PARKING SAFETY OF LNG VEHICLES

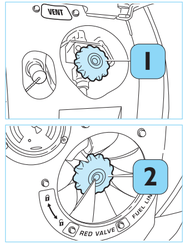
When parking your vehicle indoors always take into account that the LNG tank could vent a combustible gas mixture when the inner pressure reaches 16 bar. When parking the vehicle inside a building or under a gastight roof refer to the table below showing the estimated hold-time (time without venting) at 20°C ambient temperature for 100/50/25% fuel level in the LNG tank depending on the pressure.

Tank pressure (HLNG-158/129/126)		100% Full tank	50% Full tank	25% Full tank
130 psi	9 bar	5 days	3 days	2,5 days
145 psi	10 bar	5 days	2,5 days	2 days
160 psi	11 bar	3,5 days	2 days	1,5 day
175 psi	12 bar	3 days	1,5 day	1 day
190 psi	13 bar	2 days	1 day	1 day
205 psi	14 bar	1 day	< 1 day	< 1 day

The hold-time shown in the table is only a general guideline and may vary according to ambient conditions, different sizes of tanks and fuel level.

WARNINGS

To ensure optimal operating conditions, the LNG tank pressure must be approx. 9.5 bar. Before driving, always check the pressure. The minimum pressure in the LNG tank must be 8 bar. If the internal pressure of the tank is lower after refuelling with LNG, notify the filling station manager / operator that incorrect refuelling has been carried out. The vehicle must not be used/operated until tank pressure has reached the minimum value.
The red fuel shut-off valve must be open during normal vehicle operation; If closed no fuel will be sent to the engine and this may cause permanent damage to the engine itself and the 3-way catalyst. The red fuel shut-off valve can be closed only in the event of a fault / accident or for service and maintenance.



The grey vapour shut-off valve (1) must remain closed during normal vehicle operation and during maintenance and repair interventions. This valve may be opened, when necessary, to reduce the pressure inside the tank before the refuelling procedure.
The valve (2) must stay open. To protect the fuel system and the engine, the vehicle is equipped as standard with a fuel management software that limits the power delivered (derating) in the event of low temperatures of the natural gas itself.
This limitation can occur during cold starts with low outside temperatures or when refuelling with cold LNG (unsaturated). The duration and level of the power reduction depends on the ambient temperature, the coolant temperature and the temperature of the gas in the tanks. With external temperatures below 0 °C, leave the engine to warm up for at least 5 mins while running at idle before driving.

Before parking a vehicle equipped with an LNG or dual CNG / LNG fuel tank on sloping roads, read the instructions in the User Manual.

CHANGE IN THE CHEMICAL COMPOSITION OF THE FUEL

If the vehicle is not used for long periods, especially when the tanks are almost empty, the chemical composition of the natural gas in the tank changes progressively due to venting and may no longer meet the minimum specifications required for the correct operation of the engine. In specific circumstances, even an extended stop may cause the degradation of the gas in the tank. To prevent damage to the engine and the vehicle, the vehicle must be driven (without load, without trailer / semi-trailer) to the nearest LNG filling station and refuelled before normal vehicle use. This procedure is mandatory when the vehicle is not used for 15 days or more. For further details, refer to the Use and Maintenance Manual of the vehicle.

LOW PRESSURE CNG/LNG

The low rail pressure warning signal in the clusters indicates to the driver that there is insufficient pressure from the tank to the rail. Always check that the red valve(s) are open and that the grey valve(s) are closed. Contact the service workshop if the tank pressure is less than 7bar after these operations or less than 8bar less than 2 hours after filling (incorrect filling with LNG at insufficient pressure).

UNBALANCED FUEL LEVEL

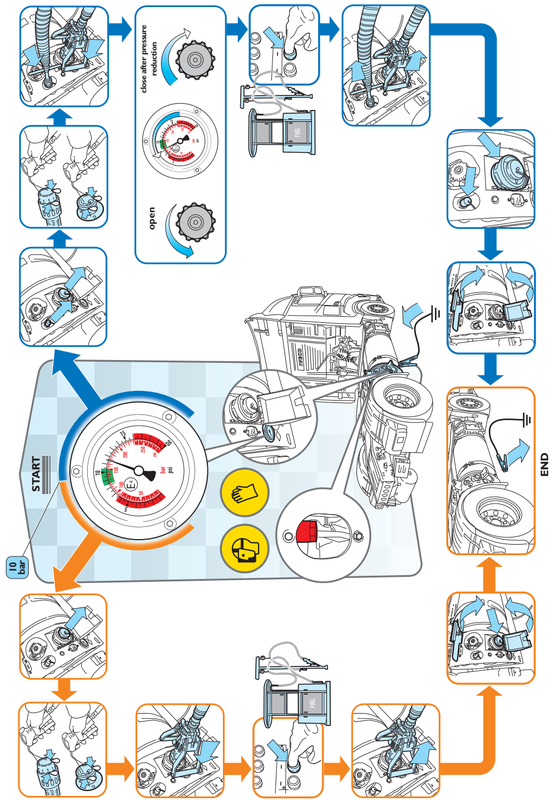
An unbalanced fuel level between 2 LNG tanks may occur. Fuel supply to the engine is controlled passively, which may lead to an unbalanced consumption of fuel from tanks. This may vary and is affected, for example, by exposure of one of the tanks to heat sources such as direct sunlight, discrepancies during refuelling and several other conditions.

