Notice for the Korean Agency of Technology and Standards **No. 2004 – 323**

In amending the technical criteria (Type Approval Criteria, Authorisation Criteria and Regular Test Criteria) of graduated tankers, which is entrusted to the Head of the Korean Agency of Technology and Standards according to the regulations articles 6, 12, and 17 of the Measures Act, ordinance article 18 of the same Act, and the enforcement regulation of the same Act, we give public notice of the objective and major contents of the amendment according to the regulations of article 41, clause 1 of the Administration Procedures Act in order to get feedback from concerned industries and individuals as follows:

December 18th, 2004

Head of the Korean Agency of Technology and Standards

Advance Notice of Amendment to Technical Criteria of Graduated Tankers

1. Objective of Amendment

This amendment is intended to make the technical criteria of Graduated Tankers, one of domestic legal gauges, in line with recommendations of OIML in order to improve the quality of Graduated Tankers and to give support to exporting companies by eliminating technical barriers to trade.

2. Major Contents

A. Amendment (Plan) of technical criteria concerning graduated tankers: As attached (if posted on Official Gazette, no attachment).

- Type Approvals Criteria, Authorisation Criteria.

* If you would like to know the entire contents of the graduated tankers' technical criteria amendment, please refer to the notice section of the Korean Agency of Technology and Standards web site (www.ats.go.kr), or read the contents at the Agency's office of Gauge and Measure Standards Section.

B. Quoted Specifications of Graduated Tankers

- Among OIML R 80(Road and rail tankers), those for roads are quoted.

C. Supplementary Provisions

a) Proposed Date of Enforcement

- The authorisation criteria of graduated tankers will become effective on July 1st, 2006. However, the authorisation of products, which are granted type approvals according to these criteria, can be made using these criteria.
- The type approvals criteria of graduated tankers will become effective as of the notice date.

b) Intermediate Action

- The regular test for products that have received authorisations or tests according to the previous criteria before the new criteria are applied will be made with the previous criteria.

3. Presentation of Feedback

If any individual, company, or organisation has an opinion on the attached data regarding the above-mentioned amendment, please provide the Gauge and Measure Standard Section of the Agency with the opinion in writing as follows:

A. Deadline: February 17th, 2005 (Thursday)

B. Opinion on the amendment (Pros or Cons and the reason)
C. Personal Information of the Opinion Presenter (Name, Address and Telephone Number)
D. In the case of an organisation, please provide information about the organisation (Name of organisation, Name of representative, Address and Telephone Number)
E. For more details, please contact us at the Gauge and Measure Standard Section of the Agency (2bunji, Jungang-dong, Gwachon-shi, Kyonggi-do Tel: 02) 509-722931, Fax: 02) 507-6875).

Amendment (Plan) of Technical Criteria of Graduated Tankers

Contents

Section 1 Type Approvals criteria of Graduated tankers

These criteria define technical requirements, testing methods and test procedures for type approvals of graduated tankers based on the regulations of article 6 of the Measures Act and enforcement regulation 9 of the same Act.

1 – 1 General Requirements

1. Scope of Application

These criteria shall be applied to graduated tankers (hereafter referred to as “tankers”), which are installed on cars and used for carrying liquids and gauging their volumes, regulated under article 8 of the enforcement regulation of the Measures Act. **Remarks:** As the volumes of products contained inside can vary according to temperature, for commercial trades, the nominal capacity of a tanker should be used after being corrected. (See Annex 1)

2. Quoted Specification

The below quoted specifications constitute the regulation of parts. These specifications are the latest versions.

2.1 KS A 3009 Measures terms
2.2 KS B 5341 Tanker attached with ruler (Graduated tanker) for cars
2.3 OIML R 71 Fixed storage tanks
2.4 OIML R 80 Road and rail tankers
2.5 OIML R 85 Automatic level gauges for measuring the level of liquid in fixed storage tanks
2.6 OIML R 120 Standard capacity measures for testing measuring systems for liquids other than water

3. Definition of Terms

3.1 Level Gauge An instrument to be used for gauging the level of liquids contained in tankers according to standards
3.2 Graduated tankers Tankers attached with level-gauging instruments such as graduated ruler or fixed ruler.
3.3 Nominal capacity of a tanker The volume of liquid that a tank contains under rated operating conditions, at reference temperature
3.4 Rated operating condition A condition that must be fulfilled during measurement in order that a measuring system performs as designed
3.5 Total contents The maximum volume of liquid that a tank may contain up to overflowing, under rated operating conditions, at reference temperature.
3.6 Expansion volume The difference between total contents and nominal capacity.
3.7 Vertical measurement axis The vertical line on which the levels of liquid are gauged.
Note: When the levels are measured by means of a sight glass and graduated ruler, the vertical measurement axis passes virtually through the centre of the dome.
3.8 Reference point (P) A point on the vertical measurement axis, with reference to which the ullage height is measured.
3.9 Ullage height (C) The distance between the free surface of the liquid and the reference point, measured along the vertical measurement axis.
3.10 Reference height (H) The distance, measured along the vertical measurement axis, between the reference point and the foot of the vertical measurement axis, on the inner surface of the tank, or on the dip plate.

3.11 Dip plate A horizontal plate located along the vertical axis descending from the upper reference point, providing a fixed contact surface from which manual liquid depth measurements are made.
3.12 Dipping datum point The intersection of the vertical measurement axis with the upper surface of the dip plate, or with the bottom surface of the tank, if the dip plate is not provided. It constitutes the origin for the measurement of liquid levels (zero reference).
3.13 Sensitivity of a tank in the vicinity of a filling level h The change in the level, Δ V, divided by the corresponding relative change in volume, Δ V/ V for the contained volume V corresponding to the level h.
3.14 Deadwood Any tank fitting which affects the capacity of a tank.
Deadwood is referred to as « positive deadwood » when the capacity of the fitting adds to the effective capacity of the tank, or « negative deadwood » when the volume of the fitting displaces liquid and reduces the effective capacity.
3.15 Test. A series of operations intended to verify the compliance of the equipment under test with certain requirements.

