



## Tank Gauging & Associated Standards

(Updated 2017)

### Ref: **American Industrial Hygiene Association (AIHA)**

ANSI/AIHA Z-10 Occupational Health and Safety Management Systems (OHSMS)

### Ref: **American National Standards Institute (ANSI)**

#### **ANSI/ISA-84.00.01-2004 Part 1 (IEC 61511-1 Mod)**

Functional Safety: Safety Instrumented Systems for the Process Industry Sector - Part 1: Framework, Definitions, System, Hardware and Software Requirements

#### **ANSI/ISA-84.00.01-2004 Part 2 (IEC 61511-2 Mod)**

Functional Safety: Safety Instrumented Systems for the Process Industry Sector - Part 2: Guidelines for the Application of ANSI/ISA-84.00.01-2004 Part 1 (IEC 61511-1 Mod)

#### **ANSI/ISA-84.00.01-2004 Part 3 (IEC 61511-3 Mod)**

Functional Safety: Safety Instrumented Systems for the Process Industry Sector - Part 3: Guidance for the Determination of the Required Safety Integrity Levels

S84.01-2004 is identical to IEC 61511 with one exception. The United States added a “grandfather clause” for existing SISs. The standard integrates the various process safety management approaches used successfully throughout the world. The SIS lifecycle provides a framework for the various activities that are considered essential to the assessment, design, maintenance, inspection, testing, and operation of SIS. A quality management system is also defined to minimize the systematic errors during major project phases, such as:

- Hazard assessment
- Design
- Engineering, Installation, Commissioning, and Validation
- Operating and Maintenance
- Change management

The standard uses a performance metric, the safety integrity level (SIL), to establish order of magnitude levels of analysis, design, diagnostics, testing, and management rigor. The SIL is related to the risk reduction allocated to the SIS to mitigate a specific process risk to a tolerable level.

The Grandfather Clause: S84.01-2004 Part 1 Clause 1y is considered the “grandfather clause” and states the following:

“For existing SIS designed and constructed in accordance with codes, standards, or practices prior to the issuance of this standard (e.g. ANSI/ISA 84.01-1996), the



owner/operator shall determine and document that the equipment is designed, maintained, inspected, tested, and operating in a safe manner.”

**Ref: American Petroleum Institute (API)  
Manual of Petroleum Measurement Standards (MPMS)**

- Chapter 1 Vocabulary** (2<sup>nd</sup> Edition, 01-Jul-1994);  
Provides definitions and terms used throughout the API Manual of Petroleum Measurement Standards (MPMS).
- Chapter 2 Tank Calibration** (including Standards 2550, 2551, 2552, 2555, & 2556);  
Contains procedures necessary for calibrating closed storage vessels larger than a drum and methods for computing the volumes contained therein.
- Chapter 2.2A Measurement and Calibration of Upright Cylindrical Tanks by the Manual Strapping Method, 1<sup>st</sup> Edition, 01-Feb-1995; Reaffirmed 2012
- Chapter 2.2B Calibration of Upright Cylindrical Tanks Using the Optical Reference Line Method, 1<sup>st</sup> Edition, 01-Mar-1989; Reaffirmed 2013
- API MPMS Standards 2.2A & 2.2B supersede API Standard 2550.
- Chapter 2.2C / ISO 7507-3:1993  
Calibration of Upright Cylindrical Tanks Using the Optical Triangulation Method, ANSI/API MPMS 2.2C-2002; Reaffirmed 2013
- Chapter 2.2D / ISO 7507-4:1995  
Calibration of Upright Cylindrical Tanks Using the Internal Electro Optical Distance Ranging Method, 1<sup>st</sup> Edition August 2003; Reaffirmed 2014
- Chapter 2.2E, Petroleum and Liquid Petroleum Products—Calibration of Horizontal Cylindrical Tanks, Part 1: Manual Methods, First Edition, April 2004  
Errata, November 2009; Reaffirmed 2014
- Chapter 2.2F Petroleum and Liquid Petroleum Products-Calibration of Horizontal Cylindrical Tanks- Part 2: Internal Electrooptical Distance ranging Method, First Edition 01-Feb-2004 / Reaffirmed 2014
- Chapter 2.7 Calibration of Barge Tanks; 1st Edition, March 1991; Reaffirmed May 2008
- Chapter 2.8A Calibration of Tanks on Ships and Oceangoing Barges; 1st Edition, March 1991; Reaffirmed March 2012
- Chapter 2.8B Establishment of the Location of the Reference Gauge Point and the Gauge Height of Tanks on Marine Tank Vessels; 1st Edition, September 1995, Reaffirmed: December 2014



- Chapter 3 Tank Gauging** (including Standard 2545);  
Covers standardized procedures for gauging liquid hydrocarbons in various types of tanks, containers, and carriers.
- Chapter 3.1A Standard Practice for Manual Gauging of Petroleum and Petroleum Products.** Describes the following: (a) the procedures for manually gauging the liquid level of petroleum and petroleum products in non-pressure fixed-roof, floating-roof tanks and marine tank vessels, (b) procedures for manually gauging the level of free water which may be found with the petroleum or petroleum products, (c) methods used to verify the length of gauge tapes under field conditions and the influence of bob weights and temperature on the gauge tape length, and (d) the influences that may affect the position of gauging reference point (either the datum plate or the reference gauge point). Throughout this Standard the term petroleum is used to denote petroleum, petroleum products, or the liquids normally associated with the petroleum industry. The method used to determine the volume of tank contents determined from gauge readings is not covered in this Standard. The determination of temperature, API gravity, and suspended sediment and water of the tank contents are not within the scope of this Standard. (3<sup>rd</sup> Edition, 01-Aug-2013)
- Chapter 3.1B Standard Practice for Level Measurement of Liquid Hydrocarbons in Stationary Tanks by Automatic Tank Gauging.** Covers level measurement of liquid hydrocarbons in stationary, aboveground, atmospheric storage tanks using automatic tank gauges (ATGs). This publication discusses automatic tank gauging in general, calibration of ATGs for custody transfer and inventory control, and the requirements for data collection, transmission, and receiving. The appendices discuss the operation and installation of the most commonly used ATG equipment and of the less commonly used, electronic ATGs. (2<sup>nd</sup> Edition, 01-Jun-2001; Reaffirmed February 2016)
- Chapter 3.2 Gauging Petroleum and Petroleum Products in Tank Cars (1<sup>st</sup> Edition, 01-Jan-1995; Reaffirmed May 2013)
- Chapter 3.3 Standard Practice for Level Measurement of Liquid Hydrocarbons in Stationary Pressurized Storage Tanks by Automatic Tank Gauging (1<sup>st</sup> Edition, 01-Jun-1996; Reaffirmed 2011)
- Chapter 3.4 Standard Practice for Level Measurement of Liquid Hydrocarbons on Marine Vessels by Automatic Tank Gauging (1<sup>st</sup> Edition, 01-Apr-1995; Reaffirmed May 2016)
- Chapter 3.5 Standard Practice for Level Measurement of Light Hydrocarbon Liquids Onboard Marine Vessels by Automatic Tank Gauging (1<sup>st</sup> Edition, 01-Mar-1997; Reaffirmed February 2013)
- Chapter 3.6 Measurement of Liquid Hydrocarbons by Hybrid Tank Measurement Systems.** Covers selection, installation, commissioning, calibration and verification of Hybrid Tank Measurement Systems (HTMSs) for the



measurement of level, static mass, observed and standard volume, and observed and reference density in tanks storing petroleum and petroleum products for custody transfer and/or inventory control purposes (1<sup>st</sup> Edition, 01-Feb-2001; Reaffirmed October 2011) (Also see API MPMS 16.2)

**Chapter 4 Proving Systems;**

Serves as a guide for the design, installation, calibration, and operation of meter proving systems.

