R_0$: Three-way valve which, in conjunction with valves $R_1$ and $R_2$, enables the following operations to be carried out:

1. Metered or unmetered delivery by pump (full or empty hose);
2. Gravity-feed metered or unmetered delivery (empty hose), emptying and filling of the tank;
3. Filling of the tank with the aid of pump P.

$R_1$: This two-way valve is optional. It may be replaced by a direct connection.

F: Filter:

A drain valve is authorized only if it includes a non-return valve preventing any admission of gas to the measuring system

$cl_1$: Non-return valve.

PgS: Special gas extractor as defined in item 1.1.5.

$V_1$: Sight glass for special gas extractor.

$T_1$, $T_2$, $T_3$: Variants authorized for the venting device.

$T_1$: vessel to catch liquid particles entrained by the gases.

$T_2$: return to the tank.

$T_3$: blow-off valve.

C: Meter.

va: Valve automatically closed by the special gas extractor when the pressure is insufficient to prevent vaporization in the meter or when a gas pocket accumulates in the extractor. In addition, this valve must close in the event of a failure in its control system.

I, II, III: Variants of the delivery device.

Variant I: one or two full hoses.

Variant II: empty hose.

Variant III: combinations of one full and one empty hose.

Vm: Operating valve.

The automatic valve va and the operating valve Vm may be combined in a special valve performing both functions. In that case, the two functions must be independent of each other. This special valve must be placed downstream of the sight glass $V_3$ in those variants (II and III) which include the latter.

$cl_2$: Non-return valve.

$V_2$: Weir-type sight glass.

$V_3$: Sight glass as defined in item 1.1.8 also acting as a gas indicator.

$fl_1$: Full hose on reel.

$fl_2$: Optional second full hose (very short) for delivery at high flow rates.

cla: Valve preventing the full hose from emptying.

at: Automatic or manual venting.

$R_2$: Device allowing deliveries to be made by either of two available delivery methods. This device must be in conformity with the first paragraph of item 1.10.1 and the second paragraph of item 2.2.4.

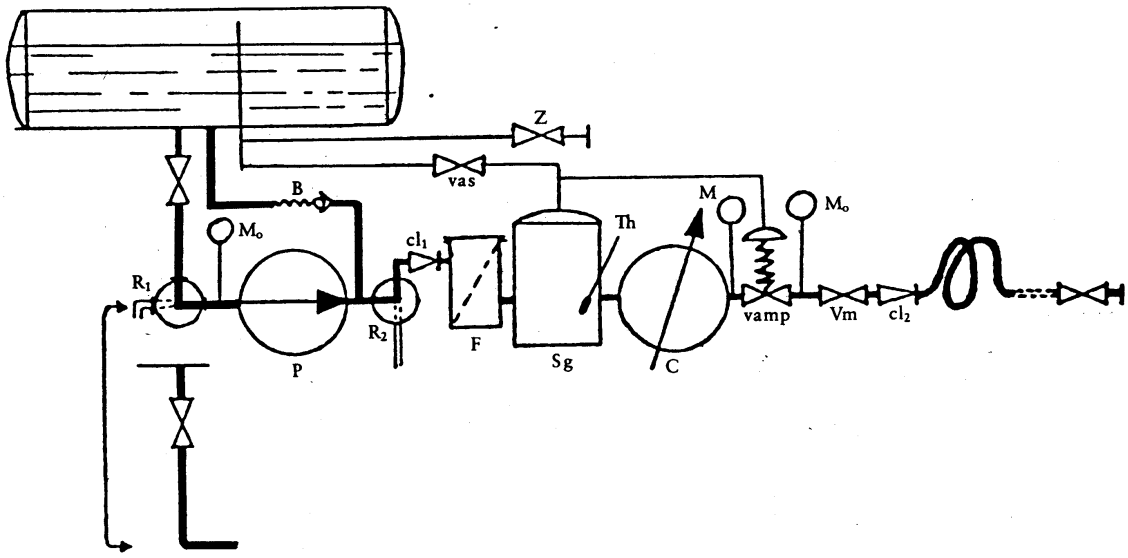
▼**M1**

*Standard scheme S 9*

The measuring system includes a pump, a gas separator, a pressure-maintaining valve and a full hose.

*Allows:* (a) metered delivery by pump (full hose);

(b) delivery with or without pump, without passing through the meter, and emptying and filling of the tank without passing through the meter.



▼**M1**

*Key to standard scheme S 9*

$R_1$: Two-way valve for metered delivery, emptying and filling of the tank without passing through the meter.

This valve is optional. It may be replaced by a direct connection.

P: Pump.

B: Adjustable pump bypass connected to the tank.

$R_2$: Optional two-way valve for direct unmetered delivery.

$cl_1$: Non-return valve stipulated in item 2.4.1. It may also be positioned between the filter and gas separator.

F: Filter.

Sg: Gas separator in conformity with either item 1.6.2.1.4 or the second paragraph of item 2.4.3.1. The venting device is connected to the gaseous phase of the tank. For safety reasons, a valve vas may be fitted to this device; in that case, it must be fitted between the tank and the branch to the valve ‘vamp’.

C: Meter.

vamp: Automatic pressure-maintaining valve adjusted to maintain a pressure at least 100 kPa higher than the saturated vapour pressure in the tank.

Vm: Operating valve.

$cl_2$: Non-return valve.

Z: Gaseous-phase pipe which may be used only to fill the vehicle tank and recover the product during checking of the measuring system.

Th: Thermometer. This thermometer must be situated near the meter, either in the gas separator or at the meter inlet or outlet.

M: Compulsory pressure gauge.

$M_0$: Optional pressure gauges.

*Note:* (a) to ensure that the requirements stipulated in item 2.4.5 are observed, it must be clearly stated on a plate that the gaseous phases in the vehicle tank and customer's tank must not be connected.

(b) Safety valves may be incorporated; in that case, they must comply with the requirements of item 2.4.6.