4. Classification and requirements
4.1 Tankers may be classified according to the following criteria:
- Method of mounting the tank on the vehicle,
- Ancillary installations,
- Conditions of use (influence factors),
- Capacity (in general, between 0.5 and 50 m3).

4.1.1 As regards the method of mounting on the vehicle, the tanks may be:
- mounted directly and permanently on the chassis of a vehicle, trailer, or semi-articulated trailer, or be self-propelled,
- detachable, mounted temporarily on the vehicle by means of devices which ensure that the position of the tank when mounted on the vehicle remains unchanged.

4.1.2 As regards ancillary installations, tanks may be with or without installations for measuring partial volumes received or delivered.
4.1.3 The main influence factors, which can have a major effect during calibration and use of road tankers, are pressure and temperature.
a) As regards pressure, the tanks may be:
- at atmospheric pressure,
- under pressure (for liquefiable gases).

b) As regards temperature, the tanks may be:
- without means for heating and with or without thermal insulation of the contents,
- with means for heating and with or without thermal insulation of the contents.

4.2 Some road tankers are divided into compartments, each being considered as a separate tank and subject to the requirements of this Amendment.
4.3 Each tank or tank compartment on a road tanker shall comprise:
- a shell and ends,
- a dome with reinforcing elements, as appropriate (for example, pressurised tanks or tanks for the transport of certain chemical products may not or shall not be provided with domes),
- discharge devices.

4.3.1 The shell is generally horizontal and cylindrical in form, and is mounted on the vehicle in such a way that it drains completely.
4.3.2 The dome, when fitted, serves as a manhole and as an expansion chamber, but it is provided mainly to increase the sensitivity of the tank and is situated at the top of the tank. The

dome may incorporate the following:
— a filling aperture, fitted with leak-proof cover,
— an orifice for the observation the filling process,
— a venting device or double-acting safety valve.
The level index may be in the dome or in the upper part of the shell, provided that the sensitivity requirements are met (see Annex 2).
4.3.3 The discharge device shall comprise a discharge pipe with a stop valve at its end; a foot valve may stop the flow of liquid between the tank and the discharge pipe. Some tanks may incorporate devices fitted at the lowest point for water separation.
4.3.4 In general, road tankers shall be provided with a ladder giving access to the dome, and a platform for the operator affecting the measurement or checking the tank.

5. Units of measurement The authorised units of measurements are those of the International System of Units (SI).

6. Technical requirement

6.1 General requirements Shapes, materials, reinforcing elements and methods of shaping or assembly shall be chosen so that the tanks are sufficiently unaffected by atmospheric agents and the liquids they contain and are practically not subject to distortion under rated operating conditions.
6.1.1 The designs shall be functional, taking into account the tankers functions of storage and transport and the nature of the liquid it is intended to contain and the structural characteristics of the tank (shape and material), shall have no adverse effect on the quality of the liquid transported
6.1.2 The vessel shall be leak tested using water at atmospheric pressure; after filling, the tank shall show no traces of leakage or dampness at the joints.
6.1.3 The reference height H of any tank or compartment shall not vary during filling by more than the larger of the following two values:
• 2 mm,
• H /1 000.
6.1.4 The capacity of a compartment shall not change by more than 1/1 000 of its measured volume when the neighbouring compartments are filled or emptied.
6.1.5 Every tank or compartment shall be of such a shape that no air is trapped on filling and no liquid is retained on emptying in all normal positions of using the equipment. Spouts, mouldings or vent pipes and valves may be used in order to comply with the above requirements. To ensure complete drainage the lower generatrix of the tank shall have a slope of at least 2° with the vehicle on level ground, in the most unfavourable position concerning the order in which the compartments are emptied. A tolerance of 1/5 of the maximum acceptable calibration error, for the volume of water remaining in the tank on the complete draining test, is permitted.
6.1.6 Anti-wave devices and reinforcing elements that may be fitted in the tank shall be of a shape and shall be provided with appropriate orifices so that filling, draining and checking the emptiness of the tank is not impeded.
6.1.7 The placing of deadwood inside the tank for the purpose of adjusting the capacity to a given value, or any other body which when removed or changed, could modify the capacity of the tanks, is prohibited.

6.2 Dome and level-gauging device

The dome, when fitted, shall be on the upper part of the body and shall be welded to the latter. In general, the level-gauging device shall be inside the dome.
6.2.1 The dome may have a cylindrical or parallelepipedic form, with vertical side-walls. If the dome is parallelepipedic in form it may be of the same length as the tank itself.
If the sidewalls of the dome are mounted so that they penetrate the tank shell, the formation of air pockets in the upper part of the shell shall be avoided by providing orifices or cutouts at the level of the upper internal generatrix.
6.2.2 The transverse section of the shell and dome shall have a vertical axis of symmetry.
The dimensions of the horizontal section of the dome shall be such as to allow inspection of the interior of the tank. A diameter of at least 500 mm is recommended.
6.2.3 The level-gauging device (see Annex 2) shall ensure a safe, easy and unambiguous readout, practically independent of tank tilt under rated operating conditions.
The index (indices), or the vertical measurement axis, shall be as near as possible to the centre of the horizontal sections of the tank.
6.2.4 The shape of the tank lorry shall be such that, in the zone where the level of the contained liquid is gauged, a sensitivity of at least 2 mm for 1/1 000 of the contained volume is attained.
6.2.5 The specification of the nominal capacity shall take into account the national or international regulations prescribing the maximum filling level of tanks (see Annex 3).
6.2.6 The use of ancillary devices to facilitate reading of the index (indices) or to stop the flow automatically when the level of the liquid reaches the index is permitted, provided that no additional measurement errors are introduced.

6.3 Discharge device The discharge device shall ensure complete and rapid discharge of the liquid contained in the tank; for this purpose, the discharge device shall be connected to the lowest part of the tank shell.
6.3.1 Each tank shall have a single drain orifice and a single stop valve.
For special construction tanks designed for use at airports, the fitting of a device to collect water and impurities precipitated by a liquid contained in the tank is permitted. This device shall have a separate drainpipe, small in diameter, when the normal discharge pipe is not connected to the lowest part of the tank.
The collecting device may be mounted:
- over the whole of the lower part of the tank, or
- over a reduced area of the lower part.

