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Second edition
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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

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 28, *Petroleum and related products, fuels and lubricants from natural or synthetic sources*, Subcommittee SC 2, *Measurement of petroleum and related products*.

This second edition cancels and replaces the first edition (ISO 4266-3:2002), which has been technically revised.

The main changes are as follows:

— terms and definitions in Clause 3 have been updated;

— in 4.3.2, the level that is measured and recorded simultaneously with the temperatures has been clarified;

— in 5.2, the information on calibration prior to installation has been updated;

— in Clause 6, the design requirements for still-wells have been clarified and the limitation of non-perforated still-wells removed.

A list of all parts in the ISO 4266 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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 document gives requirements and 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 document gives guidance on the use of ALGs in custody transfer application.

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

2 Normative reference

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

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

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
automatic level gauge
ALG
automatic tank gauge
ATG
instrument that continuously measures liquid height (i.e. dip or *ullage* (3.8)) in storage tanks

3.2
datum plate
datum point dip-plate
dipping datum 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

3.3
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

3.4
innage automatic level gauge
innage ALG
automatic level gauge (3.1) designed and installed to measure liquid, with an integral reference point at or close to the tank bottom, referenced to the *datum plate* (3.2)

3.5
intrusive automatic level gauge
automatic level gauge (3.1) where the level-sensing device intrudes within the tank and makes physical contact with the liquid, e.g. float and servo-operated-type automatic level gauges

3.6
non-intrusive automatic level gauge
non-intrusive ullage automatic level gauge
automatic level gauge (3.1) where the level-sensing device can intrude within the tank, but does not make physical contact with the liquid

EXAMPLE Microwave or radar-type automatic level gauges.

3.7
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

3.8
ullage
outage
distance between the liquid level and the gauging reference point, measured along the vertical measurement axis

3.9
ullage automatic level gauge
ullage ALG
automatic level gauge (3.1) designed and installed to measure the *ullage* (3.8) distance from the upper automatic level gauge reference point to the liquid surface

4 Precautions

4.1 Safety precautions

Relevant international standards on safety and material-compatibility precautions should be followed when using ALG equipment. The manufacturers' recommendations on the use and installation of the equipment should be followed. It is presupposed that all regulations covering entry into hazardous areas are 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 which is appropriate to their installation.

4.2.3 Precautions 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 the manufacturer's maintenance instructions should be complied with.

NOTE 1 The design and installation of ALGs can 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 can 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 Product temperatures and vapour pressure should be measured and recorded simultaneously, or as close as practical, while the tank level is measured. The temperature should be representative of the tank contents and should be measured as described in ISO 4266-6.

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 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 can show 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 to be used in a fiscal/custody transfer application should agree with a certified reference (e.g. a certified gauge tape) within ±1 mm over the entire range of the ALG. It is presupposed that the certified reference is traceable to national standards. The certified reference should be provided with a calibration record.

NOTE Metrological requirements for the uncertainty of the calibration reference can be more stringent than the certified reference.

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.

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

The accuracy of measurements by innage ALGs can be affected by vertical movement of the ALG bottom mounting point either during tank transfers or variation of pressure, or both.

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

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).

Consideration should be given to volume or mass measurements (or both) 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 can be used in fiscal/custody transfer applications. The use of ALGs in fiscal/custody transfer applications calls for 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 specified in Clause 9.