DPW 系列焊接绝热气瓶
DPW series of welded insulated cylinders

使用说明书
Operating Instruction

（液氧、液氮、液氩、液化二氧化碳、液化天然气）
(LO2、LN2、LAr、LCO2、LNG)

Zhangjiagang Furui CIT Co., Ltd.

张家港富瑞深冷科技有限公司

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目　　录

Contents

1. 前言

1. Foreword

本手册用于使操作者熟悉由本公司提供的 LO_2、LN_2、LAr、LCO_2、LNG 瓶供气系统的性能、安全防护、操作步骤和维修保养，以达到个人熟练操作的目的。

This manual is used to familiarize the operator with the performance, safety protection, operation steps and maintenance of the cylinder gas supply system for LO2, LN2, LAr, LCO2 and LNG provided by the company, so as to achieve personal proficiency in operation.

本产品设计美观大方、科学，操作方便，安装牢固；敬请客户放心使用。本手册适用于本公司（张家港富瑞深冷科技有限公司）生产的低温绝热气瓶的安全使用、操作维修及保养。

This product is designed in nice shape and scientific, is easy to operate and firmly installed. Please rest assured that. This manual is applicable to the safe use, operation, repair and maintenance of the cryogenic insulated cylinders produced by the company (Zhangjiagang Furui CIT Co., Ltd.).

敬请在阅读本手册并完全理解本手册内容之后再进行操作。

Please read this manual and fully understand its contents before operation.

1.1 允许装运介质：LO_2、LN_2、LAr、LCO_2、LNG

1.1 Medium allowed: LO_2、LN_2、LAr、LCO_2、LNG

设计温度：-196℃

Design temperature: -196℃

设计压力：1.59 MPa、2.5MPa

Design pressure: 1.59 MPa、2.5MPa

适用型号：DPW650-410-1.59Ⅱ、DPW650-480-1.59Ⅰ、DPW650-480-1.59Ⅱ、DPW650-480-2.5Ⅰ、DPW650-480-2.5Ⅱ、DPW650-500-1.59、DPW650-500-2.5、DPW650-500-1.59Ⅰ

Applicable types: DPW650-410-1.59Ⅱ, DPW650-480-1.59Ⅰ, DPW650-480-1.59Ⅱ, DPW650-480-2.5Ⅰ, DPW650-480-2.5Ⅱ, DPW650-500-1.59, DPW650-500-2.5, DPW650-500-1.59Ⅰ.

在本手册中使用下列缩写：

The following abbreviations are used in this manual:

警告：能够引起个人伤害和死亡的条件描述

Warning: Description of conditions that can cause personal injury or death

谨慎：能够引起零件破坏的条件描述

Caution: Description of conditions that can cause parts to fail

注意：对重要信息需要重复的声明。

Note: Repeat statements for important information.

2. 气瓶详述

2. Description of cylinder

2.1 气瓶

2.1 Cylinder

气瓶是作为一种低温绝热压力容器，设计有双层（真空）结构。内胆用来储存低温液态的LO_2、LN_2、LAr、LCO_2、LNG，在其外壁缠有多层绝热材料，具有超强的隔热性能，同时夹套（两层容器之间的空间）被抽成高真空，共同形成良好的绝热系统。

The cylinder is designed as a cryogenic insulated pressure vessel with a double layer (vacuum) structure. The inner vessel is used to store cryogenic liquid of LO2, LN2, LAr, LCO2 and LNG. Its exterior is wrapped with multi-layer insulation material, which has super heat insulation performance. At the same time, the jacket (the space between two layers of vessels) is pumped into a high vacuum, which forms a good heat insulation system together.

内胆设计有两个安全阀或一个安全阀一个爆破片，在超压时起到保护气瓶的作用。在超压情况下，安全阀打开，其作用是放散绝热层和支撑正常漏热损失导致的压力上升、或真空遭破坏后以及在失火条件下加速漏热导致的压力上升。

The inner vessel is designed with two relief valves or a relief valve and a bursting disc to protect the cylinder in case of overpressure. In the case of overpressure, the relief valve opens and its function is to release the insulation layer and support the pressure rise caused by normal heat leakage loss, or the pressure rise caused by accelerated heat leakage after vacuum damage and under fire conditions.