Chapter 4.1 Proving Systems, Section 1 – Introduction, 3<sup>rd</sup> Edition, February 2005, Reaffirmed June 2014

Chapter 4.4 Tank Provers, Section 4; 2<sup>nd</sup> Edition, May 1998 / Reaffirmed May 2015

Chapter 4.5 Master Meter Provers; 4<sup>th</sup> Edition, June 2016

**Chapter 5 Metering;**

Covers the dynamic measurement of liquid hydrocarbons, by means of meters and accessory equipment

Chapter 5.1 General Considerations for Measurement by Meters; 4<sup>th</sup> Edition, October 2005, Reaffirmed: July 2016

Chapter 5.2 Metering, Section 2 – Measurement of Liquid Hydrocarbons by Displacement Meters, 3<sup>rd</sup> Edition, October 2005, Reaffirmation July 2015

Chapter 5.3 Metering, Section 3 - Measurement of Liquid Hydrocarbons by Turbine Meters, 5<sup>th</sup> Edition, September 2005, Reaffirmation August 2014

**Chapter 5.6 Metering, Section 6 - Measurement of Liquid Hydrocarbons by Coriolis Meters, 1<sup>st</sup> Edition, October 2002, Reaffirmation November 2013**

Chapter 5.8 Metering, Section 8 - Measurement of Liquid Hydrocarbons by Ultrasonic Flow Meters using Transfer Time Technology, 2<sup>nd</sup> Edition, November 2011, Reaffirmation November 2011

**Chapter 6 Metering Assemblies;**

Discussion of the design, installation and operation of metering systems for coping with special situations in hydrocarbon measurement.

Chapter 6.1 Lease Automatic Custody Transfer (LACT) Systems; 2<sup>nd</sup> Edition, May 1991, Reaffirmed: May 2012

Chapter 6.2 Loading Rack Metering Systems; 3<sup>rd</sup> Edition, February 2004, Reaffirmed: August 2016

Chapter 6.4 Metering Systems for Aviation Fueling Facilities; 2<sup>nd</sup> Edition, January 2007, Reaffirmed: January 2012



- Chapter 6.5 Metering Systems for Loading and Unloading Marine Bulk Carriers; 2nd Edition, May 1991, Reaffirmed: May 2012
- Chapter 6.6 Pipeline Metering Systems; 2nd Edition, May 1991, Reaffirmed: January 2012
- Chapter 6.7 Metering Viscous Hydrocarbons; 2nd Edition, May 1991, Reaffirmed: May 2012

**Chapter 7 Temperature Determination;**

Describes methods and practices that may be used to obtain accurate measurements of temperature of petroleum and petroleum products in pipelines, storage tanks, gathering tanks, ships, barges, tank cars, pipe provers, tank provers and test measures under both static and dynamic conditions using electronic temperature measuring devices or mercury-in-glass thermometers. Describes the methods, equipment, and procedures for determining the temperature of petroleum and petroleum products under both static and dynamic conditions. This chapter discusses temperature measurement requirements in general for custody transfer, inventory control, and marine measurements. The actual method and equipment selected for temperature determination are left to the agreement of the parties involved. Addendum 1, October 2011  
First Edition, June 2001; Reaffirmed 2012

- Chapter 7.1 Static Temperature Determination Using Mercury-in-Glass Tank Thermometers; 01-Feb-1991

- Chapter 7.2 Dynamic Temperature Determination; Second Edition, March 1995

**Chapter 7.3** Fixed Automatic Tank Temperature Systems; 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. 2nd Edition, October 2011



## **Chapter 8     Sampling**

Covers standardized procedures for sampling crude oil or its products.

### **Chapter 8.1     Standard Practice for Manual Sampling of Petroleum and Petroleum Products. (ASTM D4057)**

Covers procedures and equipment for manually obtaining samples of liquid petroleum and petroleum products, crude oils, and intermediate products from the sample point into the primary container. Procedures are also included for the sampling of free water and other heavy components associated with petroleum and petroleum products. This practice also addresses the sampling of semi-liquid or solid-state petroleum products. This practice provides additional specific information about sample container selection, preparation, and sample handling. This practice does not cover sampling of electrical insulating oils and hydraulic fluids. The procedures described in this practice may also be applicable in sampling most non-corrosive liquid industrial chemicals provided that all safety precautions specific to these chemicals are followed (also, refer to ASTM Practice E300). The procedures described in this practice are also applicable to sampling liquefied petroleum gases and chemicals. 4th Edition, October 2013

Chapter 8.2     Standard Practice for Automatic Sampling of Petroleum and Petroleum Products. 4<sup>th</sup> Edition, November 2016

Chapter 8.3     Standard Practice for Mixing and Handling of Liquid Samples of Petroleum and Petroleum Products. 1<sup>st</sup> Edition, October 1995; Reaffirmed March 2015

Chapter 8.4     Standard Practice for Sampling and Handling of Fuels for Volatility Measurement. 3<sup>rd</sup> Edition, March 2014

**Chapter 9     Density Determination;** Describes the standard methods and apparatus used to determine the specific gravity of crude oil and petroleum products normally handled as liquids.

**Chapter 9.1     Standard Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method;** Describes the methods and practices relating to the determination of the density, relative density, or API gravity of crude petroleum and liquid petroleum products using the hydrometer method (laboratory determination). 3<sup>rd</sup> Edition, December 2012

Chapter 9.2     Standard Test Method for Density or Relative Density of Light Hydrocarbons by Pressure Hydrometer (2<sup>nd</sup> Edition, 01-Mar-2003; Reaffirmed 2007)

Chapter 9.3     Standard Test Method for Density, Relative Density, and API Gravity of Crude Petroleum and Liquid Petroleum Products by Thermohydrometer Method (2<sup>nd</sup> Edition, 01-Nov-2002; Reaffirmed 2008)



## **Chapter 10 Sediment and Water Determination**

Describes methods for determining the amount of sediment and water, either together or separately in petroleum products. Laboratory and field methods are covered.

