# JJG

NATIONAL METROLOGICAL VERIFICATION REGULATION

OF THE PEOPLE'S REPUBLIC OF CHINA

## JJG 1114-2015

# Liquefied Natural Gas Dispensers

液化天然气加气机

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# Verification Regulation of Liquefied Natural Gas Dispensers

## 1 Scope

This Regulation applies to the initial verification, subsequent verification and in-service inspection of liquefied natural gas (LNG) dispensers (hereinafter referred to as dispensers).

## 2 Normative references

GB/T18442.1, Static vacuum insulated cryogenic pressure vessels - Part 1: General requirements

GB/T 19204, General characteristics of liquefied natural gas

GB/T 20368, Production, storage and handling of liquefied natural gas (LNG)

GB/T 25986, Filling device of natural gas vehicles

GB 50156, Technical standard of fuelling station

OIML R81:2006(E), Dynamic measuring devices and systems for cryogenic liquids

For dated references, only the dated version applies to this Regulation; for undated references, the latest edition (including all amendments) applies to this Regulation.

## 3 Terms and units of measurement

### 3.1 Terms

#### 3.1.1 Liquefied natural gas (LNG) dispensers

A complete measuring system of LNG semi-invariant – providing LNG filling service – which generally consists of cryogenic flowmeter, control valve, dispenser nozzle, reclaiming nozzle, filling hose, reclaiming hose, as well as electronic computer and ancillary devices.

#### 3.1.2 LNG gas vessel

A vacuum insulated cryogenic pressure vessel used for storing and supplying LNG fuel, of which the technical indicators shall meet the requirements of GB/T 18442.1.

**3.1.3 Filling receptacle**

A connecting part, after being connected with the dispenser nozzle, for filling LNG fuel to the LNG gas vessel.

**3.1.4 Reclaiming receptacle**

A connecting part, after being connected with the reclaiming nozzle, used to reclaim the residual gas in the LNG gas vessel.

**3.1.5 Circulation receptacle**

A connecting part on the gas dispenser used, after being connected with the dispenser nozzle, for the pre-cooling circulation.

**3.1.6 Dispenser nozzle**

A special tool for manual operation on the gas dispenser for connecting the filling receptacle or the circulation receptacle, which shall meet the requirements of GB/T 25986.

**3.1.7 Reclaiming nozzle**

A special tool for manual operation on the gas dispenser for connecting the reclaiming receptacle, which shall meet the requirements of GB/T 25986.

**3.1.8 Breakaway coupling valve**

A special protection device on the gas dispenser, which is installed on the filling hose and the reclaiming hose of the gas dispenser, and can be broken into two sections under the action of the rated pull-out force.

**3.1.9 Emergency shutdown device**

A special protection device on the gas dispenser, which, after being manually triggered in an emergency, can execute the corresponding shutdown logic, cut off or isolate the LNG fuel source, and shut down the equipment that will aggravate and expand the accident due to continued operation. It is generally located at an obvious location of the gas dispenser.

**3.1.10 Electronic computer**

A calculation and control device of the gas dispenser, which can receive the flow electric signal transmitted by the flow meter and the pressure electric signal transmitted by the pressure sensor, etc., and calculate according to the set parameters; can carry out data transmission and display operations, and automatically judge and control the flow of the fluid; has the functions of returning to zero, indicating the payment amount, etc., and can also realize the adjustment of the measurement error.

refilling. The electronic computer of the gas dispenser automatically controls the gas filling process, and calculates according to the flow signal output by the flowmeter. The mass of LNG filled into the gas vessel is the difference between the measurement value of the liquid-phase flowmeter and the measurement value of the gas-phase flowmeter (when the gas dispenser is not connected to the reclaiming pipeline, the measurement value of the gas-phase flowmeter is zero), and the panel of the gas dispenser displays the final measurement value.

For the gas dispenser used for trade settlement, a gas-phase flow meter must be installed in the reclaiming pipeline to measure the residual gas in the gas vessel recycled.

