



**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 21451.5-2019

**Petroleum and liquid petroleum products -- Measurement of
level and temperature in storage tanks by automatic methods --
Part 5: Measurement of temperature in marine vessels**

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1 Scope

This Part of GB/T 21451 provides the selection, accuracy, installation, debugging, calibration and inspection guidance for automatic tank thermometer (ATT), which is adopted for the measurement of temperature of petroleum and liquid petroleum products in marine vessels.

This Part is applicable to the custody transfer metering of petroleum and liquid petroleum products with the Reid vapor pressure of not more than 100 kPa.

This Part is inapplicable to temperature measurement in refrigerated cargo hold or pressure cargo hold in marine vessels.

2 Normative References

The following documents are indispensable to the application of this document. In terms of references with a specified date, only versions with a specified date are applicable to this document. In terms of references without a specified date, the latest version (including all the modifications) is applicable to this document.

GB/T 8927 Petroleum and Liquid Petroleum Products - Temperature Measurement -Manual Methods (GB/T 8927-2008, ISO 4268:2000, MOD);

ISO 1998 (all parts) Petroleum Industry - Terminology

3 Terms and Definitions

What is defined in ISO 1998, and the following terms and definitions are applicable to this document.

3.1 Automatic Tank Thermometer; ATT

Automatic tank thermometer refers to an instrument which continuously measures temperature in storage (or cargo) tanks.

NOTE: a type of marine ATT, also known as automatic tank temperature measurement

4.2.2 All the marine ATTs shall be designed, selected and installed in accordance with

corresponding national and/or international (IMO, IEC, CENELEC, ISGOTT, ISO, etc.)

vessel electronic safety standards. ATT shall have certified documents that are consistent with the classification of dangerous zones that it is applied to.

4.2.3 In terms of ATT installed on vessels, all the exposed metal components shall be

firmly grounded, namely, connected to the vessel body.

4.2.4 All the ATT equipment shall be maintained under safe operating conditions.

Equipment maintenance shall be conducted in accordance with the manufacturer's requirements.

4.3.1 General requirements provided in 4.3.2 ~ 4.3.6 are applicable to various types of

ATT.

4.3.3 When temperature measurement is conducted on bulk cargo transportation, the

data shall be immediately recorded, unless long-distance digital display equipment can regularly and automatically record the temperature.

4.3.4 During the loading and/or unloading at multiple ports, before the transportation

of products (front reading) and after the transportation of products (rear reading), the same standard procedure shall be adopted to measure the temperature in marine vessels.

4.3.5 In order to prevent unauthorized adjustment or intervention, safety guarantee

shall be provided to ATT. When ATT is applied to custody transfer metering, certain conditions shall be provided to the sealing of the calibration adjustment device.

NOTE 1: this kind of protection might need to install ATT sensor in a temperature casing.

NOTE 2: ATT sensor may be integrated in the combination (for example, float, belt or rod) of automatic level gauge (ALG). When some designs (float and belt) are not in service, the combination of liquid level/temperature sensor might be raised to the location of "retention". During the tank-washing period, ATT cannot be used.

4.3.6 When ATT is applied to special occasions, its design and installation might need

to obtain type approval from relevant national institutions. After conducting a series of specific tests on ATT and complying with the authorized installation mode, type approval will generally be released.

5.1 Overview

circumstances are exceptions here:

- Cargo tank capacity is less than 159 m³, or, liquid level is lower than 3 m;
- The maximum variation of vertical temperature is less than 1 °C;
- The manually measured average temperature is used for custody transfer metering.

NOTE: when liquid temperature in the vessels is uniform, or, when temperature stratification in the vessels is relatively small and acceptable (see GB/T 8927), single-point temperature measurement may be adopted.

7 ATT Equipment - Instruction of Electronic Temperature Sensing Element

7.1 Resistance Temperature Detector In terms of generally used automatic temperature measurement equipment, its basic operating principle is that the resistance of metal (for example, copper or platinum)

varies with the temperature.

Generally speaking, copper or platinum RTD is used for temperature measurement in custody transfer metering, because it has extremely high accuracy and stability. The resistance of RTD may be measured through Wheatstone bridge circuit or other suitable electronic components. RTD may be resistance wires intertwined on non-conductor support core, or, thin-film type or other types. This component shall be correctly installed in a

stainless-steel shell. If necessary, circuit shall be intrinsically safe. Temperature sensing element shall be installed in a suitable temperature casing.

The length of the sensing part of point-type temperature sensing element shall not exceed 100 mm.

7.2 Other Temperature Sensing Element Other temperature sensing elements (such as thermocouple, thermistor, semiconductor and optical fiber, etc.) may also be adopted. However, they shall be calibrated and comply with the inspection tolerance provided in this Part, otherwise, it shall not be deemed that their accuracy is applicable to custody transfer metering.

8 Installation of Marine ATT

8.1 Overview The installation of marine ATT shall comply with the requirements in the instructions provided by ATT and ALG manufacturer.

applied for temperature measurement in custody transfer metering, the calibration tolerance provided in this Part shall be satisfied. The reference standard of ATT calibration shall be traceable to corresponding national standards.

NOTE 1: precise electronic temperature element and on-site transmitter used for fixed automatic tank thermometer need to be calibrated before installation. Generally speaking, on-site calibration adjustment device for transmitter will not be provided.

NOTE 2: the objective of 9.2 ~ 9.4 is to inspect the calibration adequacy and accuracy of ATT (including temperature element, transmitter and on-site/long-distance digital display device) after its installation.

When manual temperature measurement is adopted to inspect or calibrate ATT, manual temperature measurement shall be conducted in accordance with GB/T 8927.

The uncertainty of the reference standard for on-site calibration shall not exceed 0.1 °C (necessary calibration correction value shall be adopted).

ATT may be calibrated/inspected in accordance with system or component.

9.2 Calibration and Inspection of Single-point ATT for Custody Transfer Metering

9.2.1 Calibration before installation The reference standard of ATT calibration shall be traceable to corresponding national primary standards. Before installation, single-point ATT shall be calibrated under controllable conditions (namely, factory or laboratory) in accordance with one of the two methods below:

a) In three or more temperature points within ATT's operating range, through thermostatic bath and use standard thermometer to measure its temperature.

Conduct overall calibration of ATT (including temperature sensor, temperature transmitter/converter and digital display device); the requirement of accuracy is shown in