Designation: D7606 – 17

Standard Practice for Sampling of High Pressure Hydrogen and Related Fuel Cell Feed Gases[1]

This standard is issued under the fixed designation D7606; 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 standard practice describes a sampling procedure of high pressure hydrogen at fueling stations operating at 35 or 70 megapascals (MPa) using a hydrogen quality sampling apparatus (HQSA).

1.2 This practice does not include the analysis of the acquired sample. Applicable ASTM standards include but are not limited to test methods referenced in Section 2 of this practice.

1.3 This practice is not intended for sampling and measuring particulate matter in high pressure hydrogen. For procedures on sampling and measuring particulate matter see ASTM D7650 and D7651.

1.4 The values stated in SI units are standard. The values stated in inch-pounds are for information only.

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.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D4150 Terminology Relating to Gaseous Fuels

D7650 Test Method for Sampling of Particulate Matter in High Pressure Hydrogen used as a Gaseous Fuel with an In-Stream Filter

D7651 Test Method for Gravimetric Measurement of Particulate Concentration of Hydrogen Fuel

2.2 *SAE Standards*[3]

SAE J2600 Compressed Hydrogen Surface Vehicle Fueling Connection Devices

SAE J2719 Hydrogen Fuel Quality for Fuel Cell Vehicles

SAE J2799 Hydrogen Surface Vehicle to Station Communications Hardware and Software

3. Terminology

3.1 *Definitions:* See D4150 for definitions of terms for use with gaseous fuels.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *high pressure hydrogen*—hydrogen pressurized between 35 and 70 MPa.

3.2.2 *hydrogen quality sampling apparatus (HQSA)*—an apparatus used to collect hydrogen from a 35 or 70 MPa hydrogen fueling dispenser (SAE J2600 and SAE J2799) into a sample container.

4. Summary of Practice

4.1 This practice describes an apparatus and procedure for the sampling of high pressure hydrogen from fueling stations conforming to SAE J2600 or SAE J2799. This practice is intended as a guideline for ensuring collection of a representative sample without introducing trace levels of contaminants. Samples collected using this practice should be suitable for trace analysis of contaminants, utilizing a variety of analytical techniques.

5. Significance and Use

5.1 Hydrogen is delivered to fuel cell powered automotive vehicles and stationary appliances at pressures up to 87.5 MPa. The quality of hydrogen delivered is a significant factor in maximizing fuel cell efficiency and life span. Contamination can occur during the production of fuel cell feed gases, contaminating storage containers, station tubing, and fuel lines

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

used for fuel delivery. Collection of a representative fuel sample without the introduction of contaminants even as low as parts-per-billion (ppb) per contaminant during collection is crucial for assessing the quality of fuel in real world applications.

5.2 This practice is intended for application to high pressure, high purity hydrogen; however, the apparatus design and sampling techniques may be applicable to collection of other fuel cell feed gases. Many of the techniques used in this practice can be applied to lower pressure/lower purity gas streams.

6. Apparatus Design

6.1 A recommended general design of the HQSA, shown in Fig. 1, is a depiction of the apparatus with the nozzle hydrogen pressure regulated to approximately 6.9 MPa (1000 psi) before sampling. The lowest pressure tolerated by hydrogen station safety shutoff systems while still providing a sample that analytical laboratories can safely handle routinely is 6.9 MPa (1000 psi). All HQSA parts, including the ventilation hoses, should be made of 316 grade stainless steel (SS).

6.2 *HQSA Metal Support Plate (1,* Fig. 1*)*—The HQSA metal support plate is utilized to mitigate damage during transportation and support the apparatus. The HQSA is firmly fixed to a metal support plate by tube supports (2, Fig. 1.).

6.3 *SAE J2799 Receptacle (3,* Fig. 1*)*—This receptacle can adapt to both 35 and 70 MPa nozzles. For safety reasons, the receptacle should be positioned vertically so that the nozzle attaches to the receptacle from the top. To support the weight of the nozzle, additional support (3.1, Fig. 1), is fixed to the metal support plate is recommended (1, Fig. 1).