# 5 Metrological performance requirements

### 5.1 Maximum allowable error

The maximum allowable error of the gas dispenser is ±1.5%.

### 5.2 Repeatability

The measurement repeatability of the gas dispenser does not exceed 0.5%.

### 5.3 Flow range

The mass flow rate of the gas dispenser is less than or equal to 80 kg/min, and the range ratio is not less than 4:1.

### 5.4 Minimum quality variable

The minimum quality variable of the gas dispenser shall not be greater than 0.01 kg.

### 5.5 Payment amount error

The payment amount displayed on the gas dispenser panel shall not be greater than the calculated payment amount (the product of the unit price and the displayed value).

# 6 General technical requirements

### 6.1 Appearance and accompanying documents

#### 6.1.1 Appearance

**6.1.1.1** The nameplate and markings of the gas dispenser shall be clear and reliable.

**6.1.1.2** The connectors of the gas dispenser must be firm and reliable, and shall not loosen or fall off due to vibration.

**6.1.2 Accompanying documents**

The gas dispenser shall be provided with the factory inspection certificate and the instruction manual, which shall give the technical requirements, installation conditions, usage methods, safety protection measures and the like.

**6.1.3 Markings and nameplate**

**6.1.3.1** There shall be obvious safety and operation markings on the dispenser.

**6.1.3.2** The nameplate of the gas dispenser generally indicates the following contents:

1) Manufacturer's name (trademark), product name and model specifications;

2) Date of manufacture and serial number;

3) Marking and number of the license for manufacturing measuring instruments;

4) Applicable medium, flow range, accuracy grade or maximum allowable error;

5) Applicable ambient temperature range, maximum working pressure, power supply voltage;

6) Explosion-proof grade, explosion-proof identification and explosion-proof certificate number, etc.

**6.1.3.3** For gas dispensers with two or more nozzles, the number of the dispensers shall be marked.

**6.1.4 Cryogenic flowmeter**

The cryogenic flowmeter used in the gas dispenser shall have clear nameplate and complete identification; the measurement accuracy grade shall not be lower than 0.5; the flow range, temperature range, pressure range, and use medium shall meet the requirements of the gas dispenser.

**6.2 Error adjustment**

The gas dispenser shall have the function of adjusting the measurement error. For important parameters that can change the metrological performance, mechanical or electronic seals shall be used to ensure that the parameters of the gas dispenser cannot be changed at will.

**6.3 Seal settings**

**6.3.1** The error adjustment device or key components shall be equipped with protective devices with mechanical seals, such as cryogenic flowmeter, electronic

standard facilities by weighing method (Appendix A) for on-site verification of the gas dispenser.

**7.1.1.2** The expanded uncertainty of the verification device (including factor k=2) shall not be greater than 1/3 of the absolute value of the maximum allowable error of the tested gas dispenser.

**7.1.1.3** The verification device shall be equipped with a valid verification or calibration certificate, meet the explosion-proof requirements, and have an explosion-proof certificate within the validity period; the master standard shall be a cryogenic flowmeter, of which the accuracy grade shall not be lower than 0.15, and the pressure range and flow range shall be compatible with the gas dispenser to be inspected; the ancillary devices (such as pressure gauge, safety valve) of the verification device shall be provided with verification certificate or test report within the validity period.

**7.1.1.4** The pipelines and valves where LNG is stored and flows through shall meet the design requirements for low temperature pipelines.

**7.1.2 Verification medium**

The verification medium shall be LNG, which shall fill the pipelines and flow meters; the gas characteristics shall be in accordance with the provisions of GB/T 19204.

**7.1.3 Gas release**

The gas release after the verification shall comply with the regulations on natural gas release in GB/T 20368 and GB 50156.

