富瑞特装
FURUI GROUP

Liquefied Natural Gas Cylinders for Automobiles

Brief Operating Instructions

Zhangjiagang Furui Special Equipment Co., Ltd.

Preface

Welcome to use the products of Zhangjiagang Furui Special Equipment Co., Ltd., and welcome you to become the user of Zhangjiagang Furui Special Equipment Co., Ltd.! Zhangjiagang Furui Special Equipment Co., Ltd. will wholeheartedly provide you with the whole process service throughout the product life cycle.

Before using the product, please carefully read the brief operation manual of liquefied natural gas cylinder for automobile provided by Zhangjiagang Furui Special Equipment Co., Ltd., and operate after reading and fully understanding the manual. If you want to know more about the characteristics, performance, safety protection, operation steps, precautions and maintenance of liquefied natural gas cylinders for automobiles (hereinafter referred to as cylinders), please read the operation manual of liquefied natural gas cylinders for automobiles.

If you have any questions in the process of using, you can contact us at the following address, and we will give you a satisfactory reply in time.

Special attention should be paid to the description in bold type in this manual.

Warning: can cause personal injury or even death

Caution: conditions that can cause damage to parts

Note: repeat statements for important information

This operation manual is for reference only. It is subject to change without notice.

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Ⅰ. Daily inspection and maintenance

1. Daily maintenance requirements

Maintenance contents	Maintenance interval	Maintenance method	Results of no maintenance
Connecting nuts between cylinder and bracket	15 days	screw the nut tight	Gas cylinder drop
Connecting nuts on pipeline of cylinder	Every time before driving	Visually observe whether there is leakage.	Gas leakage causes a fire.
Vaporizer	6 months	Clean the scale on the coils.	Poor vaporization ability affects the gas demand of the engine.
Valve	often	Check for loose closure and leakage.	Gas leakage causes a fire.
safety valve	12 months	Send it to local technical supervision department for verification.	Violation of laws and regulations, leads to the punishment from the local supervision and inspection department.
pressure gage	6 months	Send it to the local metrological testing department for verification.	Violation of laws and regulations, leads to the punishment from the local supervision and inspection department.
Vacuum degree of gas cylinder	12 months	stress testing	The pressure rises quickly and the safety valve releases pressure, which causes potential safety hazards.
Leak detaction	often	Air tightness test or leak detection	Gas leakage from joints causes fire.
Self-supercharger	often	Clean dirt on fins.	The gas consumption is large and the supercharging effect is poor.
Gas cylinder	3 years	★ Regular inspection institutions for gas cylinders	Violation of laws and regulations, leads to the punishment from

			the local supervision and inspection department.

★ Units undertaking regular inspection of gas cylinders shall comply with the provisions of the national standard "Technical Conditions for Regular Inspection Stations of Gas Cylinders", and has be approved by the boiler and pressure vessel safety supervision institution of the administrative department of quality and technical supervision at or above the provincial level (including the provincial level) and obtained the qualification certificate.

2. Refer to the following table for the tightening torque of connectors of the gas supply system:

Fastener	Tightening torque at normal temperature (N.m)	Tightening torque after cold test (N.m)
Overflow valve (NPT3/8 external thread)	30-40	36-42
Overflow valve Φ 10 sleeve (M16×1.5 external thread)	23-34	30-40
NPT3/8,135 elbow (NPT 3/8 external thread)	30-40	36-42
M36×2 looper cone joint (M36×2 internal thread)	160-200	180-225
Safety valve (NPT1/4 external thread)	26-34	30-38
Axial pressure gauge sleeve nut (M14×1.5 internal thread)	17-23	22-26
Thread connector (1) (M16×1 external thread)	33-43	40-50
Threading connector (2) (NPT1/4 external thread)	26-34	30-38
Np1/4 (internal and external tread) 90 connector (Np1/4 external tread)	26-34	30-38
NPT3/8-φ 10 90 sleeve connector (NPT 3/8 external thread)	30-40	36-45
NPT 3/8-φ 10 90 sleeve connector (M16×1.5 external thread)	26-34	30-38
M27×2 looper spherical joint (M27×2 internal thread)	70-90	80-100
Radial pressure gauge (NPT1/4 external thread)	26-34	30-38
Strap nut M12 (M12 internal thread)	60-80	60-80
L-shaped strap nut M16 (M16 internal thread)	90-125	90-125
M30×2 looper spherical joint (M30×1.5 internal thread)	130-150	140-160
M18×1.5 looper spherical joint (M18×1.5 internal thread)	45-55	50-60
M20×1.5 connected to the outlet of safety valve (M20×1.5 external thread)	25-35	25-35
M18×1.5-NPT3/8 external thread connection joint (NPT3/4 external thread)	25-35	32-40
NPT1/4-M22×1.5 (NPT1/4 external thread)	26-34	30-38
M22×1.5 spherical joint (M22×1.5 external thread)	55-65	55-65
Cryogenic check valve DN15 (M27×1.5 internal thread)	80-85	85-90

Note: Gas cylinder users should prepare a detailed maintenance plan and implement it according to the plan to ensure the safe use of gas cylinders.