In the first case the lower part of the collecting device, instead of the lower generatrix of the tank, shall meet the requirements concerning minimum slope, specified in point 6.1.5
6.3.2 The discharge pipe shall be as short as possible and have an adequate slope towards the stop valve. A slope of at least 2° is recommended.
6.3.3 The discharge device may incorporate a supplementary safety valve (foot valve -see point 4.3.3)
6.3.4 Each compartment shall have the means for being discharged independently.
6.3.5 Stop valves shall be readily accessible and shall be at the rear or on the appropriate side of tank.

6.4 Installations for pumping and metering Tanks may be provided with:
- a pumping installation,
- a flow measuring assembly including a flow meter, with or without pump.

The connections between the stop valves of the tank and these installations shall be by means of detachable couplings, which shall be as short as possible and easy to assemble and take

apart. This requirement does not apply to tanks of special construction (for example, tanks used for aircraft refuelling), but in this case effective and controlled hydraulic isolation of the tank body from this equipment shall be ensured. Pumping installation shall be constructed so that it can be drained completely by gravity, each time the tank is emptied, without the need for any special measures.

6.5 Other devices
6.5.1 The following devices are permitted:
- level warning devices,
- level indicators.

6.5.2 Tanks may be thermally insulated.
6.5.3 In order to determine the volume corresponding to an index, without introducing major additional errors, the tank may be equipped with a plumb line which indicates whether the slope of the tank has exceeded 2° with respect to the reference position. The plumb line shall have a minimum length of 300 mm. The plumb line may be replaced by a level indicator, if appropriate.
6.5.4 Access shall be provided to enable the operator conveniently to open and close the filling aperture, to observe the liquid level, to take samples of the liquid and to observe the emptying of the tank. Such access may be made possible by means of a ladder and a platform with a handrail.

6.6 Maximum acceptable errors
6.6.1 The volume of the tank shall be determined up to the level gauge, unless otherwise explicitly indicated. Where a tank is fitted with a collecting device the volume of this device shall be included in the volume of the tank.
6.6.2 The maximum acceptable error of calibration shall be ± 0.2 % of the nominal volume.

6.7 Identification plate and seals
6.7.1 Identification plate An identification plate, clearly visible and easily legible, shall be fitted to the vessel at a suitable height.
The plate shall not be made from a material that deteriorates under the rated conditions of tank usage.
6.7.1.1 The following information shall be inscribed on the plate:
- Name of utensil
- Year of manufacture utensil No. per compartment
- Type approval number, if appropriate
- Type of materials to be measured
- Units of measurement
- Name or trademark of the manufacturer
- Total contents and nominal capacity of the tank, or of each compartment, in legal units of measurement (the compartments are numbered, starting at the front end of the vehicle),

6.7.1.2 Tanker’s identification plate and level-gauging instrument shall bear the same utensil No.
6.7.1.3 Tanker's identification shall follow the vehicle’s chassis No.
6.7.2 Other seals It shall be possible to seal the fixing devices of detachable level gauge so that they can be removed only by breaking the seals which carry the stamp of the Legal Metrology Service.

1-2 Type Approvals Tests
1. Scope of Application These criteria define test items, test methods and test procedures for

type approvals of graduated tankers based on the regulations of article 8 of the enforcement regulation of the Measures Act.

2. General conditions

3. Test methods and procedures
3.1 Test items
3.1.1 inspection of external and internal appearance, dimensions and general construction,
3.1.2 leak test,
3.1.3 check for invariability of capacity in service,
3.1.4 check for correct filling,
3.1.5 check for complete discharge,
3.1.6 check for sensitivity and expansion volume
3.1.7 check for maximum acceptable errors
3.2 Test methods
3.2.1 The external and internal appearance, the dimensions and the general construction, are examined in accordance with the following requirements:
- Various regulations ..... Section 1-1 point 6.1.1
- Shapes, materials and general construction Section 1-1 point 6.1 & 6.1.5 – 6.1.7
- Dome and reinforcing elements ..... Section 1-1 point 6.12 & 6.2.1 – 6.2.3, 6.26
- Discharge device . ..... Section 1-1 point 6.3 & 6.3.1 – 6.3.5
- Pumps, gauging and auxiliary installations ..... Section 1-1 point 6.4 & 6.5.1 – 6.5.4
- Identification plate and sealing ..... Section 1-1 point 6.7.1 & 6.7.1.1 – 6.7.1.3, 6.72

The external and internal appearance is inspected visually; the dimensions are checked using rulers, measuring tapes and calliper gauges.
3.2.2 Leak Tests The tank is leak tested according to **Section 1-1 point 6.1.2** by verifying, after completely filling the tank, that there are no leaks at the shell joints, walls, couplings and reinforcing elements.
3.2.3 Check for invariability of capacity in service The invariability of capacity under rated operating conditions is checked by initially determining the variation of H during filling. The height H is determined by means of a ruler with a cursor when the tank is empty and again when the tank is full. The difference between the two values shall not exceed the value stipulated in **Section 1-1 point 6.1.3.**
To check the variation in the capacity of a compartment according to the state of filling of the other compartments, the compartment located roughly in the middle of the tank shall be filled to its index, the other compartments remaining empty. The other compartments shall then be filled, this having the effect of raising the level in the compartment in the middle of the tank; the level of the water in this compartment shall then be adjusted to the index, the volume of water drawn off being measured using a volumetric measure; this volume shall comply with the requirements in **Section 1-1 point 6.1.4.**
3.2.4 Check for correct filling The correctness of filling shall be checked as follows: the tank shall be filled to the index, with dome covers fitted, and the tanker shall then travel for 5 to 10 minutes, including a number of abrupt starts and stops. The tank shall be returned to its initial position and the level of water shall again be noted; if it is not on the index the valves and venting devices are not functioning correctly, or have been incorrectly fitted. The tank may only be calibrated after this situation has been resolved.
3.2.5 Check for complete discharge The completeness of discharge shall be checked as follows:

The tank, with its interior walls dry, is filled to approximately 10 cm above the lower generatrix. The tanker is placed on a horizontal road and the stop valve opened. On termination of free flow, any water remaining inside the tanks is collected in a volumetric measure. This volume of water shall not exceed the value stipulated in **Section 1-1 point 6.1.5.**

The following procedure may alternatively be adopted: the dry tank is filled with water to a height of approximately 10 cm, measuring the volume used by means of a volumetric measure. With the tanker placed in a horizontal road, the stop valve is opened and the volume of water that is drained is measured using the volumetric measure. The difference between the two measured volumes shall not exceed the value stipulated in **Section 1-1 point 6.1.5.**

3.2.6 Check for sensitivity and expansion volume The sensitivity and expansion volume shall be checked as follows:

3.2.6.1 if the index corresponding to the nominal capacity is in a zone of constant horizontal section, filling of the tank is continued, after calibration, up to overflowing. By determining the expansion volume ΔV and the corresponding height Δh, conformity with the requirements of **Section 1-1 point 6.2.4** may be verified;

b) if the index is in a zone of variable horizontal section, the expansion volume is determined as in the first case, but the following procedure is adopted for checking the sensitivity: two levels are selected, one approximately 5 cm below the index, and the other approximately 5 cm above the index. The determination of $\Delta h1$ and $\Delta V1$ between these levels shows whether the requirements stipulated in **Section 1-1 point 6.2.4** are met.

3.2.7 Maximum acceptable errors test This test shall be applied according to Point 3.2.7.1 or 3.2.7.2.

3.2.7.1 The tank shall be calibrated using the volumetric method, determining the volume of water that fills the tank by means of standard measuring instruments.

The following may be used for this purpose:

- A proving tank installation,
- A standard flow meter installation.

These installations shall comply with the relevant metrological requirements, and shall bear valid verification marks. The road tanker shall be placed on a horizontal road.

3.2.7.1.1 Where the tank has an index, the level of the surface of the water shall be adjusted to this index, in the position indicated in the operation instructions.

Where a tank has no index, the level shall be determined by measuring the ullage height, using a length measure. For this purpose, the measure shall be positioned as indicated in the specifications, and this recorded in the calibration certificate. The zero scale mark shall coincide with the reference point.

The level of the water in the tank shall be measured only after the surface has settled and air bubbles have been eliminated. The material of the length measures used shall be compatible with the transported liquid.

3.2.7.1.2 The volumes of water that are introduced or withdrawn and the temperature of water inside tank shall be calibrated and the total volume shall be calculated and corrected so that the maximum acceptable errors (point 6.6.2 of Section 1) are not exceeded.

3.2.7.1.3 The water temperature should not vary by more than 2 °C during calibration. The water temperature shall be measured using a thermometer, of which the scale interval shall not exceed 0.5 °C and the error shall not exceed half the scale interval. The water temperature shall be measured in the standard installation and in the tank described in **3.2.7.1.**

3.2.7.1.4 To calculate the capacity of the tank at reference temperature, the following

procedure shall be adopted:
- if the water temperature is within t_R ±10 °C (*) and in compliance with the conditions in point 5.2.5.3, only the correction for the standard shall be applied (in conformity with its calibration certificate), (*) t_R is the reference temperature, for example 20 °C.
- if the water temperature lies outside the above-mentioned limits the volume of the tank shall be calculated using the relation:

$$V^c_{t_R} = V^e_{t_R} \left[1 + \beta_e (t_e - t_R) + \beta_c (t_R - t_c)\right] \frac{\rho_{t_e}}{\rho_{t_c}}$$

where:
$V^C_{t_K}$ is the volume of the tank at reference temperature,
$V^e_{t_K}$ is the volume of water measured by the standard installation, and to which the correction for the standard has been applied,
β_e is the coefficient of cubic expansion relating to the material used in the construction of the standard measures ($°C^{-1}$),
β_c is the coefficient of cubic expansion relating to the material used in the construction of the tank being calibrated ($°C^{-1}$),
t_e is the mean water temperature in the standard installation (°C),
t_c is the mean water temperature in the tank being calibrated (°C),

ρ_{t_e}, ρ_{t_c} are the densities of water at temperatures t_e and t_c respectively(See Table 1).

The value of the coefficient of cubic expansion is 3.3 ±10^{-5} $°C^{-1}$ for mild steel, 5.1 ±10^{-5} $°C^{-1}$ for stainless steel and 6.9 ±10^{-5} $°C^{-1}$ for aluminium.

Table 1

Water temperature (*) °C	Volume of 1 kg of water (dm^3)
4	1.000 03
5	1.000 04
6	1.000 06
7	1.000 10
8	1.000 16
9	1.000 22
10	1.000 30
11	1.000 40
12	1.000 51
13	1.000 63
14	1.000 76
15	1.000 90

16	1.001 06
17	1.001 23
18	1.001 41
19	1.001 60
20	1.001 80
21	1.002 01
22	1.002 24
23	1.002 47
24	1.002 72
25	1.002 97

3.2.7.2 Classified to tanker with drainage pump and that with gravity drainage, tankers shall be put to test as follows and calculation will be made according to 3.2.7.2.3. The maximum acceptable errors shall not exceed those specified in Point 6.6.2 of Section 1-1.

3.2.7.2.1 Tanker with drainage pump The test shall be applied according to procedures specified in Table 2 and Figure 1 (See figure 1)

Table 2

N°	Procedure	P1	V1	V2	V3	P2	V4	Description
1	Before the test	X	X	X	X	X	X	1)
2	Connect delivery hose to inlet of proving tank (2) 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	o	O	o	X	X	X	Fill to V_{s2} 4)
		X	X	X	X	X	X	Keep closed
		Observe and record V_{m2} and V_{s2}						
		Observe and record *t*m, t_{s1}, t_{s2}, t_{s3} 5)						
7	Proving tank draining	X	X	X	o	o	o	Drain to approx. zero (V_{s1})
8	Calculate uncorrected error E' (%)							
9	Calculate maximum acceptable errors (See 3.2.7.2.3) E = E' + E_α+ $E_{\beta(\%)}$							

1) Symbols used: O = open; X = closed (pump or valve).

