

INTERNATIONAL
RECOMMENDATION

OIML R 120

Edition 2010 (E)

(Edition 1996 with updated references)

Standard capacity measures for testing
measuring systems for liquids other than water

Mesures de capacité étalons pour l'essai des ensembles
de mesurage de liquides autres que l'eau





BIML, 2010-06-30

Updated references

OIML TC 8 updated the following references in this Publication in 2010:

Chapter	Reference	Document	New or complete reference
p.4, Terminology	VIM:1993	International vocabulary of basic and general terms in metrology	OIML V 2-200:2010
p.4, Terminology	VML:1978	Vocabulary of legal metrology	OIML V 1:2000
p.5, Scope	OIML R 117:1995	Measuring systems for liquids other than water	R 117-1:2007
p.6, 2.1	OIML R 43	Standard graduated glass flasks for verification officers	OIML R 43:1981
p.12, 3.5.2	OIML R 76-1:1992	Non automatic weighing instruments	OIML R 76-1:2006
	OIML R 76-2:1993		OIML R 76-2:2007
p.15, 4.7	OIML R 63:1994 / ISO 91-1, 1994 edition	Petroleum measurement tables, (with reference to ISO International Standard 91-1:1982 & 91-2:1991)	No new reference
p.15, 4.7	ISO 8222:1987	Petroleum measurement systems--Calibration--Temperature corrections for use with volumetric ref. Measuring systems	ISO 8222:2003

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FOREWORD

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

The two main categories of OIML publications are:

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This publication - reference OIML R 120, edition 1996 (E) - was developed within the OIML technical committee TC 8 *Measurement of quantities of fluids*. It was approved for final publication by the International Committee of Legal Metrology in 1994 and will be submitted to the International Conference of Legal Metrology in 1996 for formal sanction.

TERMINOLOGY

The general terms used in this Recommendation are in accordance with the *International Vocabulary of Basic and General Terms in Metrology* (VIM - 1993 edition), and the *Vocabulary of Legal Metrology* (VML - 1978 edition).

Other technical terms used in this text are in accordance with the International Recommendation OIML R 117 *Measuring systems for liquids other than water* (1995 edition).

STANDARD CAPACITY MEASURES FOR TESTING MEASURING SYSTEMS FOR LIQUIDS OTHER THAN WATER

1 Scope

This Recommendation specifies the characteristics of standard capacity measures and describes the methods by which measuring systems for liquids other than water (hereinafter called “measuring systems”) are tested in order to verify that they comply with the relevant metrological requirements in the International Recommendation OIML R 117 *Measuring systems for liquids other than water*.

In points 2 and 3 the metrological characteristics and the calibration methods for standard capacity measures are defined.

In points 4 to 12, the methods are given for testing the following typical measuring systems:

- 1) liquid fuel dispensers (except for LPG),
- 2) measuring systems on road tankers,
- 3) measuring systems for the unloading of road and rail tankers, ships’ tanks and tank containers,
- 4) measuring systems for the loading of road and rail tankers, ships’ tank and tank containers,
- 5) measuring systems fitted into pipelines,
- 6) measuring systems for milk.

Other types of measuring systems or measuring systems for other kinds of liquids may generally be tested according to one of the above methods.

This Recommendation does not apply to measuring systems for liquefied gases (LPG and LNG), cryogenic liquids or liquids having a viscosity above 20 mPa·s. These measuring systems will be covered by separate Recommendations.

2 Standard capacity measures

2.1 Nominal capacities and construction materials

Standard capacity measures used for the testing of measuring systems shall be of suitable nominal capacities and materials (*). The types of standard capacity measures which may be used and their nominal capacities are specified in Table 1.

(*) Care should be taken to ensure that the materials used for the capacity measures, or any subsequent contamination of such materials, do not create a safety hazard, especially when the measures may be used for the measurement of petroleum products.

Table 1

Description of standard capacity measures	Nominal capacity (L)
Standard flasks	0.1 – 0.2 – 0.5 1 – 2 – 5 – 10
Standard test measures	5 – 10 – 20
Proving tanks	20 or more
Standard flasks for special uses	0.25 – 2.5

Standard flasks shall be made of glass as specified in the International Recommendation OIML R 43 *Standard graduated glass flasks for verification officers*.

Standard test measures and proving tanks shall be made of stainless steel, mild steel with a suitable interior coating, or other materials as specified in national regulations.

2.2 Accuracy

2.2.1 General

The calibration of a standard capacity measure shall be carried out such that expanded uncertainty on calibration be within one-fifth of the maximum permissible error on pattern approval tests and one-third of the maximum permissible error on verification tests. The estimation of uncertainty shall be made according to the *Guide to the expression of uncertainty in measurement*, with $k = 2$. Expanded uncertainty includes uncertainty on measurement standards, uncertainty on calibration operation, and uncertainty on the capacity measure being calibrated. When the standard capacity measure is calibrated, the expanded uncertainty of the calibration shall be recorded in the calibration certificate.

2.2.2 Maximum permissible errors

2.2.2.1 For standard flasks, the maximum permissible errors shall be the values specified in clause 7 of OIML R 43.

2.2.2.2 For standard test measures and proving tanks, the maximum permissible errors shall be $\pm 1/2\ 000$ of the nominal capacity.

2.2.2.3 The requirement in 2.2.2.2 also applies to the scale intervals marked on both sides of the scale mark corresponding to the nominal capacity of a standard test measure or proving tank. This means that each scale mark over the range from “nominal capacity – x” (minimum value below nominal capacity) to “nominal capacity + y” (maximum value above nominal capacity) is required to be within the maximum permissible error which applies to the nominal capacity.

2.3 Construction

2.3.1 Standard flasks

Standard flasks shall meet the construction requirements specified in OIML R 43.

2.3.2 Standard test measures

The diameter of the neck of the standard test measure shall be large enough to avoid problems with regard to the trapping of liquid or air or vapor or to the cleaning of the measure, and small enough so that the sensitivity in detecting changes in the level in the measure is sufficient for achieving the measurement accuracy required in 2.2. It is assumed that the requirement will be met if a difference of at least 3 mm in the liquid level in the neck is equivalent to the absolute value of the maximum permissible error of the standard capacity measure.

The neck part shall be of the weir-type, or have glass plates, or be made of glass tube, or have a separate and fixed gauge glass(es). The scale marks corresponding to the nominal capacity and to at least 1 % of the nominal capacity, in plus and in minus, shall be marked on the glass plates, the glass tube neck or the gauge glass. Otherwise, the neck part shall be fitted with a fixed, rustproof metal plate or a sliding plate capable of being sealed, and on which the scale marks corresponding to its nominal capacity, and to the volumes below and above the nominal capacity, are marked. The scale marks on the metal plate fixed to the neck part, shall be inscribed on both edges of the plate, adjacent to the window.

The diameter of the gauge glass shall be large enough to ensure that capillary or meniscus effects do not introduce additional uncertainties such that the maximum permissible errors given in 2.2.2.2 are exceeded (*).

If adjustment plungers are used, they shall not move easily after adjustment of the volume and shall be capable of being sealed.

It shall be ensured that the liquids are easily delivered to and from standard test measures, and that no pockets, dents or crevices capable of trapping the liquid or air or vapor are present.

Examples of different designs of a standard test measure are shown in Figure 1.

2.3.3 Proving tanks

2.3.3.1 Proving tanks shall be provided with drain valves at the bottom part; they should be designed with a top neck and may be designed with a bottom neck. The requirements given in 2.3.2 on the diameter of the neck of standard test measures apply equally to the diameter of the top and bottom necks of proving tanks.

The top neck should be provided with glass plates or a separately fixed gauge glass(es), on which the scale marks corresponding to the nominal capacity and to variations of at least 1 % of the nominal capacity, in plus and in minus, are marked. Otherwise, the top neck part shall be fitted with a fixed and rustproof metal plate or a sliding plate capable of being sealed and on which the scale marks corresponding to its nominal capacity and to the volumes below and above the nominal capacity, are marked.

The bottom neck should be provided with glass plates or a separately fixed gauge glass(es) similar to the top neck, with scale marks corresponding to volumes of only 0.5 % in plus or in minus of the nominal capacity.

The diameter of the gauge glasses connected to the top and bottom necks shall be large enough to ensure that capillary or meniscus effects do not introduce additional

(*) It should be noted that even though the diameter of the gauge glass may be suitable for identical and stable temperature conditions for the liquid to be measured, the standard test measure and the ambient air, it may be too small for field use due to the fact that differential temperature effects can cause the gauge glass to act like a thermometer, changing the mean level inside the neck.