- Chapter 10.1 Standard Test Method for Sediment in Crude Oils and Fuel Oils by the Extraction Method; (ANSI / ASTM D473) 3<sup>rd</sup> Edition, November 2007; Reaffirmed October 2012
- Chapter 10.2 Determination of Water in Crude Oil by Distillation (ASTM D4006). 4<sup>th</sup> Edition, December 2016
- Chapter 10.3 Standard Test Method for Water and Sediment in Crude Oil by the Centrifuge Method (Laboratory Procedure) (ASTM D4007). 4<sup>th</sup> Edition, August 2013
- Chapter 10.4 Determination of Sediment and Water in Crude Oil by the Centrifuge Method (Field Procedure). 4<sup>th</sup> Edition, October 2013
- Chapter 10.5 Standard Test Method for Water in Petroleum Products and Bituminous Materials by Distillation (ASTM D95). 5<sup>th</sup> Edition, September 2013
- Chapter 10.6 Standard Test Method for Water and Sediment in Fuel Oils by the Centrifuge Method (Laboratory Procedure)(ASTM D1796). 5<sup>th</sup> Edition, August 2013
- Chapter 10.7 Sediment and Water - Standard Test Method for Water in Crude Oils by Potentiometric Karl Fischer Titration (ANSI /ASTM D4377) 2<sup>nd</sup> Edition, December 2002; Reaffirmed May 2011
- Chapter 10.8 Standard Test Method for Sediment in Crude Oil by Membrane Filtration 2<sup>nd</sup> Edition, November 2005; Reaffirmed 2015
- Chapter 10.9 Standard Test Method for Water in Crude Oils by Coulometric Karl Fischer Titration (ASTM D4928) Covers the determination of water in the range from 0.02 to 5.00 mass or volume % in crude oils. Mercaptan (RSH) and sulfide (S<sup>-</sup> or H<sub>2</sub>S) as sulfur are known to interfere with this test method, but at levels of less than 500 µg/g [ppm(m)], the interference from these compounds is insignificant. This test method can be used to determine water in the 0.005 to 0.02 mass % range, but the effects of the mercaptan and sulfide interference at these levels has not been determined. For the range 0.005 to 0.02 mass %, there is no precision or bias statement. This test method is intended for use with standard commercially available coulometric Karl Fischer reagent. 3<sup>rd</sup> Edition, May 2013

## **Chapter 11.0 Physical Properties Data**



**Chapter 11.1 Temperature and Pressure Volume Correction Factors for Generalized Crude Oils, Refined Products, and Lubricating Oils**, May 2004 Addendum, September 2007

Chapter 11.2 Part 4—Temperature Correction for the Volume of NGL and LPG Tables 23E, 24E, 53E, 54E, 59E, and 60E, First Edition, September 2007  
Errata, September 2011

**Chapter 11.4 Properties of Reference Materials**, Part 1—Density of Water and Water Volumetric Correction Factors for Water Calibration of Volumetric Provers, First Edition, December 2003 Errata, September 2011

**Chapter 11.5 Density/Weight/Volume Intracoversion**, Part 1—Conversions of API Gravity at 60 °F, First Edition, March 2009 Errata; Reaffirmed March 2015

**Chapter 12 Calculation of Petroleum Quantities;**  
Describes the standard procedures for calculating net standard volumes, including the application of correction factors and the importance of significant figures. The purpose of standardizing the calculation procedure is to achieve the same result regardless of which person or computer does the calculating

**Chapter 12.1.1 Calculation of Static Petroleum Quantities – Upright Cylindrical Tanks and Marine Vessels**. 3<sup>rd</sup> Edition, April 2012

**Chapter 12.1.2 Calculation of Petroleum Quantities, Calculation Procedures for Tank Cars**. 1<sup>st</sup> Edition, May 2003; Reaffirmed May 2011 with 2-Year Extension: March 2016

Chapter 12.2, Calculation of Petroleum Quantities Using Dynamic Measurement Methods and Volumetric Correction Factors, 1<sup>st</sup> Edition, May 2011  
Part 1, Introduction. 2nd Edition, May 1995; Reaffirmed May 2014  
Part 2, Measurement Tickets. Second Edition, May 1995; Reaffirmed 2016  
Part 3, Proving Reports, 1<sup>st</sup> Edition, October 1998; Reaffirmed 2014  
Part 4, Calculation of Base Prover Volumes by Waterdraw Method, First Edition, December 1997  
Part 5, Base Prover Volume Using Master Meter Method, Second Edition, September 2001; Errata, July 2009; Reaffirmed 2016

**Chapter 13 Statistical Aspects of Measuring and Sampling;** The more accurate petroleum measurement becomes, the more its practitioners stand in need of statistical methods to express residual uncertainties. This chapter covers the application of statistical methods to petroleum measurement and sampling.

**Chapter 13.3 Measurement Uncertainty;** Establishes a methodology to develop uncertainty analyses for use in writing API Manual of Petroleum Measurement Standards (MPMS) documents that are consistent with the ISO GUM and NIST Technical Note 1297. 1<sup>st</sup> Edition, May 2016





## **Chapter 14 Natural Gas Fluids Measurement**

Standardizes practices for measuring, sampling and testing natural gas Fluids.

Chapter 14.3.1 Concentric, Square-edge Orifice Meters; Part 1 – General Equations and Uncertainty Guidelines

Chapter 14.4 Converting Mass of Natural Gas Liquids and Vapors to Equivalent Liquid Volumes (1<sup>st</sup> Edition, 01-Apr-1991; Reaffirmed 2012)

Chapter 14.7 Mass Measurement of Natural Gas Liquids (4<sup>th</sup> Edition, 01-Apr-2012)

Chapter 15 Guidelines for Use of the International System of Units (SI) in the Petroleum and Allied Industries. Specifies the API preferred units for quantities involved in petroleum industry measurements and indicates factors for conversion of quantities expressed in customary units to the API-preferred metric units. The quantities that comprise the tables are grouped into convenient categories related to their use. They were chosen to meet the needs of the many and varied aspects of the petroleum industry but also should be useful in similar process industries.(3<sup>rd</sup> Edition, 11-Dec-2001; Reaffirmed 2007

## **Chapter 16 Measurement of Hydrocarbon Fluids by Weight or Mass;**

Covers the static and dynamic measurement of hydrocarbon fluids by weight or mass.

**Chapter 16.2 Mass Measurement of Liquid Hydrocarbons in Vertical Cylindrical Storage Tanks by Hydrostatic Tank Gauging.** Provides guidance on the installation, commissioning, maintenance, validation, and calibration of hydrostatic tank gauging (HTG) systems for the direct measurement of static mass of liquid hydrocarbons in storage tanks.

This edition is applicable to hydrostatic tank gauging systems that use pressure sensors with one port open to the atmosphere. It is also applicable for use on vertical cylindrical atmospheric storage tanks with either fixed or floating roofs. (Based entirely on ISO 11223.) (1<sup>st</sup> Edition, November 1994; Reaffirmed March 2012)

**Chapter 17 Marine Measurement;** Provides guidelines for the measurement and reporting of crude oil or petroleum product transfers by shore terminal operators, vessel personnel, and other parties involved in marine cargo transfer measurement and accountability operations.

