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Refrigerated light hydrocarbon fluids — General requirements for automatic level gauges —

Part 2: Gauges in refrigerated-type shore tanks

Hydrocarbures légers réfrigérés — Exigences générales pour jauges de niveau automatiques —

Partie 2: Jauges pour réservoirs côtiers de type réfrigéré

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. 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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 18132-5 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*, Subcommittee SC 5, *Measurement of refrigerated hydrocarbon and non-petroleum based liquefied gaseous fuels*.

This part of ISO 18132 together with ISO 18132-1 cancels and replaces ISO 8309:1991, ISO 10574:1993 and ISO 13689:2001, which have been technically revised.

ISO 18132 consists of the following parts, under the general title *Refrigerated light hydrocarbon fluids — General requirements for automatic level gauges*:

— *Part 1: Gauges onboard ships carrying liquefied gases*

— *Part 2: Gauges in refrigerated-type shore tanks*

Introduction

Large quantities of light hydrocarbon liquids consisting of compounds having primarily one to four carbon atoms are stored and transported in bulk as refrigerated liquids at near-atmospheric pressure. These liquids can be divided into two main groups: liquefied natural gas (LNG) and liquefied petroleum gas (LPG).

In general, the quantity of these light hydrocarbons transferred is determined and recorded on the basis of volume and/or mass, with the energy content calculated in calorific units. If the static-measurement method is used, the liquid level in the tank is one of the variables which most significantly influences the determination.

In addition to the level measurement, the following parameters are needed to determine the quantity and energy content of the light hydrocarbons in a bulk storage tank:

a) tank calibration table;

b) composition of and/or physical data for the liquefied gases and vapour;

c) vapour pressure, vapour and liquid temperature;

d) volume of liquid in the pipelines;

e) status of the flush valves for connecting lines.

The various error factors that influence the quantification based on measurements of liquid level are considered in Annex A.

It is necessary to gauge shore tanks for one or more of the following reasons:

a) tank farm operations and process control;

b) tank inventory control;

c) where parties involved require custody transfer on shore tanks.

ISO 18132-2 removes technical dependency and ensures that the market is open to all newcomers in this industrial sector.

Refrigerated light hydrocarbon fluids — General requirements for automatic level gauges —

Part 2:
Gauges in refrigerated-type shore tanks

1 Scope

This part of ISO 18132 establishes the general requirements for the specification, installation and calibration/verification testing of automatic level gauges (ALG) used for refrigerated light hydrocarbon fluids, i.e., LNG and LPG, stored in bulk storage tanks on shore at pressures close to atmosphere.

This part of ISO 18132 is not applicable to pressurized shore tanks.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

OIML R 85, *Automatic level gauges for measuring the level of liquid in fixed storage tanks*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
automatic level gauge
ALG
level gauge that automatically measures the liquid level in a tank, either by innage or outage (ullage)

NOTE An ALG is also commonly referred to as an automatic tank gauge (ATG).

3.2
datum level
tank lowest level that corresponds to zero level and zero volume in tank table

3.3
hazardous area
area in which an explosive gas atmosphere is present, or can be expected to be present, in quantities such as to require special precautions for the construction, installation and use of apparatus

[IEC 60079-10]

3.4
upper reference point
point clearly defined on the gauge hatch directly above the datum level to indicate the position (and upper datum) from which ullaging should be carried out

NOTE It is often the top of the mounting flange of an ullage ALG.

3.5
reference height
distance between the upper reference point and the datum level

3.6
liquid level
distance between the liquid surface in a tank and the datum level

NOTE This is also known as innage.

3.7
ullage
distance between the liquid surface in a tank and the upper reference point

3.8
lower reference point
lowest measurable level located above the datum level that can be measured by an ALG

3.9
overall error
total error including the intrinsic error of an ALG and error due to the effect of installation and operating condition

3.10
intrinsic error
error of an ALG when tested under controlled condition as specified by the manufacturer

4 Safety precautions

4.1 General

International Standards, government codes and regulations on safety and material compatibility precautions applicable to light hydrocarbon fluids shall be followed when selecting and installing ALGs. In addition, specific recommendations from ALG manufacturers should be followed.

4.2 Equipment precautions

4.2.1 All ALGs shall be designed and installed in accordance with applicable national standards and/or International Standards. See OIML R 85.

4.2.2 All ALGs shall be certified for use in the hazardous-area classification that corresponds to their installation.

4.2.3 All ALGs should be maintained in safe operating condition. Manufacturers' maintenance and operating instructions specific to the ALG should be complied with.