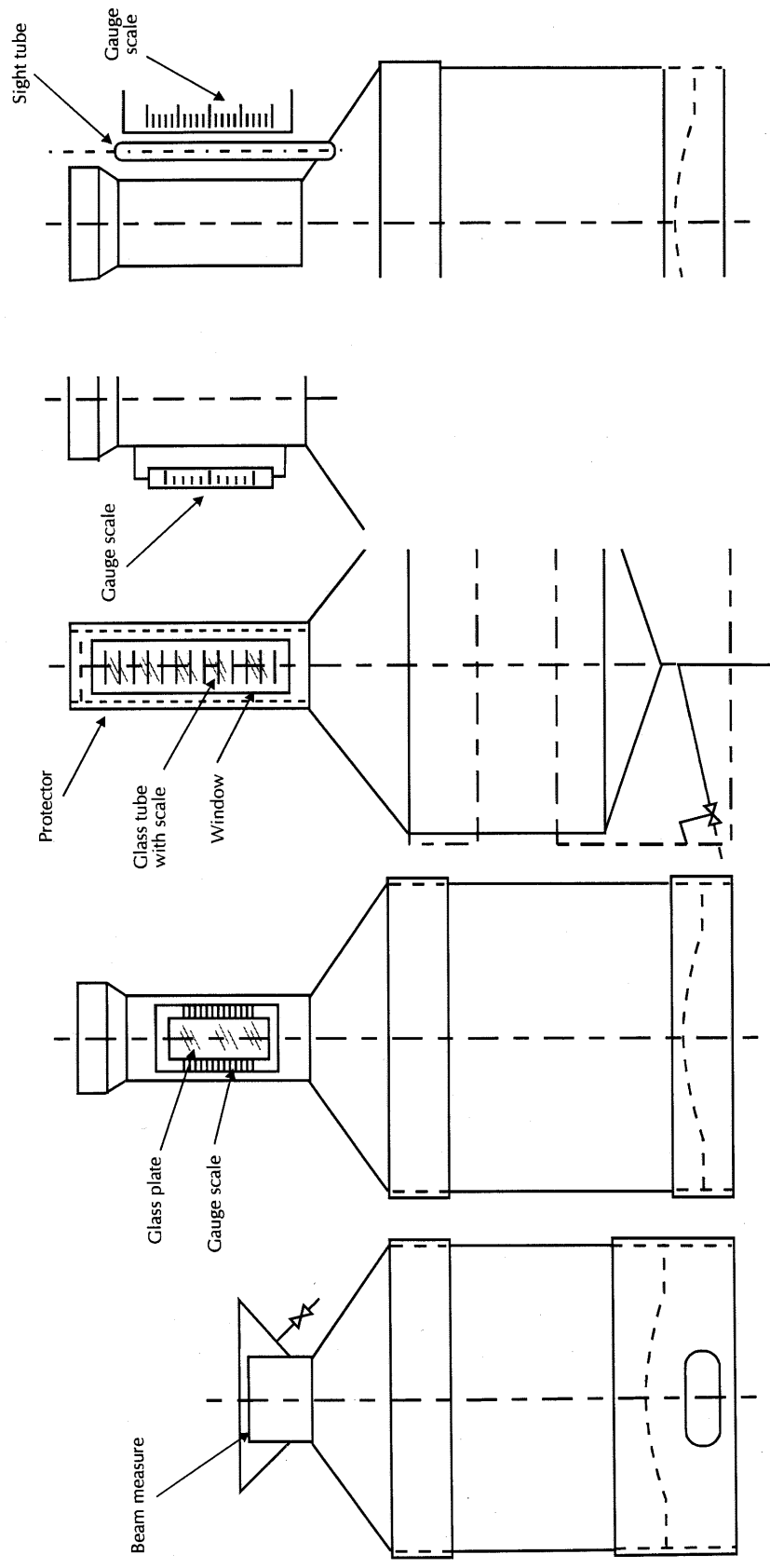


Figure 1

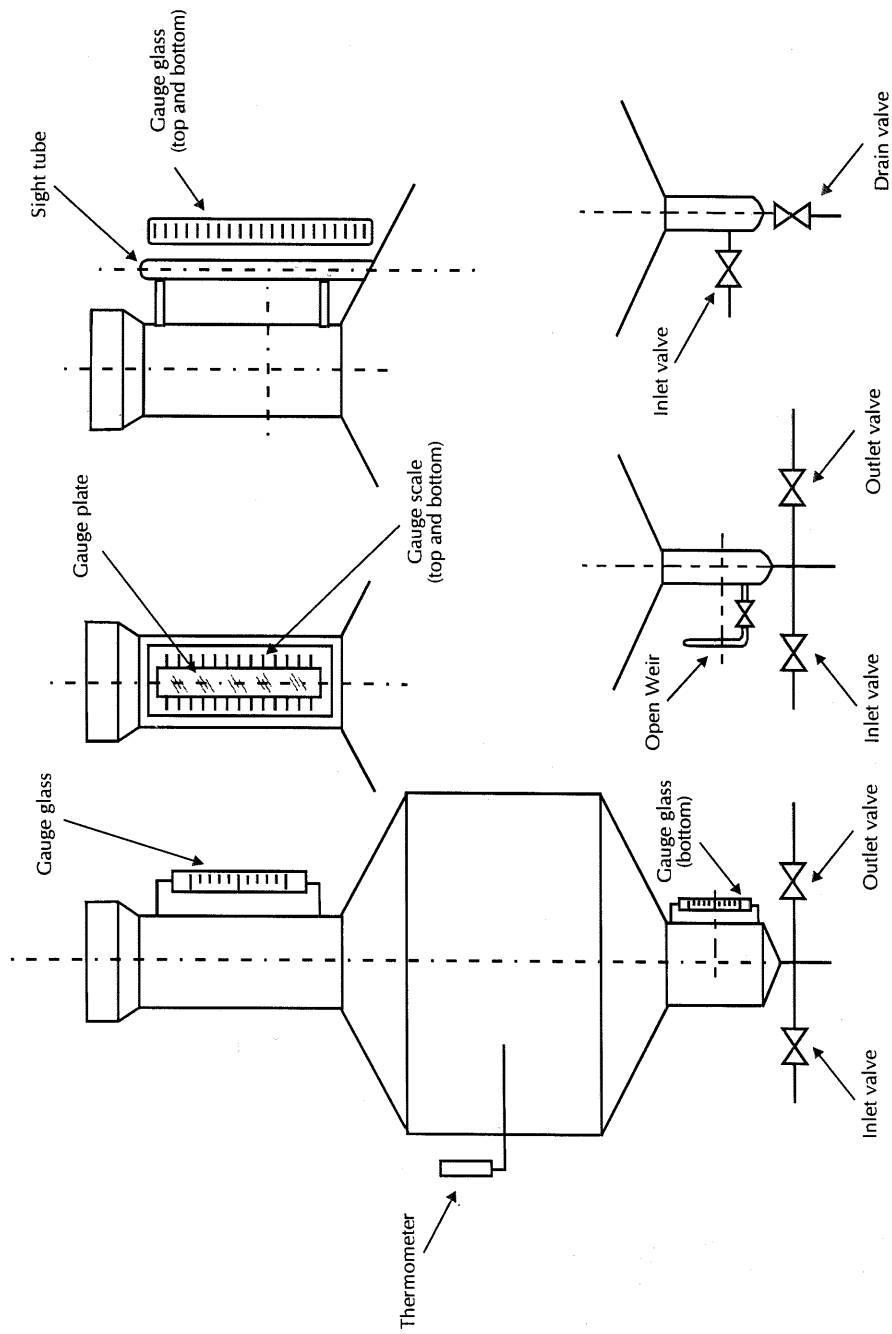


Figure 2

uncertainties such that the maximum permissible errors given in 2.2.2.2 are exceeded (see note to 2.3.2).

It shall be ensured that the liquids are easily delivered to and from the proving tanks and that no pockets, dents or crevices capable of trapping the liquid, air or vapor are present.

Examples of different designs of a proving tank are shown in Figure 2.

2.3.3.2 The proving tank shall be provided with means for measuring the temperature of the liquid it contains.

When thermometer wells are used for determining the temperature of the test liquid in the proving tank, the minimum recommended number of thermometer wells is given in Table 2.

Table 2

Nominal capacity of a proving tank	up to 500 L	more than 500 L up to 2 000 L	more than 2 000 L
Minimum number of thermometer wells	1	2	3

The thermometer well shall be deep enough to enable the correct immersion of a thermometer and shall consist of a metal socket with good heat conductivity having one end closed; it shall be inclined so that liquid can be added to the well if desired. The thermometer wells shall be installed with such an immersion that the ambient temperature outside the proving tank will not affect the thermometer.

When the installation of two or three thermometer wells is recommended, these shall be installed in accordance with the following location conditions:

- a) in the upper and lower half of the main body, or in the upper and lower third and near the center of the main body of the proving tank, and
- b) at two or three points, equally spaced around the circumference of the proving tank.

2.3.3.3 Where proving tanks are mounted on a truck or trailer, means shall be provided to secure and maintain them in a level position, during testing and use.

2.3.3.4 For testing certain types of measuring systems (for example, those for the reception of milk), it may be easier to use proving tanks of the brim measure type.

2.4 Markings

Standard capacity measures shall be marked on a permanently attached plate to indicate:

- identification designation, and
- nominal capacity.

In addition, the following information should be given in the calibration report:

- reference temperature,
- whether the measure is constructed “to contain” or “to deliver” (see definition in OIML R 43),
- drainage time, in the case of a measure constructed “to deliver”,
- coefficient of expansion, if appropriate.

3 Calibration methods for standard capacity measures

3.1 Reference temperature

The value of the reference temperature of the standard capacity measure specified in national regulations shall be stated in the calibration report and/or on the measure itself.

3.2 Liquids used for calibration

3.2.1 Standard flasks and standard test measures

The liquid used for the calibration of standard flasks and standard test measures shall be water as specified in OIML R 43.

3.2.2 Proving tanks

The liquid used for the calibration of proving tanks shall be water which shall be clean and free of contaminants or corrosive chemicals and which shall contain no air or gas bubbles.

3.3 Measures constructed “to contain” and “to deliver”

The method of calibration should correspond to the manner in which the measure is to be used; e.g. a measure constructed “to deliver” shall be calibrated by determining the volume of the water it discharges, with a specific drainage time, while a measure constructed “to contain” shall be calibrated by determining the volume of the water which is required to fill the dry or pre-wetted measure, as applicable.

3.3.1 Standard flasks

Determination of the capacity of a standard flask shall follow the procedures specified in OIML R 43.

3.3.2 Standard test measures

The capacity of a standard test measure may be determined using either the “to contain” or “to deliver” method. Where the viscosity of the liquid used for the testing of the measuring system does not exceed 5 mPa·s, the capacity of the standard test measure should be determined using the “to deliver” or pre-wetted “to contain” method.

3.3.3 Proving tanks

The capacity of a proving tank shall be determined using either the “to deliver” or pre-wetted “to contain” method.

3.4 Drainage time and delivery time

The drainage times given below for “to deliver” and “pre-wetted” measures have been found to give the required accuracy of measurement for the standard capacity measures, as specified in 2.2.2. However, shorter or longer drainage times in the range of 10 - 180 seconds may be permitted if the uncertainty requirement given in 2.2.1 can be met.

3.4.1 Standard flasks and standard test measures

A standard flask or standard test measure, after being filled to the appropriate scale marks, shall be emptied by pouring so that the liquid flows out at only one point on the rim. After the flow breaks into drops, the standard flask or test measure should be drained by holding it vertically for 30 seconds, then quickly returning it to the upright position.