3. Leak detection

The portable methane detector can be used to check the natural gas leakage point of the vehicle's gas system (it should be used correctly according to the instructions of the detector manufacturer). In order to ensure the normal operation of the vehicle, the system should be regularly leak-checked, and if any leak is found, it should be repaired immediately. Under some special conditions, when it is difficult to accurately judge the leakage point with a detector, you can check the leakage point with the help of soap solution.

4. Replacement of spare parts

Any joint or pipe with fuel leakage must be repaired once found:

If the pipe thread leaks, disconnect the connection, clean the connection surface, and seal with raw material tape.

If the pipe fittings are leaking, they should be disassembled and strictly inspected. If the nuts and clamps are not damaged in appearance, they can continue to be used. Re-install the pipeline and tighten the nuts, and finally carry out pressure leak detection.

Warning: the safety valve can only be replaced, and it is not allowed to be repaired or adjusted without permission;

The safety valve shall be verified once a year.

5. Vacuum failure

Usually, along with the vacuum failure, the cylinder body will frost or the pressure in the cylinder will rise sharply. However, for a new cylinder or a cylinder that has not been used for a long time, due to the high temperature of its inner container, the pressure rises rapidly when filling liquid. This phenomenon should be normal. Excessive pressure rise can be used as one of the bases to judge the vacuum failure of gas cylinders. The shell of the gas cylinder is equipped with a vacuum plug. When the vacuum of the gas cylinder fails, the vacuum plug will loosen (normally, the vacuum plug is pressed by atmospheric pressure). Usually, the vacuum plug is

covered with a plastic protective cap. Do not open the protective cap or vacuum plug. If you find that the vacuum of the cylinder fails, please send it back to the cylinder manufacturer for repair.

A gas cylinder that has failed in vacuum must be vacuumed again by special equipment. This operation can be carried out on the vehicle or after the gas cylinder is unloaded.

Ⅱ. Long term stop requirement

When parking for a long time (more than 10 hours), all stop valves on the cylinder should be closed, which can reduce the contact area between the liquid and the outside world, slow down the pressure rise of the gas cylinder and better preserve liquid in it.

Dust-proof devices of all components (such as filler cap, vent cap, etc.) shall not be opened at will, otherwise, the valve will leak and the engine will be damaged during use due to the ingress of dust particles.

Before storage, the gas cylinders containing liquid that are expected to be stored for more than 5 days must drain all the liquid, release the pressure to 0MPa, close all valves, and be placed in an open place or a ventilated space. The electrical appliances in the space should be explosion-proof and a combustible gas alarm should be set. The lowest alarm limit of the alarm is to give an alarm when the content of natural gas in the air in the space reaches 1% by volume. The alarm signal should be able to emit sound and light, and the driver can see the alarm display.

Caution: Do not open the vacuum plug of the gas cylinder (at the same time, the explosion-proof port of the outer container), otherwise the vacuum of the gas cylinder will be failure, and the gas cylinder will lose its heat preservation function.

III. Brief introduction of liquid level meter

The liquid level measurement system adopts capacitive liquid level gauge, which is composed of three subsystems: capacitive electrode, capacitive transmitter and liquid level indicator (equivalent to automobile oil gauge). The principle is that

because the dielectric constants of the measured medium liquid and steam are different, when the liquid level changes, the capacitance of the capacitance sensitive element (capacitance transmitter) will change accordingly, and its changed reading will be displayed by a specific liquid level display table, so that the height of the liquid level in the gas cylinder can be measured, and the volume of the liquid can be directly read out through specific conversion.

The electrode is welded and installed in the inner container of the gas cylinder, which is an integral part of the gas cylinder. It consists of two electrodes inside and outside, and its function is to generate a linear proportional capacitance signal according to the fuel height in the gas cylinder, and transmit it to the capacitance transmitter. Capacitance transmitter converts capacitance signal into electrical signal and transmits it to liquid level display meter.

The electrical signal is not affected by the fuel state (liquid phase or gas phase) or pressure, and can reflect the amount of fuel in the gas cylinder. Similar to gasoline and diesel (oil level metering system), this system can adapt to the instantaneous impact caused by the change of driving conditions such as acceleration, braking, climbing and turning.

The joint between the capacitor lead and the outside should be kept dry. If there is water here, it will cause a short circuit, and the reading of the liquid level indicator will be displayed at full scale no matter how much liquid there is in the tank.

