INTERNATIONAL STANDARD

ISO 4266-3

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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)

Pétrole et produits pétroliers liquides — Mesurage du niveau et de la température dans les réservoirs de stockage par méthodes automatiques —

Partie 3: Mesurage du niveau dans les réservoirs de stockage sous pression (non réfrigérés)

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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 part of ISO 4266 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 4266-3 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*, Subcommittee SC 3, *Static petroleum measurement*.

ISO 4266-3, together with ISO 4266-1, ISO 4266-2 and ISO 4266-4 to ISO 4266-6, cancels and replaces ISO 4266:1994, which has been technically revised.

ISO 4266 consists of the following parts, under the general title *Petroleum and liquid petroleum products — Measurement of level and temperature in storage tanks by automatic methods*:

— *Part 1: Measurement of level in atmospheric tanks*

— *Part 2: Measurement of level in marine vessels*

— *Part 3: Measurement of level in pressurized storage tanks (non-refrigerated)*

— *Part 4: Measurement of temperature in atmospheric tanks*

— *Part 5: Measurement of temperature in marine vessels*

— *Part 6: Measurement of temperature in pressurized storage tanks (non-refrigerated)*

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)

1 Scope

This part of ISO 4266 gives guidance on the accuracy, installation, commissioning, calibration and verification of automatic level gauges (ALGs) both intrusive and non-intrusive, for measuring the level of petroleum and petroleum products having a vapour pressure less than 4 MPa, stored in pressurized storage tanks.

This part of ISO 4266 gives guidance on the use of ALGs in custody transfer application.

This part of ISO 4266 is not applicable to the measurement of level in caverns and refrigerated storage tanks with ALG equipment.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this part of ISO 4266. For dated references, subsequent amendments to, or revisions of, this publication do not apply. However, parties to agreements based on this part of ISO 4266 are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 1998 (all parts), *Petroleum industry — Terminology*

3 Terms and definitions

For the purposes of this part of ISO 4266, the terms and definitions given in ISO 1998, and the following, apply.

3.1
anchor weight
weight to which the detecting element guide wires of an automatic level gauge are attached to hold them taut and vertical

3.2
automatic level gauge
ALG
automatic tank gauge
ATG
instrument that continuously measures liquid height (dip or ullage) in storage tanks

3.3
dip
innage
vertical distance between the dipping datum point and the liquid level

3.4
dipping datum plate
dipping datum point
dip-plate
horizontal metal plate located directly below the gauging reference point to provide a fixed contact surface from which manual liquid-depth measurements are made

3.5
dip-tape
graduated steel tape with a tensioning dip-weight used for measuring the depth of oil or water in a tank, either directly by dipping or indirectly by ullaging

3.6
gauge-hatch
gauging access point
dip-hatch
opening in the top of a tank through which gauging and sampling operations may be carried out

3.7
gauging reference point
reference gauge point
point clearly defined on the gauge hatch directly above the dipping datum point to indicate the position (and upper datum) from which manual dipping or ullaging should be carried out

3.8
innage-based ALGs
ALGs designed and installed to measure the liquid dip, with an integral reference point at or close to the tank bottom, referenced to the dipping datum-plate

3.9
intrusive ALG
ALG where the level-sensing device intrudes within the tank and makes physical contact with the liquid, e.g. float and servo-operated-type ALGs

3.10
non-intrusive ALG
ALG where the level-sensing device may intrude within the tank, but does not make physical contact with the liquid, e.g. microwave or radar-type ALGs

3.11
still-well
stilling-well
still-pipe
guide pole
vertical, perforated pipe built into a tank to reduce measurement errors arising from liquid turbulence, surface flow or agitation of the liquid

3.12
ullage
outage
distance between the liquid level and the gauging reference point, measured along the vertical measurement axis

3.13
ullage-based ALGs
ALGs designed and installed to measure the ullage distance from the upper ALG reference point to the liquid surface

4 Precautions

4.1 Safety precautions

International Standards and government regulations on safety and material-compatibility precautions should be followed when using ALG equipment. In addition, the manufacturers' recommendations on the use and installation of the equipment should be followed. All regulations covering entry into hazardous areas should be observed.

4.2 Equipment precautions

4.2.1 All of the ALG equipment should be capable of withstanding the pressure, temperature, operating and environmental conditions likely to be encountered in service.

4.2.2 ALGs should be certified for use in the hazardous-area classification appropriate to their installation.

4.2.3 Measures should be taken to ensure that all exposed metal parts of the ALG should have the same electrical potential as the tank.

4.2.4 All ALG equipment should be maintained in safe operating condition and manufacturers' maintenance instructions should be complied with.

NOTE 1 The design and installation of ALGs may be subject to the approval of a national measurement organization, who will normally have issued a type approval for the design of the ALG for the particular service for which it is to be employed. Type approval is normally issued after an ALG has been subjected to a specific series of tests and is subject to the ALG being installed in an approved manner.

NOTE 2 Type-approval tests may include the following: visual inspection, performance, vibration, humidity, dry heat, inclination, fluctuations in power supplies, insulation, resistance, electromagnetic compatibility, and high voltage.

4.3 General precautions

4.3.1 The general precautions given in 4.3.2 to 4.3.9 affect the accuracy and performance of all types of ALGs and should be observed where they are applicable.

4.3.2 The measurement of tank vapour pressure and temperature, liquid temperature or any other relevant parameter should be time correlated with the tank level measurement. The tank liquid temperature should be representative of the tank contents.

4.3.3 All data measured for bulk transfer should be recorded promptly when they are taken.

4.3.4 Whenever determinations of the contents of a tank are made before the movement of a bulk quantity of liquid (opening gauge) and after the movement of a bulk quantity of liquid (closing gauge), the same general procedures should be used to measure the tank level.