Chapter 17.1 Guidelines for Marine Inspection; Specifies the policy and minimum recommended practices for the manual and automatic measurement, sampling, and accounting for bulk quantities of crude oil (including spiked, blended, and reconstituted crude oil), petroleum products and chemicals that are transported on marine vessels. The activities described in these guidelines include actions by producers, buyers, sellers, terminal operators, vessel owners, and their crews, customs authorities, independent inspectors, and other parties with an interest in measurements. 6<sup>th</sup> Edition, June 2014; 2-Year Extension May 2016



**Chapter 17.2 Measurement of Cargoes On Board Tank Vessels** (2<sup>nd</sup> Edition, 01-May-1999)

**Chapter 17.2A Closed and Restricted Measurement** (1<sup>st</sup> Edition, 01-Nov-1995)

**Chapter 17.4 Method for Qualification of small Volumes on Marine Vessels** (OBQ/ROB)(1<sup>st</sup> Edition, 2016)

Chapter 17.11 Measurement and Sampling of Cargoes on Board Tank Vessels Using Closed and Restricted Equipment, First Edition, 01-May-2009

**Chapter 18 Custody Transfer**; Covers application of other measurement standards to unique custody transfer situations.

Chapter 18.1 Measurement Procedures for Crude Oil Gathered from Small Tank by Truck; 2nd Edition, April 1997, Reaffirmed: February 2007

**Chapter 18.2 Custody Transfer of Crude Oil from Lease Tanks using alternative measurement methods**; Defines the minimum equipment and methods used to determine the quantity and quality of crude oil being loaded from a lease tank to a truck trailer without requiring direct access to a lease tank gauge hatch. Methods and equipment described are grouped by tank zone, trailer zone, and the transition zone between the two.

The equipment used for measurement is dependent on the existing design of the lease equipment, the equipment used to transport the product, or a combination of the two. Some sites may require measurements from multiple zones in order to arrive at an accurate load quantity and quality.

This publication integrates by reference the API Manual of Petroleum Measurement Standards (MPMS) for sampling, temperature determination, gauging, and quality testing into a framework that may be applied during custody transfer of crude oil from lease tanks to a tank truck without requiring direct access to the tank thief gauge hatch. Many of the individual standards have guidelines defining the frequency and tolerances for installation, verification, and calibration of the specified equipment under controlled or ideal conditions allowing for uncertainty within custody transfer requirements. However, with the conditions encountered in many of today's applications, the installation, verification, and calibration of measurement devices may have higher uncertainties due to the operational characteristics and limited access available at the lease site. In the interest of safety and environmental concerns, these higher uncertainties may still provide acceptable measurement for custody transfer of crude oil from tanks using the defined alternate methods.

The alternate measurement methods discussed in this standard are intended to minimize uncertainty and bias while encouraging consistent



measurement and testing practices using existing technologies within API standards. 1<sup>st</sup> Edition, July 2016

**Chapter 19 Evaporative Loss Measurement;**

This chapter covers methods for estimating hydrocarbon evaporation losses from various types of tanks. Note that Chapter 19 is not included in the complete set of API Manual of Petroleum Measurement Standards.

Chapter 19.1 Evaporative Loss from Fixed-Roof Tanks; Contains methodologies for estimating the total evaporative losses of hydrocarbons from fixed-roof tanks. The methodologies provide loss estimates for general equipment types based on laboratory, test-tank, and field-tank data. Types of fixed-roof tanks and roof fittings described are for information only. The equations estimate average annual losses from uninsulated fixed-roof tanks for various liquid stocks, stock vapor pressures, tank sizes, meteorological conditions, and operating conditions. 4<sup>th</sup> Edition, October 2012

Chapter 19.2 Evaporative Loss from Floating Roof Tanks; Contains methodologies for estimating the total evaporative losses of hydrocarbons from external floating-roof tanks (EFRTs), freely vented internal floating-roof tanks (IFRTs), and domed external floating-roof tanks (domed EFRTs). The methodologies provide loss estimates for general equipment types based on laboratory, test-tank, and field-tank data. Types of floating roofs, rim-seal systems, and deck fittings are described for information only.

The equations estimate average annual losses from floating-roof tanks for various types of tank construction, floating-roof construction, rim-seal systems, and deck fittings, as well as for various liquid stocks, stock vapor pressures, tank sizes, and wind speeds (EFRTs). 3<sup>rd</sup> Edition, October 2012

Chapter 19.3A Wind Tunnel Test Method for the Measurement of Deck-Fitting Loss Factors for External Floating-Roof Tanks. 1<sup>st</sup> Edition, June 1997; Reaffirmed September 2012)

Chapter 19.3B Air Concentration Test Method – Rim Seal Loss Factors for Floating Roof Tanks; Describes the procedures to establish evaporative rim-seal loss factors for rim seals used on external floating-roof tanks. The test method involves passing a controlled flow rate of air through a test chamber that contains a test liquid and a test rim seal, and measuring the concentration of the test liquid vapor in the air streams entering and leaving the test chamber. The standard specifies the test apparatus, instruments, test procedures, and calculation procedures to be used. It also addresses the variables to be measured, format for reporting the test values, and their associated uncertainty. 1<sup>st</sup> Edition, August 1997; Reaffirmed October 2012

Chapter 19.3C Air Concentration Test Method – Rim Seal Loss Factors for Internal Floating Roof Tanks; Provides a uniform method for measuring evaporative loss from rim seals used on aboveground storage tanks. This information can be utilized to establish product specific loss factors in



terms of loss rate and seal gap area. 1<sup>st</sup> Edition, July 1998; Reaffirmed October 2012

Chapter 19.3D Fugitive Emission Test Method for the Measurement of Deck-Seam Loss Factors for Internal Floating-Roof Tanks; Establishes a uniform method for measuring evaporative deck-seam loss factors and deck-joint loss factors of mechanically joined deck seams that are used on internal floating-roof tanks. These deck-seam loss factors and deck-joint loss factors are to be determined in terms of their loss rate at specified pressure differences across the deck seam or deck joint for certification purposes. 1<sup>st</sup> Edition, June 2001; Reaffirmed December 2012

Chapter 19.3E Weight Loss Test Method for the Measurement of Deck-Fitting Loss Factors for Internal Floating-Roof Tanks; Describes the test methods to be used to establish evaporative loss factors for deck fittings on internal floating-roof tanks. This chapter specifies the test apparatus, instruments, test procedures, and calculation procedures to be used. The standard also addresses the requirements for reporting test report values. 1<sup>st</sup> Edition, May 1997; Reaffirmed October 2012

Chapter 19.3H Tank Seals and Fittings Certification – Administration; Provides guidance for the administration of the former API Tank Seals and Fittings Certification Program. The document includes detailed methods for monitoring and analysis of tests conducted on individual devices and describes the steps in the certification process 1<sup>st</sup> Edition, March 1998; Reaffirmation August 2016

Chapter 19.4 Evaporative Loss Reference Information and Speciation Methodology; Provides methodology to estimate emissions of individual hydrocarbon species using the total emissions of multicomponent hydrocarbon mixtures (such as crude oils and gasoline) estimated from Ch. 19.1 for fixed-roof tanks, Ch. 19.2 for floating-roof tanks, Ch. 19.5 for marine vessels, and other methods used for total hydrocarbon emission estimates. This process is referred to as speciation. Speciation of emissions from hydrocarbon mixtures accounts for the higher evaporation rate of the more volatile components, resulting in a different composition of the mixture in the vapor phase than in the liquid phase. The methodology presented in this standard assumes that there is sufficient liquid present such that the chemical composition at the liquid surface may be considered to not change as a result of the evaporative loss. Third Edition, October 2012