5 Conformity to national standards and regulations

In addition to conformity with this International Standard, all ALGs shall also conform to OIML R 85.

6 Specification of level gauges

6.1 Compatibility with process conditions in the tank

All ALGs shall be designed to withstand cryogenic and corrosive conditions, turbulence in the fluid and vibration in the fluid and operating environment.

6.2 Provisions for routine maintenance

All ALGs shall allow routine maintenance to be performed without compromising the integrity of the tank. All ALGs shall have provisions to allow field calibration or verification without taking the tank out of service. This shall include means of verifying the level gauge accuracy at high and low levels.

6.3 Self-diagnostics or other measures

All ALGs shall provide self-diagnostics or other means to minimize the time required for trouble shooting, searching for the cause(s) and eliminating the abnormal condition(s).

6.4 Countermeasures against sudden malfunctions

For ease of maintenance and of repair in case of a malfunction, ALGs should preferably be installed such that they can be isolated from the tanks, e.g. through an isolation valve.

6.5 Compatibility for electro-magnetic and other environmental conditions

All ALGs shall be designed for electromagnetic compatibility, complying with user requirements and other proper standards, which means that the gauge shall neither interfere with nor be affected by interference from other equipment. Refer to OIML D11.

In addition, ALGs shall be provided with electrostatic and lightning protection embedded in or external to the equipment.

6.6 Confirmation of functioning

All ALGs shall be designed to enable confirmation of functioning, even under service. For this purpose, at least one verification point that does not conflict with normal measurement within the intended measuring range shall be arranged in the tank.

6.7 Minimizing the unmeasured zone

AII ALGs shall be designed so as to minimize its unmeasured zone in the operating range.

6.8 Instantaneous response

All ALGs shall provide essentially instantaneous dynamic response in tracking tank-level variations arising during the operation of receiving or delivering of liquid.

6.9 Security against tampering

All ALGs shall be provided with security measures to prevent unauthorized adjustment or tampering. This security may consist of (a) software password(s).

6.10 Minimum resolution

It is recommended that the minimum resolution of the reading be 1 mm or better.

6.11 Power source voltage variation capability

All ALGs shall be designed with the capability to operate under power-source voltage variations in accordance with environmental requirements.

6.12 Compensation for thermal effects

ALGs partially or completely installed in tanks shall be equipped with a measurement function or by other equivalent means to compensate for measuring errors caused by thermal contraction/expansion of the materials from which the level gauges are constructed.

6.13 Reference factors

All ALGs shall be calibrated by the manufacturer to measure the liquid level accurately at a predetermined reference factor, such as reference temperature, reference density or reference dielectric constant, etc.

6.14 Compensation for changes in physical properties and process condition of liquid and vapor

ALG shall compensate for the possible influence of the physical properties and process condition of the liquid and vapour in the tank on the accuracy of the level measured by the ALG.

7 Installation of ALG

7.1 Redundancy

It is recommended that two or more ALGs be installed on each tank. These ALGs should operate independently, such that failure of one ALG shall not affect the other. One of the ALGs shall be designated as the primary ALG. The same ALG shall be used for the opening and closing gauge during a transfer.

7.2 Manufacturers' instructions on installation

All ALGs shall be installed in accordance with the manufacturer's instructions and the instructions mandated by the regulatory authorities.

7.3 Location of installation

It is recommended that each ALG be installed in a position that minimizes the measurement inaccuracies due to effects of boiling and turbulence, which can occur during the receiving and delivery of liquid. Such installations shall have provisions that protect the ALGs and the tanks from physical damage.

8 Accuracy tests

8.1 General

All ALGs installed on shore tanks shall be subject to tests to ensure their proper functioning and accuracy before shipment from the manufacturer (first step, initial verification prior to installation) and after installation on shore tanks (second step, initial verification) but before commencement of use. However, if any test item cannot be repeated after installation onto the shore tanks, this test item can be skipped. In such cases, results of the first step, initial verification prior to installation, can also be used for the second step, initial verification.

In addition to the above, the ALGs should be subjected to subsequent verification.

8.2 Mutual consensus on test items

Test methods and procedures vary according to the type of ALG and/or national regulations. ALG manufacturers shall obtain, in advance of implementation of the tests, the consensus of the parties concerned regarding test methods, test items, etc.; whether to apply sampling or full tests; timing of implementation and other details, such as the inspection organization; and whether the tank owners, tank constructers, or other parties shall witness the tests.

