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Liquefied Natural Gas (LNG) Fueling Installations

液化天然气（LNG）加液装置

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Liquefied Natural Gas (LNG) Fueling Installations

1 Scope

This document specifies the classification, code and model, structure and materials, requirements, test methods, inspection rules, quality certificate, marking, packaging and transportation of liquefied natural gas (LNG) fueling installations.

This document is applicable to liquefied natural gas (LNG) fueling installations used in urban LNG supply stations and automobile gas filling stations, etc. (hereinafter referred to as “fueling installations”).

The liquefied natural gas (LNG) loading and unloading installations used in urban LNG supply stations may take this as a reference.

2 Normative References

The contents of the following documents constitute indispensable clauses of this document through the normative references in this text. In terms of references with a specified date, only versions with a specified date are applicable to this document. In terms of references without a specified date, the latest version (including all the modifications) is applicable to this document.

GB/T 150 (all parts) Pressure Vessels

GB/T 191 Packaging - Pictorial Marking for Handling of Goods

GB/T 229 Metallic Materials - Charpy Pendulum Impact Test Method

GB/T 3098.6 Mechanical Properties of Fasteners - Stainless Steel Bolts, Screws and Studs

GB/T 3098.15 Mechanical Properties of Fasteners - Nuts Made of Stainless-steel

GB/T 3190 Chemical Composition of Wrought Aluminum and Aluminum Alloys

GB/T 3280 Cold Rolled Stainless Steel Plate, Sheet and Strip

GB/T 3797 Electrical Control Assemblies

GB/T 3836 (all parts) Explosive Atmospheres

GB/T 4208 Degrees of Protection Provided by Enclosure (IP code)

GB/T 4272 General Principles for Thermal Insulation Technique of Equipment and Pipes

GB/T 4437.1 Aluminum and Aluminum Alloy Extruded Tubes - Part 1: Seamless Tubes

JB/T 12624 Globe Valves and Check Valves for Liquefied Natural Gas

JB/T 12625 Ball Valves for Liquefied Natural Gas

JB/T 12665 Vacuum Insulated Cryogenic Pipe

JJF 1524 Program of Pattern Evaluation of Liquefied Natural Gas Dispensers

NB/T 47010 Stainless and Heat-resisting Steel Forgings for Pressure Equipment

NB/T 47013 (all parts) Nondestructive Testing of Pressure Equipment

NB/T 47014 Welding Procedure Qualification for Pressure Equipment

SH/T 3005 Design Specification for Instrumentation Selection in Petrochemical Industry

SH/T 3019 Design Code for Instrument Tubing and Wiring in Petrochemical Industry

SH/T 3097-2017 Specification for Design of Static Electricity Earthing in Petrochemical Industry

SH/T 3521 Technical Code of Construction of Instrumentation Engineering for Petrochemical Industry

SY/T 6503 Safety Specification of Combustible Gas Detection and Alarm System for Petroleum and Natural Gas Engineering

TSG 21 Supervision Regulation on Safety Technology for Stationary Pressure Vessel

TSG 23 Regulation on Safety Technology for Gas Cylinder

TSG D0001 Pressure Pipe Safety Technology Supervision Regulation for Industrial Pressure Pipe

TSG D7002 Pressure Piping Components Type Test Regulation

3 Terms, Definitions and Abbreviations

3.1 Terms and Definitions

The following terms and definitions are applicable to this document.

3.1.1 Liquefied natural gas; LNG

Liquefied natural gas refers to a colorless cryogenic liquid-state fluid primarily consisting of methane, with possible traces of ethane, propane, nitrogen or other components commonly found in natural gas.

[source: GB/T 19204-2020, 3.1]

3.1.2 LNG fueling installations

LNG fueling installations refer to a factory-assembled component combination device that assembles all or part of the equipment, such as: LNG pump, LNG dispenser, metering equipment, pipelines and accessories, safety release device, combustible gas alarm device and monitoring device, etc., on a foundation, and can implement LNG fueling to LNG cylinders, tanks or other storage equipment, and integrate the auxiliary functions of fueling, metering, automatic control, safety monitoring and automatic alarm, etc.

3.1.3 LNG pump

LNG pump refers to a pump that conveys LNG liquid.

3.1.4 Pump tank

Pump tank refers to a tank composed of an inner container, an outer shell and a vacuum insulation layer for placing immersion submersible pump.

