Designation: D7606 – 11

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 practice describes a hydrogen quality sampling apparatus (HQSA) and a procedure for the sampling of high pressure hydrogen at fueling nozzles of 35 or 70 Mega Pascal (MPa) fueling stations.

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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

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 Refueling Connection Devices

SAE J2799 70 MPa Compressed Hydrogen Surface Vehicle Fuelling Connection Device and Optional Vehicle to Station Communications

SAE TIR J2719 Information Report of the Development of a Hydrogen Quality Guideline for Fuel Cell Vehicles

2.3 *California Code of Regulations:*[4]

California Code of Regulations Title 4, Division 9, Chapter 6, Article 8, Sections 4180 – 4181

3. Terminology

3.1 *Definitions:*

3.1.1 *absolute pressure*—Pressure measured with reference to absolute zero pressure, usually expressed in MPa, mm Hg, or pound per square inch (psi).

3.1.2 *contaminant*—impurity that adversely affects the components within fuel cell or hydrogen storage systems

3.1.3 *gauge pressure*—Pressure measured above ambient atmospheric pressure. Zero gauge pressure is equal to ambient atmospheric (barometric) pressure.

3.1.4 *gaseous fuel*—Material to be tested, as sampled, without change of composition by drying or otherwise.

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

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *high pressure hydrogen*—For the purposes of this practice, high pressure hydrogen is hydrogen defined as hydrogen pressurized to 35 or 70MPa.

4. Summary of Practice

4.1 This practice describes an apparatus and procedure for the sampling of high pressure hydrogen from fueling nozzles 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.

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[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.

[4] Available from Office of Administrative Law, 300 Capitol Mall Suite 1250, Sacramento, CA 95814–4339.

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 arise during the production of fuel cell feed gases, storage containers, station tubing and fuel lines up to the nozzle used for fuel delivery. Collection of a representative fuel sample without the introduction of contamination 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 supply gases. Many of the techniques used in this practice can be applied to lower pressure/lower purity gas streams.

6. Apparatus Design

6.1 The general design of the HQSA is shown in Fig. 1, which is a depiction of the apparatus with the nozzle hydrogen pressure regulated to approximate 6.9 MPa (1000 psi) before sampling. The pressure of 6.9 MPa (1000 psi) is selected as an example since it is, generally, the lowest pressure tolerated by hydrogen station safety shutoff systems while still providing a sample that analytical laboratories can safely handle routinely. All HQSA parts, including the ventilation tubes, are 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 *Movable Adjustable Platform*—Before sampling, the metal plate holding the HQSA is firmly clamped onto a height adjustable and movable platform, such as a heavy duty cart with a hydraulic adjustable horizontal platform and brakes on its wheels. The cart is moved to a position close to the fueling station and the height of platform is adjusted so that the fueling nozzle attaches easily to the receptacle of HQSA. The platform height is adjusted to provide a safe and comfortable work space. The cart is then locked into place using the cart wheel brakes.

6.4 SAE J2799 Receptacle (3, Fig. 1) – This receptacle can adapt to both 35 and 70MPa hydrogen fueling nozzles. For safety reason, the receptacle must be positioned vertically so that the fueling nozzle attaches to the receptacle from the top. To support the weight of the fueling nozzle, the receptacle must have an additional support (3.1, Fig. 1), which is fixed to the metal support plate (1, Fig. 1).

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

6.5.1 *Station and HQSA leak test*—The station leak test is performed before hydrogen fuel sampling to ensure there are no leaks in the hydrogen fuel delivery system. For sampling the station personnel must attach the fueling nozzle to the SAE J2799 receptacle (3, Fig. 1) first while the main valve is closed. The station leak test procedure is then initiated. A hand held

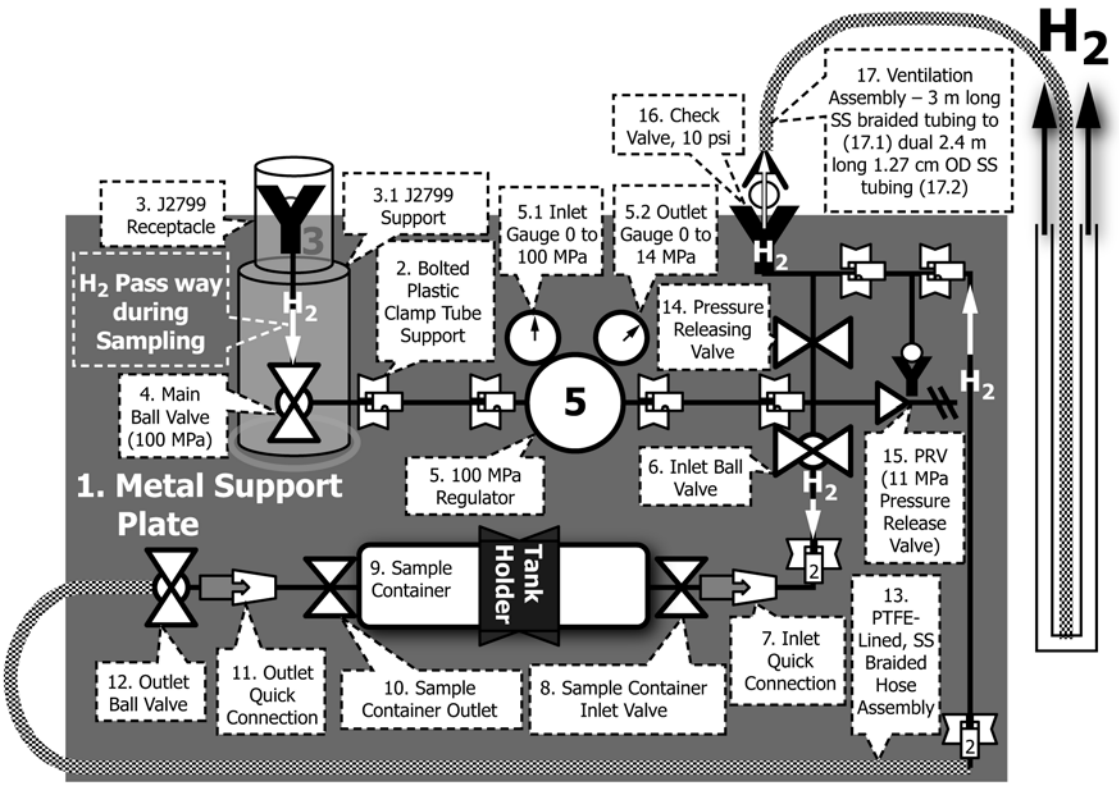

FIG. 1 Hydrogen Quality Sampling Apparatus