

Manual of Petroleum Measurement Standards Chapter 7.3

Temperature Determination—Fixed Automatic Tank Temperature Systems

SECOND EDITION, OCTOBER 2011

REAFFIRMED, DECEMBER 2016



AMERICAN PETROLEUM INSTITUTE

Currently in preview, click buy full version

Manual of Petroleum Measurement Standards

Chapter 7.3

**Temperature Determination—Fixed Automatic Tank
Temperature Systems**

Measurement Coordination

SECOND EDITION, OCTOBER 2011

REAFFIRMED, DECEMBER 2016



AMERICAN PETROLEUM INSTITUTE

Special Notes

API publications necessarily address problems of a general nature. With respect to particular circumstances, local, state, and federal laws and regulations should be reviewed.

Neither API nor any of API's employees, subcontractors, consultants, committees, or other assignees make any warranty or representation, either express or implied, with respect to the accuracy, completeness, or usefulness of the information contained herein, or assume any liability or responsibility for any use, or the results of such use, of any information or process disclosed in this publication. Neither API nor any of API's employees, subcontractors, consultants, or other assignees represent that use of this publication would not infringe upon privately owned rights.

API publications may be used by anyone desiring to do so. Every effort has been made by the Institute to assure the accuracy and reliability of the data contained in them; however, the Institute makes no representation, warranty, or guarantee in connection with this publication and hereby expressly disclaims any liability or responsibility for loss or damage resulting from its use or for the violation of any authorities having jurisdiction with which this publication may conflict.

API publications are published to facilitate the broad availability of proven, sound engineering and operating practices. These publications are not intended to obviate the need for applying sound engineering judgment regarding when and where these publications should be utilized. The formulation and publication of API publications is not intended in any way to inhibit anyone from using any other practices.

Any manufacturer marking equipment or materials in conformance with the marking requirements of an API standard is solely responsible for complying with all the applicable requirements of that standard. API does not represent, warrant, or guarantee that such products do in fact conform to the applicable API standard.

Classified areas may vary depending on the location, conditions, equipment, and substances involved in any given situation. Users of this Standard should consult with the appropriate authorities having jurisdiction.

Users of this Standard should not rely exclusively on the information contained in this document. Sound business, scientific, engineering, and safety judgment should be used in employing the information contained herein.

API is not undertaking to meet the duties of employers, manufacturers, or suppliers to warn and properly train and equip their employees, and others exposed, concerning health and safety risks and precautions, nor undertaking their obligations to comply with authorities having jurisdiction.

Information concerning safety and health risks and proper precautions with respect to particular materials and conditions should be obtained from the employer, the manufacturer or supplier of that material, or the material safety data sheet.

Work sites and equipment operations may differ. Users are solely responsible for assessing their specific equipment and premises in determining the appropriateness of applying the Standard. At all times users should employ sound business, scientific, engineering, and judgment safety when using this Standard.

API is not undertaking to meet the duties of employers, manufacturers, or suppliers to warn and properly train and equip their employees, and others exposed, concerning health and safety risks and precautions, nor undertaking their obligations to comply with authorities having jurisdiction.

All rights reserved. No part of this work may be reproduced, translated, stored in a retrieval system, or transmitted by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from the publisher. Contact the Publisher, API Publishing Services, 1220 L Street, NW, Washington, DC 20005.

Foreword

This foreword is for information and is not part of this standard. This standard discusses equipment, methods and procedures for determining the temperature of hydrocarbon liquids using fixed automatic tank temperature systems.

The below listed sections are removed from API *MPMS* Chapter 7, "Temperature Determination", 1st edition 2001 and are covered by this publication of API *MPMS* Chapter 7.3 "Temperature Determination-Fixed Automatic Tank Temperature Systems", 2nd edition, 2011.