A message is displayed on the instrument cluster if there is a difference in the fuel level between the tanks of more than 70%. This message indicates an uncommon, but perfectly safe situation provided the tank pressure is within the standard working interval.

There may also be an unbalanced fuel level, for instance one tank empty and the other tank at 30% of its maximum level, without any message on the cluster. This situation is perfectly safe and does not require any action by the driver.
If the unbalanced fuel level information is displayed, proceed as follows:
a) Check if both red valves are completely open;
if not, open them
b) Check if both grey valves are completely closed;
if not, close them
c) If the valves were not in the correct positions, continue driving and keep monitoring the fuel level. Refill both tanks completely at the next LNG fuel station. The vehicle continues to operate in a stable manner and without restrictions.

If the unbalanced fuel level information is displayed and not resolved by steps a) to c) as the valves are in the correct positions, take note of the pressure and fuel level values of both tanks, identify which has the higher fuel level and if the fuel level of one of the tanks is at 100%. Then contact the service workshop and provide this information.

Please note that in this case the operating range might be reduced.



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ENG

IVECO S-WAY NP

LNG System - Quick guide

IVECO
Your partner for sustainable transport

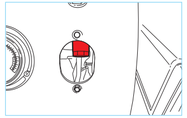
This document is intended as a quick guide for the driver. Always carefully read the user manual before any operation of the vehicle

PERSONAL PROTECTIVE EQUIPMENT (PPE)

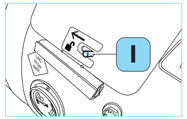
To prevent any unintentional contact of the cold liquid, cold appliances or gas with skin or eyes which could cause freezing and burns, the operator in charge of refuelling must wear suitable clothing including:
- Cryogenic protective gloves
- Long-sleeved, close fitting shirts and clothes
- Long trousers or overalls
- Work shoes

To protect the eyes and face, the operator must wear:
- protective goggles and a visor above

BEFORE DRIVING AND REFUELLING



Before driving or refuelling, check that the red plug is positioned correctly on the secondary intermediate valve (on both tanks if applicable).
A missing plug indicates a potential issue with the primary safety valve.
If this is the case, immediately contact your dealer or closest authorised workshop.



To start the engine, the doors of the filling receptacle must be closed.
Check that the retaining system is correctly hooked to the protective doors and locked by the safety mechanism (1). If the protective doors open, the engine will stop when the vehicle has decelerated to a speed of 3 km/h.
There is no error indication if the protective doors open.

MAXIMUM LNG QUANTITY PERMITTED DURING REFUELLING

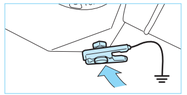
The LNG tanks on the IVECO S-WAY do not have active systems to prevent the tank from being overfilled.
The LNG dispenser will automatically stop when the tanks are full. In operation, the LNG tanks should not carry more than the capacities shown below.

LNG tank model	Section	Gross capacity indicated by the manufacturer on the tank label (litres)	Nominal net capacity (litres)	Net capacity (kg of natural gas)
HLNG-158	26" in (660 mm)	598	540	195
HLNG-119		450	410	150
HLNG-125		474	425	155
HLNG-73		276	250	90
HLNG-114	24" in (660 mm)	432	400	140
HLNG-126/129		477 / 488	440	160

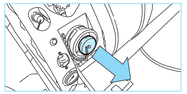
Do not attempt to overfill with LNG as this can lead to damage of the fuel supply system.
Refer only to the instrument cluster gauge to check the fuel level. The pressure inside the tank gives no indication of the amount of fuel in the tanks.

STANDARD FILLING PROCEDURE (PRESSURE < 10 bar)

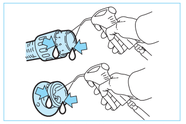
Before starting the refuelling procedure, check with the manager / operator of the filling station that the refuelling procedure corresponds to the indications below.
During refuelling operations, the flow of LNG can freeze the dispenser and the vehicle filler neck.
At the end of refuelling, the LNG dispenser and the vehicle filler neck may become blocked. If disconnection is not possible by applying normal force, the operator can pour water at ambient temperature over the connected components to melt the ice and allow the gas station dispenser and vehicle filler to disconnect.
Do not use hot water for this procedure.



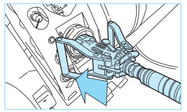
01. Connect the ground cable terminal of the station (if present) to the ground connection point of the LNG tank to prevent possible sparks.



02. Open the doors of the filling receptacle as indicated in the Use and maintenance manual.
Remove the plug of the filling receptacle.



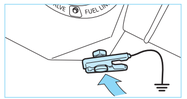
03. Clean the filling receptacle of the tank and the dispenser nozzle with a compressed air gun.



