LIQUID HYDROGEN REFUELLING

Equipment and Solutions

MannTek

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HYDROGEN

THE UPCOMING NEW ENERGY SOURCE.

To utilise its advantages – high energy density, environmental sustainability, no CO_2 emissions – the safe and eco-friendly handling of Liquid Hydrogen requires the **highest level of material and processing quality** in terms of insulation and pressure resistance. Accordingly, we have developed safe and durable products to reliably meet the special requirements of the medium (low boiling temperature of -253 °C, low ignition energy) through vacuum insulation, purge options and break-away couplings.

PRODUCT OVERVIEW

PNEUMATIC TRUCK REFUELLING NOZZLE

Connection double walled hose. Vacuum insulated.

Weld end (inner wall): 22 × 2 mm

Weld end (outer wall): 33.7 × 2 mm

Weight: approximately 12 kg

Operating pressure (pneu. system): 20 bar

Purge hose: 6 × 1 for Swagelok® connector

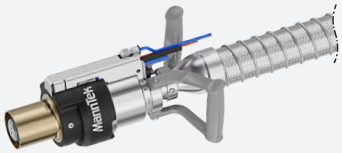
Proximity switch: Inductive NAMUR sensor (ATEX / IECEx)

Pneumatic hose: 6 × 1 quick connector

Order number: 'N-LH2-P'

Option

Anti-freezing equipment: Heated Parking Adapter



MANUAL TRUCK REFUELLING NOZZLE

Connection double walled hose. Vacuum insulation possible if welded to the coupling.

Weld end (inner wall): 22 × 2 mm

Weld end (outer wall): 35 × 2.5 mm

Weight: approximately 9.5 kg

Order number: 'N-LH2'

TRUCK RECEPTACLE

Connection double walled tank. Vacuum insulated.

Weld end (inner wall): 48.3 × 3 mm

Weld end (outer wall): 60.3 × 2 mm

Order number: 'R-LH2'

DOUBLE WALLED HOSE

Vacuum insulation possible if welded to the coupling.

Size: DN 15/20

Design temperature: -253 °C to +50 °C

Design pressure: PN 25

Order number: 'LH2-20-LXXm'

JOHNSTON COUPLING

Size: DN 15

Pressure rating: PN 25

Order number: 'JC-LH2-20-f/m-xx' (Various standard types available).

Male and female available (male usually welded to vacuum insulated hose).

Length of coupling differs between types.

DUST CAP TRUCK RECEPTACLE

Material: Aluminium

Order number: 'DC-LH2-20 (vapor)'

In case a vapor recovery line is needed (for example when refuelling LH2 instead of sLH2), the same equipment as for the Liquid Hydrogen can be used, because the returned gas phase is nearly as cold as the liquid phase. A special cap for the receptacle for the vapor line, marked with 'vapor', is available.

HEATED PARKING ADAPTER

Order number: 'HP-LH2-20'

When the nozzle is not in use, the interface should be heated in order to avoid condensation of air humidity on the surfaces, especially in so-called 'back to back' refuelling operations where many successive refuelling operations take place. This water might freeze again during the refuelling process and the ice crystals could damage the sealing. It could also happen that the nozzle is sticking to the receptacle due to the freezing water in the interspace between the nozzle and the receptacle. To keep a certain temperature above the condensation point of water on the nozzle when it is not in use, we can also supply a Heated Parking Adapter.

TRUCK REFUELLING

For refuelling trucks with Liquid Hydrogen (LH2) or subcooled Liquid Hydrogen (sLH2), ELAFLEX and MannTek have developed a nozzle and receptacle, based on the principles of a Dry Disconnect Coupling. The available system is completed by a hose assembly with a connection to the dispensing unit.

The system ensures an **easy and safe refuelling** operation **without any residual gas release volume of hydrogen.** The design of the nozzle and receptacle interface also offers a thermal insulation to minimise heat transfer into the refuelling system, keeping the outside warm to avoid surface condensation.