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

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

4) Flow rate shall be controlled V_4.

5) 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.

6) E', E, E_α+ E_β: refer to 3.2.7.2.3

3.2.7.2.2 Gravity drainage Test shall be applied according to procedures specified in Table 3 and Figure 2 (See Figure 2)

Table 3

N°	Procedure	V1	V2	V3	P2	V4	Description
1	Before the test	X	X	X	X	X	1)
2	Connect delivery hose to inlet of proving tank 2) 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 3)					
6	Test run	o	O	X	X	X	Fill to *V*s2 4)
		X	X	X	X	X	Keep closed
		Observe and record *V*m2 and *V*s2					
		Observe and record *t*m, *t*s1, *t*s2, *t*s3 5)					
7	Proving tank draining	X	X	o	o	o	Drain to approx. zero (V_{s1})
8	Calculate uncorrected error E' (%)						
9	Calculate maximum acceptable errors (See 3.2.7.2.3) E = E' + E_{α}+ $E_{\beta(\%)}$ 6)						

1) Symbols used: O = open; X = closed (pump or valve).

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

3) *V*m*:* Volume indicated by the meter or system; *V*s: Volume measured in the standard capacity measure.

4) Flow rate shall be controlled V4.

5) 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.

6) E', E, E$_{\alpha}$+ E$_{\beta}$: refer to 3.2.7.2.3

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 flow rates.

3.2.7.2.3 Maximum acceptable errors These errors are determined using the following equations:

$$E = E' + E_{\square} + E_{\square}$$
$$E' = [(V_m - V_s) / V_s] \square 100$$
$$E_{\square} = \square(t_s - t_m) \square 100$$
$$E_{\square} = \square(t_r - t_s) \square 100$$

Where,

E is the meter error, in %

E' is the uncorrected error, in %

E$_{\square}$is the temperature correction for the test liquid, in %

E□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
□is the cubic expansion coefficient of the test liquid due to temperature, in $°C^{-1}$
□is the cubic expansion coefficient of the standard capacity measure due to temperature, in $°C^{-1}$
Notes: □: Refer to OIML R 63 or ISO 91-1 for petroleum products; refer to ISO 8222 for water

