



Designation: D7606 – 24a

Standard Practice for Sampling of High Pressure Hydrogen and Related Fuel Cell Feed Gases¹

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 nominal working pressures (NWP) up to 70 megapascals (MPa) using a hydrogen quality sampling apparatus (HQSA).

1.2 This practice does not include the analysis of the acquired sample.

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 Practice [D7650](#) and Test Method [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 Practice for Sampling of Particulate Matter in High Pressure Gaseous Fuels with an In-Stream Filter](#)

[D7651 Test Method for Gravimetric Measurement of Par-](#)

[ticulate Concentration of Hydrogen Fuel](#)

2.2 *ISO Standards:*³

[ISO 14687 Hydrogen fuel quality — Product specification](#)

[ISO 17268 Compressed Hydrogen Surface Vehicle Refueling Connection Device](#)

2.3 *SAE Standards:*⁴

[SAE J2600 Compressed Hydrogen Surface Vehicle Fueling Connection Devices](#)

[SAE J2601 Fueling Protocols for Light Duty Gaseous Hydrogen Surface Vehicles](#)

[SAE J2719 Hydrogen Fuel Quality for Fuel Cell Vehicles](#)

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 *high pressure hydrogen, n*—hydrogen pressurized at a nominal working pressure up to 70 MPa.

3.2.1.1 *Discussion*—Compression fittings manufacture refers to this as medium pressure.

3.2.2 *hydrogen quality sampling apparatus (HQSA), n*—an apparatus used to collect hydrogen at a nominal working pressure up to 70 MPa hydrogen fueling dispenser into a sample cylinder.

3.2.3 *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.

3.2.3.1 *Discussion*—The compressed gas industry (for example, nitrogen, argon, etc.) may also refer to this as the working pressure.

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

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.

Current edition approved Nov. 1, 2024. Published November 2024. Originally approved in 2011. Last previous edition approved in 2024 as D7606 – 24. DOI: 10.1520/D7606-24A.

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

³ Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <https://www.iso.org>.

⁴ Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, <http://www.sae.org>.

3.2.4.1 *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.

3.2.4.2 *Discussion*—The hydrogen refueling industry may also refer to this as the working pressure.

3.3 Acronyms:

3.3.1 *HQSA*—Hydrogen Quality Sampling Apparatus

3.3.2 *MAWP*—Maximum Allowable Working Pressure

3.3.3 *NWP*—Nominal Working Pressure

3.3.4 *P&ID*—Piping and Instrumentation Diagram

3.3.5 *PRV*—Pressure Release Valve

4. Summary of Practice

4.1 This practice describes an apparatus and procedure for the sampling of high pressure hydrogen from nozzles and receptacles at fueling stations conforming to SAE J2600 or ISO 17268 to confirm the hydrogen quality according to ISO 14687 or SAE J2719. 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.

NOTE 1—Hydrogen refueling stations should conform to local regulations such as NFPA 2, CSA HGV 4.1, and CSA HGV 4.9.

5. Significance and Use

5.1 Hydrogen is delivered to mobile and stationary applications at maximum allowable working (MAWP) pressures up to 87.5 MPag (875 barg, 12 700 psig). 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 used for fuel delivery. Collection of a representative fuel sample without the introduction of contaminants even as low as parts per billion by volume (ppb(v)) per contaminant during collection is crucial for assessing the quality of fuel in real world applications and ensuring excessive fuel contaminants will not damage fuel cells or internal combustion engines.

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 an HQSA, piping and instrumentation diagram (P&ID), shown in Fig. 1. A P&ID legend and sampling flow diagrams are shown in Appendix X1. The pressure is regulated to approximately 6.9 MPag (69 barg, 1000 psig) before sampling.

6.2 *General Apparatus Requirements*—See CSA HGV 4.1 for general information on hydrogen.

6.2.1 Any electrical equipment should be rated for working in an area with flammable gas (or class I, Division 2).

6.2.2 All components upstream of the pressure regulator shall be designed to withstand 105 MPag (1050 barg, 15 000 psig) due to the HRS pressure release valve (PRV) which is set to the MAWP.