SPECIFICATIONS – MANUAL TRUCK REFUELLING NOZZLE AND RECEPTACLE

size: DN 15
design temperature: -253 °C to +50 °C
design pressure: PN 25
purge pressure: max. 0.8 bar above internal tank pressure
min. burst pressure: 100 bar
flow rate: 150l/min
material: EN 10272 – 1.4404 (316L), EN 10216-5 – 1.4404 (316L), EN 10217-7 – 1.4404 (316L)
material seals: PEEK / PE / PTFE

PRODUCT OVERVIEW

BUNKERING COUPLING (HOSE UNIT)

Connection double walled hose.
Vacuum insulated.

Inner connection (process pipe):

Butt weld end (DN 32): 42.4 × 2 mm

Butt weld end (DN 50): 53 × 1.5 mm

Outer connection (vacuum hose/pipe):

Butt weld end (DN 32): 88.9 × 2.3 mm

Butt weld end (DN 50): 101.6 × 2 mm

Purge pipe: 10 × 2 for Swagelok® connector

Proximity switch: inductive NAMUR sensor (ATEX/IECEx) NJ1,5-8GM-N, (emergency release) NJ4-12GK-SN, (purge/connected)

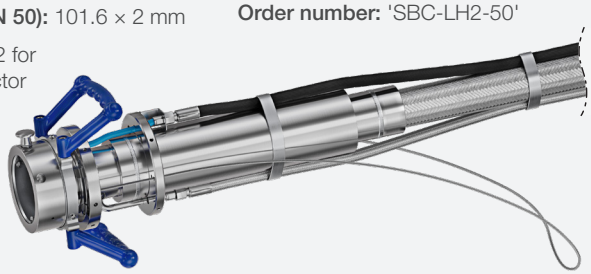
Locking device: disconnection pressure limited to 2.5 bar.

Order number: 'H-LH2-f/m'

Option

Integrated breakaway

Order number: 'SBC-LH2-50'



SHIP RECEPTACLE (TANK UNIT)

Connection double walled tank.
Vacuum insulation possible if welded to the coupling.

Inner connection (process pipe):

Butt weld end (DN 32): 42.4 × 2 mm

Butt weld end (DN 50): 53 × 1.5 mm

Outer connection (vacuum hose/pipe):

Butt weld end (DN 32): 88.9 × 2.3 mm

Butt weld end (DN 50): 101.6 × 2 mm

Order number: 'T-LH2-f/m'

DOUBLE WALLED HOSE

Vacuum insulation possible if welded to the coupling.

Size: DN 50/75

Design temperature: -253 °C to +50 °C

Design pressure: PN 25

Order number: 'LH2-50-LXXm'

JOHNSTON COUPLING

Size: DN 50

Pressure rating: PN 25

Order number: 'JC-LH2-50-f/m-xx' (Various standard types available).

Male and female available (male usually welded to vacuum insulated hose).

Length of coupling differs between types.

SHIP BUNKERING

For the **bunkering of ships**, the same basic principles apply as to the refuelling of land vehicles. An additional integrated breakaway coupling takes into account the **specific requirements of the ship-to-ship transfer** and significantly increases the safety of the entire process.

SPECIFICATIONS – BUNKERING COUPLING AND RECEPTACLE

size: DN 32/DN 50
design temperature: -253 °C to +50 °C
design pressure: PN 25
purge pressure: max. 0.8 bar above internal tank pressure
min. burst pressure: 100 bar
flow rate: K_v/C_v 25.6/31 (DN 32), K_v/C_v 50/58 (DN 50)
material: EN 10272 – 1.4404+AT / EN 10216-5 – 1.4404+AT / EN 10217-7 – 1.4404+AT

PRODUCT OVERVIEW

AIRCRAFT REFUELLING NOZZLE

Connection double walled hose.
Vacuum insulated.

Weld end (inner wall): 22 × 2 mm

Weld end (outer wall): 35 × 2.5 mm

Weight: approximately 9.5 kg

Order number: 'N-LH2-P-GRC'

AIRCRAFT RECEPTACLE

Connection double walled tank.
Vacuum insulated.