4.3.5 All parts of the ALG in contact with the product or its vapour should be chemically compatible with the product, to avoid both product contamination and corrosion of the ALG.

4.3.6 ALGs should have sufficient dynamic response to track the liquid level during maximum tank filling or emptying rates.

4.3.7 Following the transfer of product, the tank should be allowed to settle before the tank level is measured.

4.3.8 Following a rapid change in the ambient conditions, the liquid surface may show a temporary instability. The level-measuring equipment should be capable of either detecting this phenomenon or counteracting the effect of level instability.

4.3.9 ALGs should provide security to prevent unauthorized adjustment or tampering. ALGs used in fiscal/custody transfer application should provide facilities to allow sealing for calibration adjustment.

5 Accuracy

5.1 Intrinsic error of ALGs

The level measurement accuracy of all ALGs is affected by the intrinsic error of the ALG, i.e. the error of the ALG when tested under controlled conditions as specified by the manufacturers.

5.2 Calibration prior to installation

The reading of the ALG in a fiscal/custody transfer application should, prior to installation (i.e. in the factory or testing laboratory), agree with a certified reference (e.g. a certified gauge tape) within ± 1 mm over the entire range of the ALG. The certified reference should be traceable to the national standards and should be provided with a calibration correction table. The uncertainty of the certified reference should not exceed 1 mm with the calibration correction applied.

NOTE Metrological requirements for the uncertainty of the calibration reference may be more stringent.

5.3 Error caused by installation and operating conditions

The error caused by installation and operating conditions on the ALGs used in fiscal/custody transfer pressurized applications should not exceed ± 3 mm, provided that the operating conditions are within the limits specified by the ALG manufacturer.

NOTE 1 The accuracy of measurements using ullage ALGs is affected by vertical movement of the gauging reference point used to calibrate the ALG or vertical movement of the ALG top mounting point during tank transfers. Accuracy may also be affected by tank tilt, hydrostatic pressure and vapour pressure.

NOTE 2 The accuracy of measurements by innage ALGs may be affected by vertical movement of the ALG bottom mounting point during tank transfers and/or variation of pressure.

NOTE 3 Volume measurements using tanks are limited by the following installed accuracy limitations, regardless of the ALG used. These limitations may have a significant effect on the overall accuracy of both manual level gauging and of all types of automatic level gauges, and/or on the accuracy of the quantity of the content in the tank.

a) Tank capacity table accuracy (including the effect of tank tilt and hydrostatic pressure).

b) Changes of tank geometry due to temperature.

c) Random and systematic errors in level, liquid, vapour density, pressure and temperature measurement.

d) Operational procedures used in the transfer.

e) Minimum difference between opening and closing levels (parcel size).

Special consideration should be given to volume and/or mass measurements in pressurized tanks with respect to the amount of product present in the vapour space of the tank.

5.4 Overall accuracy

5.4.1 General

The overall accuracy of level measurement by ALGs, as installed, is affected by the intrinsic error of the ALG, the effect of installation, and the effect of changes in the operating conditions.

NOTE Depending on the overall accuracy of the ALG as installed (“installed accuracy”), ALGs may be used in fiscal/custody transfer applications. The use of ALGs in fiscal/custody transfer applications requires the highest possible accuracy. The use of ALGs for non-fiscal/custody transfer applications often permits a lower degree of accuracy.

5.4.2 Use of ALGs for fiscal/custody transfer applications

The ALG should meet the pre-installation calibration tolerances (see 5.2).

Including the effects of the installation and changes in operating conditions (see 5.3), the ALG should meet the field verification tolerance (see 7.3.3).

The remote readout, if used, should meet the recommendations of this part of ISO 4266 (see clause 9).

6 Installation of ALGs

6.1 General

ALGs that use technology other than those described in this part of ISO 4266 can be used in fiscal/custody transfer applications if they provide the required accuracy for the intended application. Comparable methods to those described in this part of ISO 4266 should be available that allow the ALG to be verified with the tank in service.

Clauses 6.2 to 6.5 outline recommendations and precautions for the installation of ALGs.

6.2 Mounting location

6.2.1 The mounting location of an ALG may affect the installed accuracy. For fiscal/custody transfer application accuracy, the ALG mounting location should be stable with minimal vertical under all practical operating conditions (e.g. due to changes in liquid head and/or vapour pressure).

6.2.2 The ALG should preferably be mounted as close as practical to the vertical centreline axis of the tank.

6.2.3 The level-sensing element should be protected against excessive turbulence caused by the product inlet or outlet. If this cannot be achieved then an installation with a still-well should be considered.

6.3 Manufacturer's requirements

The ALG and level transmitter should be installed and wired in accordance with the manufacturer's instructions.

6.4 Installation

6.4.1 Installation of intrusive ullage ALGs (e.g. float-operated and servo-operated type) mounted on still-wells

6.4.1.1 For fiscal/custody transfer application accuracy, the ALG should be mounted on a properly suspended still-well. Figure 1 is an example of this installation. The still-well protects the ALG level-sensing element from liquid turbulence, and may provide the fixation point for the datum plate.

6.4.1.2 For ease of maintenance and verification, the ALG should be installed such that it can be isolated from the tank (e.g. through an isolation valve).

NOTE For ALGs used for other purposes, a still-well is not a mandatory requirement.

6.4.2 Installation of intrusive ullage ALGs (e.g. float and servo-operated types) using guide wires

6.4.2.1 For fiscal/custody transfer application accuracy and for operational accuracy, the ALG should be mounted on a properly installed nozzle. Figure 2 is an example of this installation. The spring-tensioned guide wire protects the ALG level-sensing element from liquid turbulence.