6.2.3 All components downstream of the pressure regulator shall be designed for the MAWP of the gaseous cylinder (typically 12.4 MPag (124 barg, 1800 psig)). 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 MPag (69 barg, 1000 psig).

6.2.4 All HQSA fittings, valve, gauges, tubing, etc. shall be made of 316 grade stainless steel (SS).

6.2.5 All equipment shall be designed to the MAWP of the dispenser.

6.2.6 All equipment shall be designed to the maximum peak flow rate of the dispenser. The peak flow rate for SAE J2601 dispensers is 60 g/s. The flow rate for other vehicles or forklifts can be significantly higher.

6.2.7 All apparatus components shall be constructed with materials compatible with the gaseous fuel being tested. See ANSI/CSA CHMC 1 and CHMC 2:19.

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

6.2.9 The equipment shall be designed to operate under ambient conditions.

6.2.10 Refer to Section 8 (Hazards) for more information regarding safety requirements. A hazard analysis shall be performed on the apparatus. This shall be available for inspection by dispenser manufacturers/operators and other interested parties.

6.3 *HQSA Metal Support Plate*—The HQSA metal support plate is utilized to prevent damage during transportation and support the apparatus. The HQSA is fixed to a metal support plate by tube supports.

6.4 *ISO 17268 or SAE J2600 Receptacle (H-R1, Fig. 1)*—This receptacle can adapt to both 35 MPag and 70 MPag 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, adding additional support to the metal support plate is recommended.

6.5 *Main Valve (H-VI, Fig. 1)*—A shut off valve that can be quickly closed to stop all flow of hydrogen through the HQSA.

6.6 *Regulator (H-PR, Fig. 1) and all connections from the SAE J2600 or ISO 17268 Receptacle to Regulator*—All the connections (including tubing, tube fittings, adapter fittings and unions). The regulator shall have one gauge (PG1 and PG2, Fig. 1) to monitor the outlet pressure and may have a gauge to monitor the inlet pressure.

6.7 *Inlet and Outlet Valves (H-V2, V4, Fig. 1, respectively)*—The valves should be easily opened and closed, such as a quick shutoff ball valve.