Weld end (inner wall):
48.3 × 3 mm

Weld end (outer wall):
60.3 × 2 mm

Order number: 'R-LH2-ARC'

DOUBLE WALLED HOSE

Vacuum insulation possible if welded to the coupling.

Size: DN 15/20

Design temperature:
-253 °C to +50 °C

Design pressure: PN 25

Order number: 'LH2-40-LXXm'

JOHNSTON COUPLING

Size: DN 15

Pressure rating: PN 25

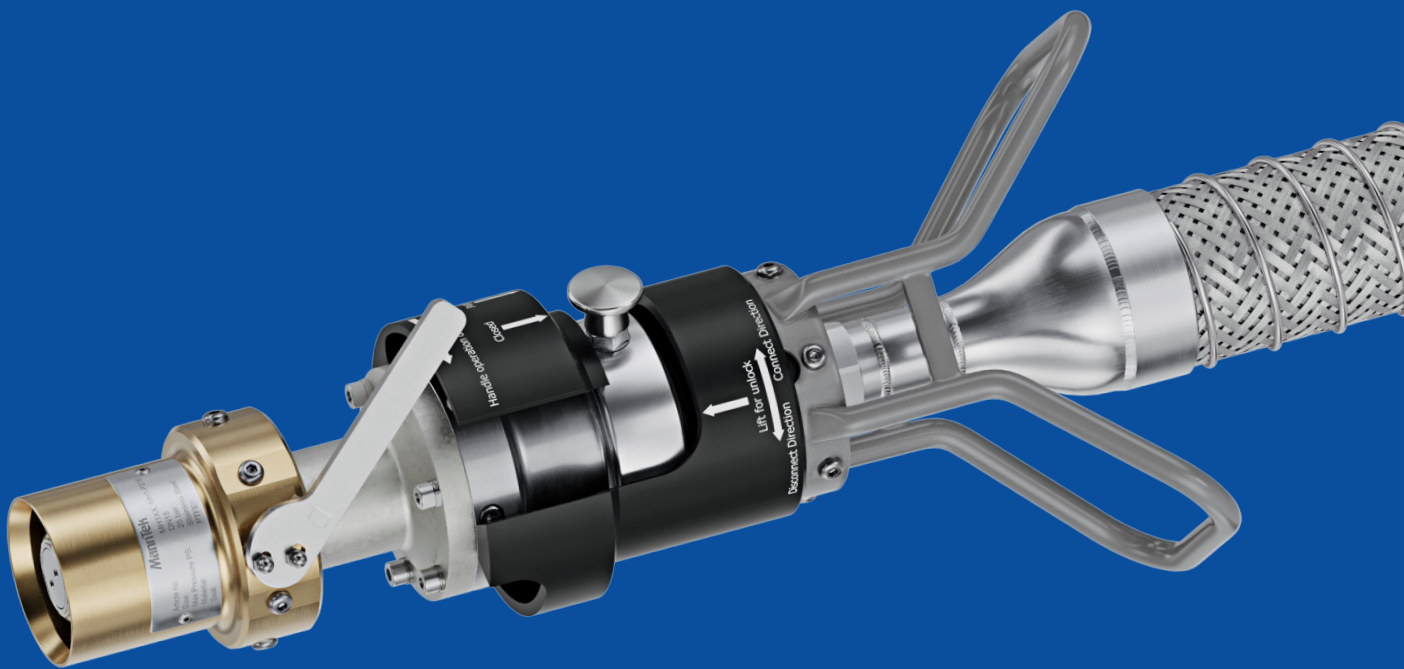
Order number: 'JC-LH2-40-f/m-xx'
(Various standard types available).

Male and female available (male usually welded to vacuum insulated hose).