6.4 *Main Valve (4,* Fig. 1*)*—The functions of the main valve are explained as follows:

6.4.1 *Station and HQSA Leak Test*—The station leak test is performed before sampling to ensure there are no leaks in the delivery system. While the main valve is closed, attach the nozzle to the SAE J2799 receptacle (3, Fig. 1). Check for leaks around all of the connections from the nozzle to the main valve as in 10.7 and the complete HQSA system as in 10.8 using a hand held hydrogen leak detector.

6.4.2 *Prevention of High Pressure Hydrogen Passing through the Regulator*—If the main valve (4, Fig. 1) is not installed and the station fueling starts, the diaphragm of the regulator (5, Fig. 1) may fail due to rapid hydrogen pressurization. In this case, pressure relief valve (PRV, 15, Fig. 1) will open to release hydrogen pressure above 10.3 MPa (1500 psi). The main valve (4, Fig. 1) when closed, is designed to contain high pressure hydrogen when sampling starts. The main valve is slowly turned to the open position and the hydrogen is regulated to 6.9 MPa (1000 psi).

6.5 *Regulator (5,* Fig. 1*) and all connections from the* SAE J2799 *Receptacle to Regulator*—All the connections (including tubing, tube fittings, adapter fittings and unions) from the receptacle to regulator must have a pressure rating of 103 MPa (15,000 psi) or higher. The regulator should have two gauges (5.1 and 5.2, Fig. 1) to monitor both inlet and outlet pressures.

6.6 *Inlet and Outlet Valves (6 and 12,* Fig. 1*, respectively)*—The valves should be easily opened and closed, such as ball valves. The HQSA and sample container are cleaned by allowing hydrogen to pass through the HQSA and sample container (10.9) using these valves.

6.7 *Sample Containers (9,* Fig. 1*)*—The pressure rating of the sample containers must exceed the set point on the PRV (15, Fig. 1). The maximum pressure rating for sample containers before bursting is 12.4 MPa (1800 psi). The sample containers and both inlet and outlet valves (8 and 10, Fig. 1,

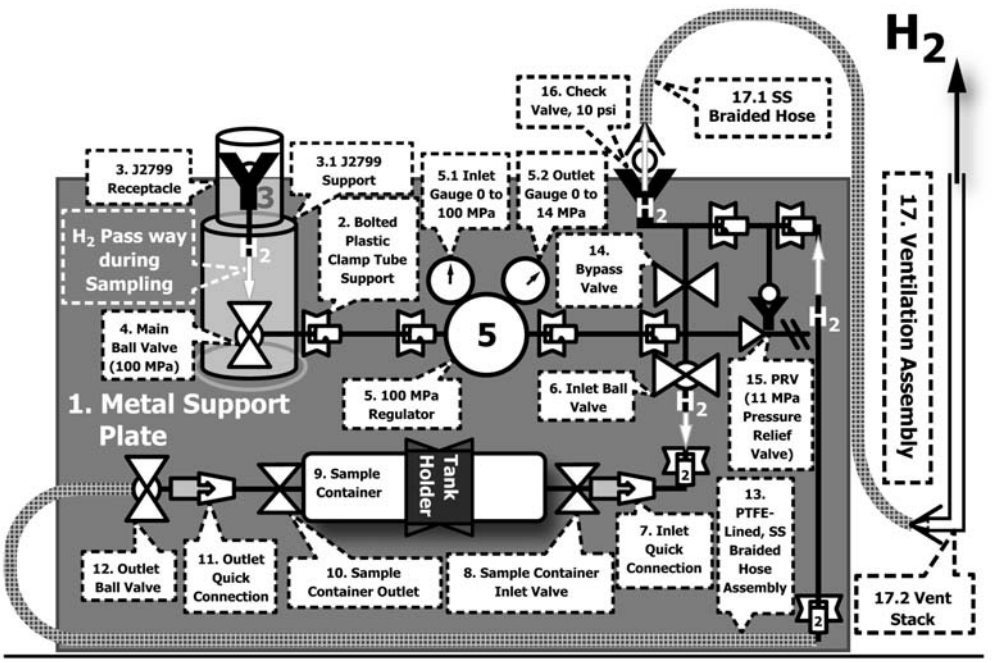

FIG. 1 Hydrogen Quality Sampling Apparatus