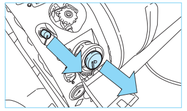
04. Insert the LNG dispenser nozzle into the filling receptacle.
05. Start refuelling. If/when the tanks are full, the dispenser will stop automatically.
06. Disconnect the LNG dispenser nozzle.
07. Fit the plug back onto the filling receptacle.
08. Disconnect the ground cable.
09. Close the protective door of the filling receptacle.

REFUELLING PROCEDURE WITH THE "VENT" VALVE CONNECTED (PRESSURE > 10 bar)

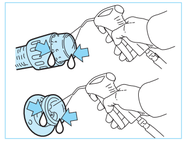
Before refuelling, check with the refuelling station manager/operator if venting via the "VENT" line is required based on the refuelling system and the tank pressure. Otherwise, the value of 10 bar can be used as a reference for venting via the "VENT" line.



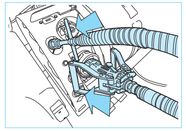
01. Connect the ground cable terminal of the station (if present) to the ground connection point of the LNG tank to prevent possible sparks.
Use the ground connection point of the LNG tank to ensure a safe connection.



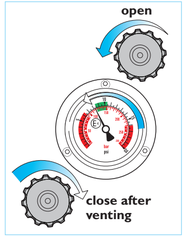
02. Open the protective door of the fillig receptacle.
- Remove the plug of the filling receptacle.
- Remove the plug of the "VENT" valve.



03. With the compressed air gun, clean the filling receptacle of the tank, the dispenser nozzle, the station ventilation duct and the "vent" connection.



04. Insert the LNG dispenser nozzle into the filling receptacle.
Connect the station ventilation line to the "VENT" valve.



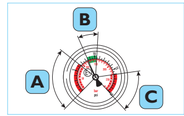
05. Open the vapour shut-off valve (grey valve).
Do not operate the fuel shut-off valve (red valve)!
It needs to remain open.
06. Close the grey valve when the pressure drops below 9 bar.
07. Disconnect the station ventilation line from the "VENT" valve.
08. Put the plug of the "VENT" valve back into position.
Do not fill LNG in parallel to the venting process.
09. Start refuelling.
10. Disconnect the dispenser nozzle.
11. Put the plug of the filling receptacle back into position.
12. Disconnect the ground cable.
13. Close the protective door of the filling receptacle.
14. Look at the instrument cluster gauge to check if the tanks are full.

PROCEDURE FOR FIRST FILL OR FOR VEHICLES LEFT UNUSED FOR NORE THAN 10 DAYS

01. Fill the tank as described in the "STANDARD FILLING PROCEDURE" up to point 04.
02. Start refuelling and put 8-16 kg of LNG into the tank.
03. Check that there are no visible leaks in the LNG system.
04. Drive the vehicle for 10-15 min to reduce the pressure inside the LNG tanks and to check the fuel system. Pressure in both tanks will reduce below 10 bar.
05. Check that there are no visible leaks in the LNG system.
06. Refuel as described in the "STANDARD FILLING PROCEDURE".

VEHICLE WORKING PRESSURE

All the values in bar must be considered in barg, the value which indicates the pressure without considering atmospheric pressure.



For optimal operating conditions, the stabilized pressure of any LNG tank after refuelling must be equal to or higher than the standard working pressure of the LNG tank.
The following table shows the pressure characteristics relating to the LNG tanks and the meaning of the coloured codes on the pressure gauge .

A Severe engine derating	Minimum pressure	Standard working pressure (economizer set point)	B Optimal pressure during standard operation	C Maximum pressure (primary safety valve set pressure)
≤6.5 bar	8 bar	9.5 bar	8.5 - 10.5 bar	16 bar

- Pressure ≤ 6,5 bar: insufficient injection pressure. Risk of power reduction and risk of permanent damage to the catalyst.
- Pressure between 6.5 bar and 8 bar: no risk of damage for the catalyst, but not favourable as power reduction may occur.
- Pressure between 8.5 and 10.5 bar: Optimal pressure range.
- Pressure between 10.5 and 16 bar: non critical condition for vehicle use, reduced time until an unused tank can be vented.
- An internal pressure of > 16 bar indicates a malfunction in the primary vent valve.

Contact the Service Network immediately.

VENTING

When the internal pressure of the LNG tank exceeds the nominal primary safety valve setting (16 bar), the system vents the necessary amount of gas from the vertical pipe behind the cab in order to reduce the pressure to below 14.5 bar.
The LNG tank is designed to maintain the pressure below the set pressure of the primary safety valve for at least 5 days with a full tank at standard working pressure, vehicle stationary, ambient temperature of 20 ± 5 °C.
Under the same conditions a full tank will empty if left venting over a period of about 6 weeks.
The time required by the tank before it starts venting depends on the initial internal pressure (the lower the better) and the % of fuel in the tank (the higher the better).
Therefore it is recommended to:
- Where possible refill the tanks at the end of the working shift.
- Refill the tanks before the weekend or short periods of inactivity (7 days).
- Leave the tank with the smallest possible amount of fuel in case of LNG tank service or long period of inactivity to prevent venting of natural gas in the atmosphere.