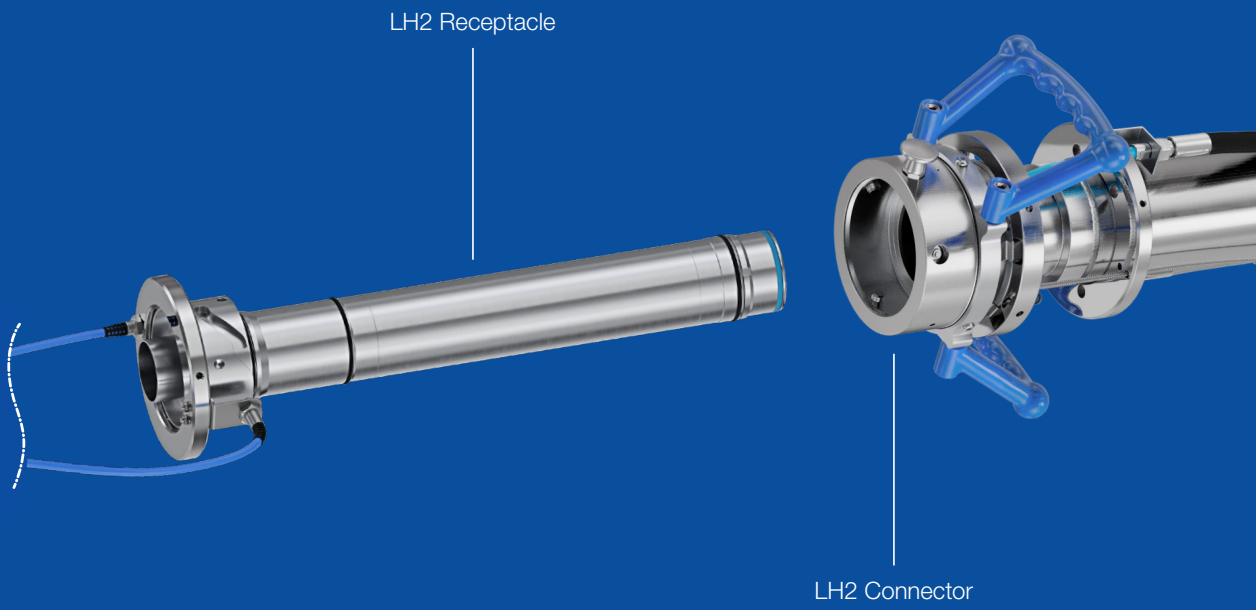
Length of coupling differs between types.

AVIATION REFUELLING

The aviation industry also offers considerable potential for **saving fossil fuels** such as kerosin using **Liquid Hydrogen.** Various sizes are possible here. A few test facilities are currently planned, but the existing truck refuelling systems are suitable here. However, for standardised operations in regular refuelling processes **the flow rate must be increased.** The expected necessary sizes will be up to 3".



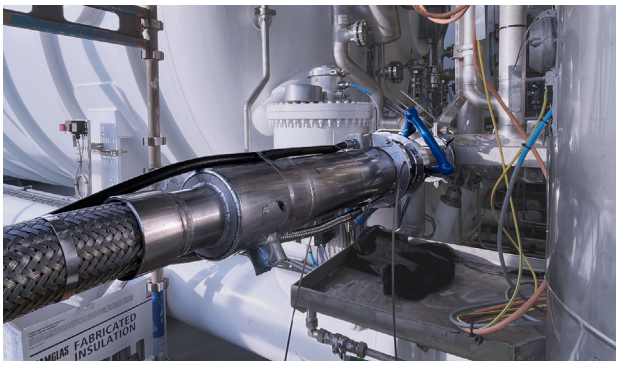
THE COMPLETE SYSTEM



The complete system consists of a tank unit (or receptacle), a hose unit (or nozzle), a vacuum insulated hose, a safety breakaway coupling (optional) and a bayonet style coupling (Johnston coupling) to connect the complete hose line to an existing pump or refuelling equipment. All components are **vacuum insulated** to minimise heat intake. An optional Heated Parking Adapter for the nozzle or hose unit is available to avoid condensed water and ice on the coupling surface, which could impair the functionality of the seals during the next LH2 transfer.

ELAFLEX and MannTek deliver **whole systems for any kind of hydrogen refuelling or transfer application.** We always see the whole refuelling or loading process from an operational point of view and offer suitable solutions, considering ergonomics, safety and environmental demands.