Chapter 19.5 Atmospheric Hydrocarbon Emissions From Marine Vessel Transfer Operations; 1st Edition, September 2009

## **Chapter 20 Allocation Measurement of Oil and Natural Gas**

Chapter 20.3 Measurement of Multiphase Flow (Supersedes RP 86); Addresses multiphase flow measurement in the production environment, upstream of the custody transfer (single-phase) measurement point, where allocation measurement for onshore, offshore, or subsea is applied. For other



multiphase flow measurement applications such as reservoir management, well tests, and flow assurance, the standard can be used as a reference or guide. However, the focus of this standard is on those applications where the accuracy of multiphase flow measurement for allocation systems is required. 1<sup>st</sup> Edition, January 2013

## **Chapter 21 Flow Measurement Using Electronic Metering Systems**

Chapter 21.2 Electronic Liquid Volume Measurement Using Positive Displacement And Turbine Meters; 1<sup>st</sup> Edition, June 1998

Chapter 21.2-A1 Addendum 1 to Flow Measurement Using Electronic Metering Systems, Inferred Mass; 1<sup>st</sup> Edition, August 2000

## **Chapter 22 Testing Protocols**

Chapter 22.1 Testing Protocols—General Guidelines for Developing Testing Protocols for Devices Used in the Measurement of Hydrocarbon Fluids; 2<sup>nd</sup> Edition, August 2015

Chapter 22.2 Testing Protocols—Differential Pressure Flow Measurement Devices (Supersedes Chapter 5.7); 1<sup>st</sup> Edition | August 2005; Reaffirmed August 2012

## **Ref: American Petroleum Institute (API) Recommended Practices / Standards / Technical Reports / Publications**

API RP 12R1 Recommended Practice for Setting, Maintenance, Inspection, Operation and Repair of Tanks in Production Service; 5<sup>th</sup> Edition August 1997; Reaffirmed April 2008

API PUBL 353 Managing Systems Integrity of Terminal and Tank Facilities; First Edition October 2006

API RP 500 Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division I and Division 2 (3<sup>rd</sup> Edition, December 2012)

API STD 520 Sizing, Selection, and Installation of Pressure-relieving Devices in Refineries, Part I - Sizing and Selection, Recommended practice for the design and installation of pressure relieving systems. 9<sup>th</sup> Edition July 2014

API STD 521 Pressure-Relieving and Depressuring Systems; 6<sup>th</sup> Edition January 2014



- API STD 526 Flanged Steel Pressure-Relief Valves (includes Errata 1 dated May 2009 and Errata 2 dated October 2012); 6<sup>th</sup> Edition April 2009, 2-year Extension April 2015
- API STD 527 Seat Tightness of Pressure Relief Valves, 4<sup>th</sup> Edition November 2014
- API RP 551 Process Measurement Instrumentation, 1<sup>st</sup> edition May 1993, Reaffirmed February 2007
- API RP 552 Transmission Systems, 1<sup>st</sup> Edition October 1994, Reaffirmed August 2015
- API RP 553 Refinery Valves and Accessories for Control and Safety Instrumented Systems, 2<sup>nd</sup> Edition October 2012
- API RP 554 Process Control Systems, 2<sup>nd</sup> Edition July 2007
- API RP 557 Guide to Advanced Control Systems, 2<sup>nd</sup> Edition October 2013
- API RP 560 Fired Heaters for General Refinery Service, 4<sup>th</sup> Edition August 2007, Reaffirmed November 2014
- API RP 598 Valve Inspection and Testing, 9<sup>th</sup> Edition September 2009
- API STD 620 Design and Construction of Large, Welded, Low-Pressure Storage Tanks; 12<sup>th</sup> Edition October 2013
- API STD 650 Welded Steel Tanks for Oil Storage; 12<sup>th</sup> Edition March 2013
- API STD 653 Tank Inspections, Repair, Alteration, and Reconstruction, 5<sup>th</sup> Edition November 2014
- API RP 1109 Marking Liquid Petroleum Pipeline Facilities, 4<sup>th</sup> Edition October 2010
- API RP 1165 Recommended Practice for Pipeline SCADA Displays; 1<sup>st</sup> Edition January 2007, Reaffirmed July 2012
- API RP 1168 Pipeline Control Room Management, 2<sup>nd</sup> Edition February 2015
- API RP 1543 Documentation, Monitoring and Laboratory Testing of Aviation Fuel During Shipment from Refinery to Airport
- API RP 1595 Design, Construction, Operation, Maintenance, and Inspection of Aviation Pre-Airfield Storage Terminals, 2<sup>nd</sup> Edition October 2012
- API 1620 Bulk Design and Operating Practices to Protect Product Quality of Gasoline and Distillate Fuels, 1<sup>st</sup> Edition 1963**
- AP 1622 Barge Terminal Design and Operating Practices to Protect Product Quality of Gasoline and Distillate Fuels, 1st ed. 1963**



API RP 1626 Storing and Handling Ethanol and Gasoline-ethanol Blends at Distribution Terminals and Filling Stations, 2<sup>nd</sup> Edition August 2010

**API RP 1640 Product Quality in Light Product Storage and Handling**

Prepared by the API Fuels Marketing Subcommittee with technical participation and feedback from other industry stakeholders. It assists those involved in fuel handling at distribution and intermediate storage facilities. This publication provides guidance on the minimum equipment standards and operating procedures for the receipt, storage, blending, and delivery of light products, their blend components, and additives at distribution and intermediate storage terminals, including related operations of pipeline, marine vessel (barge or ship), and road/rail transport. This RP also covers the minimum equipment standards and operating procedures for the receipt, storage, blending of light products, including but not limited to gasoline, kerosene, diesel, heating oil and their blend components (i.e. ethanol, biodiesel, and butane) at distribution and storage terminals, as well as light product shipments directly via a pipeline, marine vessel (barge or ship) or road and rail transport. In addition, this RP provides guidance for the design, construction, operation, and maintenance of light products storage and distribution terminals with the specific intent of protecting or ensuring product quality.

API STD 2000 Venting Atmospheric and Low-pressure Storage Tanks, 7<sup>th</sup> Edition March 2014

API RP 2003 Protection against Ignitions Arising Out of Static, Lightning, and Stray Currents, 8<sup>th</sup> Edition September 2015

API RP 2009 Safe Welding, Cutting, and Hot Work Practices in the Petroleum and Petrochemical Industries; First Edition 2009, Reaffirmed March 2012

API RP 2021 Management of Atmospheric Storage Tank Fires; 4<sup>th</sup> Edition May 2001, Reaffirmed June 2006

API RP 2028 Flame Arresters in Piping Systems, 3<sup>rd</sup> Edition February 2002, Reaffirmed 2010

API RP 2201 Safe Hot Tapping Practices in the Petroleum and Petrochemical Industries; 5<sup>th</sup> Edition June 2003, Reaffirmed October 2010.

