Designation: D7650 – 21

Standard Practice for Sampling of Particulate Matter in High Pressure Gaseous Fuels with an In-Stream Filter[1]

This standard is issued under the fixed designation D7650; 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 is primarily for sampling particulates in gaseous fuels up to a nominal working pressure (NWP) of 70 MPa (10 152 psi) using an in-stream filter. This practice describes sampling apparatus design, operating procedures, and quality control procedures required to obtain the stated levels of precision and accuracy.

1.2 *Units*—The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

1.3 *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.*

1.4 *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:*[2]
D4150 Terminology Relating to Gaseous Fuels
D7651 Test Method for Gravimetric Measurement of Particulate Concentration of Hydrogen Fuel

2.2 *NFPA Standard:*[3]
NFPA 2 Hydrogen Technologies Code

2.3 *CSA/ANSI/NGV Standards:*[4,5]
HGV 4.1 Hydrogen Dispensing Systems
NGV 1 Fueling Connection Devices
NGV 4.1 Natural Gas Vehicle (NGV) Dispensing Systems

2.4 *SAE Standards:*[6]
SAE J2579 Standard for Fuel Systems in Fuel Cell and Other Hydrogen Vehicles
SAE J2600 Compressed Hydrogen Surface Vehicle Fueling Connection Devices
SAE J2719 Hydrogen Fuel Quality for Fuel Cell Vehicles

2.5 *ISO Standard:*[7]
ISO 14687 Hydrogen Fuel Quality— Product Specification

2.6 *ASME Standard:*[8]
Boiler and Pressure Vessel Code

2.7 *UN Global Technical Regulation:*[9]
No. 13 Global Technical Regulation on Hydrogen and Fuel Cell Vehicles

2.8 *NIST Standard:*[10]
Handbook 44 Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices

3. Terminology

3.1 *Definitions*—For definitions of general terms used in D03 Gaseous Fuels standards, refer to Terminology D4150.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *maximum allowable working pressure (MAWP), n*—the maximum gauge pressure of the working fluid (gas or liquid) to which a piece of process equipment or system is rated with consideration for initiating fault management above normal operation.

[1] This practice is under the jurisdiction of ASTM Committee D03 on Gaseous Fuels and is the direct responsibility of Subcommittee D03.14 on Hydrogen and Fuel Cells.

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[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.

[3] Available from National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471, http://www.nfpa.org.

[4] Available from Canadian Standards Association (CSA), 178 Rexdale Blvd., Toronto, ON M9W 1R3, Canada, http://www.csagroup.org.

[5] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[6] Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, http://www.sae.org.

[7] Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, http://www.iso.org.

[8] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, http://www.asme.org.

[9] Available from UNECE, https://unece.org/.

[10] Available from National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 1070, Gaithersburg, MD 20899-1070, http://www.nist.gov.

3.2.2 *nominal working pressure (service pressure, working pressure), n*—the gauge pressure that characterizes typical operation of a pressure vessel, container, or system.

3.2.2.1 *Discussion*—For compressed hydrogen gas containers, NWP is the container pressure, as specified by the manufacturer, at a uniform gas temperature of 15 °C (59 °F) and full gas content.

3.2.3 *pinhole, n*—a small hole generated during sampling of particulates that can be identified by microscope.

3.3 *Abbreviations:*
MAWP—Maximum Allowable Working Pressure
PM—Particulate Matter
NWP—Nominal Working Pressure
PPE—Personal Protective Equipment
PRD—Pressure Relief Device

4. Summary of Practice

4.1 This practice provides a procedure for the sampling of particulate matter (PM) contained in gaseous fuels primarily used in motor vehicles. It is designed to collect all particulates 0.2 µm or larger contained in a known amount of fuel at a station dispenser nozzle in a way that simulates a vehicle fueling event.

4.1.1 The practice has two different approaches:

(1) The Tank Approach emulates a typical fueling by collecting the gas, which passes across the filter, into a tank.

(2) The Atmosphere Approach allows the gas to escape to atmosphere but sets a constant back pressure typically found during a fueling.

