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

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

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

*Partie 2: Mesurage du niveau dans les citernes de navire*

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# Contents

Page

<b>Foreword</b> .....	<b>v</b>
<b>Introduction</b> .....	<b>vi</b>
<b>1 Scope</b> .....	<b>1</b>
<b>2 Normative references</b> .....	<b>1</b>
<b>3 Terms and definitions</b> .....	<b>1</b>
<b>4 Precautions</b> .....	<b>3</b>
4.1 Safety precautions.....	3
4.1.1 General.....	3
4.1.2 Equipment precautions.....	3
4.2 General recommendations.....	3
4.2.1 Accuracy and performance.....	3
4.2.2 Speed of response.....	3
4.2.3 Protection from mechanical damage.....	4
4.2.4 Manual gauging.....	4
4.2.5 Minimum measurable level.....	4
4.2.6 Trim and list.....	4
4.2.7 Product temperatures.....	4
4.2.8 Compatibility.....	4
4.2.9 Entrained air and vapour.....	4
4.2.10 Vessel motion.....	4
4.3 Use of marine ALGs in fiscal/custody transfer.....	5
<b>5 Accuracy</b> .....	<b>5</b>
5.1 Intrinsic error of ALGs.....	5
5.2 Calibration prior to installation.....	5
5.3 Initial shipyard adjustment.....	5
5.4 Error caused by operating conditions.....	5
5.5 Overall accuracy.....	6
5.5.1 General.....	6
5.5.2 Use of ALGs for fiscal/custody transfer purposes.....	6
<b>6 Installation of marine ALGs</b> .....	<b>6</b>
6.1 General.....	6
6.2 Location of ALG.....	6
6.3 Location of manual calibration check point.....	6
6.4 Gauging of inerted tanks.....	6
<b>7 Onboard verification of marine ALGs</b> .....	<b>7</b>
7.1 General precautions.....	7
7.1.1 Check for smooth operation of level-sensing elements— at the shipyard.....	7
7.1.2 ALG technology-specific considerations.....	7
7.2 Verification by innage gauging or ullage gauging.....	7
7.3 Initial verification.....	7
7.4 Subsequent verification.....	7
7.4.1 General.....	7
7.4.2 Agreement between ALG reading and manual gauge reading.....	7
7.4.3 Use of average gauge readings.....	7
7.4.4 Adjustment of the ALG.....	8
7.5 Verification by alternate methods.....	8
7.6 Schedule for regular ALG verification.....	8
7.7 Record keeping.....	8
<b>8 Data communication and receiving</b> .....	<b>8</b>
8.1 General.....	8
8.2 Use of remote readout in fiscal or custody transfer.....	8

8.3 Telemetry and readout equipment.....	9
<b>Annex A (informative) Accuracy limitations of marine level measurement.....</b>	<b>10</b>
<b>Annex B (informative) Accuracy limitations of marine volume measurement.....</b>	<b>11</b>
<b>Bibliography.....</b>	<b>12</b>

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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.

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](http://www.iso.org/directives)).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at [www.iso.org/patents](http://www.iso.org/patents). ISO shall not be held responsible for identifying any or all such patent rights.

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

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 4266-2:2002), which has been technically revised.

The main changes are as follows:

- in [Clause 2](#), the reference to ISO 8697 has been removed as it is a withdrawn document;
- in [4.2.7](#), it has been clarified that the tank level should be measured and recorded simultaneously with the temperature;
- in [7.4.4.1](#), it has been clarified regarding the procedure prior to making adjustments against manual measurements;
- added addition documents in Bibliography.

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](http://www.iso.org/members.html).

## Introduction

Marine automatic level gauges (ALGs) are not normally used in fiscal or custody transfer applications because of the limitations described in [Annexes A](#) and [B](#). However, level measurement by marine ALGs may be used in fiscal or custody transfer when no other alternative, reliable measurement is available. The use of marine-vessel-based ALGs in fiscal or custody transfer normally requires mutual contractual agreement between the buyer and the seller and can be subject to government regulations.

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

## Part 2: Measurement of level in marine vessels

### 1 Scope

This document gives guidance on the accuracy, installation, calibration and verification of automatic level gauges (ALGs), both intrusive and non-intrusive, for measuring the level of petroleum and liquid petroleum products having a Reid vapour pressure less than 100 kPa, transported aboard marine vessels (i.e. tankers and barges).

This document gives guidance for buyers and sellers who mutually agree to use marine ALGs for either fiscal and/or custody transfer applications.

This document is not applicable to the measurement of level in refrigerated cargo tanks.

NOTE For information on the measurement of level in refrigerated cargo tanks, please see ISO 18132-1 and ISO 18132-3.