API RP 2218 Fireproofing Practices in Petroleum and Petrochemical Processing Plants; 3<sup>rd</sup> Edition July 2013

**API 2350 Overfill Protection for Storage Tanks in Petroleum Facilities; Edition: 4<sup>th</sup>, May 2012 (R2017 Pending)**

ANSI/API Standard 2350 addresses overfill protection for petroleum storage tanks. It recognized that prevention provides the most basic level of protection, thus while using both terms "protection" and "prevention",



the document emphasizes prevention. The standard's scope covers minimum overfill (and damage) prevention practices for aboveground storage tanks in petroleum facilities, including refineries, marketing terminals, bulk plants, and pipeline terminals that receive flammable and combustible liquids.

Use of this standard is intended for storage tanks associated with marketing, refining, pipeline and terminals containing Class I or Class II petroleum liquids. Use is recommended for Class III petroleum liquids. This standard does not apply to underground storage tanks; aboveground tanks of 1320 US gallons (5000 liters) or less; aboveground tanks which comply with PEI 600; pressure vessels; tanks containing non-petroleum liquids; tanks storing LPG and LNG; tanks at service stations; tanks filled exclusively from wheeled vehicles (i.e. tank trucks or railroad tank cars); and tanks covered by OSHA 29 CFR 1910.119 and EPA 40 CFR 68 or similar regulations.

This standard recommends application of **PEI Recommended Practice 600 Recommended Practices for Overfill Prevention for Shop-Fabricated Aboveground Tanks** for overfill protection where applicable for aboveground tanks falling outside the scope of this document.

The purpose of this standard is to assist owner/operators and operating personnel in the prevention of tank overfills by implementation of a comprehensive overfill prevention process (OPP). The goal is to receive product into the intended storage tank without overfill or loss of containment.

This standard is one of minimum requirements. Alternate approaches or variations on the principles of this standard that provide equivalent or more robust overfill prevention are acceptable. Alternate approaches may be needed when the tank system varies from the typical configurations described in this standard. The rationale for the implementation of each overfill prevention process (OPP) should be documented and retained by the owner and operator.

API 2509B Shop Testing of Automatic Liquid-Level Gauges, 1<sup>st</sup> Edition 1961

API STD 2510 Design and Construction of LPG Installations, 8<sup>th</sup> Edition May 2001, Reaffirmed October 2011

API Publ 2524 Impact Assessment of New Data on the Validity of American Petroleum Institute Marine Transfer Operation Emission Factors; July 1992

API STD 2540 Standard Petroleum Measurement Tables: These Petroleum Measurement Tables are for use in the calculation of quantities of crude petroleum and petroleum products at required conditions in any of three widely used systems of measurement. Tables are provided over normal operating ranges for the reduction of gravity and volume to standard states, for calculation of weight-volume relationships, and interconversion of a wide variety of commercially useful units. The tables, issued in three





volumes, cover United States, British, and Metric systems of measurement

Note 1- These tables supersede ASTM d 206, Abridged Volume Correction Tables, and ASTM D 1090. Tentative Factors and Tables for Volume Correction and Specific Gravity Conversion of Liquefied Petroleum Gases. Because of the broader range of values covered, and the larger number of individual tables provided, these tables replace the National Bureau of Standards Circular C-410, and the Supplement thereto ( Abridged Volume Correction Table for Petroleum Oils), which were withdrawn form circulation by the NBS effective January 1, 1954.

API STD 2545 Standard Method of Gauging Petroleum and Petroleum Products, 1<sup>st</sup> Edition 1965

API STD 2551 Standard Method for Measurement and Calibration of Horizontal Tanks;1966

API STD 2552 Measurement and Calibration of Spheres and Spheroids; 1st Edition, October 1966,

API STD 2554 Measurement and Calibration of Tank Cars; 1st Edition, October 1966, Reaffirmed September 2012

API STD 2555 Liquid Calibration of Tanks; 1st Edition, September 1966, Reaffirmed May 2014

API RP 2556 Correcting Gauge Tables for Incrustation; 2nd Edition, August 1993, Reaffirmed November 2013

API Publ 2558 Wind Tunnel Testing of External Floating-Roof Storage Tanks; Publication 1st Edition, June 1993

API STD 2560 Reconciliation of Liquid Pipeline Quantities; Provides methodologies for monitoring liquid pipeline loss/gain, and for determining the normal loss/gain level for any given pipeline system. Troubleshooting suggestions are also presented. 1st Edition, December 2003

API TR 2567 Evaporative Loss from Storage Tank Floating Roof Landings; Technical Report 1st Edition, April 2005

API TR 2568 Evaporative Loss from the Cleaning of Storage Tanks; Technical Report 1st Edition, November 2007

**API TR 2569 Evaporative Loss from Closed-Vent Internal Floating-Roof Storage Tanks;** Addresses evaporative loss from internal floating-roof tanks (IFRTs) with closed vents. When the vents in the fixed roof of an IFRT are closed, rather than open, estimation of emissions is shown to be highly complex. This subject is not covered in other API standards such as Ch. 19.1, which specifically excludes fixed-roof tanks that have an internal floating roof, and Ch. 19.2, which specifically excludes closed internal



floating-roof tanks (that is, tanks vented only through a pressure-vacuum relief vent, blanketed with an inert gas, vented to a vapor processing unit, or otherwise restricted from being freely vented).  
Technical Report 1st Edition, August 2008

**API TR 2570 Continuous On-Line Measurement of Water Content in Petroleum (Crude Oil and Condensate)** Provides guidance for the application, installation, operation, verification, and proving of on-line water devices (OWDs) for use in the non-custody transfer measurement of water in crude oil and condensate. A joint API/ Energy Institute (EI) standard, it also carries the (EI) designation Hydrocarbon Management, HM56. 1<sup>st</sup> Edition, October 2010; Reaffirmed January 2016

**API TR 2573 Standard Guide for Sediment and Water Determination in Crude Oil (ASTM D7829)** Covers a summary of the water and sediment determination methods from Ch. 10 for crude oils. The purpose of this guide is to provide a quick reference to these methodologies such that the reader can make the appropriate decision regarding which method to use based on the associated benefits, uses, drawbacks, and limitations. 1st Edition, September 2013

API STD 2610 Design, Construction, Operation, Maintenance, and Inspection of Terminal & Tank Facilities; Edition 2, May 5, 2000

## Ref: **AIChE Center for Chemical Process Safety (CCPS)**

Guidelines for Hazard Evaluation Procedures, Third Edition

Layer of Protection, First Edition

Simplified Process Risk Assessment, First Edition

## Ref: **ASTM International (American Standard Testing Materials)**

D287-12b	Standard Test Method for API Gravity of Crude Petroleum and Petroleum Products (Hydrometer Method)
D1250	Volume Correction Factors
D1250-08(2013)e1	Standard Guide for Use of the Petroleum Measurement Tables
D1298-12b(2017)	Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
D2161-17	Standard Practice for Conversion of Kinematic Viscosity to Saybolt Universal Viscosity or to Saybolt Furol Viscosity
D4006-16e1	Standard Test Method for Water in Crude Oil by Distillation



D4007-11(2016)e1	Standard Test Method for Water and Sediment in Crude Oil by the Centrifuge Method (Laboratory Procedure)
D4052-16	Standard Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter
D4177-16e1	Automatic Sampling of Petroleum and Petroleum Products
D4928-12	Standard Test Method for Water in Crude Oils by Coulometric Karl Fischer Titration
D5002-16	Standard Test Method for Density and Relative Density of Crude Oils by Digital Density Analyzer

## Ref: British Standards

BS EN ISO 3993:1996

Liquefied petroleum gas and light hydrocarbons - Determination of density or relative density. Pressure hydrometer method

BS ISO 4266-1:2002

Petroleum and Liquid Petroleum Products Measurement of Level and Temperature in Storage Tanks by Automatic Methods - Measurement of Level in Atmospheric Tanks

BS ISO 4266-2:2002

Petroleum and Liquid Petroleum Products Measurement of Level and Temperature in Storage Tanks by Automatic Methods - Measurement of Level in marine vessels.