5. Significance and Use

5.1 This sampling procedure is used to collect a particulate filter sample containing particulates 0.2 µm or larger in size to be used to measure the size and concentration of particulates in a gaseous fuel stream.

6. Interferences

6.1 Dust and other environmental PM 10 µm or larger will interfere with the accurate measurement of particulates; therefore, every measure should be taken according to Section 13 to prevent contamination of the apparatus and all equipment, supplies, and gases used in these procedures.

7. Apparatus Design

7.1 Fig. 1 and Fig. 2 below show a recommended piping and instrumentation design of the two different sampling approaches. Both apparatuses have the following:

(1) Receptacle to attach to dispenser nozzle,

(2) Filter and filter holder,

(3) Pressure relief valve to protect against overpressurization,

(4) Control valves to regulate the gas,

(5) Pressure gauge to monitor the pressure of the apparatus, and

(6) Check valves to prevent back flow of the gas from the vent stack. If the apparatus has a tank, check valves should be placed upstream of the tank to prevent any gas from the tank from flowing backwards across the filter.

7.1.1 The requirements for these components and for components specific to sampling are discussed below. The design of the apparatus can vary if the requirements below are met.

7.2 *General Apparatus Requirements*—See CSA HGV 4.1 for general information on hydrogen and NGV 4.1 for general information on natural gas.

7.2.1 All equipment shall be designed to the maximum allowable working pressure (MAWP) of the dispenser.

7.2.2 All equipment shall be designed to the maximum peak flow rate of the dispenser. The peak flow rate for most dispensers for passenger cars is typically 60 g/s.

7.2.3 All apparatus components shall be constructed with materials compatible with the gaseous fuel being tested. High pressure hydrogen may alter the mechanical properties of common structural metal alloys. These effects are similar for all relevant structural metals and alloys in that hydrogen reduces the resistance to crack initiation and crack growth and reduces ductility. The reduction is dependent on several variables based on the material, the environment, and the mechanical loading conditions. This can lead to failure or hydrogen leaks. The sampling apparatus and all equipment used according to this test method must be closely inspected for signs of cracks or any other combination of signs of wear and damage.

7.2.4 The apparatus shall be built to withstand gaseous fuel temperatures ranging from −40 °C to 50 °C, except the tank which should have a temperature range of −40 °C to 85 °C.

7.2.5 The equipment shall be designed to operate in ambient conditions.

7.2.6 Refer to Section 10 (Hazards) for more information regarding safety requirements. A hazard analysis shall be performed on the apparatus. This shall be available to share with dispenser manufacturers/operators.

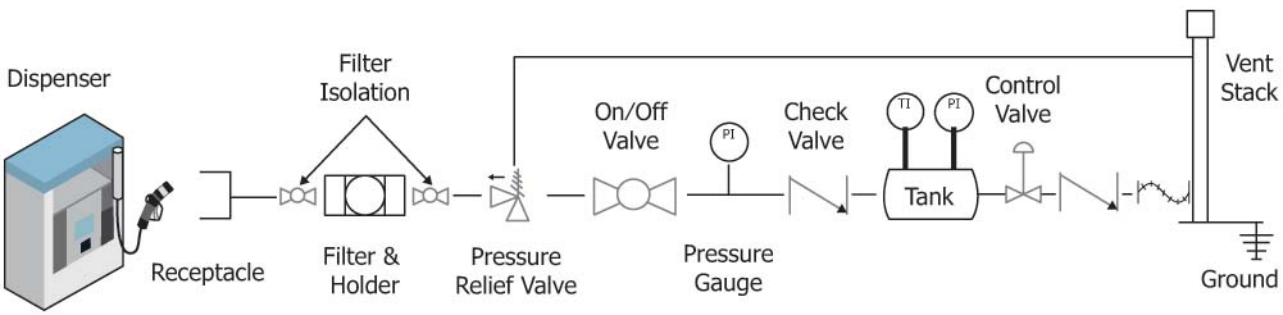

FIG. 1 Piping and Instrumentation Diagram Sampling Using the Tank Approach