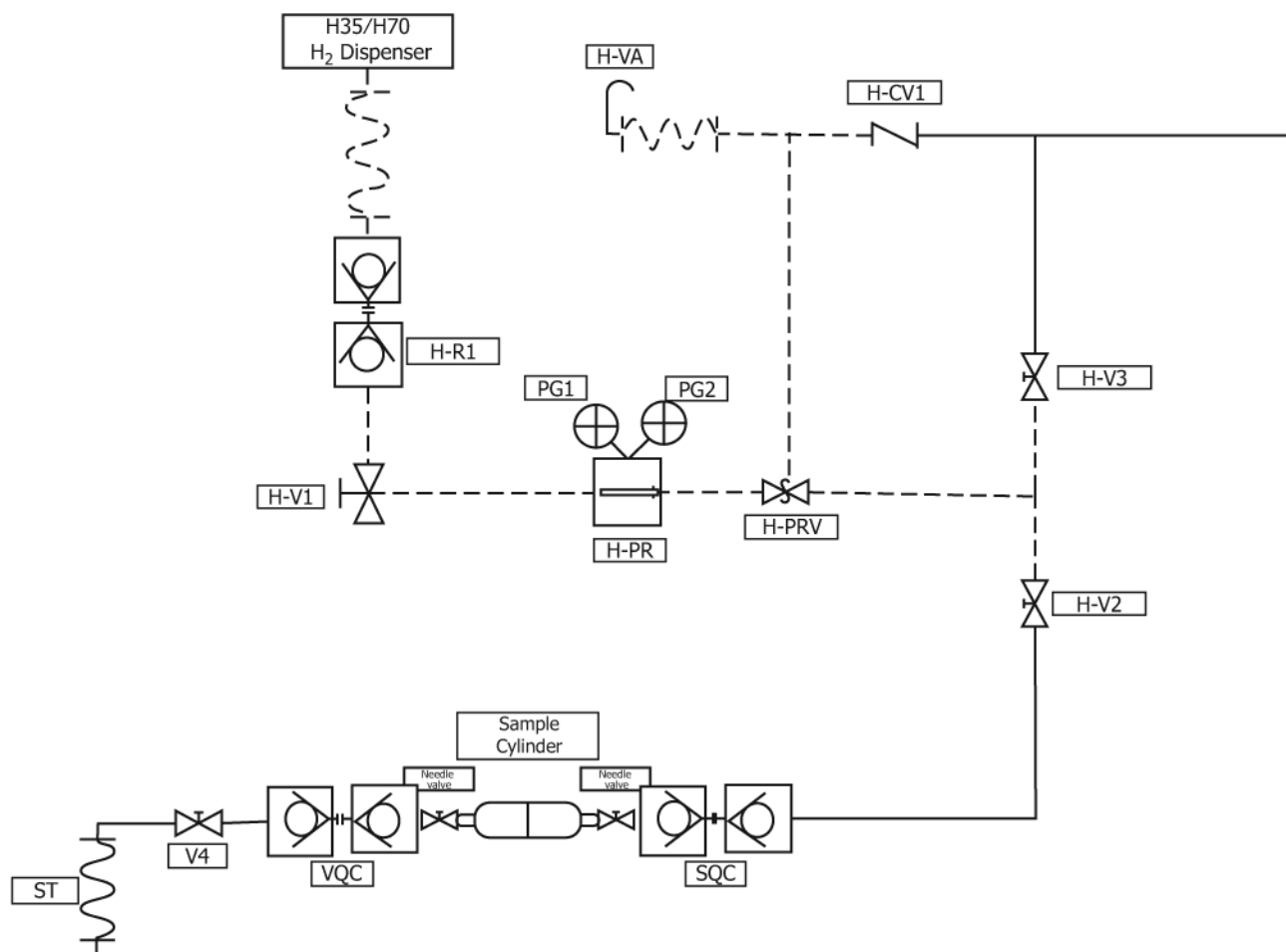


FIG. 1 A P&ID Diagram for a Potential Hydrogen Quality Sampling Apparatus

6.8 *Sample Cylinder Connection (SQC and VQC, Fig. 1, respectively)*—The sample cylinder shall be connected on both the inlet and outlet side to the HQSA using a tube fitting or quick connect fitting. Typically, these are connected by a braided SS hose rated to 12.4 MPag (124 barg, 1800 psig).

NOTE 2—Quick connect shall have a double end shut off to avoid air contamination.

6.9 *Sample Cylinder*—The pressure rating of the sample cylinder shall exceed the set point on the PRV and shall be greater than or equal to 12.4 MPag (124 barg, 1800 psig). The sample cylinder and both inlet and outlet valves shall be passivated with a sulfur inert coating.

6.10 *Bypass Valve (H-V3, Fig. 1)*—The valve should be easily open and closed, such as can be done using a needle or ball valve. This valve is closed before and during sampling. After sample collection, the bypass valve is opened, before the sample cylinder is removed, to release the hydrogen pressure in the HQSA through the check valve (H-CV1, Fig. 1).

6.11 *Pressure Release Valve (H-PRV, Fig. 1)*—The PRV is set below the working pressure of the low-pressure side of the HQSA.

6.12 *Check Valve (H-CV1, Fig. 1)*—The check valve shall have a cracking pressure rating of 69 kPag (10 psig) and is installed at the vent of the HQSA to prevent back diffusion of air into the HQSA.

6.13 *Ventilation Assembly (H-VA, Fig. 1)*—The use of the dispenser/station ventilation system is strongly recommended.

6.13.1 A portable vent assembly can be used but shall be designed to CGA G5.5 and meet the vent system termination requirements in NFPA 2. The hydrogen shall also be vented away from personnel, equipment, public, ignition sources, other hazardous materials, building openings, ventilation intakes, and overhead structures and areas that can entrap the hydrogen. The vent system shall also be secured to prevent movement and protected from collision from vehicles.

6.14 *Hose*—The ventilation hose shall be rated for hydrogen and have abrasion protection.

6.14.1 All hose assemblies shall have an anti-whip protection that is attached to a suitable anchor point during sampling to prevent the hose from whipping should the connection become uncoupled.

6.15 *Earth Grounding*—All components of the apparatus shall always be electrically grounded to earth.