Please refer to the instruction manual of liquid level meter for the specific principle and instructions.

IV. Precautions for adding liquid:

1. Environmental requirement

When refueling, there must be no fire source or flammable or combustible items within 50m around the vehicle. The site should be open and well ventilated.

Equipped with two or more dry powder fire extinguishers (potassium carbonate) with a capacity of not less than 5kg.

There should be enough water around. The purpose of the water source is to cool the tank, not to extinguish the fire.

2. Vehicle status

When adding liquid, the vehicle should be turned off, and all valves of gas cylinders should be closed. The gas cylinder should be kept clean, the filling nozzle should be wiped clean with dry cloth, and there should be no water residue in the filling nozzle. Before filling, you should check the appearance of the cylinder for condensation or frost. It is recommended that the cylinder with this phenomenon should not be filled and should be sent back to the manufacturer for repair.

3. Preventive measure

When filling or using liquefied natural gas liquid, the liquid should be prevented from splashing or overflowing, and anti-freezing measures should be taken during operation. During filling or use, the valve may not be easily opened or closed due to frost, and the user cannot twist it forcibly, which may cause the valve to be damaged, thus causing personal injury. It can be thawed with warm water before opening and closing.

Wear goggles, face mask, insulating gloves and protective clothing when working. Protective clothing should be made of cotton, trousers, skirts and shorts are not allowed to operate, and nails are not allowed to be nailed to soles; The trouser legs should not be rolled up, and the trousers should cover the opening of the upper. Gloves should be made of cotton or leather, long and wide, and easy to take off quickly; Gloves should be in good condition, dry, and free from damage and moisture. Just after the operation related to natural gas, the clothes are likely to be soaked with natural gas, it is strictly forbidden to smoke immediately after the operation or close to the fire place.

When filling and overhauling LNG equipment, if it is not sure whether the gas leaks or not, any unauthorized electrical and communication equipment, such as mobile phones and radio transmitters, should not be used (the requirements of gas filling stations should be observed during filling).

4. Operation specifications

Warning: Make sure that the gas cylinder is well grounded before filling;

Check the joint before filling to make sure there is no leakage before filling.

Note: When the liquid-filled seat is installed on the side of the vehicle, the liquid-filled pipe should be bent into an "S" shape to prevent external force from the side.

(1) Normal filling

The filling of liquefied natural gas in automobiles is completed by an independent

hose. Before filling, first control the pressure in the cylinder within a certain range (lower than the filling pressure of the gas dispenser), connect the gas dispenser with the filling connector, then start the filling switch of the gas dispenser, and the liquefied natural gas will enter into the inner cylinder through the connecting hose. Re-liquefy (BOG) through the liquid inlet pipe at the top of the inner cylinder to reduce the pressure in it, so that liquid filling can be completed quickly. The filling valve is a one-way valve. When filling liquid, the liquid will automatically open under the action of pressure without manual switch. When the liquid filling reaches the rated amount, the liquid filling will automatically stop. When the check valve is closed, the inflator stops filling.

(2) Filling when venting

LNG tanks or dispensers can be used to fill the liquefied natural gas cylinders for vehicles, and a filling hose can be connected to the filling interface of the liquefied natural gas cylinders for vehicles through a joint before filling. When the pressure in the vehicle LNG cylinder rises to a certain pressure (0.03~0.05MPa lower than that of the storage tank), open the vent valve to vent and maintain the pressure. Stop filling until full filled (venting liquid), and then close the venting valve, LNG storage tank or dispenser switch and filling gun in turn.

Note: Pay attention when venting: the vented gas should be returned to the large storage tank of the gas station or discharged to a safe place.

Gas cylinders should be used as soon as possible after filling. Long-term storage and long-distance transportation are prohibited.

(3) Hot bottle filling

Usually, the cylinders before the first filling of liquefied natural gas and after stopping working for more than two weeks are called "hot cylinders". The filling of hot cylinders shall be carried out according to the following procedures:

First, fill about 30L of liquefied natural gas into the cylinder, precool the cylinder, and after the liquefied natural gas in the cylinder is gasified and pressurized for 20-30 minutes, continue to fill the cylinder with liquid according to the approved filling amount. If filling when venting, it will take short time, if necessary, connect the gas return hose and relieve the internal pressure of the cylinder to a certain pressure (1.0MPa).

In addition, the venting and filling procedure is also applicable to a known "hot cylinder".

Ⅴ. Driving operation specification

When the car needs to be used, slowly turn the liquid outlet stop valve by 1/4 turn (too fast opening speed will block the overflow valve, and the liquid cannot be discharged). When you hear the sound of liquid flowing, check the pressure gauge on the gas path (buffer tank). After the pressure of the gas path is equal to that of the gas cylinder, fully open the liquid outlet valve and screw it back for 1 turn.