3.1.5 LNG dispenser

LNG dispenser refers to a special-purpose equipment used for fueling LNG to vehicle LNG storage cylinder, and with metering and pricing devices.

[source: GB/T 50156-2021, 2.1.36, modified]

3.1.6 Safety breakaway valve

Safety breakaway valve refers to a special-purpose safety protection device installed on LNG dispenser, gas fueling (venting) column hose or loading and unloading arm, and can be automatically disconnected under a certain external force, and with self-sealing function after disconnection on both ends, which can prevent the hose or loading and unloading arm from being pulled off, leading to leakage accidents.

[source: GB/T 50156-2021, 2.1.20, modified]

3.1.7 LNG pressure build-up (PBU) vaporizer

LNG pressure build-up (PBU) vaporizer refers to a device that vaporizes and pressurizes LNG to increase the pressure of LNG storage tank or the storage tank of LNG lorry truck.

NOTE: it includes storage tank supercharger and unloading supercharger.

3.1.8 Emission ambient gas; EAG

Emission ambient gas refer to the natural gas intensively emitted by the LNG plant stations when the system is over-pressurized and overhauled.

3.1.9 EAG heater

EAG heater refers to an equipment connected to the centralized emission pipe to heat and emit low-temperature natural gas.

3.1.10 Emergency cut-off device

Emergency cut-off device refers to a device that can be locally or remotely operated to cut off the LNG flow inside the liquid fueling device in case of emergency.

3.1.11 Safety relief device

Safety relief device refers to a device used to quickly discharge the natural gas in the liquid fueling device and release its internal pressure in case of emergency.

3.1.12 Emergency shutdown system

Emergency shutdown system refers to a safety protection system that facilitates the liquid fueling device to quickly cut off the power supply of LNG pumps and close important LNG pipeline valves in case of emergency (such as: fire, over-pressure, over-temperature and leakage, etc.).

3.1.13 Cold insulation

Cold insulation refers to coating measures taken on the outer surface to reduce the heat in the surrounding environment entering the cryogenic equipment and the inside of the pipeline, and prevent condensation on the outer surface of the cryogenic equipment and the pipeline.

3.1.14 Cryogenic nitrogen test

Cryogenic nitrogen test refers to a cooling test that uses low-temperature nitrogen to cool the LNG pipeline to inspect the performance and applicability of the system before the equipment is put into use.

3.1.15 Maximum operating pressure

Maximum operating pressure refers to the maximum pressure, under which, the system can continuously operate under normal working conditions within the design temperature range.

3.2 Abbreviations

The following abbreviations are applicable to this document.

EAG: emission ambient gas

FS: full scale

LEL: lower explosive limit

LNG: liquefied natural gas

- b) the end face of the first threaded joint of the threaded connection;
- c) the first flange sealing surface of the flange connection;
- d) the first sealing surface of the special connection or pipe connection.

5.1.3 The process configuration of the fueling installations used in the automobile gas filling stations shall comply with the following requirements:

- a) Basic configuration: cryogenic pump, valve, piping assembly, safety relief device, EAG heater, emergency cut-off device, combustible gas alarm device, instrumentation, electrical control device, necessary supporting protection and other related supporting equipment;
- b) Optional configuration: dispenser, unloading supercharger and storage tank supercharger, etc.

5.1.4 The process configuration of the fueling installations used in urban liquefied natural gas supply stations shall comply with the following requirements:

- a) Basic configuration: cryogenic pump, valve, piping assembly, safety relief device, EAG heater, emergency cut-off device, combustible gas alarm device, instrumentation, electrical control device, necessary supporting protection and other related supporting equipment;
- b) Optional configuration: metering equipment, unloading supercharger and storage tank supercharger, etc.

5.1.5 The configuration of the equipment and pipeline arrangement of the fueling installations shall be reasonable in structure, standardized in wiring, and easy to operate, observe and maintain.

5.1.6 The fueling installations shall be able to adapt to the temperature, humidity, wind speed and altitude of the operating environment, and shall comply with the following requirements:

- a) The selection of the design pressure and design temperature of the process equipment and pipelines in the fueling installations shall satisfy the parameters when the pipeline components need the maximum thickness and the highest nominal pressure in the strength calculation;
- b) The strength of the fueling installations shall be able to resist accidental loads, such as: strong wind, ice and snow, that might occur in the operating environment.

