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Refrigerated light-hydrocarbon fluids — Measurement of liquid levels in tanks containing liquefied gases — Float-type level gauges

Hydrocarbures légers réfrigérés — Mesurage du niveau de liquide dans les réservoirs contenant des gaz liquéfiés — Jauges à flotteur

Reference number
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 10574 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*, Sub-Committee SC 5, *Measurement of light hydrocarbon fluids*.

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Refrigerated light-hydrocarbon fluids — Measurement of liquid levels in tanks containing liquefied gases — Float-type level gauges

1 Scope

This International Standard specifies the essential requirements and verification procedures for float-type level gauges (including those operated by servo-mechanism) to be used for ship and shore tanks containing refrigerated light-hydrocarbon fluids.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 79-0:1983, *Electrical apparatus for explosive gas atmospheres — Part 0: General requirements.*[1)]

IEC 79-1:1971, *Electrical apparatus for explosive gas atmospheres — Part 1: Construction and test of flameproof enclosures of electrical apparatus.*[1)]

IEC 79-2:1983, *Electrical apparatus for explosive gas atmospheres — Part 2: Electrical apparatus — Type of protection "p".*[1)]

IEC 79-3:1972, *Electrical apparatus for explosive gas atmospheres — Part 3: Spark test apparatus for intrinsically-safe circuits.*[1)]

IEC 79-4:1975, *Electrical apparatus for explosive gas atmospheres — Part 4: Method of test for ignition temperature.*[1)]

IEC 79-5:1967, *Electrical apparatus for explosive gas atmospheres — Part 5: Sand-filled apparatus.*[1)]

IEC 79-6:1968, *Electrical apparatus for explosive gas atmospheres — Part 6: Oil-immersed apparatus.*[1)]

IEC 79-7:1969, *Electrical apparatus for explosive gas atmospheres — Part 7: Construction and test of electrical apparatus, type of protection "e".*[1)]

IEC 79-10:1986, *Electrical apparatus for explosive gas atmospheres — Part 10: Classification of hazardous areas.*[1)]

IEC 79-11:1984, *Electrical apparatus for explosive gas atmospheres — Part 11: Construction and test of intrinsically-safe and associated apparatus.*[1)]

IEC 79-12:1978, *Electrical apparatus for explosive gas atmospheres — Part 12: Classification of mixtures of gases or vapours with air according to their maximum experimental safe gaps and minimum igniting currents.*[1)]

IEC 92-502:1980, *Electrical installations in ships — Part 502: Special features — Tankers.*

IEC 92-504:1974, *Electrical installations in ships — Part 504: Special features — Control and instrumentation.*[2)]

IEC 654-1:1979, *Operating conditions for industrial process measurement and control equipment — Part 1: Temperature, humidity and barometric pressure.*[1)]

1) Reference for level gauges in shore tanks.

2) Reference for level gauges in ships' tanks.

IEC 654-2:1979, *Operating conditions for industrial-process measurement and control equipment — Part 2: Power.*[1)]

IMO (International Maritime Organization) — Resolution MSC 5(48), *International Code for the Construction of Ships Carrying Liquefied Gases in Bulk*[2)], IMO, London.

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 float: Liquid level-detecting element, floating on or in the liquid, which follows the vertical movement of the liquid level. If the mass of the element is greater than that of the liquid which it displaces, the element is specifically called a displacer.

3.2 gas-dangerous space: Space where gas or vapour may form flammable mixtures when mixed with air.

This term is equivalent to "hazardous area" as described in IEC 79-10 for shore tanks and to "gas-dangerous spaces or zones" as described in IMO Resolution MSC 5 (48) for ships' tanks.

3.3 gauge reference point: Point fixed as a reference for measuring the liquid level. This point is usually set near the tank bottom.

3.4 liquid level: Distance between the surface of the liquid in a tank and the gauge reference point, measured along the centreline of the level gauge.

3.5 overall error: Error composed of error factors related to mechanical parts, data transmission, local indicator and/or remote indicator, but not including error factors related to installation and deformation of the tank.

3.6 reading of level gauge: Value indicated by the level gauge.

3.7 verifying measuring tape: Measuring tape to be used for verification of the level gauge.

4 Gauge materials and construction

4.1 The materials and construction of a float-type level gauge shall be such that the gauge will withstand, without damage, exposure to the environmental conditions specified in tables 1 and 2.

4.2 The gauge head shall be so constructed as to prevent leakage of vapour from the tank. Schematic diagrams of typical float-type level gauges are shown in figure 1 for ships' tanks and figure 2 for shore tanks.

