INTERNATIONAL STANDARD

ISO 4266-1

First edition
2002-11-15

Petroleum and liquid petroleum products — Measurement of level and temperature in storage tanks by automatic methods —

Part 1: Measurement of level in atmospheric tanks

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

Partie 1: Mesurage du niveau dans les réservoirs à pression atmosphérique

Reference number
ISO 4266-1:2002(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

Contents

Page

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 4266-1 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*, Subcommittee SC 3, *Static petroleum measurement*.

ISO 4266-1, together with ISO 4266-2 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 1:
Measurement of level in atmospheric tanks

1 Scope

This part of ISO 4266 gives guidance on the accuracy, installation, commissioning, calibration and verification of automatic level gauges (ALGs), of both intrusive and non-intrusive types, for measuring the level of petroleum and petroleum products having a Reid vapour pressure less than 100 kPa, stored in atmospheric storage tanks.

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

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 4266. For dated references, subsequent amendments to, or revisions of, any of these publications 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 editions of the normative documents 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*

ISO 4512:2000, *Petroleum and liquid petroleum products — Equipment for measurement of liquid levels in storage tanks — Manual methods*

3 Terms and definitions

For the purposes of this part of ISO 4266, the terms and definitions given in ISO 1988, and the 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 have the same electrical potential as the tank.

4.2.4 All ALG equipment should be maintained in safe operating condition and the 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 4.3.8 apply to all types of ALGs and should be observed where they are applicable.

4.3.2 Tank temperatures should be measured at the same time as the tank level is measured. The tank temperature should be representative of the tank contents.

4.3.3 Levels 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 ALGs should provide security to prevent unauthorized adjustment or tampering. ALGs used in fiscal/custody transfer applications 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 ALGs 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 $\pm$ 1 mm over the entire range of the ALG. The certified reference should be traceable to national standards and should be provided with a calibration correction table. The uncertainty of the reference should not exceed 0,5 mm, with the calibration correction applied.

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

5.3 Error caused by installation and operating conditions

The total error of the ALG in a fiscal/custody conditions transfer application should not be affected by more than $\pm$ 3 mm due to installation, due to variation of operating conditions and due to variation of physical and electrical properties of the liquid and/or vapour, provided these conditions are within the limits specified by the ALG manufacturer.

NOTE 1 The accuracy of measurements using ullage-based ALGs is limited 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. The accuracy may be affected by tank-shell bulging due to liquid head stress. Any vertical movement of the gauging reference point due to liquid head stress of the tank shell may be compensated by a correction in the ALG.

NOTE 2 The accuracy of measurements using innage-based ALGs may be limited by any vertical movement of the dipping datum plate used to calibrate the ALG, or vertical movement of the ALG bottom mounting point during tank transfers.

NOTE 3 Volume measurements using tanks are limited by the following installed accuracy limitations, regardless of the ALGs 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) Bottom movement.

c) Encrustation of the tank shell.

d) Expansion of the tank diameter due to temperature.

e) Random and systematic errors in level, density, and temperature measurements.

f) Operational procedures used in the transfer.

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

5.4 Overall accuracy

5.4.1 General

The overall accuracy of level measurement by ALGs, as installed, is limited by the intrinsic error of the ALG equipment, the effect of installation methods, and the effect of the operating conditions.

NOTE Depending on the overall accuracy of the ALG as installed (“installed accuracy”), ALGs may be used for fiscal/custody transfer purposes. The use of ALGs in fiscal/custody transfer applications requires the highest possible accuracy. The use of ALGs for other (i.e. stock control or for plant or terminal operations) purposes often permits a lower degree of accuracy.

5.4.2 Use of ALGs for fiscal/custody transfer purposes

The ALG should meet the calibration tolerance prior to installation (see 5.2).

Including the effects of installation methods and changes in operating conditions (see 5.3), the ALG should meet the field verification tolerance (see 7.4.3.3).

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

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

6.2 Mounting location

The mounting location of an ALG may affect the installed accuracy. For fiscal/custody transfer accuracy, the ALG mounting location should be stable, with minimal vertical movement under all practical operating conditions (e.g. due to changes in liquid head, vapour pressure and loading of the roof or gauging platform, etc.). (See 6.5.)

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 For fiscal/custody transfer accuracy, an ullage ALG should be mounted on a properly supported, perforated still-well, as illustrated in Figures 1 and 2.

6.4.2 As an alternative, an ullage-based ALG may be mounted on the roof or on a “gallows” supported from the top course of the shell. The ALG's calculation procedure for liquid level should include a means which compensates or corrects for movement of the ALG with respect to the gauging reference point (due to liquid height and temperature). Various types of “gallows” designs are used. An example of this type of installation is shown in Figure 3. Installation of some other ullage-based ALGs may involve a mounting attached to the outside of the tank shell near the tank bottom. An example of this type of installation is shown in Figure 4.

NOTE An ALG may include a programme to compensate or correct for the movement of the ALG due to liquid height and temperature.

6.4.3 Innage-based ALGs should be mounted at a stable location at the tank bottom where any effects due to liquid turbulence and/or tank bottom movement will be minimized. An example of this type of installation is shown in Figure 5.

6.4.4 Where possible, the ALG should be located in close proximity to the manual gauge-hatch and should be accessible from the gauger's platform so that the ALG's accuracy can be easily verified by manual gauging. The ALG mounting and the gauging reference point of the manual gauging hatch should be rigidly connected to avoid errors due to differential and unpredictable movement.