Intelligent Energy®

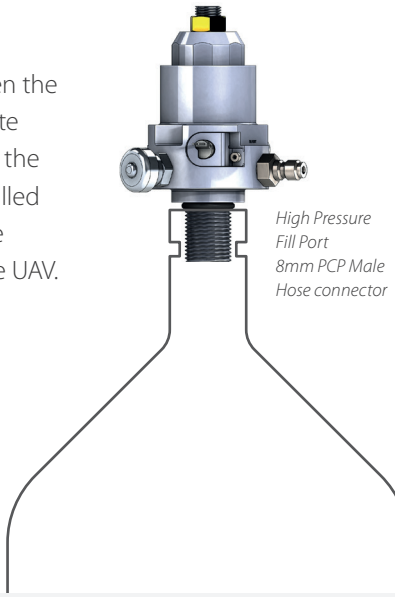
Refuelling UAV Pressurised Lightweight Composite Cylinders

IE-Soar™ modules operate from a fuel supply of hydrogen gas. The hydrogen gas is stored on-board the UAV in lightweight composite cylinders. **This guide contains details of several methods for refilling the UAV fuel cylinders.**

Refill **on board UAV** or **on the ground?**

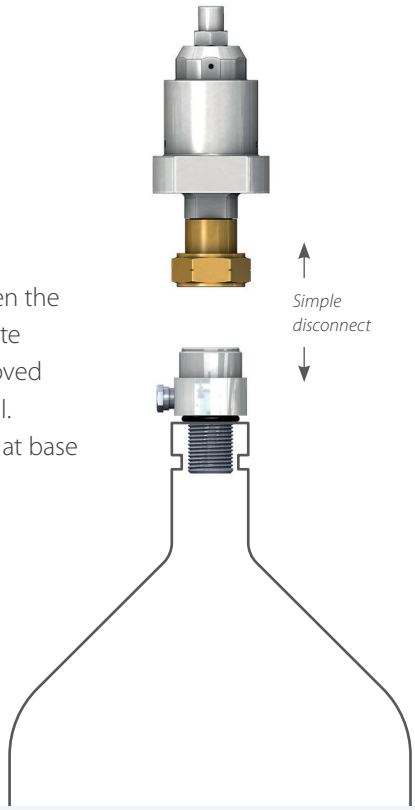
Cartridge regulator
M18 Cylinder interface

On Board UAV
A good solution when the lightweight composite cylinder is integral to the UAV. The cylinder is filled through a filling hose while attached to the UAV.



Cartridge regulator
HP Valve interface

On The Ground
A good solution when the lightweight composite cylinder will be removed from the UAV for refill. Either in-situ or back at base



1 Cylinder Exchange Filling Service

Cylinders can be filled if you take them to the filling location or they can be delivered directly to you and empties collected by a carrier.

IGX Group, Inc.
820 Greenville Road, Livermore, CA 94550
Sales Contact: Delisa Leighton
Telephone: 415-763-9790
delisa@igxgroup.com

NanoSUN
Unit 25, Lake Enterprise Park,
Caton Park, Lancaster LA1 3NX
info@nanosun.co.uk

2 Decanting

Decanting is the direct connection from the source cylinder to the destination cylinder using a decanting hose.

Decanting is ideal for integration and proof-of-concept work. It minimises upfront investment and is simple to setup, but less efficient for larger operations.

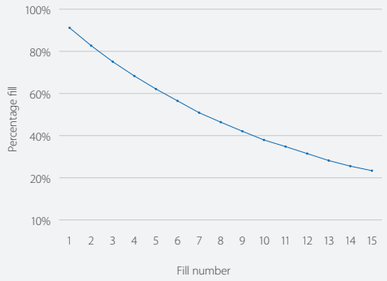
This is because the UAV cylinder can only be filled to the pressure remaining in the source cylinder. The graph (see right) indicates the pressure that can be achieved on consecutive fills. First fill is to 90% pressure (270bar), second fill to 81% (243bar) etc.

The decanting hose comes complete with Nevoc (ISO5145) fitting to mate with the BOC/Linde G20 Genie cylinder. The hose has a pressure gauge, a bleed valve, and an 8mm PCP connector that will connect directly to the UAV fill port.

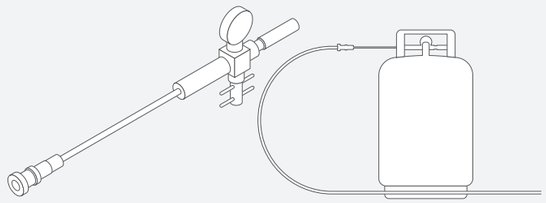
Decanting hoses are available from the following suppliers:

Intelligent Energy
Contact us at
sales@intelligent-energy.com

Fuel Cell Systems Ltd
Station Yard, Hungerford, Berkshire, RG17 0DY, UK.
Part no. 1010/000 FCSL PCP Drone Refuelling Hose.
www.fuelcellsystems.co.uk



Fill Pressure for BOC/Linde Genie cylinder with decanting hose



Decanting hose connected to Genie cylinder

3 Booster pumps

Fill the UAV cylinders yourself directly from a bulk high pressure gas cylinder. An in-line compressor ensures you get a full cylinder, regardless of source pressure.