4.3 The necessary main equipment comprises the following.

a) A float following the vertical movement of liquid level in the tank.

b) A tape or wire attached to the float in order to measure its position.

c) Guide wires or a guide pipe to prevent horizontal movement of the float. A guide pipe should be perforated at suitable intervals.

d) Mechanical, electrical or electromechanical equipment for local and/or remote readout.

e) Equipment to provide necessary tension to the tape or wire.

f) Equipment to wind the float up and down.

g) A device to control the rate of descent of the float.

h) Equipment or apparatus in ships' tanks to lock the float in position while it is not in use.

i) Adequate provision in the tank to protect the tank bottom from damage by a falling float.

4.4 Provision should be made for repair and maintenance of the gauge without taking the tank out of service.

5 Environmental conditions and allowable power supply fluctuations

The environmental conditions for float-type level gauges shall be as shown in table 1 for shore tanks and in table 2 for ships' tanks.

Fluctuations of the power supply shall not exceed the values shown in table 3. Note that these limits are imposed to prevent damage to the system, not to maintain its accuracy.

6 Performance

6.1 Indicator

The indicator shall have a minimum resolution not greater than 1 mm.

6.2 Power supply fluctuations

The operation of the level gauge shall not be adversely affected by any fluctuation in the characteristics of the power supply, within the limits specified in table 3.

6.3 Maximum permissible error

For custody transfer measurement or for the determination of stock inventory, the overall error of the liquid level reading allowed in the test at the manufacturer prior to shipment shall not exceed ± 0,02 % of the corresponding liquid level, with a minimum of ± 2 mm. It is assumed that all the necessary corrections have been applied to the above error.

7 General requirements for measurement of liquid level

7.1 In order to correct the reading of the level gauge for changes in the immersion level of the float, the density of the fluid at the operating temperature shall be known.

7.2 The tank in which the level gauge is installed shall be equipped with a suitable number of thermometers for the measurement of the temperatures of both the liquid and vapour phases.

7.3 Suitable correction tables or formulae shall be provided for the correction of gauge readings for:

a) float buoyancy based on the density of the measured fluid;

b) tape contraction based on the difference between the tank vapour temperature and the temperature at which the gauge was calibrated.

7.4 The lowest level measurable on the gauge in its installed state shall be stated on the equipment.

8 Installation

8.1 The float shall be installed in the tank such that the variation of the gauge reference point due to movement of the tank shell or bottom is minimized.

8.2 The float shall be located in a position where any effect of liquid flowing into or out of the tank is minimized.

9 Calibration and verification

Calibration and verification by the manufacturer shall be carried out prior to shipment.

9.1 The mass of the float itself, the mass of the float in operational condition and the float dimensions shall be measured. The immersion level of the float in distilled water or specified liquid shall be measured at four points equidistant on the perimeter.

9.2 The mass per unit length of the tape or wire and its length shall be measured and its material shall be ascertained. In the case of a perforated tape, the pitch of the perforation shall be measured.

9.3 The float level gauging system shall be operated and checked, at five or more points equidistant over its working range, by comparison with the verifying measuring tape. These test points shall each be examined twice, at the time of raising and of lowering the float, and the results shall be within the tolerance specified in 6.3.

If this method is not feasible, an alternative test method of equivalent function or performance can be adopted.

10 Instrumentation requirements for gas-dangerous spaces

Performance of the float-type level gauge shall be in accordance with relevant national or International Standards (see clause 2).

Table 1 — Environmental conditions for the various parts of float-type level gauges (for shore tanks)

	Inside tank	Outside tank	
		Exposed area	Other areas
Temperature	LNG: – 165 °C to + 55 °C LPG: – 50 °C to + 55 °C	– 25 °C to + 70 °C [1]	0 °C to 55 °C [1]
Relative humidity	5 % to 100 % at 0 °C to 40 °C [1] 5 % to 70 % above 40 °C		

NOTES

1 In the case of liquid other than liquefied natural gas or liquefied petroleum gas, lower temperature limits inside the tank may be specified on the basis of the boiling points of the liquid.

2 Every part of the equipment installed inside the tank shall possess sufficient strength to withstand the static pressure and wave motion or other action of the liquid.

1) Quoted from IEC 654-1.

Table 2 — Environmental conditions for the various parts of float-type level gauges (for ships' tanks)

	Inside tank	Outside tank	
		Exposed area	Other areas
Temperature	LNG: – 165 °C to + 80 °C LPG: – 50 °C to + 80 °C	– 25 °C to + 70 °C [1]	0 °C to 55 °C [1]
Vibration	No natural frequencies of equipment within 0 Hz to 80 Hz [1] Amplitude ± 1,0 mm within 2,0 Hz to 13,2 Hz Acceleration 0,7g within 13,2 Hz to 80 Hz Maximum acceleration 0,7g_n		
Relative humidity	0 % to 100 % at 0 °C to 40 °C [1] 5 % to 70 % above 40 °C		
Inclination	Inclination angle: 22,5° [1]		
Rolling	Roll angle (10 s period): 22,5° [2]		
Pitching	Acceleration: + 1,0g_n in vertical direction [1] [2]		

NOTES

1 In the case of liquid other than liquefied natural gas or liquefied petroleum gas, the lower temperature limit inside the tank may be specified on the basis of the boiling point of the liquid.