**7.1.4 Verification environment**

**7.1.4.1** Ambient temperature: -25 ℃ ~ 55 ℃.

**7.1.4.2** Relative humidity: 35% ~ 95%.

**7.1.4.3** Atmospheric pressure: 86 kPa ~ 106 kPa.

**7.1.4.4** Power supply voltage: voltage (220±22) V, frequency: (50±1) Hz.

**7.2 Verification items and methods**

**7.2.1 Verification items**

See Table 1 for the items of the initial verification, subsequent verification and in-service inspection.

value of the verification device at the same time. Use Formula (2) to calculate the relative error $E_{ij}$ of a single measurement indication value of the gas dispenser:

$$E_{ij} = \frac{(m_J)_{ij} - (m_B)_{ij}}{(m_B)_{ij}} \times 100\% \qquad (2)$$

Where:

$E_{ij}$ – relative error of a single measurement indication value of the $j^{th}$ measurement at the flow point $q_i$, %;

$(m_J)_{ij}$ – the accumulative flow indication value displayed on the gas dispenser panel during the $j^{th}$ measurement at the flow point $q_i$, kg;

$(m_B)_{ij}$ – the accumulative flow indication value of the verification device during the $j^{th}$ measurement at the flow point $q_i$, kg.

**7.2.6.5 Maximum allowable error**

1) After the three measurements at the flow point $q_i$, take the average value of the relative errors of the three indication values as the indication error $E_i$ at the flow point. See Formula (3).

$$E_i = \frac{\sum_{j=1}^{n} E_{ij}}{n} \qquad (3)$$

Where:

$E_i$ – indication error at the flow point $q_i$, %;

n – measurement times, n=3.

2) Take the maximum absolute value of the indication error, when the flow point $q_1$ and $q_2$ are subject to separate verification of the liquid-phase flowmeter and the flow point $q_1$ is subject to whole machine verification, as the indication error of the gas dispenser.

3) The maximum allowable error of the gas dispenser shall meet the requirements of 5.1.

**7.2.6.6 Repeatability**

1) The repeatability $E_r$ is calculated by Formula (4):

$$(E_r)_i = \frac{E_{i\max} - E_{i\min}}{d_n} \quad (4)$$

Where:

$(E_r)_i$ – measurement repeatability at the flow point $q_i$, %;

$E_{i\ max}$ – the maximum value of relative error of a single measurement indication value at the flow point $q_i$, %;

$E_{i\ min}$ – the minimum value of relative error of a single measurement indication value at the flow point $q_i$, %;

$d_n$ – range coefficient (when the number of measurements is 3, $d_n$ = 1.69).

2) Take the maximum repeatability value, when the flow points $q_1$ and $q_2$ are subject to separate verification of the liquid-phase flowmeter, and the flow point $q_1$ is subject to the whole machine verification, as the repeatability of the gas dispenser.

3) The repeatability of the gas dispenser shall meet the requirements of 5.2.

**7.2.6.7 Minimum quality variable**

Check the minimum quality variable of the gas dispenser, which shall meet the requirements of 5.4.

**7.2.6.8 Payment amount error**

1) The payment amount error can be performed simultaneously with the maximum allowable error verification.

2) After the single gas filling is completed, record the gas filling volume $Q_j$ and the payment amount $P_j$ displayed on the gas dispenser panel, and use the Formula (5) to calculate the single payment amount error $E_j$.

$$E_j = |P_j - Q_j \times P| \quad (5)$$

Where:

$E_j$ – the $j^{th}$ gas dispenser payment amount error, yuan;

$P_j$ – the payment amount displayed on the gas dispenser panel after the $j^{th}$ refilling, yuan;

$Q_j$ – the refilling volume displayed on the gas dispenser panel after the $j^{th}$ refilling, kg;