3.4.2 Proving tanks

A drainage time of 30 seconds should be allowed after the main flow has ceased and the flow breaks into drops.

For proving tanks to which the delivery time applies, it is recommended to specify this delivery time so that the fall rate of the liquid level in the main body of the tank does not exceed 1 cm/s. The proving tank may also be fitted with a sight glass for verifying that it is emptied completely.

3.5 Gravimetric method

The gravimetric method is recommended for the calibration of standard capacity measures.

3.5.1 Standard flasks

Standard flasks shall be calibrated using the gravimetric method described in OIML R 43.

3.5.2 Standard test measures and proving tanks

Standard test measures and proving tanks should be calibrated using a gravimetric method which, in principle, shall follow the method described in OIML R 43. Use of a weighing instrument of an adequate accuracy class, as specified in OIML R 76 *Non-automatic weighing instruments*, is recommended for calibration.

3.6 Volumetric method

Standard capacity measures may be calibrated using the volumetric method, with liquid transfer and other standard capacity measures which have been calibrated to an accuracy level significantly higher than that of the measure to be calibrated. The volumetric method may be used where the capacity of a standard capacity measure is so large that the use of weighing instruments is impracticable or the maximum permissible errors of the available weighing instruments are excessive when compared to those intended for the standard capacity measure.

Two volumetric methods may be used: the withdrawing method and the filling method.

3.6.1 Withdrawing method

This method involves the determination of the volume of water drained by gravity, from the measure being calibrated, into one or several, smaller or equally large, standard capacity measures, which have been calibrated to an accuracy level significantly higher than that of the measure being calibrated.

3.6.2 Filling method

This method consists of filling the standard capacity measure being calibrated with water from a smaller or equally large standard capacity measure that has been calibrated.

rated using the gravimetric method. An automatic pipette is a suitable device for this purpose. This method shall be carried out in situ and within a period so that the water temperature in the standard capacity measure being calibrated will not vary by more than 2 °C during the filling.

4 General requirements for testing measuring systems using standard capacity measures

If the test method is such that the standard capacity measures are used under conditions that differ from their calibration method, repeatability must be guaranteed and any systematical difference must be evaluated and used for correction, if the accuracy cannot be met otherwise.

4.1 Test liquids

A measuring system shall be tested using either the liquid marked on the data plate of the system or a liquid whose viscosity and other flow characteristics are within the ranges of those of the stated liquid.

Any regulation concerning the security for handling the system shall be observed.

A measuring system for milk shall be tested with either milk or potable water. However, during the test in situ, only milk should be used as test liquid.

4.2 Preliminary runs

A sufficient number of preliminary runs shall be carried out before the test run in order to eliminate any air that may be contained in the measuring system or the testing equipment, and to ensure that the temperatures of the liquid used for testing, the measuring system and the standard capacity measures are stable.

A leakage test of the measuring system shall be carried out before the test run.

4.3 Temperature and pressure measurement

4.3.1 Temperature measuring devices shall be used to determine the necessary temperature correction for the test liquid, the measuring system and the standard capacity measures being used. These devices shall be mounted at representative positions for the volume on the measuring system and the testing equipment. It is recommended to use temperature measuring devices with an accuracy of ± 0.2 °C or better. For accurate measurement of large volumes of petroleum products, it may be necessary to measure the temperature to within ± 0.05 °C to take account of the expansion and contraction changes in these products and in the measuring systems. Temperature measuring devices should be provided with calibration certificates.

4.3.2 When a correction for the pressure of the liquid is required, a pressure gauge shall be mounted at a suitable place on the measuring system or the testing equipment. Normally, pressure gauges with an accuracy of ± 0.05 MPa (0.5 bar) will be suitable. Pressure gauges should be provided with calibration certificates.

4.4 Test flowrates

The number of flowrates at which the measuring system shall be checked is specified in OIML R 117, or in other OIML Recommendations for the control of particular measuring systems.

The following flowrates are recommended as a minimum.

4.4.1 For the verification of a meter or for the first stage in a two-stage verification, where the first stage concerns the meter itself or any ancillary devices which must be associated with it and possibly included in a sub-system if these are fitted to the meter, the tests shall be carried out at the following flowrates:

- the minimum flowrate Q_{\min} , stated on the meter,
- the maximum flowrate Q_{\max} , stated on the meter,
- a flowrate between Q_{\min} and Q_{\max} .

4.4.2 For the second stage in a two-stage verification or for the complete test in a single-stage verification, and for the subsequent verification of a measuring system, the tests shall be carried out at the following flowrates:

- the minimum flowrate Q_{\min} , stated on the measuring system,
- the maximum attainable flowrate, but not exceeding Q_{\max} ,
- a flowrate at which the measuring system is normally operated.

4.5 Test volumes

4.5.1 For the verification described in 4.4.1, the smallest volume to be measured at each flowrate shall be as follows:

- at Q_{\min} , the minimum measured quantity stated on the meter,
- at other flowrates, at least three times the minimum measured quantity.

4.5.2 For the verification described in 4.4.2, the smallest volume to be measured at each flowrate shall be as follows:

- at Q_{\min} , the minimum measured quantity stated on the measuring system,
- at other flowrates, at least three times the minimum measured quantity.

4.5.3 It is recommended that, at all flowrates, the test time should never be less than 1 min.

4.5.4 At least one test shall be carried out using a volume equal to the minimum measured quantity.

4.6 Number of test runs

The number of test runs to be carried out at a particular test flowrate is specified in OIML R 117, or in other Recommendations for the control of particular measuring systems. In certain cases, for example in the periodic verification of a fuel dispenser or where there is no risk that the uncertainty introduced will cause doubt about the performance of the measuring system, it may be acceptable to carry out only one test run at each flowrate.

In general, the number of test runs carried out at a particular flowrate shall be more than two so that an estimate may be made with regard to the repeatability of the measurement and also to verify whether each individual measurement meets the maximum permissible errors.

4.7 Calculation of meter error

The value of the meter error is determined using the following equations:

$$\begin{aligned}E &= E' + E_{\alpha} + E_{\beta} \\E' &= [(V_m - V_s) / V_s] \times 100 \\E_{\alpha} &= \alpha (t_s - t_m) \times 100 \\E_{\beta} &= \beta (t_r - t_s) \times 100\end{aligned}$$

where

E is the meter error, in %

E' is the uncorrected error, in %

E_{α} is the temperature correction for the test liquid, in %

E_{β} is the temperature correction for the standard capacity measure (%)

V_m is the volume indicated by the meter, in L

V_s is the volume measured in the standard capacity measure, in L

t_s is the average liquid temperature in the standard capacity measure, in °C

t_m is the average liquid temperature in the meter, in °C

t_r is the reference temperature of the standard capacity measure, in °C

α is the cubic expansion coefficient of the test liquid due to temperature, in °C⁻¹

β is the cubic expansion coefficient of the standard capacity measure due to temperature, in °C⁻¹

Notes: α : Refer to OIML R 63 or ISO 91-1 for petroleum products; refer to ISO 8222 for water

β : 33×10^{-6} °C⁻¹ for mild steel, 51×10^{-6} °C⁻¹ for stainless steel

An example of a test report is given in Annex A.

5 Test procedures for the verification of measuring systems

The test procedures described in clauses 6 to 12 may be used for the testing of the following typical measuring systems:

clause 6: • meter on its own or fitted with ancillary devices

clause 7: • fuel dispenser

clause 8: • measuring system on a road tanker

clause 9: • measuring system for the unloading of road and rail tankers, ships' tanks and tank containers

clause 10: • measuring system for the loading of road and rail tankers, ships' tanks and tank containers

clause 11: • measuring system fitted into a pipeline

clause 12: • measuring system for milk

It should be noted that there exist many other acceptable methods which may be described in OIML Recommendations or in ISO Standards; example below are given to illustrate the range. The sole criterion for the acceptability of a method is whether it complies with the metrological requirements of this Recommendation and thus ensures the integrity of testing.

6 Test procedure for a meter on its own or fitted with ancillary devices (Figure 3)

N°	Procedure	P	V ₁	V ₂	V ₃	V ₄	V ₅	Description	
1	Before the test	X	X	X	X	X	X	(*)	
2	Meter installation in the test line								
3	Preliminary run	O	O	O	O	O	X	Fill proving tank to V _{s2}	
4	Proving tank draining	X	X	X	X	O	O	Drain to approx. zero (V _{s1}) (**)	
5	Start reading	Observe and record V _{m1} and V _{s1}							(***)
6	Test run	(1)	O	O	O	O	O	X	Fill to V _{s2} (****)
		(2)	X	X	X	X	O	X	Keep closed
		(3)	Observe and record V _{m2} and V _{s2}						
		(4)	Observe and record t _m , t _{s1} , t _{s2} , t _{s3}						
7	Proving tank draining	X	X	X	X	O	O	Drain to approx. zero (V _{s1})	
8	Calculate uncorrected error E' (%)								
9	Calculate meter error E (%) (E = E' + E _α + E _β) (*****)								

(*) Symbols used: O = open; X = closed (pump or valve). These symbols are also used in the following tables.

(**) The standard test measure and the proving tank shall be emptied and drained as described in 3.4.

(***) V_m: Volume indicated by the meter or system; V_s: Volume measured in the standard capacity measure.

(****) Flowrate shall be controlled V₄.

(*****) Average temperature t_m is determined by the results observed during test flow and t_s is determined from t_{s1}, t_{s2} and t_{s3} observed promptly after reading the volume.

(*****) E', E, E_α, E_β: refer to 4.7. This note applies also to the following tables.

