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

Part 4:

**Measurement of temperature in
atmospheric tanks**

*Pétrole et produits pétroliers liquides — Mesurage du niveau et
de la température dans les réservoirs de stockage par méthodes
automatiques — 2023*

*Partie 4: Mesurage de la température dans les réservoirs à pression
atmosphérique*



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Published in Switzerland

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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).

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. 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.

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 4266-4:2002), which has been technically revised.

The main changes are as follows:

- in [4.3.2](#), it has been clarified that the tank level should be measured and recorded simultaneously with the temperature;
- in [9.2](#), it has been clarified that individual component verification is optional, but verification as a whole system is required.

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 4: Measurement of temperature in atmospheric tanks

1 Scope

This document gives requirements and guidance on the selection, accuracy, installation, commissioning, calibration and verification of automatic tank thermometers (ATTs) in fiscal/custody transfer applications.

The ATT is used for measuring the temperature of petroleum and liquid petroleum products having a Reid vapour pressure less than 100 kPa, stored in atmospheric storage tanks.

This document is not applicable to the measurement of temperature in caverns or in refrigerated storage tanks.

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 (all parts), *Petroleum industry — Terminology*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1998 (all parts) 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 tank thermometer

ATT

instrument that continuously measures temperature in storage tanks

Note 1 to entry: An ATT, which can also be known as an automatic tank temperature system, typically includes precision temperature sensors, field-mounted transmitters for electronic signal transmission, and receiving/readout device(s).

3.2

resistance temperature detector

RTD

electrical temperature-sensing element in common use to measure the temperature of the contents of a storage tank

3.3

single-point automatic tank thermometer

spot automatic tank thermometer

automatic tank thermometer (3.1) that measures the temperature at a particular point in a tank by the spot temperature element

3.4

multiple-point automatic tank thermometer

automatic tank thermometer (3.1) consisting of multiple (usually three or more) spot temperature elements to measure the temperature(s) at selected liquid level(s)

Note 1 to entry: The readout equipment can average the readings from the submerged temperature elements to compute the average temperature of the liquid in the tank and can also display the temperature profile in the tank.

3.5

multiple-point automatic tank thermometer

averaging *automatic tank thermometer* (3.1) where the readout equipment selects the individual, spot temperature element(s) that are submerged in the liquid to determine the average temperature of the liquid in the tank

3.6

variable-length averaging automatic tank thermometer

averaging *automatic tank thermometer* (3.1) consisting of several temperature elements of varying length, with all the elements extending upwards from a position close to the bottom of the tank, and where the readout equipment selects the longest, completely submerged temperature element to determine the average temperature of the liquid in the tank

3.7

temperature transmitter

instrument that typically provides electrical power to the temperature element(s), converts the temperature measured by the element(s) to an electrical or electronic signal, and transmits the signal to a remote readout

Note 1 to entry: A local readout may be provided. Often, the function of the temperature transmitter is provided by the level transmitter of the automatic level gauge (ALG).

4 Precautions

4.1 Safety precautions

International standards and government regulations on safety and material-compatibility precautions can apply when using ATT equipment. In addition, the manufacturer's 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 ATT equipment should be capable of withstanding the pressure, temperature, operating and environmental conditions likely to be encountered in service.

4.2.2 ATTs 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 ATT have the same electrical potential as the tank.

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

4.2.5 All ATT equipment should be maintained in safe operating condition and the manufacturer's maintenance instructions should be complied with.

4.2.6 The temperature elements should be located in an area where it can be ensured that the temperature of any sediment deposits or free water bottoms that can be present in the tank are not measured.

4.3 General precautions

4.3.1 The general precautions given in [4.3.2](#) to [4.3.6](#) apply to all types of ATTs and should be observed where they are applicable.

4.3.2 Tank levels should be measured and recorded simultaneously, or as close as practical, as the tank temperature is measured. For more details on level measurement, refer to ISO 4266-1.

4.3.3 Temperatures measured for bulk transfer should be recorded when they are taken, unless the remote readout equipment of the ATT automatically records the temperatures periodically.

4.3.4 The same general procedures should be used to measure a tank temperature before product transfer (opening gauge) and after product transfer (closing gauge).

4.3.5 ATTs should provide security to prevent unauthorized adjustment or tampering. ATTs used in fiscal/custody transfer applications should provide facilities to allow sealing for calibration adjustment.

4.3.6 The design and installation of ATTs can be subject to the approval of the national measurement organization, who normally have issued a type or pattern approval ("Type Approval") for the design of the ATT for the particular service for which it is to be employed. Type approval is normally issued after an ATT has been subjected to a specific series of tests and is subject to the ATT being installed in an approved manner. 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.

