



Designation: D7961 – 22

Standard Practice for Calibrating U-tube Density Cells over Large Ranges of Temperature and Pressure¹

This standard is issued under the fixed designation D7961; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This practice outlines procedures for the calibration of U-tube density cells. It is applicable to instruments capable of determining fluid density at temperatures in the range $-10\text{ }^{\circ}\text{C}$ to $200\text{ }^{\circ}\text{C}$ and pressures from just greater than the saturation pressure to 140 MPa. The practice refers to density cells as they are utilized to make measurements of fluids primarily in the compressed-liquid state. Examples of substances for which the density can be determined with a calibrated U-tube density meter include: crude oils, gasoline and gasoline-oxygenate blends, diesel and jet fuels, hydraulic fluids, and lubricating oils.

1.2 This practice specifies a procedure for the determination of the expanded uncertainty of the density measurement.

1.3 This practice pertains to fluids with viscosities $< 1\text{ Pa}\cdot\text{s}$ (1000 centipoise) at ambient conditions.

1.4 The values listed in SI units are regarded as the standard, unless otherwise stated. The SI unit for mass density is kilograms per cubic metre ($\text{kg}\cdot\text{m}^{-3}$) and can be given as grams per cubic centimetre ($\text{g}\cdot\text{cm}^{-3}$).

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

¹ This practice is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.04.0D on Physical and Chemical Methods.

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2. Referenced Documents

2.1 ASTM Standards:²

- D1193 Specification for Reagent Water
- D4052 Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter
- D4175 Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants
- D5002 Test Method for Density, Relative Density, and API Gravity of Crude Oils by Digital Density Analyzer
- D6792 Practice for Quality Management Systems in Petroleum Products, Liquid Fuels, and Lubricants Testing Laboratories
- D7483 Test Method for Determination of Dynamic Viscosity and Derived Kinematic Viscosity of Liquids by Oscillating Piston Viscometer
- D7578 Guide for Calibration Requirements for Elemental Analysis of Petroleum Products and Lubricants
- D7740 Practice for Optimization, Calibration, and Validation of Atomic Absorption Spectrometry for Metal Analysis of Petroleum Products and Lubricants

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this practice, refer to Terminology D4175.

3.1.2 *calibration, n*—set of operations that establishes the relationship between the reference density of standards and the corresponding density reading of the instrument. **D4052**

3.1.3 *certified reference material (CRM), n*—reference material one or more of whose property values are certified by a technically valid procedure, accompanied by a traceable certificate or other documentation that is issued by a certifying body. **[D02.94] D6792, [D02.03] D7578**

3.1.4 *density (ρ), n*—mass per unit volume at a specified temperature. **[D02.07] D7483**

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

*A Summary of Changes section appears at the end of this standard