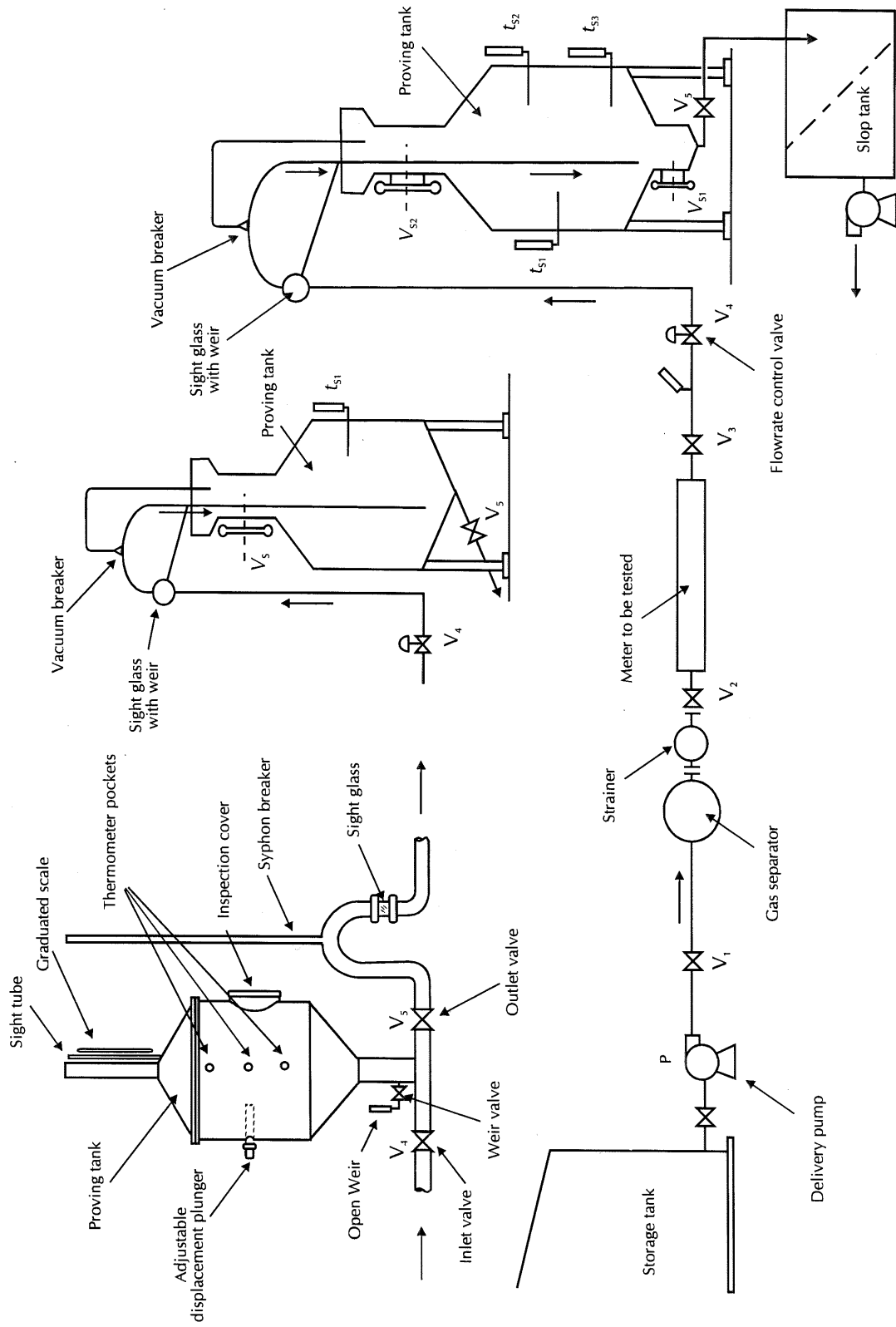


Figure 3

7 Test procedure for a fuel dispenser (Figure 4)

N°	Procedure	N	S _w	P _m	V ₁	V ₂	Description	
1	Before the test operation	X	X	X	X	X		
2	Preliminary run	(1)	Insert nozzle into reservoir					
		(2)	O	O	O	O	X	Approx. 50 L at test flowrate
		(3)	Insert closed nozzle into standard capacity measure					(*)
		(4)	O	O	O	O	X	Approx. full V _s at test flowrate
3	Standard capacity measure draining	X	O	O	X	O		
4	Test run	(1)	Reset indicator to zero					(**)
		(2)	O	O	O	X	X	Full V _s at test flowrate (***) (****)
		(3)	Observe and record V _m and V _s					
5	Standard capacity measure draining	X	O	O	X	O		
6	Calculate meter error for the test run E' (%)							
7	When the measuring system is fitted with a price indicator and/or a printer, such devices shall be checked during the test							

(*) A proving tank, or a large or small standard test measure, is used according to the volume to be measured at each test flowrate.

(**) Every testing shall be carried out after resetting the volume indicator to zero.

(***) Flowrate shall be controlled by the nozzle.

(****) The nozzle shall be taken out of the standard capacity measure after it has been closed and the interval between drops is not less than 5 s.

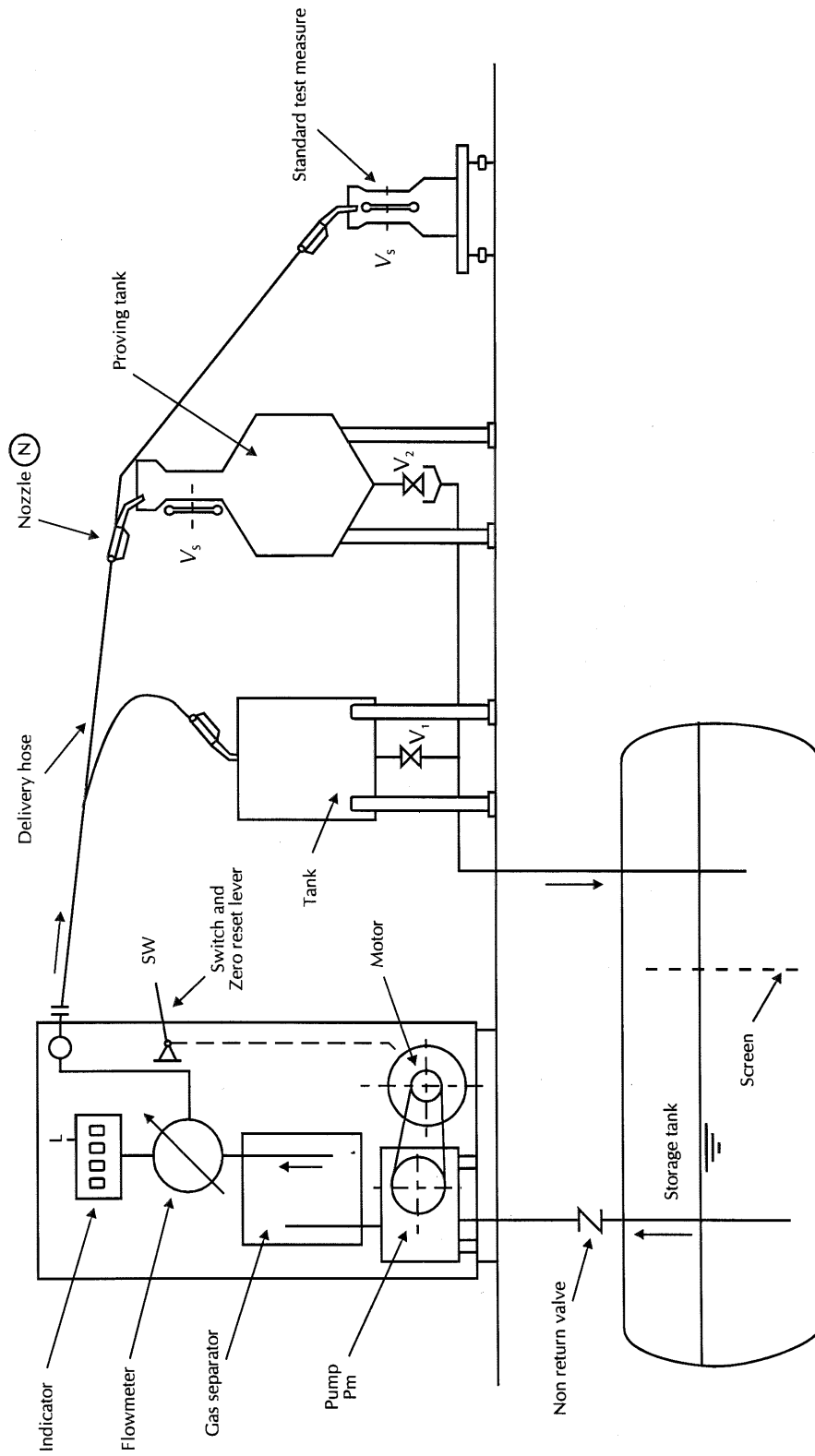


Figure 4

8 Test procedure for a measuring system on road tanker

8.1 In the case of a road tanker with delivery pump (Figure 5)

N°	Procedure	P ₁	V ₁	V ₂	V ₃	P ₂	V ₄	Description	
1	Before the test	X	X	X	X	X	X		
2	Connect delivery hose to inlet of proving tank (*) and open compartment valve(s)								
3	Preliminary run	O	O	O	X	X	X	Fill proving tank to V _{s2}	
4	Proving tank draining	X	X	X	O	O	O	Drain to approx. zero (V _{s1})	
5	Start reading	Observe and record V _{m1} and V _{s1}							
6	Test run	(1)	O	O	O	X	X	X	Fill to V _{s2} (**)
		(2)	X	X	X	X	X	X	Keep closed
		(3)	Observe and record V _{m2} and V _{s2}						
		(4)	Observe and record t _m , t _{s1} , t _{s2} , t _{s3}						
7	Proving tank draining	X	X	X	O	O	O	Drain to approx. zero (V _{s1})	
8	Calculate uncorrected error E' (%)								
9	Calculate meter error E = E' + E _α + E _β (%)								

(*) A portable proving tank may be used. This note applies also to the following clauses.

(**) Flowrate shall be controlled by V₁.