5 Accuracy

5.1 General

The accuracy of petroleum temperatures taken by the ATTs should be consistent with the accuracy of the levels taken by the automatic level gauging system so that the overall accuracy of the standard volume measurement is not seriously degraded. Observance of the accuracy requirements for level and temperature gauging systems given in ISO 4266-1 and in this document will ensure overall accuracy of the standard volume measurement.

5.2 Intrinsic error of ATTs

The intrinsic error of ATTs, i.e. the accuracy of the ATTs when tested under controlled conditions as specified by the manufacturers, can be a major component of the uncertainty of the temperature measurement of the ATT, as installed. It is presupposed that the calibration reference device used to calibrate the ATT is traceable to appropriate national standards.

NOTE The temperature elements and field transmitters used for fixed, automatic tank temperature measurement are calibrated prior to installation. The transmitters normally do not provide field calibration adjustments.

5.3 Calibration prior to installation

5.3.1 General

ATTs to be used in fiscal/custody transfer applications can be calibrated/verified either as a system, or by components.

5.3.2 ATT calibrated as a system

If verified as a system, the temperature reading of the ATT readout should agree with that of the thermostatically controlled reference bath or oven temperature within 0,25 °C, at a minimum of three test temperatures spanning the anticipated working range of the ATT.

5.3.3 ATT calibrated by components

If the ATT is verified by components:

- a) the temperature equivalent of the measured resistance should agree with the reference bath temperature within 0,20 °C at each temperature;
- b) the temperature transmitter/converter and the ATT readout should be checked using precision resistors or a recently calibrated thermal calibrator. The ATT readout should agree with the temperature equivalent of the resistors or calibrator within 0,15 °C at each temperature.

5.3.4 Multiple-point ATTs

The required accuracy for each spot temperature sensor should be as given in [5.3.2](#) or [5.3.3](#), depending on the method used.

5.3.5 Variable-length ATTs

The required accuracy for each temperature element should be as given in [5.3.2](#) or [5.3.3](#), depending on the method used.

5.3.6 Uncertainty of the reference

The uncertainty of the reference should not exceed $\pm 0,05$ °C.

5.4 Error caused by installation and operating conditions

The total error of the ATT in fiscal/custody transfer applications can be affected by the installation and by variations in the operating conditions.

The accuracy of an ATT depends on the following:

- the number of the temperature-sensing elements;
- the location of the temperature-sensing elements.

The tank content's temperature can be subject to stratification which varies with:

- tank mixing;
- multiple sources of supply;
- viscosity or density of the liquid in the tanks, and
- tank insulation.

NOTE 1 Temperatures in large tanks (i.e. 750 m³ or larger) are often vertically stratified unless the contents are thoroughly mixed. Larger stratification can be expected in high-viscosity or high-density petroleum liquids.

NOTE 2 With some mass measurement technologies (e.g. hydrostatic tank gauges which are pressure-based), a single spot temperature can suffice.

5.5 Overall accuracy

5.5.1 General

The overall accuracy of temperature measurement by the ATT, as installed, is limited by the intrinsic error of the ATT equipment (temperature-sensing element, transmitter and readout), the effect of installation methods, and the effect of the operating conditions.

5.5.2 Use of ATT for fiscal/custody transfer purposes

An ATT system should be considered suitable for fiscal/custody transfer services if the ATT system meets the field verification tolerances given in [9.2.2](#), [9.3.2](#) and [9.4.2](#).

The ATT should meet the calibration tolerances prior to installation (see [5.3](#)).

The ATT should meet the field verification tolerance (see [9.2.2](#), [9.3.2](#) and [9.4.2](#)), as well as the effects of installation methods and changes in operating conditions.

The remote readout, if used, should meet the recommendations of [Clause 10](#).

6 Selection of ATTs (standards.iteh.ai)

6.1 General

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Copper or platinum temperature element bulbs, i.e. resistance temperature detectors (RTDs), are normally used for this application. Three types of ATT elements are widely used:

- single-point (spot) ATT;
- multiple-point ATT;
- variable-length averaging ATT.

Other types of ATT elements, which provide comparable performance, may be used.

The selection of a suitable ATT should be made based on the following criteria:

- a) the accuracy required;
- b) the operating conditions which can affect the accuracy (e.g. expected product temperature stratification);
- c) the minimum level in the tank at which temperature measurement is required;
- d) environmental conditions;
- e) type and size of the tank;
- f) available tank entries for new or existing tanks;
- g) requirements for local and remote readout, signal transmission, and cabling.