steel

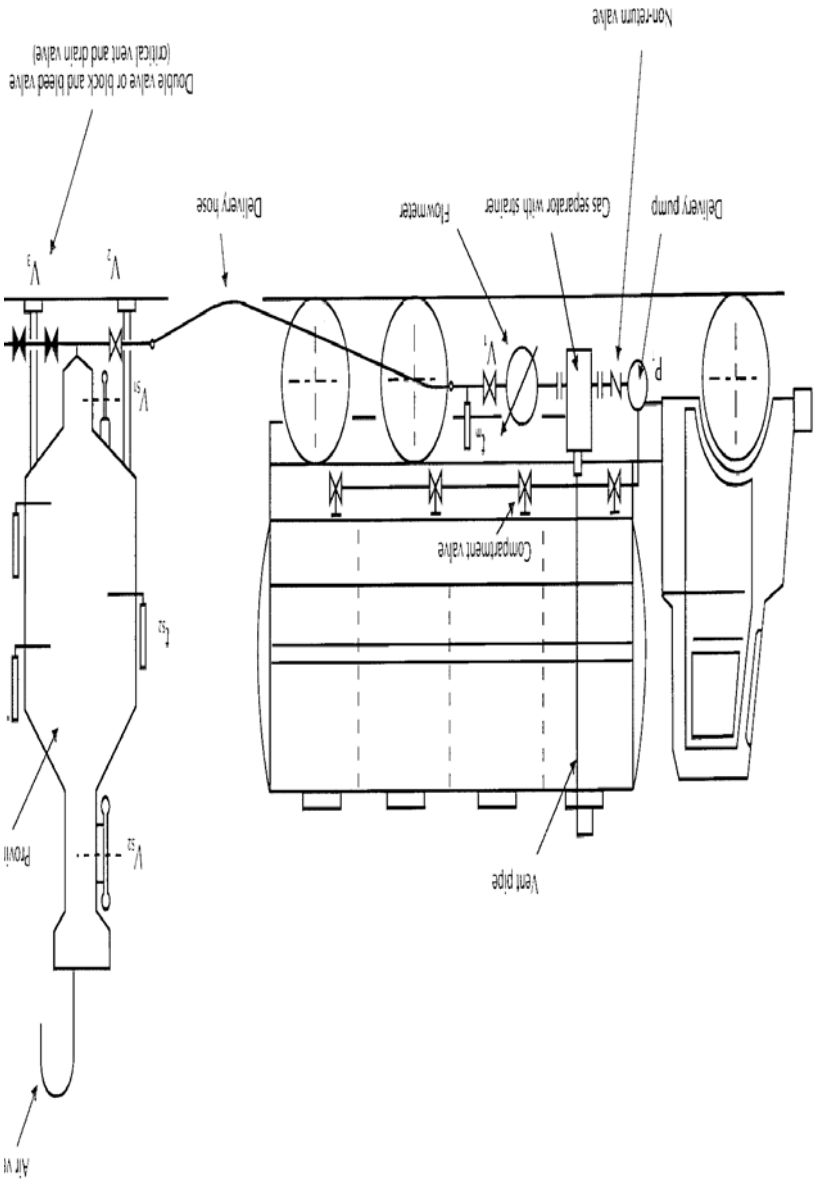


Figure 1

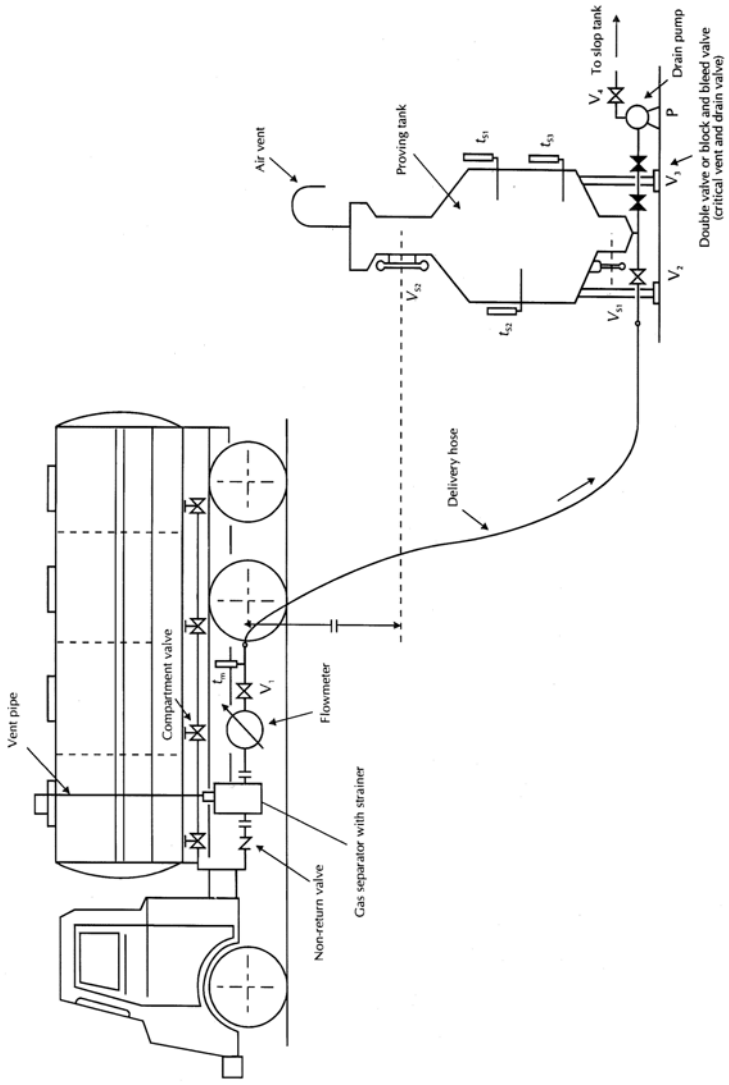

Air vent
Proving tank
t_{s1}
t_{s3}
V_4 To slop tank
Drain pump
P
V_3
Double valve or block and bleed valve (critical vent and drain valve)
V_2
V_{s1}
V_{s2}
t_{s2}
Delivery hose
Vent pipe
Compartment valve
t_m
V_1
Flowmeter
Gas separator with strainer
Non-return valve

Figure 2

ANNEX 1

SUMMARY OF OPERATIONS TO DETERMINE THE VOLUMES OR QUANTITIES OF LIQUID IN A TANKER CONSIDERED AS A MEASURING CONTAINER

The following operations are generally required for measuring the volume of liquid contained in a tank:

a) gauging the level of the free surface of the liquid, to obtain the volume V tc at the temperature tc of the product in the tank,

b) measuring the mean temperature tc,

c) taking a representative sample of the product and determining the density ρ t1 at a temperature t1 very close to tc, in the laboratory, calculating the mass of the product using the equation:

$$M = V_{t_c} \cdot \rho_{t_c}$$

The operations d) and e) may be replaced by the following:

— obtaining the volume and density at reference temperature (to) by calculation or from tables, and then determining the mass using the equation:

$$M = V_{t_o} \cdot \rho_{t_o}$$

— obtaining the volume V at reference temperature (to) from tables, if the quantities are expressed as a volume.

It should be noted that sometimes, for example when the product is inexpensive, the value of c t V is adequate for use in the calculation (operation a).

Notes:

A) If the density has been determined earlier, operation c is not required.

B) In addition, no layer of water is permitted at the bottom of the tank and sometimes the following measurements must be made:

— the volume of water in suspension,

— the volume of solid impurities in suspension,

and make the corrections which result from such suspensions.

C) If the liquid is padded under pressure, without gaseous phase, the pressure shall be measured and the volume shall be corrected for the compressibility of the liquid and the elastic deformation of the tank due to this pressure.

D) If the gaseous and liquid phases of the same product are present in the tank, the condensed volume of saturated vapour shall be determined and added to that of the liquid, in addition to the corrections mentioned in Note C above.