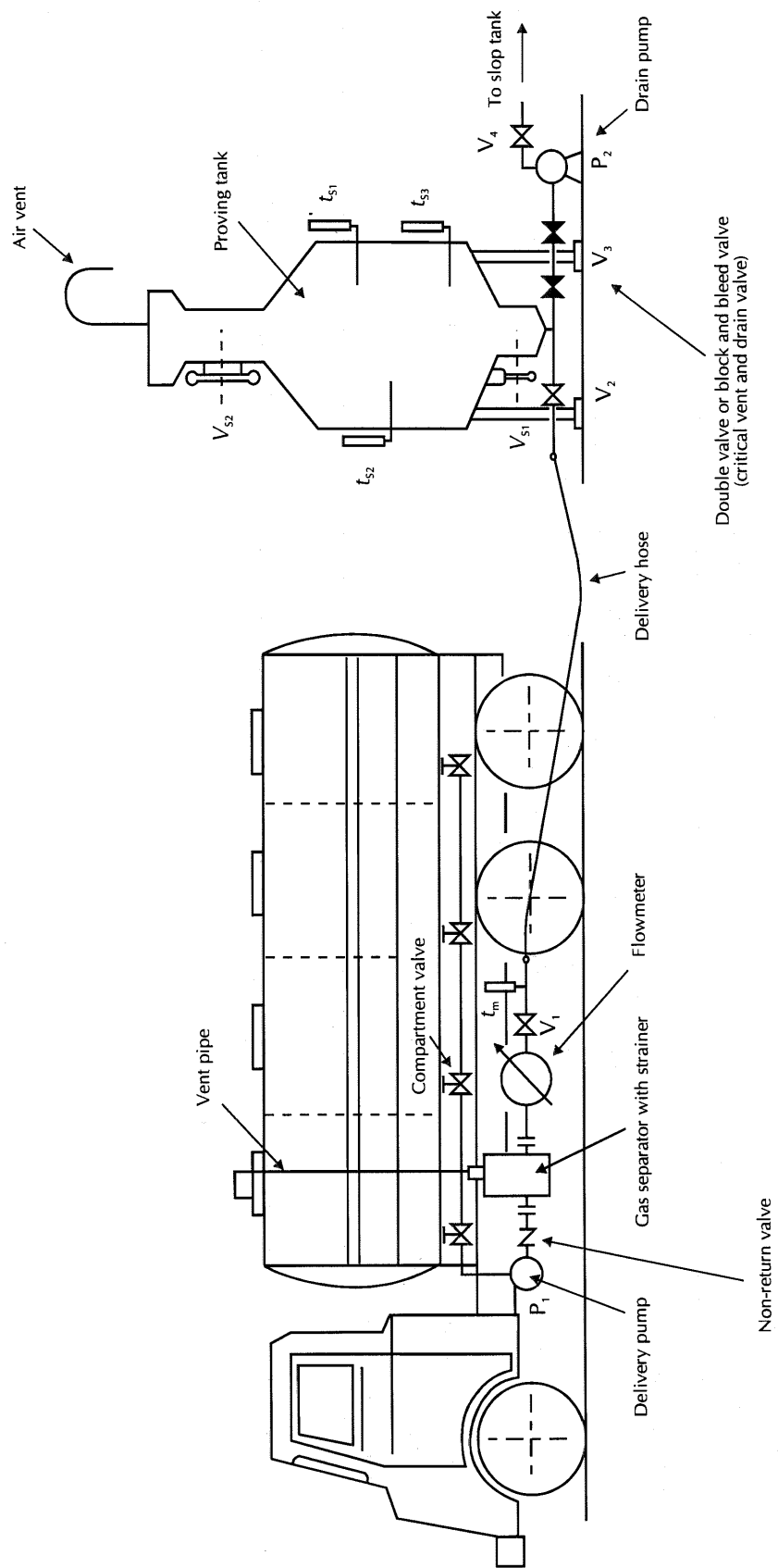


Figure 5

8.2 In the case of a road tanker delivered by gravity (Figure 6)

N°	Procedure	V ₁	V ₂	V ₃	P ₂	V ₄	Description	
1	Before the test	X	X	X	X	X		
2	Connect delivery hose to inlet of proving tank and open compartment valve(s)							
3	Preliminary run	O	O	X	X	X	Fill proving tank to V _{s2}	
4	Proving tank draining	X	X	O	O	O	Drain to approx. zero (V _{s1})	
5	Start reading	Observe and record V _{m1} and V _{s1}						
6	Test run	(1)	O	O	X	X	X	Fill to V _{s2}
		(2)	X	X	X	X	X	Keep closed
		(3)	Observe and record V _{m2} and V _{s2}					
		(4)	Observe and record t _m , t _{s1} , t _{s2} , t _{s3}					
7	Proving tank draining	X	X	O	O	O	Drain to approx. zero (V _{s1})	
8	Calculate uncorrected error for the test run E' (%)							
9	Calculate meter error E = E' + E _α + E _β (%)							

Note: In the case of a road tanker delivered by gravity, it is essential to ensure a sufficient height difference, *H*, between the road tanker and the proving tank for obtaining the test flowrates.