1 Haskel Europe Ltd
North Hylton Road, Sunderland, SD5 3JD.
Part description: Portable Hydrogen Booster pump in hardened plastic case plus accessories Kit Part No. 100225.
www.haskel.com

2 MAXIMATOR GmbH
Lange Strasse 6, 99734 Nordhausen. Germany
Several options for filling hydrogen cylinders.
www.maximator.de

3 Staffordshire Hydraulic Services Ltd
Mount Road, Kidsgrove, Stoke-on-Trent, Staffordshire ST7 4AZ, UK
Part No. Single Acting Gas Booster Pack, Model GB-75-H2, single stage-single acting air driven gas booster in Heavy Duty Pelican case.
www.staffshydraulics.co.uk

4 Hydraulics International, Inc.
20961 Knapp Street, Chatsworth, CA 91311, USA
Several options for filling hydrogen cylinders both electrically driven and air driven.
www.hiipumps.com

5 MPS (Italy)
Via Po 1, 33054 Lignano Sabbiadoro (Italy). Several options for filling hydrogen cylinders both electrically driven and air driven.
www.mpstechnology.it

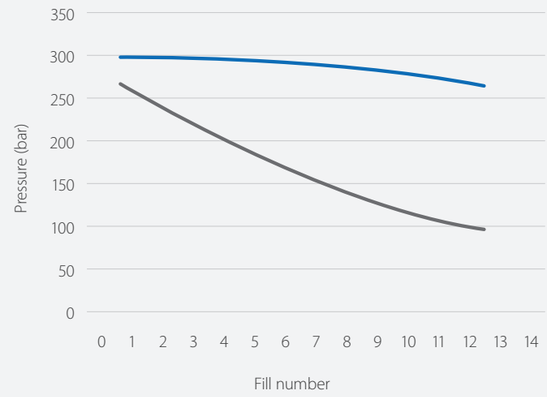
4 Cascade filling

Cascading refuelling enables filling of significantly more UAV fuel cylinders to higher fill pressures than the decant option.

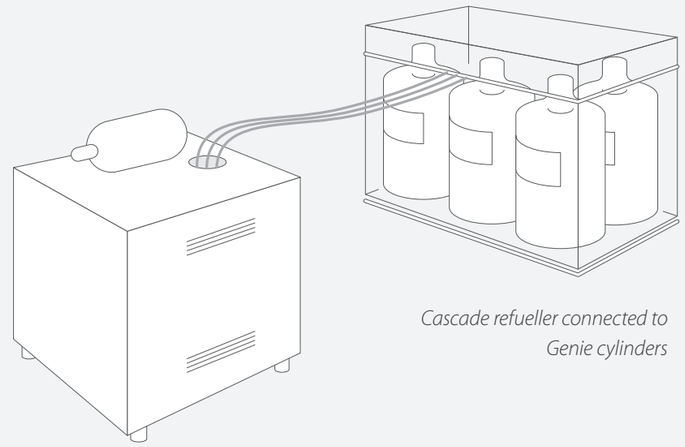
This approach optimises utilisation of hydrogen from a standard source cylinder. The graph (see graph to the right) indicates the relative performance of the two solutions when filling a 2L UAV tank from an industry standard 300bar (20L) supply.

Filling protocols and safety checks on the Cascade Refueller are controlled by the onboard PLC and operation is via simple push button interface.

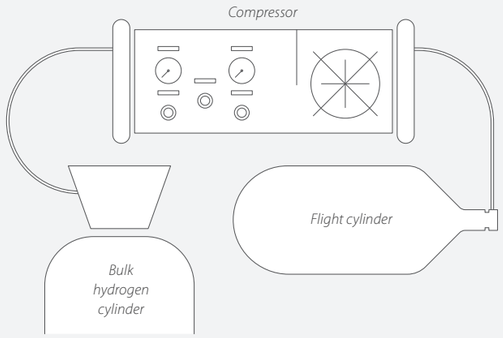
Unlike booster pumps, Cascade Refuellers require no external power source, hence they work well for field and mobile refuelling.



Fill pressure for a BOC/Linde Genie Cylinder using a cascade refueller



Cascade refueller connected to Genie cylinders



Hydrogen availability

Hydrogen is widely available across Europe, from the three major industrial gas suppliers; Air Products, Air Liquide and Linde. In some countries they operate under different names.

Hydrogen is typically delivered throughout Europe in the following cylinder sizes and pressures:

K size, mass 65kg with 648g of hydrogen at 200bar
B size, mass 16kg with 133g of hydrogen at 200bar
G20 (Genie) size, mass 22.4kg with 424g at 300bar
Multi cylinder packs, larger trailer packs and other packaged solutions are available.

In the USA alternative cylinders are available
(Praxair options shown below):

6K size, mass 139kg with 1260g of hydrogen at 460bar
T size, mass 66kg with 653g of hydrogen at 183bar
K size, mass 61kg with 491g of hydrogen at 138bar
Q size, mass 30kg with 163g of hydrogen at 138bar

Supplier	Web site
Air Products (most of Europe)	www.airproducts.co.uk
BOC/Linde (most of Europe)	www.boconline.co.uk
Gas Direct (UK)	www.gas-direct.co.uk
Hygear (The Netherlands)	www.hygear.com/gases
SOL Group (Italy)	www.solgroup.com
Praxair (USA), Part of Linde	www.praxair.com
Air Liquide (most of Europe)	www.industry.airliquide.us
Airgas (USA – owned by Air Liquide)	www.airgas.com

For more information about our products visit our website: **www.intelligent-energy.com**
To arrange a meeting with a sales representative in your region email: **sales@intelligent-energy.com**

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