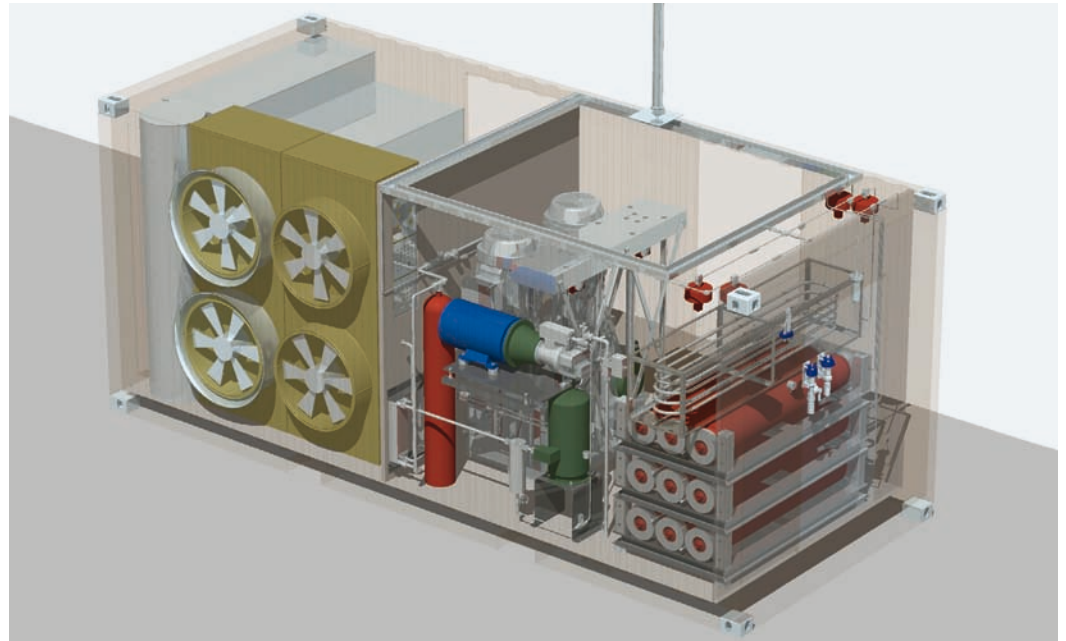


## Hydrogen technologies. The Max fueller 90.



**The solution** The BOC Max Fueller 90 is a high-performance transportable solution with a listed and certified design that is easy to deploy and mobilize. It allows for the quick, safe, efficient and economical fuelling of hydrogen vehicles to 35 or 70 MPa (350 or 700 bar). At 70 MPa, up to 5 kg hydrogen can be delivered in less than 3 minutes.

**Specifications** The requirements for CGH<sub>2</sub> refuelling have been defined in the "Fuelling Protocols for Light Duty Gaseous Hydrogen Surface Vehicles SAE-J2601". The compressor technology of the Max Fueller 90 is in operation in numerous applications, fully complies with this standard and utilizes components field-proven at multiple stations throughout the world. It packages the industry-leading fast-fill technology into a compact, low-maintenance offering with very high reliability. The Max Fueller 90 uses BOC's standard refuelling protocol to provide > 95% complete fills for both 35-MPa and 70-MPa vehicles in less than 3 minutes for up to 5 kg. The 70-MPa fuelling nozzle is equipped with an IRDA communication interface to collect and record data from the vehicle during the fuelling operation.

**Design** The compression station is built in a transportable 20ft standard steel ISO container. The electrical system and the compressor/storage compartments are separated by a gas-tight wall. All controls and electrical power switch gear are located in the electronics compartment. A pressure discharge vent is located in the roof of the gas compartment. In the standard configuration, the container is equipped with an on-board dispenser installed at the end of the container. The dispenser controls can be connected to the local point-of-sale system for retail sales. An optional external 35/70-MPa hydrogen fuel dispenser can be added at any stage of a project.

**Storage** In order to use stored pressure and compressor capacity in the most cost-efficient manner, the station has a three-bank cascade system. It consists of three pressure storage banks (buffer sections) in which the hydrogen for the refuelling is stored.