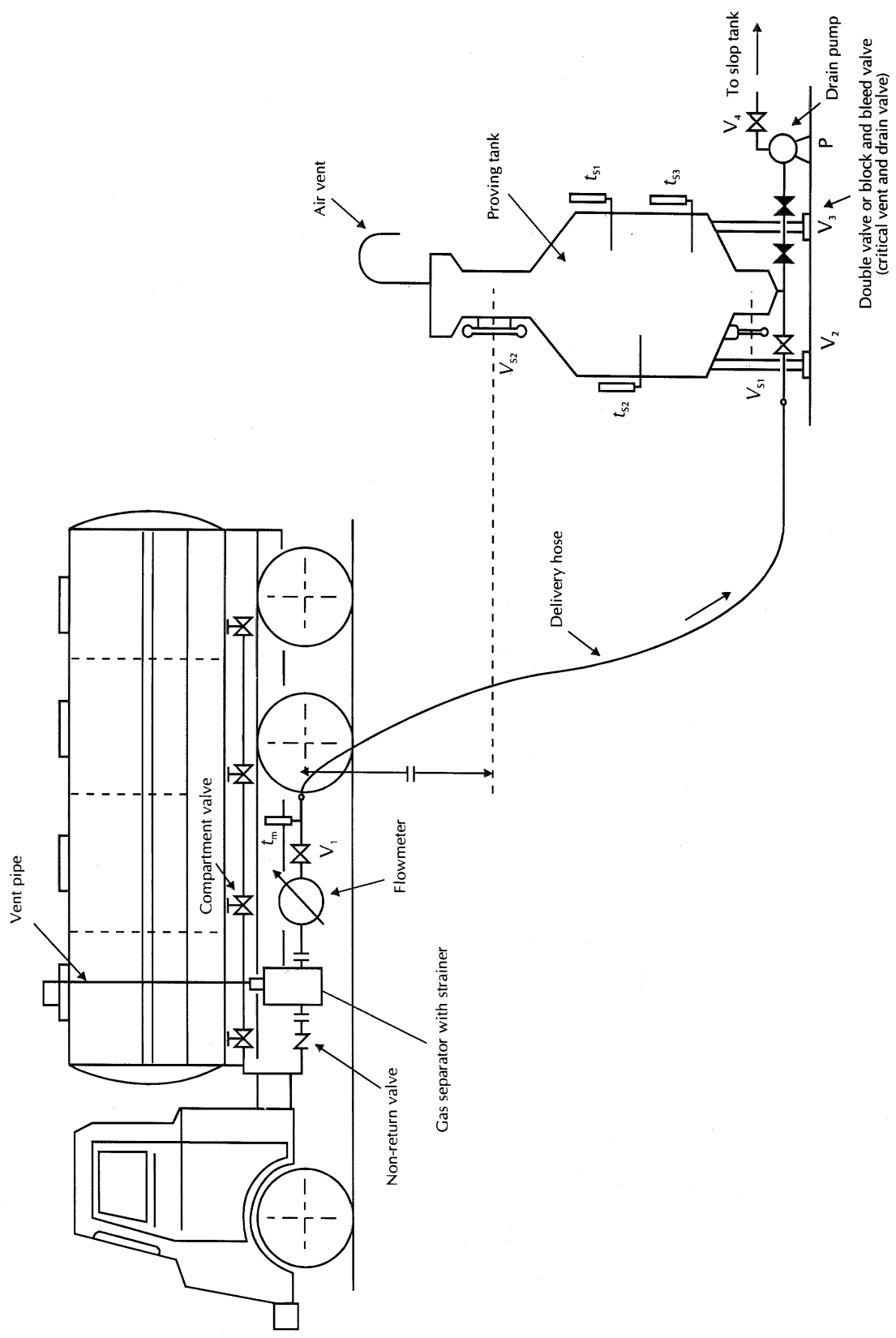


Figure 6

9 Test procedure for a measuring system for the unloading of road and rail tankers, ships' tanks and tank containers

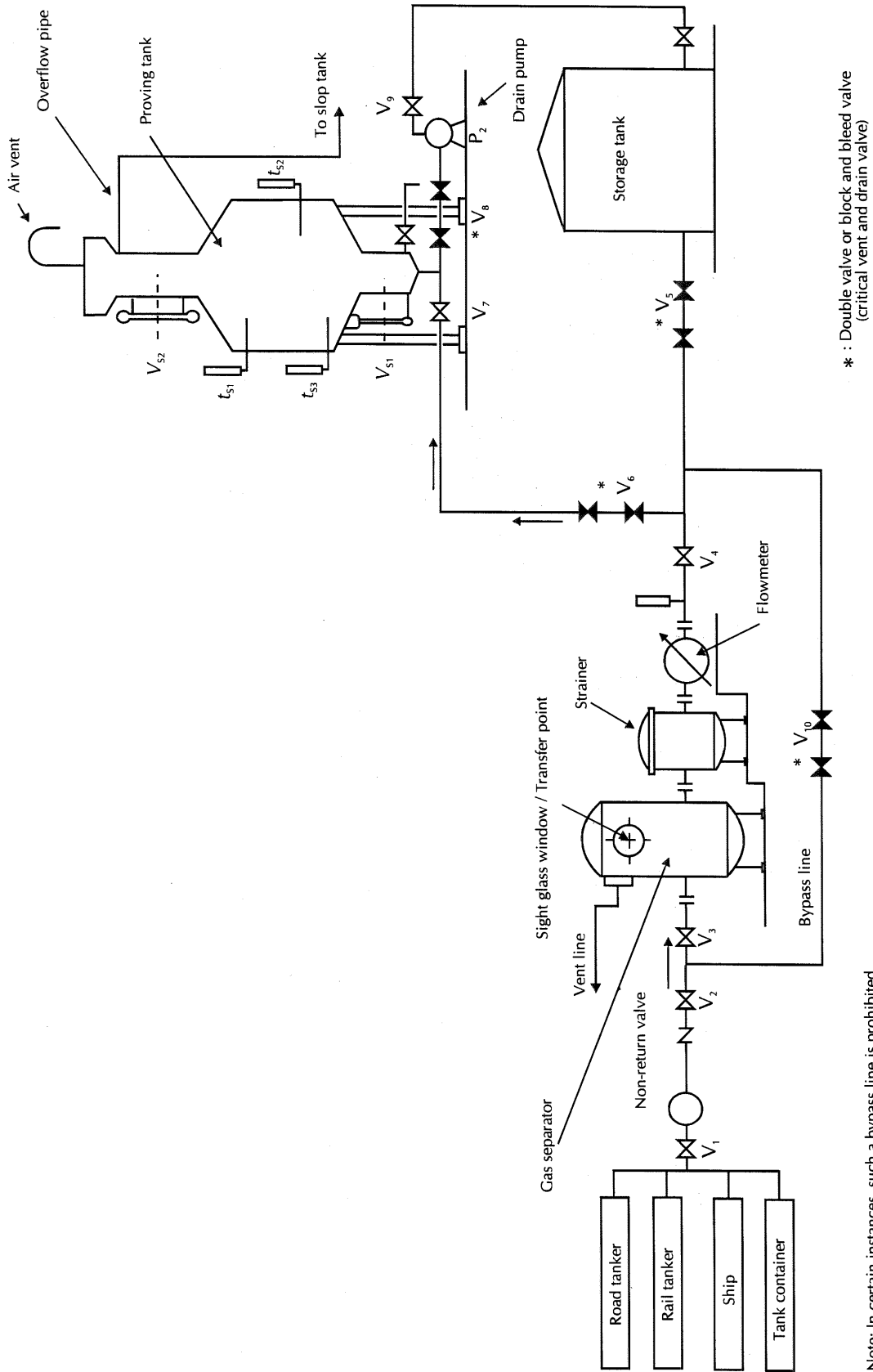
9.1 Test run being carried out during unloading operation (Figure 7)

N°	Procedure	P ₁	V ₁	V ₂	V ₃	V ₄	V ₅	V ₆	V ₇	V ₈	P ₂	V ₉	Description
1	Preliminary run	O	O	O	O	O	X	O	O	X	X	X	Fill proving tank to V_{s2}
2	Proving tank draining	X	X	X	X	X	X	X	X	O	O	O	Drain to approx. zero (V_{s1})
3	Test procedure	Refer to 8.1, Nos. 5 to 9											

Notes: (1) Flowrate shall be controlled by V₄.

(2) It is essential to maintain a constant level on the sight glass of the gas separator in which the transfer point is shown during a test run. This note applies to the following clauses.

(3) In bypass line, double valve or block-and-bleed valve, V₁₀, should be blocked securely. This note applies to the following clauses.



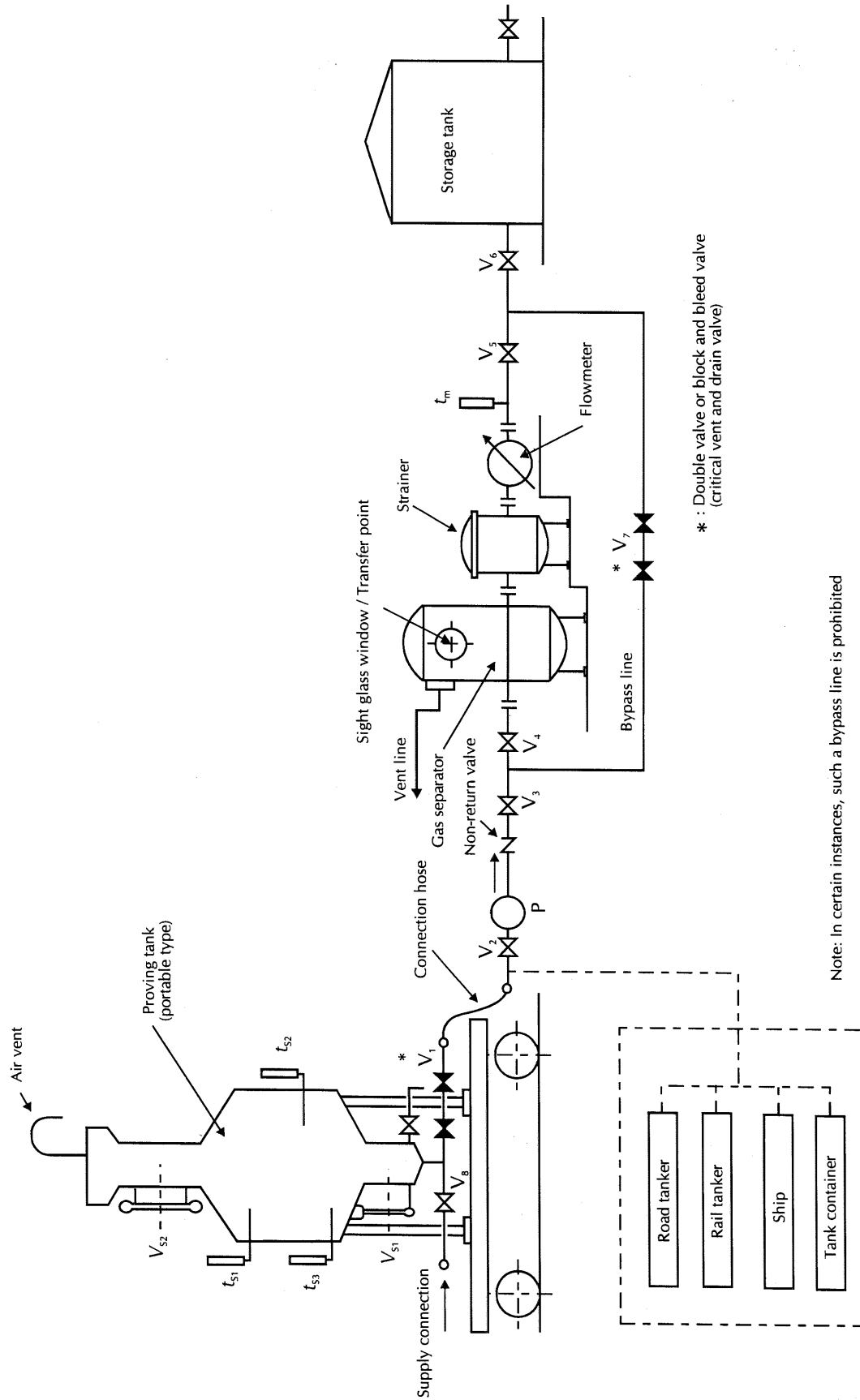
Note: In certain instances, such a bypass line is prohibited

Figure 7

9.2 Test run being carried out without unloading operation (Figure 8)

N°	Procedure	P	V ₁	V ₂	V ₃	V ₄	V ₅	V ₆	V ₈	Description	
1	Proving tank filling	X	X	X	X	X	X	X	O	Fill proving tank to V _{s2} from supply connection	
2	Connect ready filled proving tank to unloading pump of road tanker, etc.										
3	Preliminary run	O	O	O	O	O	O	O	X	Nos. 3 and 4 shall be done at the same time	
4	Proving tank draining	O	O	O	O	O	O	O	X		
5	Proving tank filling	X	X	X	X	X	X	X	O	Fill proving tank to V _{s2}	
6	Start reading	Observe and record V _{m1} and V _{s2} , and t _{s1} , t _{s2} , t _{s3}									
7	Test run	(1)	O	O	O	O	O	O	O	X	Other valves should be closed
		(2)	Observe and record t ₁								
		(3)	O	O	O	O	O	O	O	X	Drain to approx. zero (V _{s1})
		(4)	X	X	X	X	X	X	X	X	Keep closed
		(5)	Observe and record V _{m2} and V _{s1}								
8	Proving tank filling	X	X	X	X	X	X	X	O	Fill proving tank to V _{s2}	
9	Calculate uncorrected error for the test run E' (%)										
10	Calculate meter error E = E' + E _α + E _β (%)										

Note: This method should be applied e.g. when the test is impossible during an unloading operation.



* : Double valve or block and bleed valve
(critical vent and drain valve)