### 2 Normative references

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 1998-1, *Petroleum industry — Terminology — Part 1: Raw materials and products*

ISO 1998-2, *Petroleum industry — Terminology — Part 2: Properties and tests*

ISO 1998-3, *Petroleum industry — Terminology — Part 3: Exploration and production*

ISO 1998-4, *Petroleum industry — Terminology — Part 4: Refining*

ISO 1998-5, *Petroleum industry — Terminology — Part 5: Transport, storage, distribution*

ISO 1998-6, *Petroleum industry — Terminology — Part 6: Measurement*

ISO 1998-7, *Petroleum industry — Terminology — Part 7: Miscellaneous terms*

ISO 1998-99, *Petroleum industry — Terminology — Part 99: General and index*

ISO 4512, *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 document, the terms and definitions given in ISO 1998-1, ISO 1998-2, ISO 1998-3, ISO 1998-4, ISO 1998-5, ISO 1998-6, ISO 1998-7, ISO 1998-99 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 [*dip* (3.2) or *ullage* (3.5)] in storage tanks

### 3.2

#### **dip**

innage

vertical distance between the dipping datum point and the liquid level

### 3.3

#### **innage-based automatic level gauge**

*automatic level gauge* (3.1) designed and installed to measure the liquid *dip* (3.2) directly

### 3.4

#### **still-pipe**

stilling-well

stand pipe

guide pole

vertical, perforated pipe built into a tank to contain the liquid-level-detecting element in order to reduce measurement errors arising from liquid turbulence, surface flow or agitation of the liquid, and to provide a stable mounting point for an automatic level gauge

### 3.5

#### **ullage**

outage

distance between the liquid level and the upper reference point, measured along the vertical measurement axis

### 3.6

#### **ullage-based automatic level gauge**

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

### 3.7

#### **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. a float and servo-operated-type automatic tank gauge

### 3.8

#### **non-intrusive 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, e.g. a microwave or radar-type automatic tank gauge



## 4 Precautions

### 4.1 Safety precautions

#### 4.1.1 General

In addition, the manufacturers' recommendations on the use and installation of the equipment should be followed.

NOTE International Standards and government regulations, classification societies and ISGOTT on safety and material-compatibility precautions can apply when using marine ALG equipment.

#### 4.1.2 Equipment precautions

**4.1.2.1** All marine ALGs should be capable of withstanding the pressure, temperature and other environmental conditions likely to be encountered in marine service. When an ALG is installed in a corrosive service, any parts exposed to the liquid or vapours should be of durable, corrosion-resistant construction.

**4.1.2.2** All ALGs should be sealed to withstand the vapour pressure of liquid in the tank. ALGs mounted on vessels with an inert gas system (IGS) should be designed to withstand the operating pressure of the IGS.

**4.1.2.3** All marine ALGs should be specified and installed in accordance with the appropriate national and/or international (IMO, IEC, CENELEC, ISGOTT, ISO, etc.) marine electrical safety standards. ALGs should be certified for use in the hazardous-area classification appropriate to their installation.

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 can be subject to the approval of the national measurement organization and classification societies, who can have issued a general 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.

**4.1.2.4** The ALGs should provide security to prevent unauthorized adjustment or tampering. For ALGs to be used in fiscal or custody transfer application, the ALG should provide facilities to allow sealing of the calibration adjustment.

### 4.2 General recommendations

#### 4.2.1 Accuracy and performance

The general recommendations given in [4.2.2](#) to [4.2.10](#) affect the accuracy and performance of all types of marine ALGs and should be observed where they are applicable.

#### 4.2.2 Speed of response

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

#### 4.2.3 Protection from mechanical damage

Marine ALGs should be designed to withstand damage caused by waves in the tanks due to ship movement. They should also be able to withstand damage from high velocity jets of water or oil used to wash the tanks.

NOTE 1 This protection can require mounting the ALGs in still-pipes.

NOTE 2 Alternately, this protection can require that the ALGs with a float or displacer-type level-sensing element be raised to a “store” position when it is not being used. Such ALGs cannot be used during tank washing.

#### 4.2.4 Manual gauging

When an ALG is set or verified by manual gauging, the manual gauging shall be performed to obtain the highest accuracy in accordance with ISO 4512.

#### 4.2.5 Minimum measurable level

The ALG should be able to measure levels as near to the bottom of the tank as possible. This may require provision of a sump in the tank bottom in vessels with double bottoms.

NOTE The minimum measurable level of certain types of ALGs can limit their ability to measure small volumes of remaining on board (ROB)/on board quantity (OBQ).

#### 4.2.6 Trim and list

For the best accuracy, the vessel should be on an even keel and upright. In situations where both trim and list exist, every effort should be made to eliminate at least one condition, preferably list.

Trim and list corrections are not required on vessel tanks of cuboid (i.e. rectangular prism) shape, provided that the ALG is located at the geometric centre of the deck area for the tank. Where the ALG is not so located, correction will be required. On vessel tanks that have curvature(s), such as the aft and forward wing tanks, trim and list corrections are recommended. Correction for trim, list and wedge is permissible by table or calculation, using the procedure described in API MPMS Chapter 17.4.

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#### 4.2.7 Product temperatures

Product temperatures should be measured and recorded simultaneously, or as close as practical, as the tank level is measured. The temperature should be representative of the tank contents and should be measured as described in ISO 4266-5.

#### 4.2.8 Compatibility

All parts of the ALG in contact with the product should be compatible with the product, to avoid product contamination.

#### 4.2.9 Entrained air and vapour

Sufficient time should be allowed before gauging a tank to permit the liquid to free itself of entrained air or gas vapours.

#### 4.2.10 Vessel motion

During lightering or offshore operation, or when the vessel is at an exposed berth, vessel motion causes waves on the surface of the product. At least three readings should be taken as quickly as possible and the readings should be averaged. If the vessel is in heavy motion due to large swells or waves, at least five readings should be taken.