



Designation: D7620 – 10 (Reapproved 2020)

# Standard Test Method for Determination of Total Sulfur in Liquid Hydrocarbon Based Fuels by Continuous Injection, Air Oxidation and Ultraviolet Fluorescence Detection<sup>1</sup>

This standard is issued under the fixed designation D7620; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This test method covers the determination of total sulfur in liquid hydrocarbon based fuel with a final boiling point of up to 450 °C. It is applicable to analysis of natural, processed and final product materials containing sulfur in the range of 4.0 mg/kg to 830 mg/kg (see [Note 1](#)).

NOTE 1—For liquid hydrocarbons containing less than 4.0 mg/kg total sulfur or more than 830 mg/kg total sulfur, Test Method [D5453](#) may be more appropriate.

1.2 This test method is applicable for total sulfur determination in liquid hydrocarbons containing less than 0.35 % (m/m) halogen(s).

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 *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.* For specific hazard statements, see [4.1](#), [8.3](#), and Section [9](#).

1.5 *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.*

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee [D02](#) on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee [D02.03](#) on Elemental Analysis.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

- [D1298](#) Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
- [D4052](#) Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter
- [D4057](#) Practice for Manual Sampling of Petroleum and Petroleum Products
- [D4175](#) Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants
- [D4177](#) Practice for Automatic Sampling of Petroleum and Petroleum Products
- [D5453](#) Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence
- [D6299](#) Practice for Applying Statistical Quality Assurance and Control Charting Techniques to Evaluate Analytical Measurement System Performance
- [D6300](#) Practice for Determination of Precision and Bias Data for Use in Test Methods for Petroleum Products, Liquid Fuels, and Lubricants
- [D6792](#) Practice for Quality Management Systems in Petroleum Products, Liquid Fuels, and Lubricants Testing Laboratories

## 3. Terminology

### 3.1 Definitions:

3.1.1 See Terminology [D4175](#) for definitions of other terms used in this test method.

3.1.2 *oxidative pyrolysis, n*—process in which a sample undergoes complete combustion in an appropriate oxygen containing environment at a sufficiently elevated temperature.

3.1.2.1 *Discussion*—Organic compounds pyrolytically oxidize to carbon dioxide and water and oxides of other elements that are in the sample.

## 4. Summary of Test Method

4.1 A small, very controlled flow of hydrocarbon sample is continuously injected during measurement. It is introduced via a syringe into a high temperature combustion tube containing air where sulfur is oxidized to sulfur dioxide (SO<sub>2</sub>). Water produced during the sample combustion is removed, as

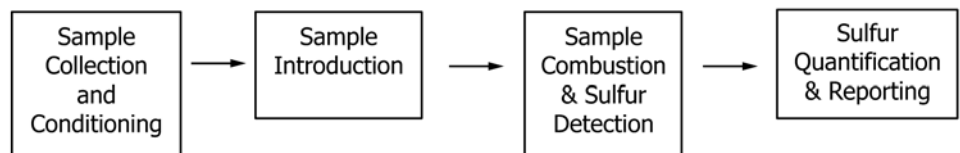


FIG. 1 Basic Block Diagram Describing Sulfur Determination

required, and the sample combustion gases are next exposed to ultraviolet (UV) light. The SO<sub>2</sub> absorbs the energy from the UV light and is converted to excited sulfur dioxide (SO<sub>2</sub>\*). Fluorescence emitted from the excited SO<sub>2</sub>\* as it returns to a stable state SO<sub>2</sub> is detected by a photomultiplier tube and the resulting signal is a measure of the sulfur contained in the sample. (**Warning**—Exposure to excessive quantities of ultraviolet light is injurious to health. The operator shall avoid exposing their body, especially their eyes, not only to direct UV light but also to secondary or scattered radiation that is present.)

4.2 Fig. 1 illustrates a basic block diagram describing sulfur determination. Sample collection and conditioning, sample introduction, detection system and data handling are depicted.

### 5. Significance and Use

5.1 Some process catalysts used in refining can be poisoned when trace amounts of sulfur bearing materials are contained in the feedstocks. There are also government regulations as to how much sulfur is permitted to be present in commercial transportation fuels. This test method can be used to determine sulfur in process and downstream distribution streams. It can also be used for purposes of screening and quality control of finished hydrocarbon fuel products.