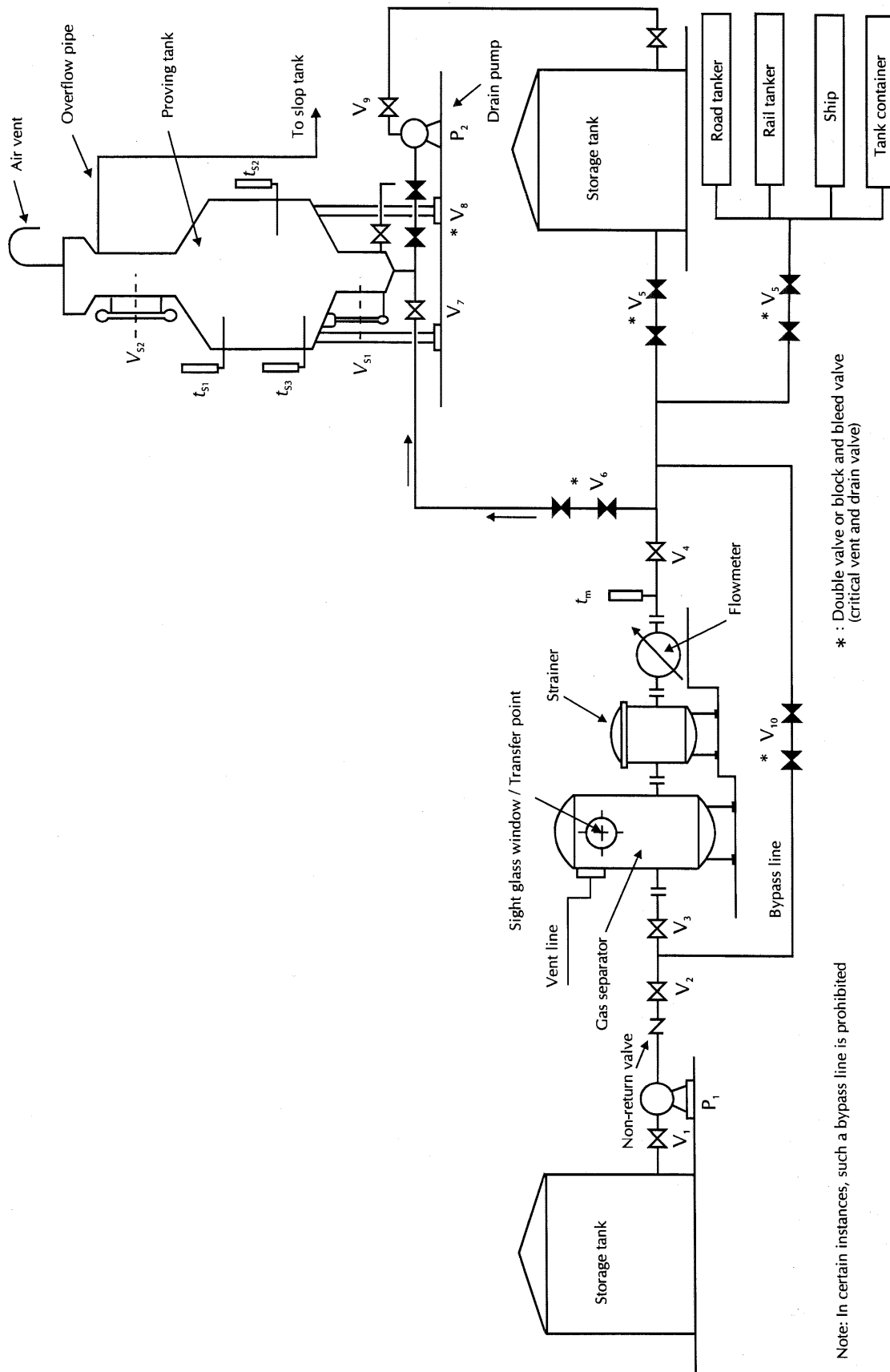
Note: In certain instances, such a bypass line is prohibited

Figure 8

10 Test procedure for a measuring system for the loading of road and rail tankers, ships' tanks and tank container (Figure 9)

N°	Procedure	P ₁	V ₁	V ₂	V ₃	V ₄	V ₅	V ₆	V ₇	V ₈	P ₂	V ₉	Description
1	Preliminary run	O	O	O	O	O	X	O	O	X	X	X	Fill proving tank to V _{s2}
2	Proving tank draining	X	X	X	X	X	X	X	X	O	O	O	Drain to approx. zero (V _{s1})
3	Test procedure	Refer to 8.1, Nos. 5 to 9											

Note: Flowrate shall be controlled by V₄.



* : Double valve or block and bleed valve (critical vent and drain valve)

Note: In certain instances, such a bypass line is prohibited

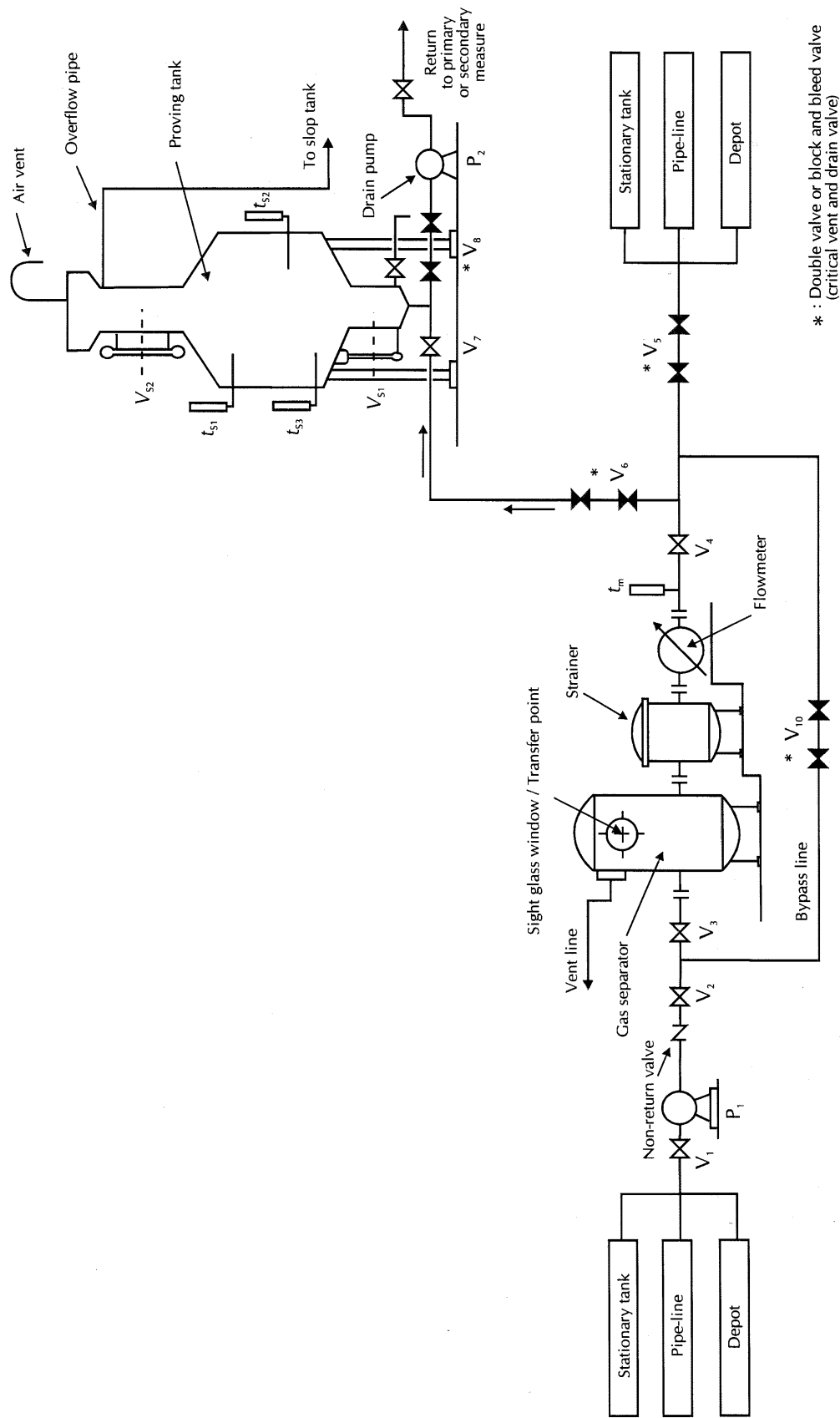
Figure 9

11 Test procedure for a measuring system fitted into a pipeline (Figure 10)

N°	Procedure	P ₁	V ₁	V ₂	V ₃	V ₄	V ₅	V ₆	V ₇	V ₈	P ₂	V ₉	Description
1	Preliminary run	O	O	O	O	O	X	O	O	X	X	X	Fill proving tank to V_{s2}
2	Proving tank draining	X	X	X	X	X	X	X	X	O	O	O	Drain to approx. zero (V_{s1})
3	Test procedures	Refer to 8.1, Nos. 5 to 9											

Notes: (1) Flowrate shall be controlled by V_4 .

(2) Drained liquid from the proving tank may be returned to either the primary installation or to the secondary installation.



Note: In certain instances, such a bypass line is prohibited

Figure 10

12 Test procedure for a measuring system for milk

12.1 Road tanker with delivery pump (Figure 11)

Refer to 8.1, Nos. 3 to 9.

12.2 Road tanker with suction pump (Figure 12)

Refer to 9.2, Nos. 3 to 10. In this case, the valve V_7 is always closed during the test.

12.3 Reception at dairy (Figure 13)

Apply the procedure referred to in 12.1.

