Manual of Petroleum Measurement Standards Chapter 7.5

Temperature Determination—Automatic Tank Temperature Measurement Onboard Marine Vessels Carrying Refrigerated Hydrocarbon and Chemical Gas Fluids

ANSI/API MPMS CHAPTER 7.5
FIRST EDITION, SEPTEMBER 2014

REAFFIRMED, MARCH 2026

ISO 8310:2012 (Identical), Refrigerated hydrocarbon and non-petroleum based liquefied gaseous fuels—General requirements for automatic tank thermometers on board marine carriers and floating storage

American Petroleum Institute

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Introduction

Large quantities of liquefied natural gas (LNG), liquefied petroleum gas (LPG) and other liquefied gases are usually transported by marine carriers dedicated for these applications and traded based on static measurement on board by automatic tank measurement. Such an automatic tank measurement may be a part of the custody transfer measurement system (CTMS) which involves determination of liquid/vapor interface, i.e. liquid level, average temperatures of liquid and vapor, and vapor pressure. The volumetric quantity of the liquid and gas is then computed with the tank capacity table based on which the delivered quantity in terms of energy content or mass is calculated.

In most cases, shore tank measurement is not used due to the active and dynamic conditions of the shore tank operations. In the absence of other means of acceptable measurement, custody transfer measurement usually takes place on board the carrier or floating production storage offshore (FPSO) and floating storage offshore (FSO). Liquid cargo density is very sensitive to temperature; therefore, obtaining accurate temperature readings is extremely important. For example, a change of 0.2 °C (0.36 °F) for liquid methane cargo results in a change in density of approximately 0.07 %.

This International Standard also discusses use of automatic tank thermometers on board marine vessels for other volatile, non-petroleum liquids in fully refrigerated conditions. Many of these non-petroleum liquids, such as di-methyl ether (DME) are measured in a similar manner to that used for fully refrigerated LPGs.

Values of temperature in this International Standard are in terms of the International Temperature Scale of 1990, ITS-90. Temperatures in degrees Celsius are denoted by the symbol t.

Automatic Tank Temperature Measurement onboard Marine Vessels Carrying Refrigerated Hydrocarbon and Chemical Gas Fluids

1 Scope

This International Standard specifies the essential requirements and verification procedures for automatic tank thermometers (ATTs) consisting of platinum resistance thermometers (PRT) and an indicating device used for custody transfer measurement of liquefied natural gas, liquefied petroleum and chemical gases on board ships. Temperature detectors other than PRT are considered acceptable for use in the custody transfer service of liquefied gases if they meet the performance requirements of this International Standard and are approved by national regulations.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60751, *Industrial platinum resistance thermometers and platinum temperature sensors*

ASTM E1137, *Standard Specification for Industrial Platinum Resistance Thermometers*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
automatic tank gauge
ATG
automatic level gauge
ALG
instrument that automatically measures and displays liquid levels or ullages in one or more tanks, either continuously, periodically or on demand

3.2
automatic tank gauging system
ATG system
system that includes ATGs at the cargo tanks and control/display unit that processes and displays output signals from the ATG along with any other parameters required to determine the liquid level, i.e. liquid/vapor interface

3.3
automatic tank thermometer
ATT
automatic tank temperature system
instrument that continuously measures temperature in cargo tanks

NOTE 1 An ATT typically includes temperature sensors, such as PRTs, field-mounted transmitters for electronic signal transmission, and indicating device(s).

NOTE 2 ATTs on liquefied gas carriers are usually multiple-point ATTs which consist of three or more temperature sensors, such as PRTs, to measure the temperatures at selected heights in the cargo tank.