### 6. Interferences

6.1 Halogens above 0.35 % (mass/mass) will interfere with accurate sulfur determination.

6.2 Bound nitrogen at concentration greater than 150 mg N/kg can cause a 1 mg S/kg positive bias.

6.3 Excessive moisture produced during the combustion step will interfere if not removed prior to the detector.

### 7. Apparatus

7.1 *Furnace*—An electric furnace held at a temperature sufficient to pyrolyze the entire sample (typically 1050 °C ± 25 °C) and oxidize sulfur to SO<sub>2</sub>.

7.2 *Combustion Tube*—A quartz combustion tube constructed to allow the direct injection of a continuous flow of sample into the heated oxidation zone of the furnace. The oxidation section shall be large enough to ensure complete combustion of the sample. Fig. 2 illustrates a typical combustion tube (**Note 2**).

NOTE 2—Other combustion tube configurations are acceptable if precision and accuracy are not degraded.

7.3 *Flow Control*—The apparatus shall be equipped with suitable flow control apparatus capable of maintaining a constant supply of air.

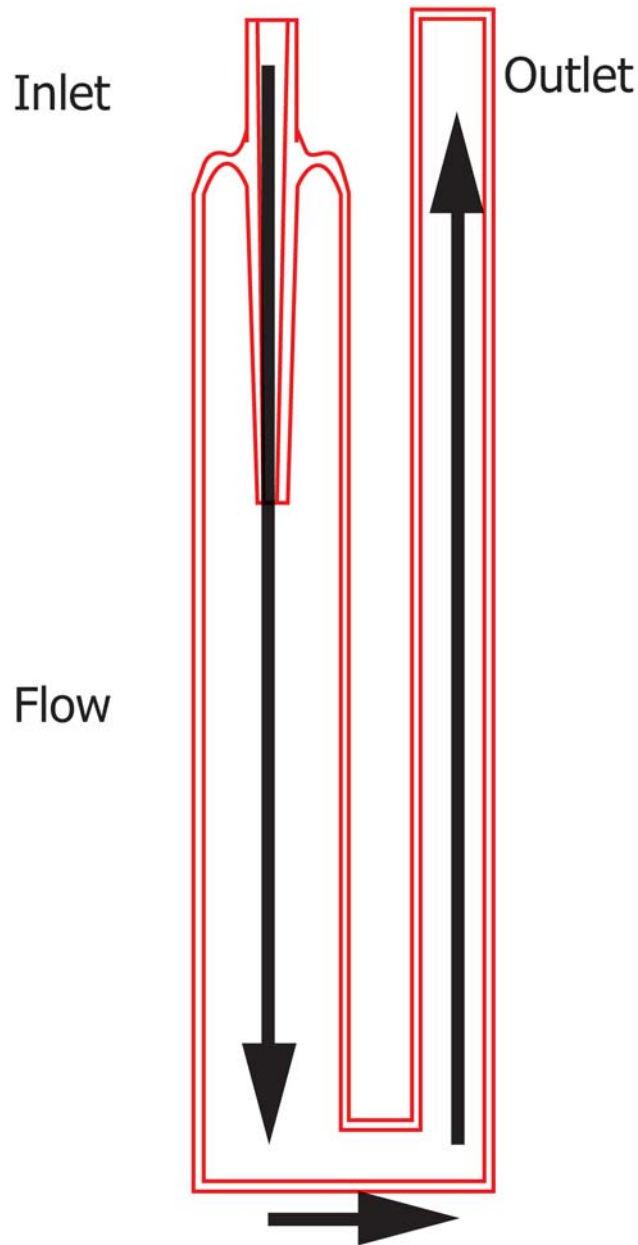


FIG. 2 Typical Combustion Tube

7.4 *Drier Tube*—The apparatus shall be equipped with a mechanism for the removal of excessive water vapor. The oxidation reaction produces water vapor which must be eliminated prior to measurement by the detector. This may be accomplished with a membrane drying tube, or a permeation dryer, that utilizes a selective capillary action for water removal.