ANNEX 2

EXAMPLES OF DEVICES FOR MEASURING THE LIQUID LEVEL IN A TANKER

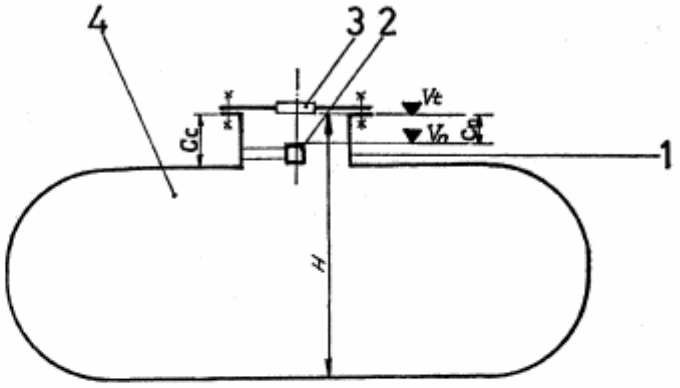


Figure 1

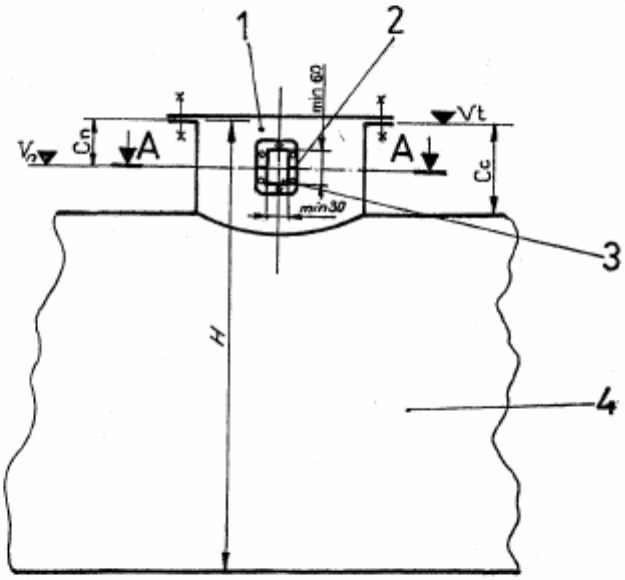
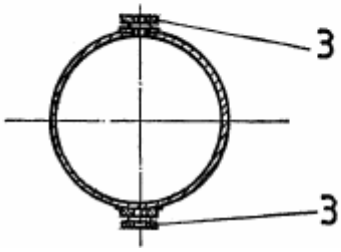
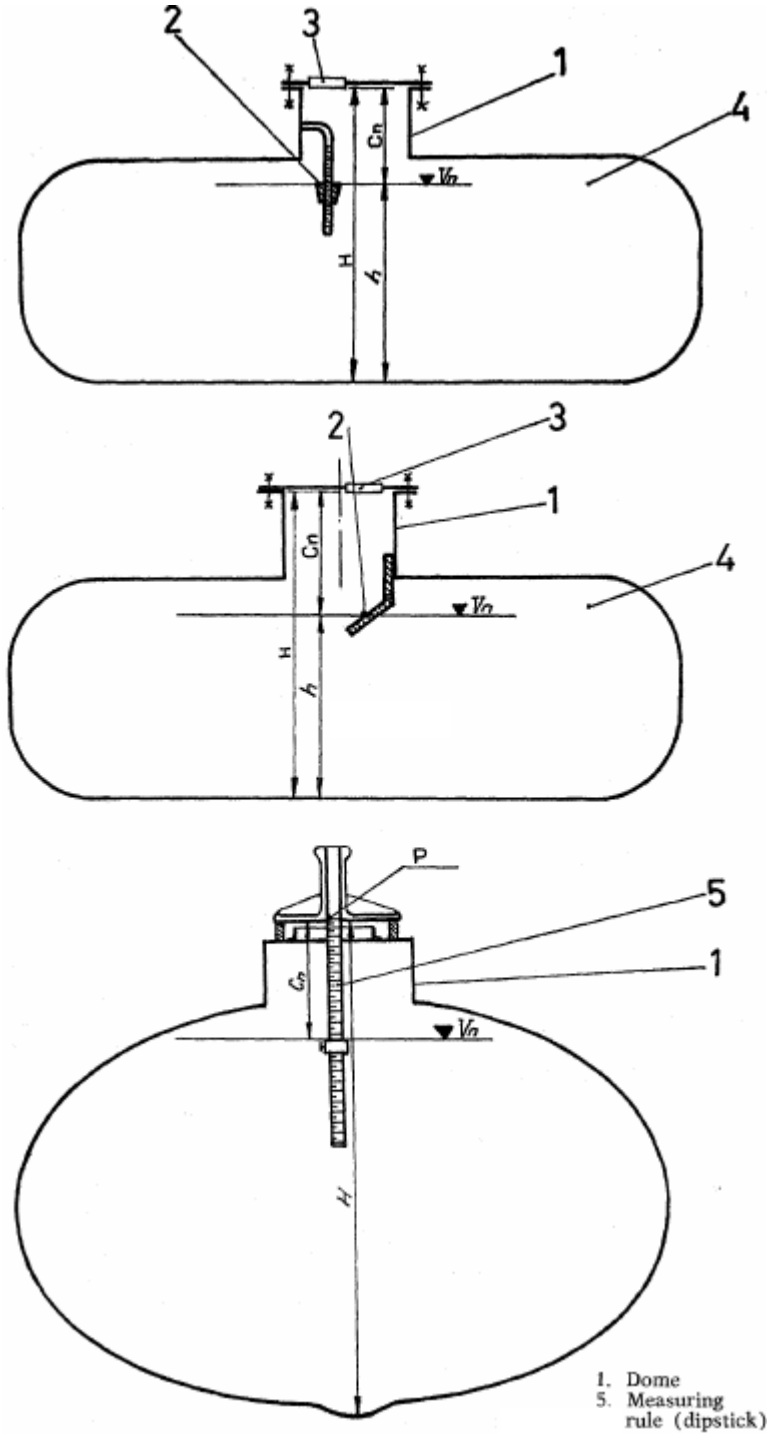