外壳在超压条件下的保护是通过一个环形的真空塞来实现的。如果内胆发生泄漏（导致夹套压力超高），真空塞将打开泄压。万一真空塞发生泄漏将导致真空破坏，这时可以发现外壳出现“发汗”和结霜现象。当然，在与瓶体连接的管道末端出现的结霜或凝水现象是正常的。

Protection of the outer shell against overpressure conditions is achieved by an annular vacuum plug. If the inner vessel leaks (resulting in excessively high pressure inside the jacket), the vacuum plug will open to relieve pressure. "Sweating" and frosting on the outer shell can be observed in the event of a vacuum plug leak causing vacuum damage. Of course, frost or condensation at the end of the pipe connected to the cylinder body is normal.

所有的管阀件都设置在瓶的一端。

All tube valves and fittings are arranged at one end of the cylinder.

2.2液位计/表

2.2 Liquid-level meter

液位计量系统采用电容式液位计，该系统由三个子系统导线组成：分别为电容探测器/极板、信号转换器和显示仪表。

Capacitive level meter is used in the level measurement system, which consists of three subsystem wires: capacitance probe/plate, signal converter and display meter.

电容探测器作为气瓶整体的一个组成部分，安装在气瓶的内部。其作用是根据气瓶内的液位高度产生一个成线性比例的电信号，并传送给信号转换器。再由转换器根据信号转送到显示仪表，电信号不受液位状态（液相或气相）和压力的影响，能够精确反映气瓶内液位的多少。液位传感器安装在瓶内靠近充液管的一端。

As an integral part of the cylinder, the capacitance probe is installed inside the cylinder. Its function is to generate a linear proportional electrical signal according to the height of the liquid level in the cylinder, and transmitted to the signal converter. By the converter according to the signal transferred to the display meter, the electrical signal is not affected by the liquid level state (liquid or gas phase) and pressure, can accurately reflect the amount of liquid level in the cylinder. The liquid level sensor is installed in the cylinder near one end of the liquid filling tube.

注意：液位计采用了模块化设计，在出厂前就已调整到位，用户无须调整。如果表的计量精度出了问题，请与本公司服务部联系。

Note: the level meter adopts modular design and has been adjusted in place before delivery, so users do not need to adjust. If there is any problem with the accuracy of the meter, please contact our service department.

2.3 增压器

2.3Pressurizer

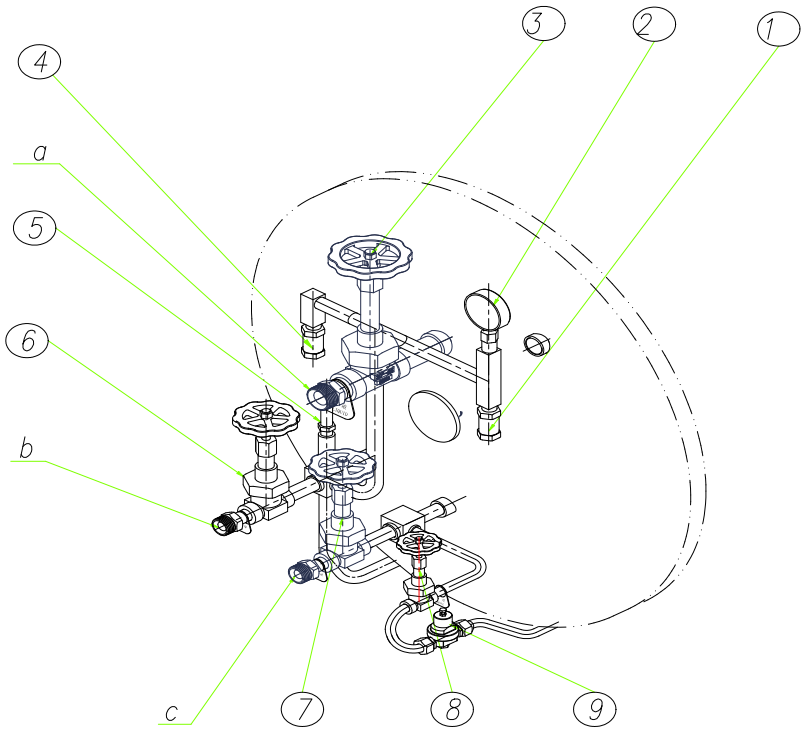
增压器安装在瓶的底部，用以提高瓶的压力，但当瓶内液体液位较低时，增压速度是很慢的，因此，建议用户在使用前，应将瓶内的压力提高到 0.8MPa/2.1MPa 以上，以便使用液体时瓶内的压力能够满足要求。增压时打开增压器前的截止阀开始增压，增压时操作人员不得离开，应注意压力的变化，当压力升至规定压力时停止升压，关闭增压器进口截止阀；压力低于规定使用压力时，重新按上述步骤增压。

