

USCAR Hydrogen Fuel System Component Working Group (H2FSC WG) - Targets for Hydrogen Fuel Lines and Fittings on a light-duty fuel cell vehicle

The purpose of this document is to promote common requirements and designs for use by the H2FSC WG.

The fuel lines and fittings shall provide the hydrogen gas interconnection for the high pressure from the fueling receptacle to the storage system components and then to the pressure regulator (inlet) and low pressure from the regulator (outlet) to fuel cell system.

Characteristic	Target – High Pressure Fuel Lines and Fittings	Target – Low Pressure Fuel Lines and Fittings	Reference/Source*
Fuel	Hydrogen per ISO 14687		ISO 14687 (ref. SAE J2719)
Hydrogen Compatibility	Evidence of Hydrogen Compatibility		ANSI HGV 3.1-2015 SAE J2579 Appendix B
Nominal Working Pressure (NWP)	700 bar	20 bar	H2FSC WG
Maximum Operating Pressure	875 bar (1.25x NWP)	23 bar	ANSI HGV 3.1-2015
Burst Pressure	1750 bar (2.5x NWP)	50 bar (2.5x NWP)	ANSI HGV 3.1-2015
Maximum Flow for Fueling	60 g/s	n/a	SAE J2601
Maximum Outlet Flow for Delivery (includes pulse conditions per OEM feedback)	3 g/s**		H2FSC WG
Maximum Service Temperature (ambient and operation)	85°C (Maximum environmental ambient is 50°C)		ANSI HGV 3.1-2015
Minimum Service Temperature	-40°C		ANSI HGV 3.1-2015
Maximum Gas Temperature	85°C	100°C	H2FSC WG
Minimum Gas Temperature	-60°C		H2FSC WG
Endurance Test (pneumatic)***	75,000 Cycles (1.5x 50k duty cycles)		EC/79/2009
Pressure Cycle Test (hydraulic)***	150,000 Cycles (3x 50k duty cycles)		EC/79/2009
Refueling Endurance Test (pneumatic)***	7,500 Cycles (1.5x 5k duty cycles)		EC/79/2009
Refueling Pressure Cycle Test (hydraulic)***	15,000 Cycles (3x 5k duty cycles)		EC/79/2009
Assembly/Disassembly Cycles***	25		ANSI HGV 3.1-2015
Assembly Criteria	Connect fitting using a torque specification Lubricant free or fuel cell compatible (per OEM approval)		H2FSC WG
Maximum External Leakage	< 10 Ncm ³ /h (end of life)		ANSI HGV 3.1-2015
Component Certification Requirement	ANSI HGV 3.1-2015 (USA) EC/79/2009 (Europe) or UN R134 (Europe) Must comply with applicable local and national regulations in which deployment will occur per customer (above are typical references)		H2FSC WG

System Certification Compliance (system criteria awareness)	UN GTR No. 13 UN R134 SAE J2579		H2FSC WG
NVH Requirement	Needs to be robust to shock loads and vibrations exposed to during normal operation as determined for the specific customer and vehicle application		H2FSC WG
Corrosion Protection***	144 hours salt spray		ANSI HGV 3.1-2015
Water Ingress Protection***	IPx6 (high-pressure, heavy spray) IPx6K (extreme high pressure spray)		ISO 20653
Thermal Endurance***	At minimum, perform 100 temperature cycles between minimum and maximum service temperature in 5 minutes with a 30 minute hold at temperature For complete endurance assessment, needs to be robust to thermal fatigue and degradation that is caused by temperature change. Perform a customer defined thermal cycle profile		H2FSC WG (ref. IEC 60068-2-14)
Lifetime	15 years		H2FSC WG
Service Criteria	Shall not require any scheduled maintenance involving disassembly and/or replacement of parts to maintain proper function over lifetime		H2FSC WG
Fitting Interface	Female cone end-connection per ISO 2974 (6 mm OD tubing interface)	O-ring face seal per SAE J1453 and ISO 8434-3 (10 mm OD tubing interface)	H2FSC WG
Restricted Materials	Must avoid use of hazardous substances (for example, parts containing lead, mercury, cadmium, hexavalent chromium, etc.) per government regulations, environmental goals, and vehicle manufacture list of prohibited substances (suppliers are required to report)		H2FSC WG (ref. EPA TSCA Inventory, EU Directive 53/2000, other applicable national and OEM restrictions)

**Reference/source information provide the foundation or additional information for the requirement. The "H2FSC WG" notation indicates the requirement was developed by the Hydrogen Fuel System Component Working Group rather than another source.*

***Flow rates are based on a light duty fuel cell vehicle (~80 to 100 kW) and will increase for higher power fuel cell vehicles.*

****At the completion of the test, the component shall comply with the external leakage and burst pressure requirements.*

NOTE: This list of targets represent the core requirements for the basic design while a series-production product will have additional criteria per vehicle manufacture such as but not limited to:

- design validation for lifetime robustness in vehicle environmental conditions
- quality control, reliability and production part approval process requirements
- suitable materials to prevent fuel cell contamination
- material requirements including recyclability and recoverability