BS ISO 4266-3:2002

Petroleum and Liquid Petroleum Products Measurement of Level and Temperature in Storage Tanks by Automatic Methods - Measurement of Level in pressurized storage tanks (non-refrigerated)

BS ISO 4266-4:2002

Petroleum and Liquid Petroleum Products Measurement of Level and Temperature in Storage Tanks by Automatic Methods. Measurement of Temperature in Atmospheric Tank

BS ISO 4268:2000

Petroleum and liquid petroleum products. Temperature measurements. Manual methods (British Standard)

BS 6441:1993

Schedule for petroleum measurement tables

BS EN ISO 7278-2:1996

Liquid hydrocarbons. Dynamic measurement. Proving systems for volumetric meters. Pipe provers



BS 7723-1:1994, ISO 7507-1:1993

Methods for calibration of vertical cylindrical tanks for petroleum and liquid petroleum products. Strapping method

BS 7723-2:1994, ISO 7507-2:1993

Methods for calibration of vertical cylindrical tanks for petroleum and liquid petroleum products. Optical-reference-line method

BS ISO 7507-3:2006

Petroleum and liquid petroleum products. Calibration of vertical cylindrical tanks. Optical-triangulation method

BS ISO 7507-4:2010

Petroleum and liquid petroleum products. Calibration of vertical cylindrical tanks. Internal electro-optical distance-ranging method

BS ISO 7507-1:2003

Petroleum and liquid petroleum products. Calibration of vertical cylindrical tanks. Strapping method

BS 7849-1:1996

Petroleum and Petroleum Products – Direct Static Measurements; Contents of vertical storage tanks, Part 1 – Mass Measurement by Hydrostatic Tank Gauging.

BS EN 13160-5:2016

Leak detection systems. Requirements and test/assessment methods for in-tank gauge systems and pressurized pipework systems

BS EN 13352:2012

Specification for the performance of automatic tank contents gauges

BS EN 60529:1992+A2:2013

Degrees of protection provided by enclosures (IP code)

## **Ref: China National Standards (GB/T)**

**GB/T 18273-2000**

Petroleum and liquid petroleum products--Direct static measurements--Contents of vertical storage tanks--Mass measurement by hydrostatic tank gauging

## **Ref: International Electrotechnical Commission (IEC)**

IEC/EN 60529

Degrees of protection provided by enclosures (IP code)

PD IEC TR 60721-4-0:2002



Classification of environmental conditions. Guidance for the correlation and transformation of environmental condition classes of IEC 60721-3 to the environmental tests of IEC 60068. Introduction

PD IEC/TR 61508-0:2005

Functional safety of electrical/electronic/programmable electronic safety-related systems  
- Part 0: Functional safety and IEC 61508

IEC 61508-2 Ed. 2.0 b:2010

Functional safety of electrical/electronic/programmable electronic safety-related systems  
- Part 2: Requirements for electrical / electronic / programmable electronic safety-related systems

IEC 61508-3 Ed. 2.0 b:2010

Functional safety of electrical/electronic/programmable electronic safety-related systems  
- Part 3: Software requirements

IEC 61508-4 Ed. 2.0 b:2010

Functional safety of electrical/electronic/programmable electronic safety-related systems  
- Part 4: Definitions and abbreviations

IEC 61508-5 Ed. 2.0 b:2010

Functional safety of electrical/electronic/programmable electronic safety-related systems  
- Part 5: Examples of methods for the determination of safety integrity levels

IEC 61508-6 Ed. 2.0 b:2010

Functional safety of electrical/electronic/programmable electronic safety-related systems  
- Part 6: Guidelines on the application of IEC 61508-2 and IEC 61508-3

IEC 61508-7 Ed. 2.0 b:2010

Functional safety of electrical/electronic/programmable electronic safety-related systems  
- Part 7: Overview of techniques and measures

IEC 61511-1 ED. 2.1 EN:2017

Functional safety - Safety instrumented systems for the process industry sector - Part 1: Framework, definitions, system, hardware and software requirements;

IEC 61511-2 ED. 2.0 B:2016

Functional safety - Safety instrumented systems for the process industry sector - Part 2: Guidelines for the application of IEC 61511-1;

IEC 61511-3 Ed. 2.0 b:2016

Functional safety. Safety instrumented systems for the process industry sector. Guidance for the determination of the required safety integrity levels; April 30, 2003

**Ref: International Standards Organization (ISO)  
Petroleum and Liquid Petroleum Products**



ISO 91:2017

Petroleum and related products -- Temperature and pressure volume correction factors (petroleum measurement tables) and standard reference conditions

ISO/IEC Guide 98-1:2009

Uncertainty of measurement -- Part 1: Introduction to the expression of uncertainty in measurement; Reaffirmed 2015

ISO/IEC Guide 98-3:2008

Uncertainty of measurement -- Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)

ISO 3170:2004

Petroleum liquids -- Manual sampling

ISO 3171:1988

Petroleum liquids – Automatic pipeline sampling; Reaffirmed 2004

ISO 3675:1998

Crude petroleum and liquid petroleum products; Laboratory determination of density, Hydrometer method; Reaffirmed 2005

ISO 3735:1999

Crude petroleum and fuel oils. Determination of sediment. Extraction method; Reaffirmed 2010

ISO 3838:2004

Crude Petroleum and liquid petroleum products; Determination of density or relative density, Capillary-stoppered pycnometer and graduated bicapillary methods; Reaffirmed 2016

ISO 3993:1984

Liquefied petroleum gas and light hydrocarbons -- Determination of density or relative density -- Pressure hydrometer method; Reaffirmed 2016

ISO 4257:2001

Liquefied petroleum gases; Method of sampling; Reaffirmed 2006

**ISO 4266-1:2002**

Petroleum and liquid petroleum products -- Measurement of temperature and level in storage tanks -- Automatic methods

**ISO 4266 - Part 1:2002**

Petroleum and liquid petroleum products – Measurement of level and temperature in storage tanks by automatic methods - Part 1: Measurement of level in atmospheric tanks

**ISO 4266 – Part 2:2002**

Petroleum and liquid petroleum products - Measurement of level and temperature in storage tanks by automatic methods -- Part 2: Measurement of level in marine vessels