The pressurizer is installed at the bottom of the cylinder to improve the pressure, but when the liquid level in the cylinder is low, the pressurization speed is very slow, therefore, it is recommended that the user should increase the pressure in the cylinder to 0.8MPa / 2.1MPa above before using, so that the pressure in the cylinder can meet the requirements when using the liquid. When pressurizing, open the globe valve before the pressurizer to start pressurizing and the operator shall not leave. Attention should be paid to the change of pressure, when the

pressure rises to the specified pressure, close the globe valve before pressurizer. When the pressure is lower than the specified pressure, pressurize again according to the above steps.

2.4 阀门布置图

2.4 Valve layout drawing



阀门布置简图表 1

Diagram 1 of valve layout

序号 Sr. No.	代号 Code	名称 Name	规格、型号 Specification/ Model	功能 Function	备注 Remark
1	A6/B6	爆破片/安全阀 Bursting disc/relief valve	DA08-A6 /DA-08B6	用泄压方式来保护气瓶 To protect the cylinder by pressure relief	低 压 low pressure 2.4MPa 高压 high pressure 3.6MPa
2	/	压力表 Pressure gauge	Y0-60	显示气瓶内压力 To indicate the pressure in cylinder	低 压 low pressure 0-4.0MPa 高压 high pressure 0-6.0MPa
3	V2	进液阀 Filling valve	DN25	用于气瓶充液连接 For liquid filling connection	
4	A4	安全阀 Relief valve	DA08-A4	用泄压方式来保护气瓶 To protect the cylinder by pressure relief	低 压 low pressure1.75MPa 高压 high pressure 3.0MPa

5	/	液位计 Liquid level meter	DYJ-10	显示气瓶内介质液位 To indicate the liquid level of medium in cylinder	
6	V1	放空阀（气相阀） Vent valve(gas phase valve)	DN15	用于气瓶压力泄放 To release the pressure in cylinder	
7	V3	出液阀（手动） Discharge valve(manual)	DN15	用于控制介质供应 To control the supply for medium	
8	V4	增压器进口截止阀 Pressure building valve	DN10	用于气瓶增压连接 To connect to the pressurizer	
9	V5	管路调压阀 Pressure building regulator	DN6	调整供气压力 To adjust the gas supply pressure	
a	/	进液口 Filling connection	M36×2 M30×1.5	用于气瓶充液连接 Connection for filling to cylinder	
b	/	放空口 Vent connection	M27×2 M30×1.5	用于气瓶压力泄放连接 Connection for pressure relief	
c	/	出液口 Discharge connection	M27×2 M30×1.5	用于控制介质供应连接 Connection for medium supply	

3. 安全

3. Safety

手册的此部分涉及必要的低温设备防护。液氮、液氩、液氧、液化二氧化碳、液化天然气瓶操作过程中潜在危害主要来自其物理性质：

This part of the manual involves the necessary protection against cryogenic equipment. The potential hazards of liquid nitrogen, liquid argon, liquid oxygen, liquefied carbon dioxide and liquefied natural gas cylinders during operation mainly come from their physical properties:

- 液氮在环境大气压下具有极低的温度：-195.8℃；
- Liquid nitrogen has very low temperature at ambient atmospheric pressure: -195.8 ° C;
- 液氩在环境大气压下具有极低的温度：-186℃；
- Liquid argon has very low temperature at ambient atmospheric pressure: -186℃;
- 液氧在环境大气压下具有极低的温度：-183℃；
- Liquid oxygen has an extremely low temperature at ambient atmospheric pressure: -183 ° C
- 液化二氧化碳在环境大气压下具有很低的温度：-78.5℃；

- Liquefied carbon dioxide has a very low temperature at ambient atmospheric pressure: -78.5℃
- 液化天然气在环境大气压下具有极低的温度：-162℃；
- LNG has an extremely low temperature at ambient atmospheric pressure: -162 ° C
- 具有很大的气液体积比，如果减压措施不当将导致压力迅速升高。液氮标准气液体积比约为：640:1，液氩标准气液体积比约为：780:1，液氧标准气液体积比约为：800:1，液化二氧化碳标准气液体积比约为：550:1，液化天然气标准气液体积比约为：620:1；
- Has a large gas-liquid volume ratio, if the decompression measures are not appropriate will lead to rapid pressure rise. Liquid nitrogen standard gas-liquid ratio is about: 640:1, liquid argon standard gas-liquid ratio is about: 780:1, liquid oxygen standard gas-liquid ratio is about: 800:1, liquefied carbon dioxide standard gas-liquid ratio is about: 55:1, liquefied natural gas standard gas-liquid ratio is about: 620:1;
- 天然气是窒息性气体；
- Natural gas is an asphyxiating gas
- 天然气是易燃性气体。
- Natural gas is flammable

3.1 安全防护

3.1 Safety protection

在有液氮、液氩、液氧、液化二氧化碳、液化天然气的现场工作时，需具有如下安全常识：

When working in the field with liquid nitrogen, liquid argon, liquid oxygen, liquefied carbon dioxide and liquefied natural gas, the following safety knowledge should be had:

- 需戴护目镜、脸罩、绝热手套；
- Wear goggles, face mask and insulation gloves;
- 在拆卸零件维修时需把气瓶排空、卸压；
- When disassembling parts for maintenance, the cylinder should be emptied and pressure relieved;
- 操作人员应培训上岗；
- Operators should be trained to work;
- 在有液氧的现场内工作时，需具有如下安全常识：
- Have the following safety precautions when working in the field with liquid oxygen:
- 使液氧、液化天然气设备远离火焰或电火花；
- Keep liquid oxygen and liquefied natural gas equipment away from flames or electric sparks;
- 在液氧、液化天然气设备维修、充装、存储的地区不允许烟火进入；

- ♦ Fireworks are not allowed in areas where liquid oxygen and liquefied natural gas equipment is maintained, filled and stored;
- ♦ 在有液氧的地区工作时需戴护目镜、脸罩、绝热手套；
- ♦ Wear goggles, face mask and insulation gloves when working in areas with liquid oxygen;
- ♦ 在拆卸零件维修时需给液氧瓶排空、卸压、置换；
- ♦ When disassembling parts for maintenance, the liquid oxygen cylinder should be emptied, decompressed and replaced;
- ♦ 所有进入盛装液氧、液化天然气气瓶现场人员均应穿能防火和防静电的工作服及工作鞋；
- ♦ All personnel entering the site has liquid oxygen and liquefied natural gas cylinders should wear fireproof and antistatic work clothes and shoes;
- ♦ 操作人员应培训上岗；
- ♦ Operators should be trained to work
- ♦ 气瓶在不使用时，操作人员应关好所有阀门；
- ♦ Operators should close all valves when cylinders are not in use;
- ♦ 安全阀的出口均应连接入安全外部排泄系统。
- ♦ The outlet of the relief valve should be connected to a safe external discharge system.