- 5.1 Fixed Automatic Tank Thermometers (ATTs)
- 5.5 Thermowells
- 5.6 Data Collection, Data Transmission, and Receiving Equipment
- 6.1 Ambient Temperature
- 6.3 Fixed Automatic Tank Thermometers
- 8.1 Fixed Automatic Tank Thermometers (ATTs)
- 9.1 Fixed Automatic Tank Thermometers

Revision of API *MPMS* Chapter 7-2001 is ongoing. The revision of API *MPMS* Chapter 7 will divide the current standard into four separate standards. It is anticipated that these four standards, including API *MPMS* Chapter 7.3-2011 referenced above, will supersede the sections of API *MPMS* Chapter 7-2001 as follows.

API *MPMS* Chapter 7, "Temperature Determination", 1st edition 2001, sections:

- 5.3 Glass Thermometers
- 5.5 Thermowells
- 5.6 Data Collection, Data Transmission, and Receiving Equipment
- 6.1 Ambient Temperature
- 6.5 Mercury-in-Glass Thermometers
- 8.3 Glass and Mercury-in-Glass Thermometer Verification

to be covered by API *MPMS* Chapter 7.1, 2nd Edition, "Liquid-in-Glass Thermometers".

API *MPMS* Chapter 7, "Temperature Determination", 1st edition 2001, sections:

- 5.2 Portable Electronic Thermometers (PETs)
- 5.4 Electronic Temperature Devices
- 5.5 Thermowells
- 5.6 Data Collection, Data Transmission, and Receiving Equipment
- 6.1 Ambient Temperature
- 6.4 Portable Electronic Thermometers
- 8.2 Portable Electronic Thermometers (PETs)

to be covered by API *MPMS* Chapter 7.2, 3rd Edition, "Portable Electronic Thermometers (PETs)".

API *MPMS* Chapter 7, “Temperature Determination”, 1st edition 2001, sections:

- 5.5 Thermowells.
- 5.6 Data Collection, Data Transmission, and Receiving Equipment
- 7 Dynamic Temperature Measurement
- 8.4 Dynamic Verification and Calibration
- 9.2 Dynamic Temperature Equipment

to be covered by API *MPMS* Chapter 7.4, 2nd Edition, “Dynamic Temperature Measurement”.

For the purposes of business transactions, limits on error or measurement tolerance are usually set by law, regulation, or mutual agreement between contracting parties. This publication provides guidance on tolerances that are recommended for custody transfer applications, and also describes methods by which acceptable approaches to any desired accuracy can be achieved.

Nothing contained in any API publication is to be construed as granting any right, by implication or otherwise, for the manufacture, sale, or use of any method, apparatus, or product covered by letters patent. Neither should anything contained in the publication be construed as insuring anyone against liability for infringement of letters patent.

Shall: As used in a standard, “shall” denotes a minimum requirement in order to conform to the specification.

Should: As used in a standard, “should” denotes a recommendation or that which is advised but not required in order to conform to the specification.

This document was produced under API standardization procedures that ensure appropriate notification and participation in the developmental process and is designated as an API standard. Questions concerning the interpretation of the content of this publication or comments and questions concerning the procedures under which this publication was developed should be directed in writing to the Director of Standards, American Petroleum Institute, 1220 L Street, NW, Washington, DC 20005. Requests for permission to reproduce or translate all or any part of the material published herein should also be addressed to the director.

Generally, API standards are reviewed and revised, reaffirmed, or withdrawn at least every five years. A one-time extension of up to two years may be added to this review cycle. Status of the publication can be ascertained from the API Standards Department, telephone (202) 682-8000. A catalog of API publications and materials is published annually by API, 1220 L Street, NW, Washington, DC 20005.

Suggested revisions are invited and should be submitted to the Standards Department, API, 1220 L Street, NW, Washington, DC 20005, standards@api.org.