NORLEDs Liquid Hydrogen-Powered Ferry 'MF Hydra'



LH2 Bunkering of 'MF Hydra'

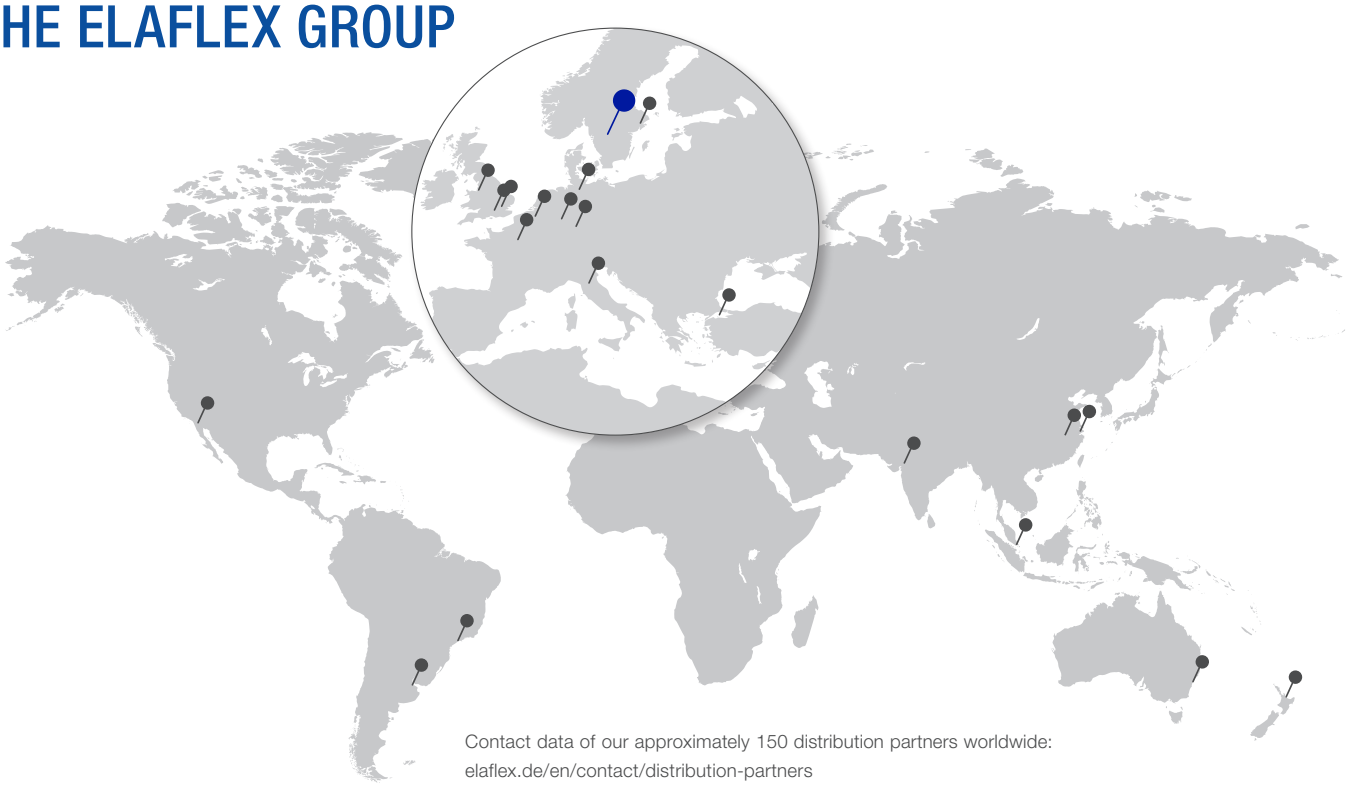
The complete system for LH2 ship bunkering is shown here. This is to be seen as an example for all other hydrogen refuelling systems.

Insulated Double Walled Hose

Johnston Coupling

Heated Parking Adapter (shown version is meant for truck refuelling)

THE ELAFLEX GROUP



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