**A.2.2** Check the flow range marked on the nameplate of the gas dispenser, which shall meet the requirements of 5.3.

**A.2.3** The verification flow point and actual flow range shall meet the requirements in Table 2.

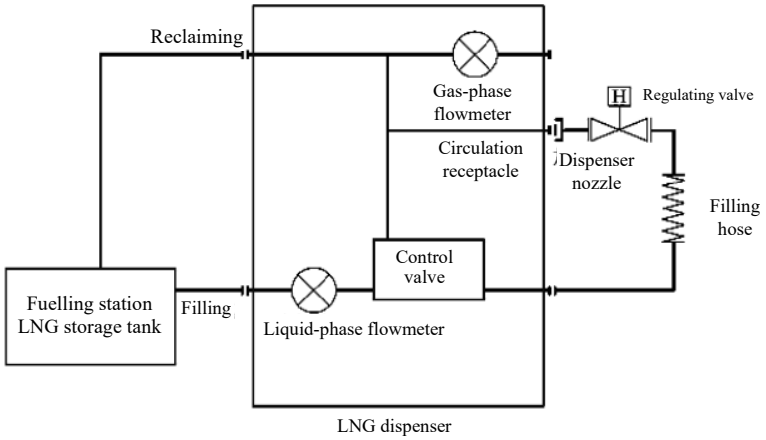
**A.2.4** Strictly follow the safety protection requirements in 7.2.6.3 during verification.

**A.2.5** Place the electronic balance on a hard flat ground; ground the electronic balance, and place an electronic balance windproof device around it; adjust the electronic balance to a horizontal position; power on and pre-heat the balance to the prescribed time. According to the weighing range used on site, use standard weights to calibrate the balance to check whether it is within the maximum allowable error range.

**A.2.6** Before each refilling, use compressed air or nitrogen to purge the surface of the frost-prone parts such as the dispenser nozzle, filling receptacle, reclaiming nozzle and reclaiming receptacle.

**A.2.7** Place the emptied gas vessel on the electronic balance smoothly; then, reset the electronic balance to zero (tare).

**A.2.8** The circulation process of the gas dispenser: connect the dispenser nozzle of the gas dispenser and the circulation receptacle (see Figure A.1); turn on the gas dispenser for filling; observe the transient flow rate displayed on the gas dispenser panel; at the same time, adjust the flow rate through methods such as adjusting the output pressure of the cryogenic pump of the fuelling station or reducing the pressure in the LNG storage tank or installing a control valve at the end of the gas filling pipeline of the gas dispenser. When it is observed that the flow value of the circulation process meets the actual flow range corresponding to a certain flow point and meets the verification conditions such as temperature and density, stop the circulation process.



$E_{imin}$ – the minimum value of relative error of a single measurement indication value at the flow point $q_i$, %;

$d_n$ – range coefficient (when the number of measurements is 3, $d_n$ = 1.69).

**A.4.2** Take the maximum repeatability, when the flow points $q_1$ and $q_2$ are subject to liquid-phase flowmeter separate verification and the flow point $q_1$ is subject to whole machine verification, as the repeatability of the gas dispenser.

**A.4.3** The repeatability of the gas dispenser shall meet the requirements of 5.2.

**A.5 Minimum quality variable**

Check the minimum quality variable of the gas dispenser, which shall meet the requirements of 5.4.

**A.6 Payment amount error**

**A.6.1** The payment amount error can be performed simultaneously with the maximum allowable error verification.

**A.6.2** After the single gas filling is completed, record the gas filling volume $Q_j$ and the payment amount $P_j$ displayed on the gas dispenser panel, and use the Formula (A.4) to calculate the single payment amount error $E_j$.

$$E_j = |P_j - Q_j \times P| \qquad (A.4)$$

Where:

$E_j$ – the $j^{th}$ gas dispenser payment amount error, yuan;

$P_j$ – the payment amount displayed on the gas dispenser panel after the $j^{th}$ refilling, yuan;

$Q_j$ – the refilling volume displayed on the gas dispenser panel after the $j^{th}$ refilling, kg;

P – the unit price of LNG displayed on the gas dispenser panel, yuan/kg.

**A.6.3** Repeat 3 times, the payment amount error shall meet the requirements of 5.5.

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