2 Every part of the equipment installed inside the tank shall possess sufficient strength to withstand the static pressure and wave motion or other action of the liquid.

3 The material and the construction of the gauge head shall be such that no leakage of gas from the tank occurs at any temperature below 925 °C in accordance with IMO Resolution MSC 5(48).

1) Quoted from IEC 92-504.

2) Applicable only when the float is fixed [see 4.3 h)].

Table 3 — Allowable fluctuations of power supply source (for ship and shore tanks)

Power supply source	Variant item	Variation		
		Permanent	Transient	
		Variant value %	Variant value %	Recovery time s
Pneumatic/hydraulic	Pressure	± 20	± 20	—
Alternating current	Voltage frequency	± 10 [1] ± 5	± 20 [1] ± 10	3 [1] 3
Direct current	Voltage	+ 30 [1] − 25	—	—

NOTE — D.c. power supply (battery-maintained supply) to the equipment is to be taken as having voltage variations from the nominal value in the range + 30 % to − 25 % or as determined by the charging/discharging characteristics, including ripple voltage, from the charging device.

When equipment is not connected to the battery during charging, the highest value may be reduced to + 20 %.

1) Quoted from IEC 654-2 and IEC 92-504.

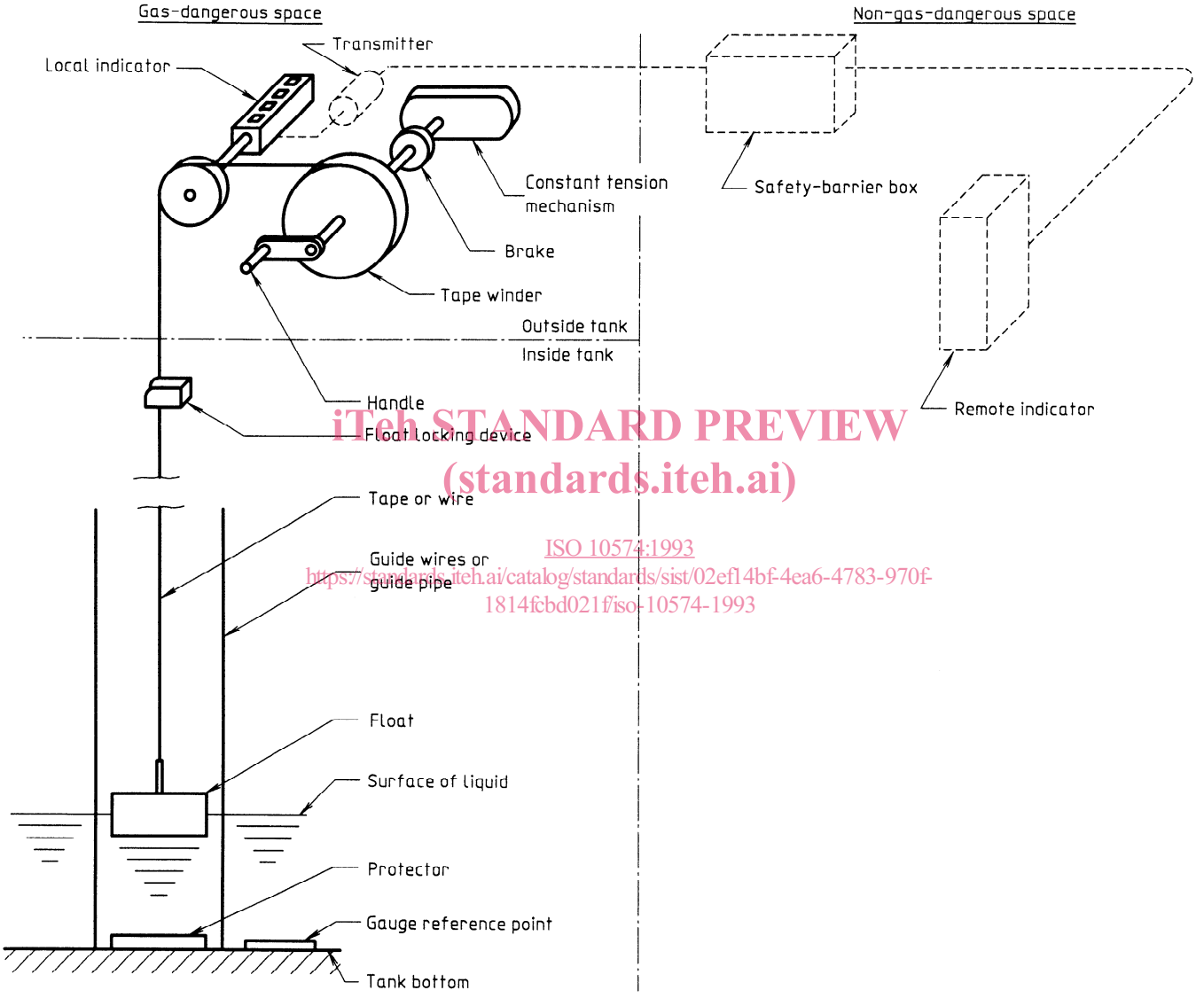

Figure 1 — Example of system diagram of a float-type level gauge (mechanical type for ships' tanks)

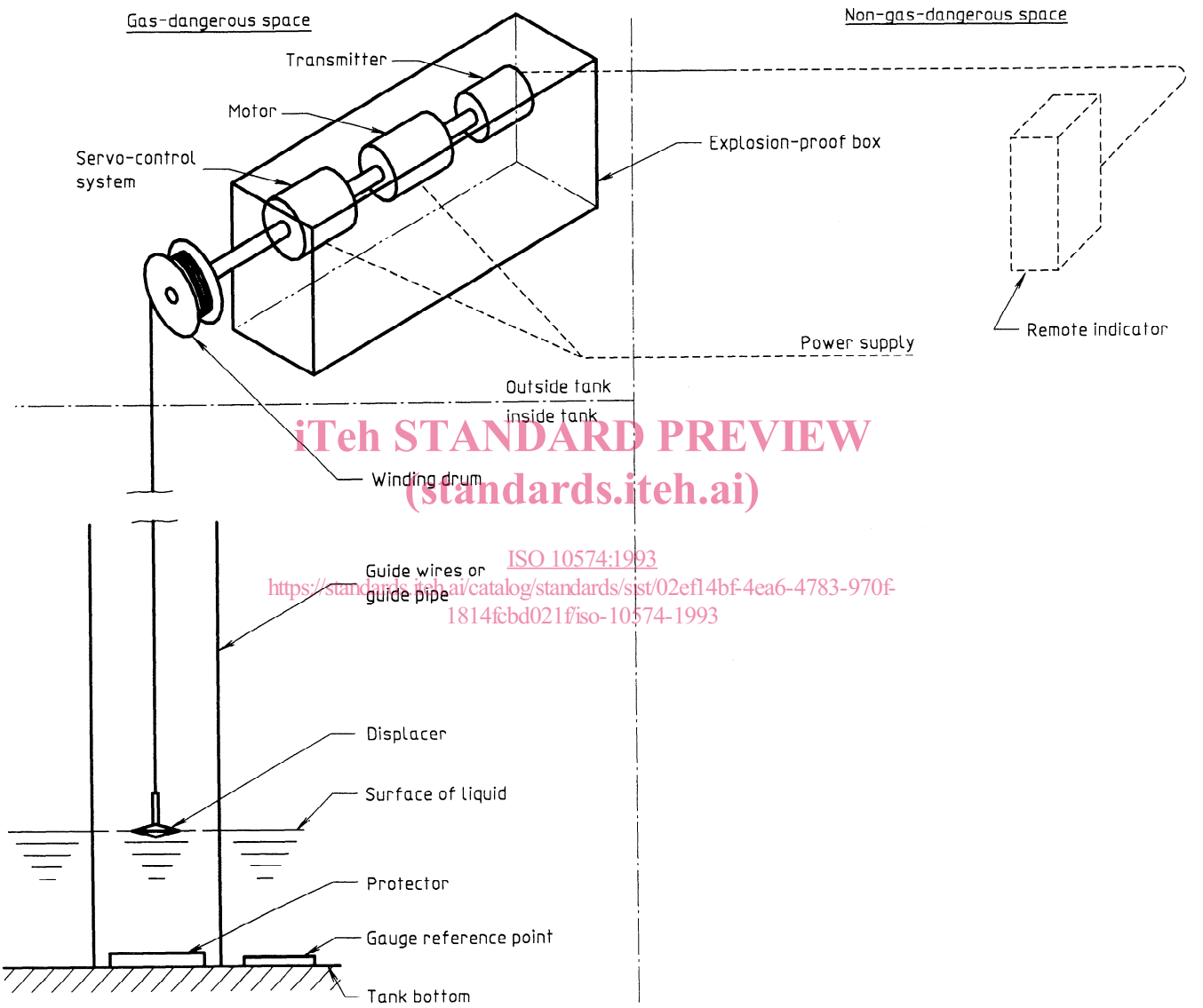

Figure 2 — Example of system diagram of a float-type level gauge (servo-operated for shore tanks)