ISO 4266 – Part 3:2002

Petroleum and liquid petroleum products - Measurement of level and temperature in storage tanks by automatic methods -Part 3: Measurement of level in pressurized storage tanks (non-refrigerated)

**ISO 4266 – Part 4: 2002**

Petroleum and liquid petroleum products - Measurement of level and temperature in storage tanks by automatic methods - Part 4: Measurement of temperature in atmospheric tanks

**ISO 4266 - Part 5: 2002**

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

**ISO 4266 – Part 6: 2002**

Petroleum and liquid petroleum products - Measurement of level and temperature in storage tanks by automatic methods - Part 6: Measurement of temperature in pressurized storage tanks (non-refrigerated)

ISO 4267-2:1988

Petroleum and liquid petroleum products. Calculation of oil quantities. Dynamic measurements; Reaffirmed 2017

ISO 4268:2000

Petroleum and liquid petroleum products - Temperature measurements - Manual methods; Reaffirmed 2011

ISO 4269:2001

Petroleum and liquid petroleum products - Tank calibration by liquid measurement; Incremental method using volumetric meters; Reaffirmed 2016

ISO 4512:2000

Petroleum and liquid petroleum products – Equipment for measurement of liquid levels in storage tanks; Manual method.

ISO 7240-1:2014

Fire detection and alarm systems; Part 1: General and Definitions;

ISO 7240-2: 2014

Fire detection and alarm systems -- Part 2: Control and indicating equipment

ISO/TR 7507-1:2003

Petroleum and liquid petroleum products -- Calibration of vertical cylindrical tanks; Part 1: Strapping method

ISO/TR 7507-2:2005

Petroleum and liquid petroleum products -- Calibration of vertical cylindrical tanks; Part 2: Optical-reference-line method



ISO/TR 7507-3:2006

Petroleum and liquid petroleum products -- Calibration of vertical cylindrical tanks; Part 3: Optical-triangulation method

ISO/TR 7507-4:2010

Petroleum and liquid petroleum products -- Calibration of vertical cylindrical tanks; Part 4: Internal electro-optical distance-ranging method

ISO/TR 7507-5:2000

Petroleum and liquid petroleum products -- Calibration of vertical cylindrical tanks; Part 5: External electro-optical distance-ranging method

ISO 8216-99:2002

Petroleum products. Fuels (class F). Classification. General

ISO/DIN 8222:2002

Petroleum measurement systems -- Calibration -- Temperature corrections for use when calibrating volumetric proving tanks

ISO 8697:1999

Crude petroleum and petroleum products -- Transfer accountability -- Assessment of on board quantity (OBQ) and quantity remaining on board (ROB)

ISO/IEC 9075-9:2016

Information technology. Database languages. SQL. Information technology. Database Languages. SQL. Management of external data (SQL/MED)

ISO/IEC 9075-10:2000

Information technology. Database languages. SQL. Object Language Bindings (SQL/OLB)

ISO/IEC 9075-13:2016

Information technology. Database languages. SQL. SQL routines and types using the Java programming language (SQL/JRT)

ISO/IEC/IEEE DIS 26511

Systems and software engineering -- Requirements for managers of information for users of systems, software, and services

ISO 9403:2000

Crude petroleum. Transfer accountability. Guidelines for cargo inspection

ISO/IEC 9545:1994

Information technology. Open Systems Interconnection. Application Layer structure

ISO TR 9547:1988

Programming language processors. Test methods. Guidelines for their development and acceptability

ISO/IEC 9548-1:1996/Amd 1:2000





Information technology. Open systems interconnection. Connectionless session protocol. Protocol specification

ISO/IEC 9548-2:1995

Information technology. Open systems interconnection. Connectionless session protocol. Protocol Implementation Conformance Statement (PICS) proforma

ISO/IEC 9796-2:2010

Information technology. Security techniques. Digital signature schemes giving message recovery. Integer factorization based mechanisms

ISO/IEC 9797-1:2011

Information technology. Security techniques. Data integrity mechanism using a cryptographic check function employing a block cipher algorithm

ISO/IEC 9797-2:2011

Information technology. Security techniques. Message authentication codes (MACs). Mechanisms using a dedicated hash-function

ISO/IEC 9798-1:2010

Information technology. Security techniques. Entity authentication mechanisms. General

ISO/IEC 9798-2:1999

Information technology. Security techniques. Entity authentication mechanisms. Mechanisms using symmetric encipherment algorithms

ISO/IEC CD 9798-2

Information technology -- Security techniques -- Entity authentication -- Part 2: Mechanisms using authenticated encryption

### **ISO 11223:2004**

Petroleum and liquid petroleum products -- Direct static measurements – Measurement of contents of vertical storage tanks by Hydrostatic Tank Gauging.

ISO/TR 12767:2007

Measurement of fluid flow by means of pressure differential devices -- Guidelines on the effect of departure from the specifications and operating conditions given in ISO 5167

ISO 12917-1:2017

Petroleum and liquid petroleum products – Calibration of horizontal cylinder tanks; Part 1: Manual methods

ISO 12917-2:2002

Petroleum and liquid petroleum products – Calibration of horizontal cylinder tanks; Part 2: Internal electro-optical distance ranging method

### **ISO 15169:2003**



Petroleum and liquid petroleum products – Determination of volume, density and mass of the hydrocarbon content of vertical cylindrical tanks by Hybrid tank measurement systems.

ISO/PRF TR 15377

Measurement of fluid flow by means of pressure-differential devices -- Guidelines for the specification of orifice plates, nozzles and Venturi tubes beyond the scope of ISO 5167

## Ref: National Fire Protection Association (NFPA)

NFPA 30	Flammable and Combustible Liquids Code; Enforceable under OSHA and many state and local regulations, NFPA 30 provides safeguards to reduce the hazards associated with the storage, handling, and use of flammable and combustible liquids.  Topics covered include fire and explosion prevention and risk control, storage of liquids in containers, storage of liquids in tanks, piping systems, processing facilities, bulk loading and unloading, and wharves.
NFPA 67	Guideline on Explosion Protection for Gaseous Mixtures in Pipe Systems
NFPA 70	National Electric Code (NEC)
NFPA 326	Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair
NFPA 385	Standard for Tank Vehicles for Flammable and Combustible Liquids
NFPA 386	Standard for Portable Shipping Tanks for Flammable and Combustible Liquids
NFPA 820	Standard for Fire Protection in Wastewater Treatment and Collection Facilities
NFPA 1989	Standard on Breathing Air Quality for Emergency Services Respiratory Protection
NFPA 2112	Standard on Flame-Resistant Garments for Protection of Industrial Personnel Against Flash Fire

## Ref: Organisation Internationale de Metrologie Legal (OIML) (Organization International of Metrology Legal)



R 85-1 &2 EN	Automatic level gauges for measuring the level of liquid in fixed storage tanks; Part 1: Metrological and Technical Requirement; Part 2: Metrological Controls and Test. First Edition 1998, Revised 2008	
R 117 - EN	Measuring systems for liquids other than water	2014
R 125 - EN	Measuring systems for the mass of liquids in tanks	1998