**Fuelling** The initial vehicle pressure is determined by a test pulse from the high-pressure storage bank. Based on this test measurement and taking the ambient temperature into account, the final vehicle target pressure is calculated. The fuelling process starts with the equalization of the low-pressure bank, followed by the equalization of the medium- and the high-pressure bank. The selection of the bank system is based on the hydrogen flow rate to the dispenser. After fuelling, the station switches automatically into the recharge mode and fills the 85-MPa storage banks. The specific energy required for 70-MPa fuelling is 2.43 kWh/kg (including cooling). All vehicles are fuelled with pressure ramp rise control over the fuelling rate according to SAE-J2601 specifications. The quantity of motor fuel dispensed is recorded using a mass flow meter with support for retail sales.

**Capacity** Equipped with dual compressors, the base BOC Max Fueller 90 is capable of fuelling multiple vehicles “back to back” per hour depending upon vehicle service pressure, state of charge and size of vehicle tanks. When the Max Fueller storage banks are fully charged, the station can dispense up to 5 kg in 3 minutes (at -40 °C). The hydrogen for the Max Fueller 90 can be supplied at any inlet pressure from 0.15 up to 30 MPa.

**Automation system** Safe and fast refuelling is achieved by a PLC-based automation system:

- Optimized software reflecting the experience of numerous refuellings
- A touch-panel-based operator system is used to monitor all processes
- Online access to the entire control system and data acquisition is supported
- Remote diagnostics and maintenance is part of the operating strategy

**Safety concept** Designed and built to global technical standards, the BOC Max Fueller 90 can be adapted to region-specific codes and standards (e.g. US, EU). The BOC hydrogen safety concept for vehicle fuelling includes:

- Continuous monitoring of system leakage in stand-by mode
- Initial pulse and hold, then continuous leak testing of the vehicle during fuelling
- All hydrogen components are located in a gas-tight compartment with overpressure relief flap
- Hydrogen gas detection and smoke detection in confined areas; earthquake detection
- Automatic Emergency Shutdown (ESD) shuts down station, hydrogen supply and any co-located fuel supplies
- Ultra-low cold-fill technology allows for fast-fill refuelling and prevents overheating of vehicle storage systems

**Safety concept****Compressor station**

Dimensions (L x W x H)	6.0 x 2.6 x 2.9 m (20-ft container)
Weight	6–12 tonnes
Electrical requirements	480 V, 60 Hz, 80 kW
Inlet pressure	0.15 to 30 MPa
Delivery rate (one compressor)	120 Nm <sup>3</sup> /h, 10.8 kg/h
Delivery rate (two compressors)	240 Nm <sup>3</sup> /h, 21.5 kg/h
Noise level	67 dB(A)
Ambient temperature	+50 °C/-20 °C
<b>Buffer storage</b>	
Three-bank cascade	450-litre water volume
Maximum operating pressure	85 MPa (MAWP is 90 MPa)
Full buffer storage capacity	20 kg
<b>Buffer storage</b>	
Flow rate measuring	Mass flow meter
Maximum flow rate	60 g/s (35 MPa), 28 g/s (70 MPa)
35-MPa maximum delivery pressure	43.75 MPa
70-MPa maximum delivery pressure	87.5 MPa
Minimum nozzle temperature at 70 MPa	-40 °C
Temperature compensation	BOC protocol
<b>Fuelling nozzles</b>	
Manufacturer	WEH
35-MPa nozzle	TK-16
70-MPa nozzle	TK-17 with IRDA
70-MPa communication interface	SAE-2799

Subject to technical modifications.

**Competitive advantages**

- Field-tested, proven compressor system hardware (plant) and software (BOC Fuelling Protocol) used today in over fifty 35-MPa and 70-MPa stations
- Compact construction of the system: all components are located in one housing with the dispenser at one end and optional support for an external dispenser, which is to be mounted on the fuelling island
- No need for liquid nitrogen cooling; the only required station utilities are electricity and a minor amount of gaseous nitrogen or compressed air for the operation of pneumatic valves
- Support for public access dispenser, type testing, and certification for commercial fuel retail sales
- CE certified, NRTL-listed station, approved for use

**BOC**

The Priestley Centre, 10 Priestley Road, The Surrey Research Park, Guildford, Surrey GU2 7XY, United Kingdom  
Tel +44 1483 579 857, Fax +44 1483 505 211, h2refuelling@boc.com, www.BOCOnline.co.uk