5.1.7 The materials of the fueling installations shall be selected in accordance with comprehensive factors, such as: service conditions (design temperature, design pressure, medium characteristics and operating characteristics, etc.), material properties (mechanical properties, chemical properties, physical properties and process properties), manufacturing process and economic rationality, etc. In addition, it shall comply with the stipulations of the

current national standards.

5.1.8 The materials of the fueling installations shall have sufficient mechanical strength and chemical stability, and the materials in contact with the fueling medium shall be compatible with the medium.

5.1.9 The design pressure and vaporization capacity of the ambient air vaporizer for the LNG unloading truck and storage tank supercharger shall satisfy the design requirements for application.

5.1.10 The distance between the equipment in the fueling installations shall comply with the relevant stipulations of GB 50156 and GB 50028.

5.1.11 The parameters and performance of the cryogenic submersible pumps, such as: lift, flow rate, nominal pressure and design temperature, shall satisfy the design and application requirements. All parts and components, such as: submersible pump motors, insulation materials and cables, shall be able to adapt to the operating conditions of low-temperature LNG medium.

5.1.12 The electrical instrument shall adopt explosion-proof design and comply with the stipulations of GB 50058. The explosion-proof electrical equipment shall have an explosion-proof certificate.

5.1.13 The connector of the loading and unloading pipeline shall match the liquid unloading port of the tank truck.

5.1.14 A compressed air or nitrogen blowing connector shall be set near the dispenser; the gas source pressure and dew point shall satisfy the process requirements.

5.2 Structures

5.2.1 Piping system

5.2.1.1 Pipeline and connection

5.2.1.1.1 Flexibility calculation shall be performed for cryogenic pipelines; the scope and method of the flexibility calculation shall comply with the stipulations of GB 50316.

5.2.1.1.2 The design of the process pipeline of the fueling installations shall comply with the relevant stipulations of TSG D0001, GB/T 20801 (all parts) and GB 50316.

5.2.1.1.3 The design temperature of LNG cryogenic piping system shall not be higher than -196°C .

5.2.1.1.4 The design pressure of the pipes and fittings of the fueling installations shall not be lower than 1.2 times the maximum operating pressure, and shall not be lower than the sum of the design pressure and the hydrostatic head of the connected equipment (or container). The design pressure of the outlet pipeline of the fueling pump shall not be less than 1.2 times the

and the inlet and outlet piping of the pump tank shall adopt cold insulation measures. The top cover of the pump tank should be provided with a cold insulation structure.

5.2.4.3.5 The return gas pipeline of the submersible pump tank should be connected with the gas phase pipeline of the LNG storage tank. When the submersible pump is used for unloading, a pipeline connected to the gas phase of the LNG lorry truck tank should be reserved.

5.2.4.3.6 The submersible pump tank shall be equipped with a temperature and pressure measuring instrument, which shall be able to indicate on the site and transmit the detection signals to the control room for interlocking control.

5.2.4.3.7 The submersible pump tank shall be equipped with a fully open and closed safety valve; the set pressure of the safety valve shall not be higher than the design pressure of the pump tank.

5.2.4.3.8 The diameter of the inlet pipe of the submersible pump tank shall not be smaller than the diameter of the pump suction port, and the diameter of the outlet pipe shall not be smaller than the pipe diameter of the pump outlet. The inlet pipeline shall be short and straight.

5.2.4.3.9 The submersible pump tank shall be equipped with a blowdown valve; the connection between the blowdown valve and the pump tank shall adopt welding, and the material of the valve body shall be compatible with the pipe material.

5.2.4.3.10 The supporting structure of the submersible pump tank shall be able to withstand static and dynamic loads under the working conditions of transportation and operation.

5.2.4.3.11 The safety valve port, vent valve port and blowdown valve port of the pump tank shall be connected to the centralized emission pipe, and be vented after being heated by the EAG heater.

5.2.5 Fueling metering system

5.2.5.1 The LNG dispenser shall be compatible with the LNG medium; the design temperature shall be not higher than -196°C ; the design pressure shall not be lower than the maximum outlet pressure of the pump.

5.2.5.2 The fueling pressure of the LNG dispenser shall not be greater than the maximum operating pressure of the filling cylinder or liquid receiving tank.

5.2.5.3 The LNG dispenser shall be equipped with an emergency shutdown device. In case of leakage, fire, breaking and other emergency situations, an emergency signal shall be quickly manually triggered or by the dispenser; important LNG valves shall be closed, and the power supply of the LNG submersible pump shall be cut off. In addition, after being triggered, it can be re-set after manual confirmation. The emergency stop device shall be located in a conspicuous position and marked with its functions; there shall also be protective measures to prevent malfunction.