1. When the level gauge displays an alarm, it should be filled with liquid in time, otherwise it may cause the vehicle to break down.

Note: the accuracy of the liquid level display is the same as that of the automobile oil gauge, and it is not a universal liquid level measuring device, nor is it used for metering level gauge.

2. During use, the residual amount of LNG in the cylinder should be guaranteed to be 5-10L. Its function is to keep a certain positive pressure in the cylinder and prevent air from entering when the vent valve is opened.

3. The cylinder needs to be pressurized in the following situations:

(1) When the gas cylinder is used for the first time and the pressure is lower than that of the engine;

(2) After the safety valve and pressure gauge of gas cylinder are calibrated;

(3) The gas cylinder is repaired after venting;

Ⅵ. Common faults and treatment methods:

Phenomenon	Apparent phenomenon of gas cylinder system	Inspection contents	Processing method
Lack of engine power	Frosting on the surface of vaporizer	1. The inlet and outlet pipes of vaporizer are squashed and leaking	Rounding and plugging
		2. There is leakage in the air supply pipeline	Plugging
		3. The engine has a cylinder that doesn't work	Depot maintenance
		4. The cooling water pipe is too small	Reconfiguration
		5. The selection of engine water pump is unreasonable	Reconfiguration
		6. The vaporizer is not matched	Reconfiguration
		7. There is a large amount of leakage near the engine end of the filter	Engine problems
	High surface temperature of vaporizer	1. The cooling water temperature is too high (the selection of vaporizer is too large)	Reconfiguration

	The cylinder pressure continues to drop, and the pressurization coil does not frost	1. The pressure regulating valve fails	Replacement of wearing parts
		2. The pressurization pipeline is blocked	1. Discharge the liquid in the cylinder and release the pressure to 0mpa at the same time; 2. Replace the cylinder inside with dry nitrogen to ensure that the concentration of natural gas is less than 1%; 3. Purge the cylinder with 0.3 ~ 0.4MPa nitrogen, and detect the dew point < - 40 ℃.
	The cylinder pressure continues to drop, and the pressurization coil frosts	The setting value of the economy valve is lower than that of the pressure regulating valve and lower than the pressure demand of the engine	Adjust the economy valve to a proper pressure and resin the pressurization coil with water.
	The pressure of the cylinder is normal, and the pressurization coil is not frosted, and the pressure after the pressure regulating valve is lower than the engine pressure	The setting value of the line pressure regulating valve is lower than that required by the engine	Adjust the pipeline pressure regulating valve to the appropriate pressure.
	The vaporizer surface is normal	1. The altitude is too high	Engine problem, return to the depot for repair.
		2. The intake gas temperature is too high after intercooling	
		3. The gas filter is blocked	
		4. The natural gas pipeline of the engine is blocked	
The engine fails to start or stops suddenly		1. The solenoid valve does not work	
		2. The battery voltage is low	
		3. Poor contact of connector	
	The overflow valve is blocked	1. The setting pressure of the economic valve is lower than that of the pressurization regulating valve	Adjust the economy valve to proper pressure
		2. When the car starts, the valve is opened too fast	Close the gas using valve, gently tap the over-flow valve with the handle of a screw driver, and then open the valve to observe the pressure gauge of vaporizer, and the pressure will rise.
	Solenoid valve does not work	1. The pressure of the cylinder is too high, which exceeds the working range of the solenoid valve	Adjust the pipeline pressure regulating valve and economic valve to the appropriate pressure.
	The cylinder pressure is too low.	The pressurization regulating valve of gas cylinder is out of order or set incorrectly.	Adjust the pressurization valve to an appropriate pressure.
Engine power instable	The gas cylinder pressure gauge is stable, but the pipeline pressure gauge is not stable.	Pipeline depressurization regulating valve failure	Re-debug the pipeline regulating valve.
	Pressure gauge is not stable	Cylinder pressurization regulating valve failure	Re-debug the pressurization regulating valve.
The pressure of	Condensation	Vacuum deterioration	Return to factory for repair

the cylinder rises too fast or continuously.	and frost on the surface of gas cylinder		
	Cylinder surface is normal.	Small check valve failure	replace
		Economy valve setting too high	Adjust the economy valve to proper pressure.
The safety valve is not sealed after opening		Safety valve failure	replace
Venting when filling the cylinder		The nozzle hose is not a vacuum hose	Gas station problem
Freezing of cryogenic valve		Valve leakage	repair
There is no reaction on the pressure gauge before or after filling or when the safety valve is opened		The pressure gauge is broken	Replace the pressure gauge