Contents

	Page
1	Scope 1
2	Normative References 1
3	Terms, Definitions, and Acronyms 1
3.1	Terms and Definitions 1
3.2	Acronyms and Abbreviations 3
4	Precautions 4
4.1	General 4
4.2	Equipment Precautions 4
5	Equipment and Design Requirements 5
5.1	Equipment and Apparatus 5
5.2	System Description 13
5.3	Selection of an ATT System 13
5.4	Ambient Temperature 16
5.5	ATT Systems for Marine Applications 16
6	Installation Requirements 16
6.1	Location Requirements for ATTs in Custody Transfer Applications 16
6.2	Location Requirements for ATTs in Inventory Applications 17
6.3	Other Mechanical Installation Arrangements 18
6.4	ATT Systems for Marine Applications 18
6.5	Data Acquisition, Data Transmission, and Receiving Equipment 18
6.6	Configuration 19
7	Procedures for Temperature Determination 19
7.1	Timing of Temperature Measurement 19
7.2	Reporting of Temperatures 19
7.3	Ambient Temperature 19
8	Accuracy Requirements 20
8.1	Requirements for ATTs 20
8.2	Requirements for Test Equipment 20
9	Inspection, Verification, and Calibration Requirements 21
9.1	General 21
9.2	Verification 21
9.3	Calibration 25
9.4	Certification 25
9.5	Inspection and Maintenance 25
	Annex A (normative) Accuracy Limitations of Tank Temperature Measurements Onboard Marine Vessels . 26
	Bibliography 27
	Figures
1	Example of Multiple-Spot Temperature Element Installation 9
2	Example of Variable-Length ATT Temperature Element Installation 10
3	Example of Automatic Tank Temperature System Diagram 14

Contents

Page

Tables

1	Minimum Number of Temperature Sensors	7
2	Example of Sensor Lengths for a Variable Length ATT	7
3	Recommendations for the Use of ATTs	15
4	ATT Tolerances at Different Verification Stages.....	20
5	Requirements for Test Equipment.....	21
6	Calibration and Verification Frequency	24

Currently in preview, click buy full version

Introduction

The purpose of this standard is to describe methods and practices that can be used to obtain accurate temperature measurements of petroleum and petroleum products in storage tanks, ships and barges under static conditions by the use of an automatic method.

Temperature has a significant effect on the accurate determination of liquid quantities when correcting to standard conditions for custody transfer and inventory control purposes. A temperature of the liquid in the tank is used in these applications, so it is imperative that temperatures be determined accurately and are representative of the tank content.

This standard presents both Metric (SI) and US Customary units, and can be implemented in either system of units. The presentations of both units are for convenience of the user, and are not necessarily exact conversions. The units of implementation are typically determined by contract, regulatory requirement, the manufacturer or the user's calibration program.

In cases where marine applications have different requirements, they are handled in separate subsections.

Currently in preview, click buy full version

Temperature Determination—Fixed Automatic Tank Temperature Systems

1 Scope

This standard describes the methods, equipment, and procedures for determining the temperature of petroleum and petroleum products under static conditions by the use of an automatic method. Automatic temperature measurement is discussed for custody transfer and inventory control for both onshore and marine measurement applications.

Temperatures of hydrocarbon liquids under static conditions can be determined by measuring the temperature of the liquid at specific locations. Examples of where static temperature determination is required include storage tanks, ships and barges.

The application of this standard is restricted to automatic methods for the determination of temperature using fixed automatic tank thermometer (ATT) systems for hydrocarbons having a Reid Vapor Pressure at or below 101.325 kPa (14.696 psia).

Although not included in the scope, requirements in this standard or other Chapter 7 Sections (see the Foreword) can be used for other fluids and other applications including petroleum liquids having Reid vapor pressures in excess of 101.325 kPa (14.696 psia) tanks with inert gas systems and cryogenic liquids. However, such applications can require different performance and installation specifications.

2 Normative References

The following referenced documents are indispensable for the application 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.

API *MPMS* Chapter 12.1.1, *Calculation of Static Petroleum Quantities, Part 1—Upright Cylindrical Tanks and Marine Vessels*

3 Terms, Definitions, and Acronyms

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

3.1 Terms and Definitions

Terms used in this chapter are defined as follows:

3.1.1

automatic tank thermometer

ATT

An instrument used to continuously generate and transmit a representative measure of the temperature of the contents of any tank, vessel, or compartment by any means other than by the manual use of a thermometer or Portable Electronic Thermometer (PET). ATTs may include a local temperature display.

3.1.1.1

spot ATT

single-point ATT

A temperature instrument that measures the temperature at a particular point in the tank where the spot temperature sensor is located.