Figure 2

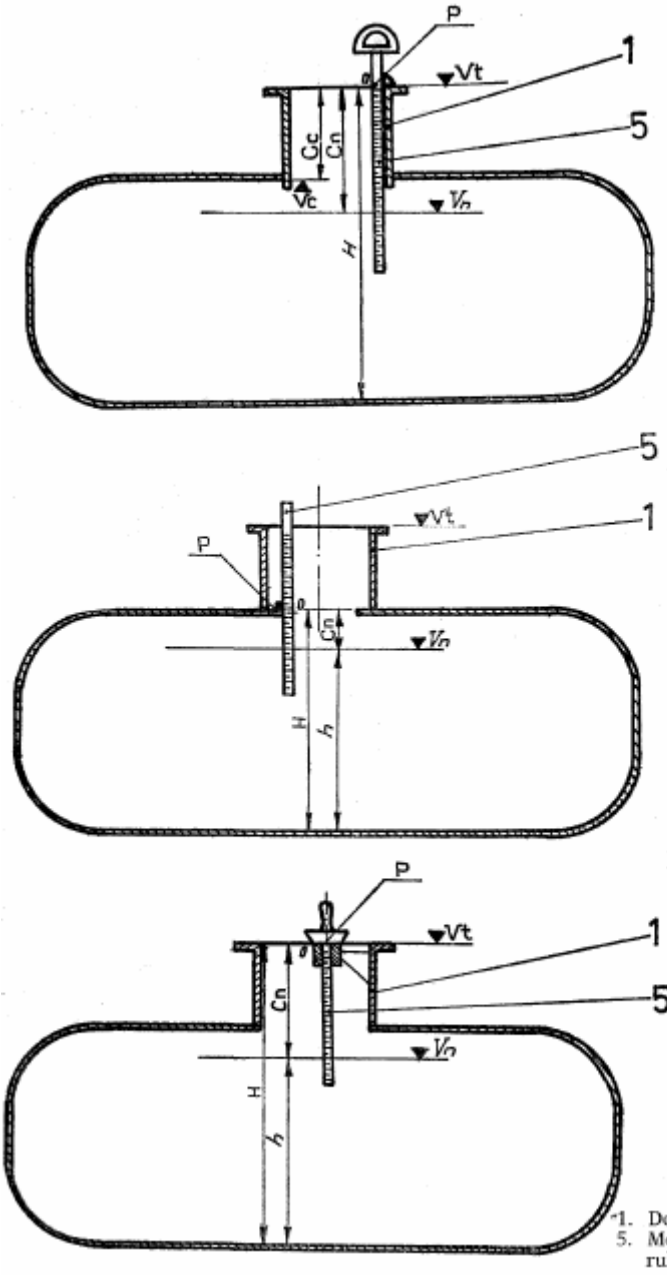
Section A-A



1. Dome
2. Level index
3. Observation window
4. Shell of the tank



1. Dome
5. Measuring rule (dipstick)



1. Dome
5. Measuring rule (dipstick)

ANNEX 3
MAXIMUM FILLING LEVEL OF ROAD TANKERS

National and international regulations prescribe the maximum filling level of road tankers used for the transport of dangerous goods.

Example: the European agreement concerning the international transport of dangerous goods by road (ADR) specifies that for inflammable liquids such as petrol (gasoline) the maximum level of filling is:

$$\frac{100}{1+35\,\alpha}\,\%$$ of total contents

where α is the coefficient of cubic expansion of the liquid, calculated according to the formula:

$$\alpha = \frac{d_{15} - d_{50}}{35 \cdot d_{50}}$$

where:

d15 and d50 are the densities of the liquid at 15 °C and 50 °C respectively.

Therefore, for petrol with d15 = 0.700 kg/dm3 the calculated expansion volume is approximately 3 % for a variation of 35 °C.

For potable liquids (milk, wine) an expansion volume of 0.5 % is considered reasonable for countries with temperate climates.

Section 2 Verification Criteria

These criteria define the verification and periodic verification of graduated tankers (tank lorries) according to the regulations of article 12 and article 17 of the Measures Act.

2 – 1 Verification

1. Scope of Application
These criteria are applied to graduated tankers regulated under article 11 of the enforcement ordinance of the Measures Act.

2. Testing methods and procedures
2.1 Verifications on measuring instruments shall be categorised and executed as structure tests and tolerance tests.
2.2 For any test method not specified in these criteria, refer to those specified in Section 1 (Type approval criteria of graduated tankers)

2.3 Structure test
2.3.1 This test, in principle, is based on sampling. However, if the applicant requests and the applied numbers per batch are the same as or less than the minimum sample numbers, the test shall be applied on a total-inspection basis.
2.3.2 When the test is performed based on sampling, the one-time sampling methods of **KS A ISO 2859-1 attached-table 1** sample (size) letter and **attached-table 2-A** ordinary tests are applied. The test level is set as a special test level (S-2). AQL is set as 2.5%.
2.3.3 Any measuring instrument applicable to the regulations of article 18 of the enforcement regulation of the Measures Act can be exempt from this test.
2.4 Tolerance test
2.4.1 This test, in principle, is based on sampling. However, if the applicant requests and the applied numbers per batch are the same as or less than the minimum sample numbers; the test shall be applied on a total-inspection basis.
2.4.2 When the test is performed based on sampling, the one-time sampling methods of **KS A ISO 2859-1 attached-table 1** sample (size) letter and **attached-table 2-A** ordinary tests are applied. The test level is set as a normal test level (II). AQL is set as 0.65%.

3. Verification items
3.1 Structure This verification is applied to all items except 6.6 (maximum acceptable errors), of Point 4 (Classification and requirements) Point 6 (Technical requirements) of Section 1 (Type approvals criteria of graduated tankers). The testing methods set out in Point 3.2 of Section1-2 (Testing methods) shall be applied.

3.2 Tolerance This verification is applied to all items except item 6.6.2 in 6.6 (maximum acceptable errors) of Section 1 (Type approvals criteria of graduated tankers). The testing methods set out in Point 3.2 of Section1-2 (Testing methods) shall be applied.

4. **Verification seal**
4.1 It is vital that a verification seal be attached to the part displaying volume of level gauging instruments.
4.2 In case of detachable level gauge, the seal shall be attached to the fixing devices of

detachable level gauge.
4.3 Verification seals shall be attached to each volume of all compartments displayed in the identification plate

2 – 2 Periodic verifications

1. Scope of Application
These criteria are applied to graduated tankers regulated under article 29 of the enforcement regulation of the Measures Act.

2. Classification of Periodic verifications
Periodic verifications shall be classified and implemented as structure tests and tolerance tests.

3. Periodic verifications methods and procedures
3.1 For any test method not specified in these criteria, refer to those specified in Section 1 (Type approvals criteria of graduated tankers).
3.2 Structure tests
These tests are applied on a total-inspection basis
3.3 Tolerance tests
These tests are applied on a total-inspection basis

4. Periodic verifications items
4.1 Structure These tests shall be applied to all times specified in Point 6.7.1 (Identification plate) of Section 1 (Type approvals criteria of graduated tankers).
4.2 Tolerance These tests shall be applied to 6.6.2 of 6.6 (Maximum acceptable errors) of Section 1 (Type approvals criteria of graduated tankers). In this case, the tolerance regulated under the article of the enforcement ordinance of the Measures Act is applied as maximum tolerance. Testing methods specified in Point 3.2 of Section1-2 (Testing methods) shall be applied.