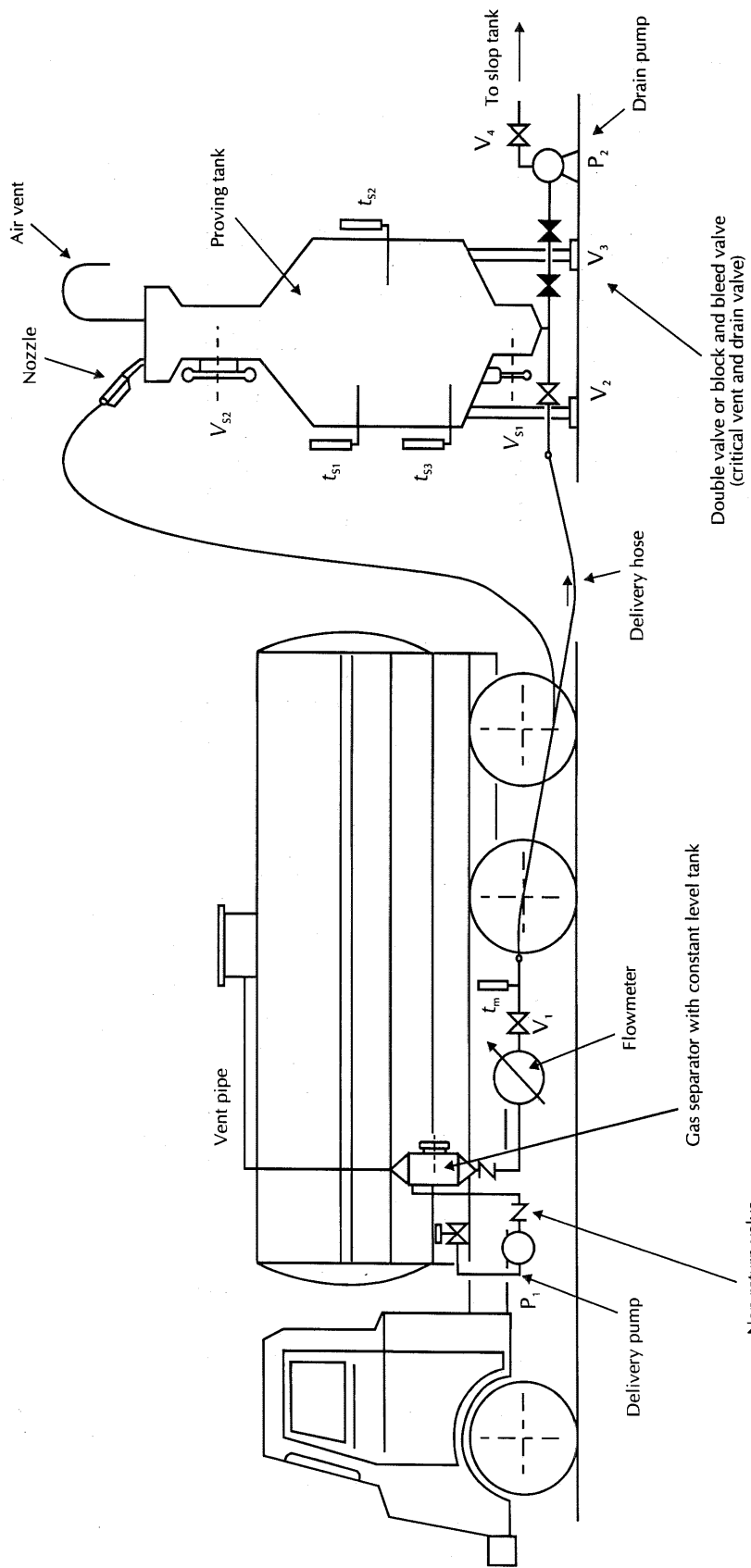
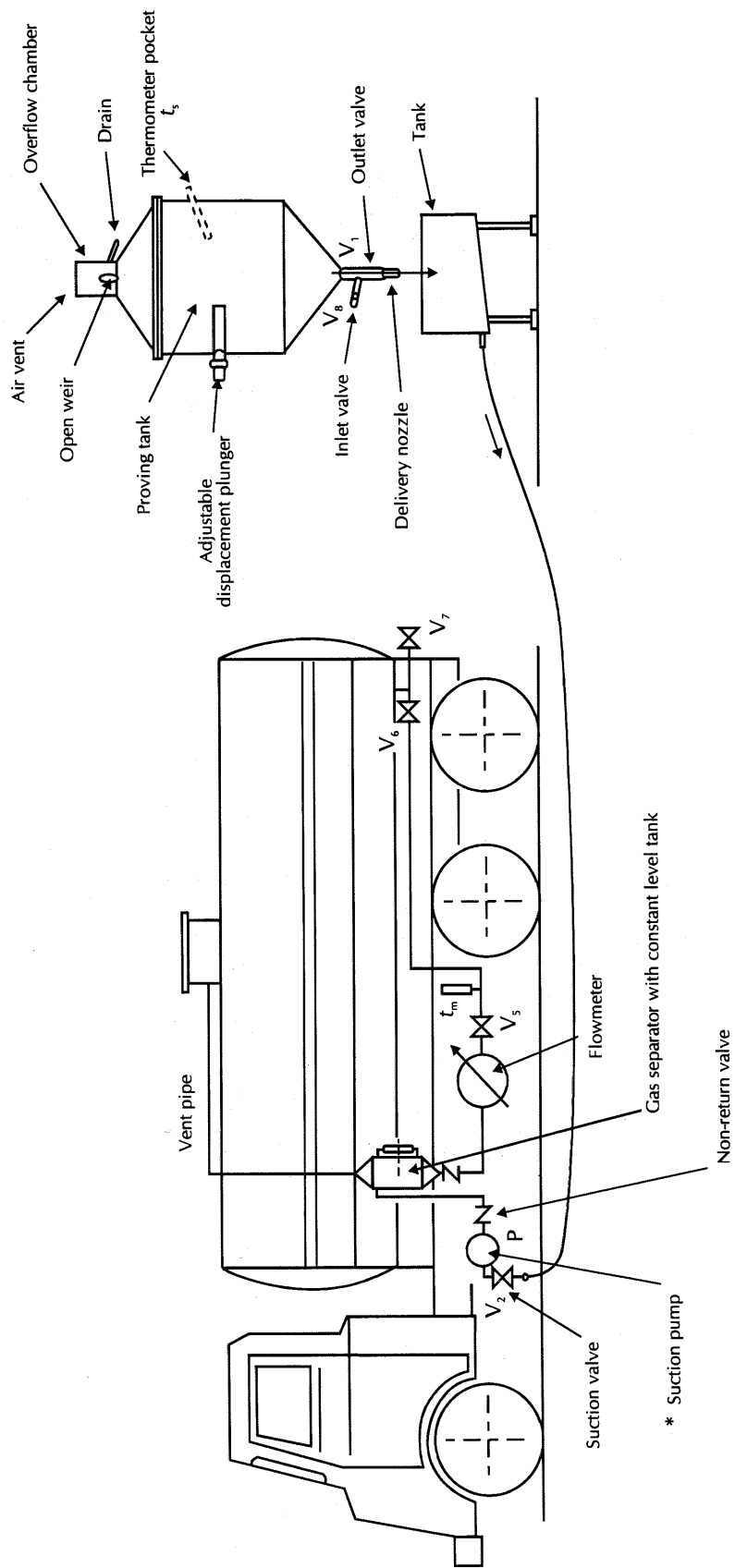
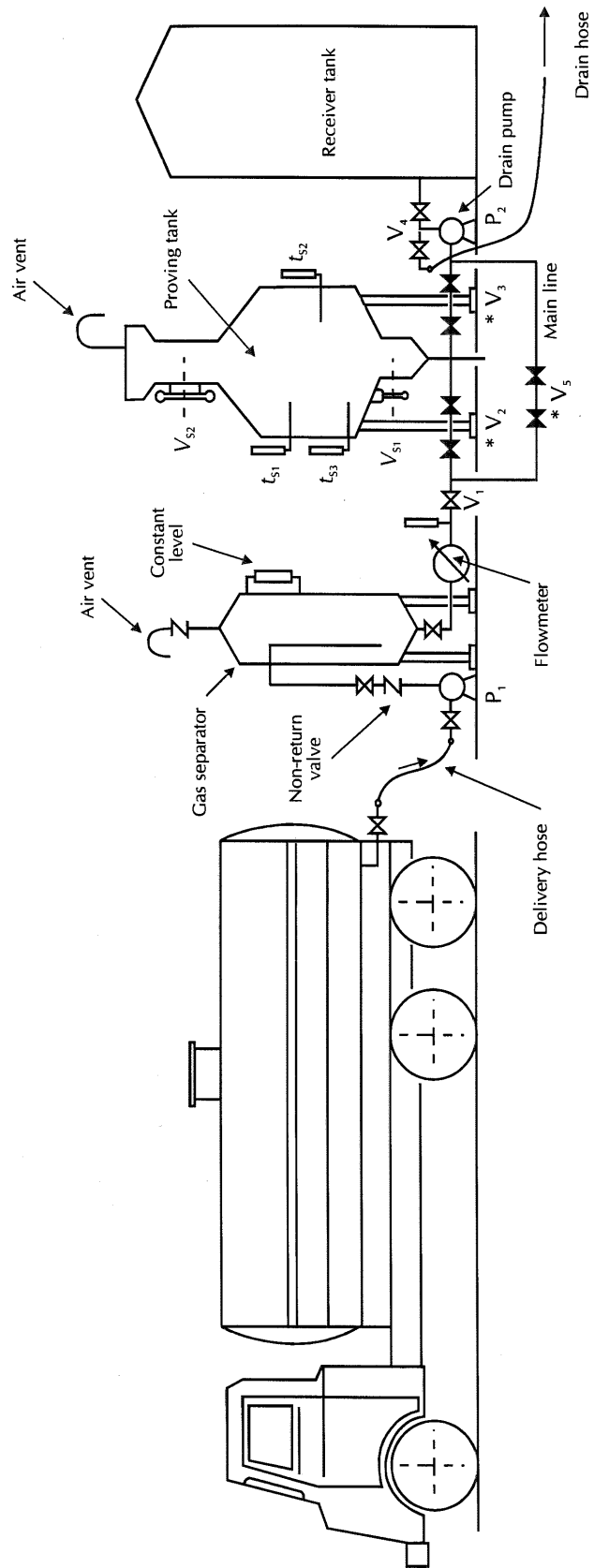


Figure 11



* For 1) Collection
 2) Connecting to standard flask

Figure 12



* Double valve or block and bleed valve
(critical vent and drain valve)

Figure 13

ANNEX A
EXAMPLE OF TEST REPORT
(Informative)

Location:				Date:			
Test liquid:				Viscosity of test liquid: _____ mPa at _____ °C			
Designation of meter:		Meter model:		Identification number of meter:			
Type and capacity of standard:				Identification number of standard:			
Test flowrate m ³ /h							
No	Item						
1	Liquid temperature in standard measure						
	$t_{s1} - - t_{s3}$	°C					
	Average liquid temperature t_s						
2	Closing measure reading V_{s2}			L			
3	Opening measure reading V_{s1}			L			
4	$V'_s = V_{s2} - V_{s1}$			L			
5	Volume to be corrected v			L			
6	$V_s = V'_s + v$			L			
7	Measure filling time			min			
8	Actual flowrate			m ³ /h			
9	Liquid temperature in meter						
	$t_{m1} - - t_{m3}$	°C					
	Average liquid temperature t_m						
10	Closing meter reading V_{m2}			L			
11	Opening meter reading V_{m1}			L			
12	Indicated volume of meter $V_m = V_{m2} - V_{m1}$			L			
13	Uncorrected error E'			%			
14	Temp. correction for test liquid E_α			%			
15	Temp. correction for standard measure E_β			%			
16	Meter error E			%			

For: _____

Signed by: _____

Notes:

$$E = E' + E_\alpha + E_\beta$$

$$E' = [(V_m - V_s) / V_s] \times 100$$

$$E_\alpha = \alpha (t_s - t_m) \times 100$$

$$E_\beta = \beta (t_R - t_s) \times 100$$

$$\alpha = \text{_____ } ^\circ\text{C}^{-1}$$

$$\beta = \text{_____ } ^\circ\text{C}^{-1}$$