5.2.5.4 The explosion-proof type and explosion-proof performance of the LNG dispenser shall comply with the explosion-proof requirements for liquefied natural gas applications in GB/T 3836.1, GB/T 3836.2, GB/T 3836.3, GB/T 3836.4, GB/T 3836.5, GB/T 3836.9, GB 3836.14, GB/T 3836.15 and GB 50058, and obtain an explosion-proof certificate.

5.2.5.5 Nitrogen or compressed air blowing joints shall be arranged near the LNG dispenser.

5.2.5.6 When used for trade settlement, a liquid phase flowmeter for measuring the amount of filled gas and a gas phase flowmeter for measuring the amount of return gas shall be simultaneously installed.

5.2.6 Filling metering system

5.2.6.1 The electrical appliances, instrument configuration, installation and acceptance inspection of the filling metering system shall comply with the stipulations of GB 50058 and GB 50257.

5.2.6.2 LNG welded insulated gas cylinders shall be filled through the weighing method.

5.2.6.3 The filling measuring system shall be equipped with a weighing and measuring instrument that matches the number of filling joints and is equipped with the function of overfilling prevention and automatic cut-off. The weighing and measuring instrument shall comply with the following requirements:

- a) The measuring range and calibration of the weighing and measuring instrument shall comply with the stipulations of the relevant national standards, and shall be able to adapt to the working conditions of the changing filling flow. In addition, they shall ensure the measurement accuracy under the highest and lowest flow conditions;
- b) The maximum weighing value of the weighing and measuring instrument shall not be greater than 3 times the actual weight of the filled cylinder (including the weight of the cylinder and the weight of the filled liquid), and shall not be less than 1.5 times;
- c) LNG electronic weighing and measuring instrument shall comply with the stipulations of GB/T 7723; the accuracy shall not be lower than the requirements of Level-3 scale;
- d) The weighing and measuring instrument shall be regularly calibrated in accordance with the stipulations and calibrated once a day before use, so as to ensure accurate and reliable indications;
- e) The weighing and measuring instrument for re-inspection and filling shall be separately used;
- f) The weighing and measuring instrument shall be provided with an overfilling alarm device and an interlocking device for automatic pump stop of the submersible pump.

5.2.6.4 The power supply load of the filling metering system can be three-level; the control

system shall be equipped with an uninterruptible power supply, and shall have a fail-safe function;

- b) The fueling installations shall have an emergency lighting for accidents. When the battery pack attached to the lamp is used as a backup battery, its continuous operating time shall not be less than 30 min. The setting of emergency lighting shall comply with the stipulations of GB 50156;
- c) The type selection and installation of electrical equipment, and laying of power lines in explosion-hazardous areas shall comply with the relevant stipulations of GB 50058 and GB 50257;
- d) The grade division of explosion-hazardous areas shall comply with the stipulations of GB 50058, GB 50156 and GB 50028. The design of electrical installations in explosion-hazardous locations shall comply with the stipulations of GB 50058; the electrical equipment shall comply with the stipulations of GB 3836 (all parts);
- e) The lightning protection design of the fueling installations shall comply with the relevant stipulations of GB 50057, GB 50650 and GB 50028;
- f) The metal containers, superchargers, EAG heaters, LNG pumps, LNG dispensers, metal pipelines and metal supports in the fueling installations shall be electrostatically grounded, and the electrostatic grounding shall comply with the relevant stipulations of GB 50160 and SH/T 3097-2017;
- g) The LNG unloading port of the fueling installations shall be equipped with a grounding device for unloading. The steel flange in the explosion-hazardous area shall be bridged with metal wires;
- h) The control cabinet shall be equipped with overload, overcurrent, undervoltage, zero position protection, lightning protection, anti-static and self-locking devices.

5.2.9.2 Instrumentation and automatic control system

The instrumentation and automatic control system equipment shall comply with the following requirements:

- a) The type selection and setting of instrumentation and automatic control system equipment shall comply with the relevant stipulations of SH/T 3005, and satisfy the requirements of actions and control of the process system;
- b) The installation and inspection of the instrumentation and automatic control system shall comply with the stipulations of SH/T 3521 and GB 50093;
- c) The instrumentation automatic control system shall be provided with an uninterruptible power supply with a power supply time of not less than 1 h, and shall have a failure protection. Hence, even when the power supply or instrument air is

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