

Annexure A, H59 Gas-Flow-Management™ Refuelling Station Overview, Standards Alignment & Risk Assessment for Refuelling Hydrogen Powered Vehicles

Category	ESSNA™ H59™	Standard Reference
Hydrogen Purity	The ESSNA™ H59™ station or ESSNA™'s™ scope of a retrofit strictly adheres to the SAE J-2719 standard, with consistent reliable on-spec Fuel Cell Standard purity of 99.97% and CO < 0.2 ppm. Our system ensures hydrogen meets the quality requirements necessary for fuel cell vehicles. ESSNA™ owns a purification technology that outperforms PSA (pressure swing adsorption) and meets the required fuel cell standards.	SAE J-2719 “Hydrogen Fuel Quality for Fuel Cell Vehicles”; ISO 19880-8 “Gaseous hydrogen Fueling stations — Part 8: Fuel Quality Control”; ISO 14687 “Hydrogen Fuel Quality – Product Specification”
HD Dispensing Capability	The ESSNA™ H59™ station or ESSNA's™ scope of a retrofit will be designed to meet SAE J2601-2 standard and complies with ISO 19880-1, providing safe and efficient fueling protocols for heavy-duty hydrogen vehicles. The station features HD Dispensing Capability at 700 Bar (H70) and a compression capacity to meet operational objectives. The control parameters relating to fueling such as fueling speed, pre-cooling class, and final pressure are to be determined, ensuring safe hydrogen transfer. The station may support higher flow rates, up to 120 grams per second (g/s), to accommodate the larger fuel requirements of heavy-duty vehicles. The system may be designed to achieve fueling times of less than 20 minutes for larger vehicles	SAE J2601-2 “Fueling Protocols for Gaseous Hydrogen Powered Heavy Duty Vehicles”; ISO 19880-1 “Gaseous hydrogen Fueling stations — Part 1: General requirements”; ISO 19880-2 “Gaseous Hydrogen—Fuelling stations Part 2: Dispensers and dispensing systems”; ISO 19880-5:2019 “Gaseous hydrogen — Fueling stations — Part 5: Dispenser hoses and hose assemblies”; ANSI/CSA-HGV 4.1 (ETL) “Hydrogen Dispensing Systems”; ANSI/CSA-HGV 4.2 “Hoses for compressed hydrogen fuel stations, dispensers and vehicle fuel systems”; ANSI/CSA-HGV 4.3 “Test Methods for Hydrogen Fueling Parameter Evaluation”

	with compressed hydrogen storage systems (CHSS) up to 70 kilograms. Compliance with J2601-2 standards for 700 bar (H70) fueling as well as ANSI/CSA-HGV 4.1 (ETL) will be demonstrated through fuel logs. Hot and Cold case scenarios are implemented to guarantee optimal performance under varying environmental conditions, preventing overheating and overfilling during refueling. Included components are confirmed / estimated to be hydrogen compressor and associated hydraulic unit, internal high-pressure storage pack, hydrogen heat exchanger, integrated dispenser, and hydrogen flowmeter.	
Hydrogen Station Communication, Control Systems, Operational Standards, and Safety	We would deliver the following in designing and building a station (1) implementation of SAE J-2799 communication protocols to ensure 95–100% SOC fueling (state of charge), (2) the presence of a point-of-sale or data-logging system, and (3) design adaptability to various configurations and pressures suitable for medium, heavy and light-duty vehicles. Implementing and installing a main electrical disconnect, nitrogen distribution panel, hydrogen-distribution sequencing instrumentation/valve panels, and safety devices (flame detection, hydrogen gas detection, emergency-stop buttons, and pressure, temperature, and flow	SAE J2799; ISO 17268:2020; SAE J2600; NFPA 2; NBIC; SCA B51:2019; CAN/BNQ 1784-000:2008; AIAA G-095:2004; ASME STP-PT-006:2007; ANSI/NACE TM0284-2016; IEC 61508 / IEC 61511; IEC 60079 Series; ISO 19880-1 Annex G; ISO 9001; ISO 14001

	monitoring). The station will also have warning red strobe lights and audible horns for abnormal conditions. Additional components include the main electrical power and control enclosure with a dedicated HMI for on-site monitoring and station control, the process PLC and safety system, and a nitrogen distribution panel with automatic switching between primary and secondary nitrogen sources. Added: Functional safety lifecycle per IEC 61508/61511 with SIL assignment for safety instrumented functions (SIFs); hazardous-area electrical compliance per IEC 60079; and a documented compliance program (inspection, testing, maintenance) with audit intervals ≤ 12 months, including HAZOP/FMEA in line with ISO 19880-1 Annex G.	
Optional LD Dispensing Capability	ESSNA™ H59™ station or to meet the SAE J2601-1 standard and complies with ISO 19880-1, providing safe and efficient fueling protocols for light-duty hydrogen vehicles. Optional integration.	SAE J2601-1; ISO 19880-1; ISO 19880-2; ISO 19880-5:2019; ANSI/CSA-HGV 4.1; ANSI/CSA-HGV 4.2; ANSI/CSA-HGV 4.3
Functional Safety (SIL/SIS)	Safety instrumented systems shall comply with IEC 61508/61511 lifecycle requirements. SIL targets will be assigned, validated, and verified using quantitative risk assessment; SIF proof-test intervals and diagnostics will be documented.	IEC 61508 / IEC 61511 — Functional Safety Standards

Material Compatibility & Pressure Vessels	Cylinders, piping, and composite storage shall use materials compatible with hydrogen service and embrittlement resistance; fabrication and testing shall comply with ISO 11114, ISO 11120, and ISO 15869.	ISO 11114; ISO 11120; ISO 15869
Explosive Atmospheres (Hazardous Area Electrical)	All electrical/electronic equipment within classified areas shall meet IEC 60079 requirements for selection, installation, and protection methods (e.g., Ex d, Ex e, Ex i).	IEC 60079 Series — Explosive Atmospheres (ATEX)
Transport & Handling Standards	Portable and transportable hydrogen storage systems shall meet ISO 16111 (metal hydride), ADR, and DOT CFR 49 requirements for packaging, relief devices, and safe carriage.	ISO 16111; ADR 2023; DOT CFR 49
Risk Assessment & Continuous Compliance	Perform HAZOP and FMEA per ISO 19880-1 Annex G; maintain a formal inspection, testing, and maintenance program with audit intervals not exceeding 12 months. Maintain quality and environmental controls per ISO 9001 and ISO 14001.	ISO 19880-1 Annex G; ISO 9001; ISO 14001