9 First step — Initial verification prior to installation

Accuracy tests are conducted by comparing an indication of simulated level against that of a reference standard device. The reference standard shall be traceable to the national standard and should be a device external to the ALG sensor. However, in some cases, the reference standard is incorporated as part of the ALG. In either case, the reference standard shall bear a valid certification traceable to national standards.

The difference between the reference and the ALG measurement over the entire operating range shall not exceed ± 3 mm.

10 Second step initial verification after installation

10.1 Initial setting

The initial settings shall be configured when installing the ALG on the shore tank. The ALG settings shall be adjusted to indicate the accurate liquid level measured from the datum level. The zero point of some ullage types of ALGs is at the top reference point, e.g., at the mounting flange or process connection. In either case, configuring an ALG mounted on a tank prior to service can include compensation for the influence of the factors described in Clause 6.

10.2 Verification of an ALG with the tank out of service

After configuring the initial settings as described in 10.1, an ALG may have provisions for verifying the initial settings against reference points in the tank, e.g. using reference points on the still pipe on which the ALG is mounted. With this method, the ALG shall be calibrated or verified against all reference points to within ± 7,5 mm under normal ambient conditions, i.e., at ambient temperature and pressure.

10.3 Verification of an ALG with the tank in service

The ALG shall be tested with the tank in service by comparing the ALG reading against a reference point in the tank that is above the liquid/vapour interface for ullage ALGs. If a reference device is incorporated in the ALG, this device can be used as an alternative to the external reference point in the tank. In addition, the parties may agree, when feasible, to test the ALG with the liquid near the minimum operating level and with the tank at least 2/3 full. With this method, then, the difference between the reference and the ALG measurement shall not exceed ± 10 mm. National regulations can differ.

Alternatively, the ALG level reading can be compared against a level simulated by electrical signal. The electrical signal is designed to be an equivalent to the pre-defined test levels including at least two points. With this method, the difference between the ALG reading and the simulated, pre-defined level shall not exceed ± 10 mm at each point.

In all cases, the reference shall bear valid certification traceable to national standards.

11 Subsequent verification

11.1 Frequency

After the ALG has been placed in service, it is subject to mandatory accuracy tests to verify the ALG remains in calibration. It is recommended that the periodic accuracy tests be carried out at least annually, with the tank in service. The frequency of periodic tests can also be subject to national and/or international metrological requirements.

11.2 Procedure

Subsequent verification is implemented with the tank in service. The test shall include verifying the ALG accuracy following the procedure in 10.3. No adjustment on the ALG measured level shall be allowed during the testing. The difference between the ALG reading and the reference level shall not exceed $\pm$ 10 mm. If an ALG is found out of the accuracy tolerance stated above, the ALG shall be re-calibrated with the procedure described in 10.3.

All ALGs should be provided with appropriate equipment for the periodic accuracy tests.

Annex A
(informative)

Factors affecting the determination of the quantity of the fully refrigerated hydrocarbon liquids

Determination of the quantity (volume and/or mass) of the fully refrigerated hydrocarbon liquids based on measurements of liquid level by an automatic level gauge can be affected by the following factors:

a) volume determination: The bottom configuration of the tank is subject to deformation due to liquid head and this affects the liquid volume below the lower reference point.

b) temperature measurement: A large temperature gradient in the vapour and/or liquid phase can make difficult an accurate determination of the average vapour temperature for gauge correction and the temperature of the tank shell for the contraction/ expansion correction.

For details of the temperature measurement, refer to ISO 8310.

c) pipeline volumes: For purposes of a quantitative determination of the liquid volume delivered/received relative to the gauge opening and closing, the volume of liquid in the pipelines involved shall be constant, either full or empty, for both gauge opening and closing.

In the case of a single gauging, such as for inventory checks for example, it is necessary to give consideration to the volume of liquid in the pipelines connected to the tank.

Bibliography

[1] ISO 8310:1991, *Refrigerated light hydrocarbon fluids — Measurement of temperature in tanks containing liquefied gases — Resistance thermometers and thermocouples*

[2] OIML D11, *General requirements for electronic measuring instruments*

[3] ISO 4266-3, *Petroleum and liquid petroleum products - Measurement of level and temperature in storage tanks by automatic methods — Part 3: Measurement of level in pressurized storage tanks (non-refrigerated)*

[4] IEC 60079-10, *Electrical apparatus for explosive gas atmospheres — Part 10: Classification of hazardous areas*

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