警告

Warning：

- ♦ 运输过程严禁碰撞；
- ♦ No collision during transportation
- ♦ 保护眼睛和暴露的皮肤；
- ♦ Protect eyes and exposed skin
- ♦ 保持设备所在地区通风良好；
- ♦ Keep the area where the device is located well ventilated
- ♦ 在维修或保养设备时确保系统已泄压；
- ♦ Ensure that the system is pressure relieved when repairing or maintaining equipment
- ♦ 液位计电池、显示部分不能进水；
- ♦ Do not let water into the battery and display part of the level meter
- ♦ 如果充装液氧或液化天然气，应在有完备的安全措施及固定点使用, 严禁随便移动使用；

并远离易燃品或电火花；

If the liquid oxygen or liquefied natural gas is filled, it should be used at a fixed point with complete safety measures, and it is strictly prohibited to move it freely;

Keep away from flammable materials or sparks

- ♦ 液化天然气的泄漏，容易导致火灾或爆炸；
- ♦ Leakage of liquefied natural gas can easily lead to fires or explosions
- ♦ 所有电气设备都应符合危险区域防暴等级的要求；

- All electrical equipment shall comply with the riot control level requirements for hazardous areas
- 在有 LNG 的区域内，不能使用明火或任何未经允许的电气及通讯设备，例如手机和无线电广播发射机。

Do not use open fires or any unauthorized electrical and communication equipment, such as mobile phones and radio transmitter, in areas where there is LNG.

4. 接地系统 Grounding system

如充装液氧或液化天然气，所有设备应确保导电率，并确保接地，且接地电阻不大于 10Ω，主要设备（如气瓶本身）要直接和地面接触，应设置专用接地柱, 操作时应确保电位的平均。

If liquid oxygen or liquefied natural gas is filled, all equipment should be conductive and grounded, and the grounding resistance should not be greater than 10Ω. Major equipment (such as cylinder) should be in direct contact with the ground, and special grounding poles should be installed. Ensure the average potentials during operation.

5. 操作 Operation

充装前应将所有螺纹接头拧紧，充装后检查螺纹接头是否泄漏；若泄漏，再拧紧。

All threaded joints should be tightened before filling, check whether the threaded joints leak after filling; If leakage, tighten again.

5.1 常规充装 Normal filling

空瓶或首次，（如果充装液氧或液化天然气，需有接地设施）使用瓶应先充入干燥的热惰性气体置换，排出罐内空气,并去除容器中的湿气，清除连接软管中的空气和杂质，充装只允许在室外进行。（充装液态二氧化碳时，需将压力升至不低于 1.3MPa）

Empty cylinder or for the first time (if liquid oxygen or liquefied natural gas is filled, there should be a grounding device) the cylinder should be filled with dry hot inert gas to replace the air in the cylinder, remove the moisture in the cylinder, and remove the air and impurities in the connection hose. Filling is only allowed outdoors. (When filling liquid carbon dioxide, the pressure shall be increased to no less than 1.3mpa)

注意：充装时，充入罐内与被充入瓶内的压差不宜大于 0.2MPa。

Note: When filling, the pressure difference between storage tank and filled cylinder should not be greater than 0.2mpa.

低温瓶的充装是通过一根独立的软管完成。充液时，首先将充装软管与瓶的充装接口 a 连接，然后开启进液阀 V2，低温介质将通过连接软管进入瓶内胆。液体通过安装在内胆顶部的喷淋管以喷淋的方式注入（采取这种充液方式的目的是降低瓶顶部压力、对瓶内存留的闪蒸气进行再液化回收以避免放空损失）。

The filling is done through a separate hose. When filling liquid, first connect the hose with the filling connector A of the cylinder, then open the liquid inlet valve V2, and the cryogenic medium will enter the inner vessel of cylinder through the connecting hose. The liquid is injected by spraying through the spray pipe installed at the top of the inner vessel (the purpose of this liquid filling method is to reduce the pressure at the top of the cylinder and to re-liquefy and recover the BOG remaining in the cylinder to avoid venting loss).

注意：充装阀是一个截止阀，充液时应打开此阀。

Note: The filling valve is a globe valve, which should be opened when filling.

警告：充装前应确认瓶内介质，如瓶内介质与欲充装介质不一致，应用氮气彻底置换。

Warning: Before filling, confirm the medium in the cylinder. If the medium in the cylinder is inconsistent with the medium to be filled, completely replace it with nitrogen.

5.2 放气充装 Return gas filling

当充装液氮、液氩、液氧、液化天然气时，可用一根充装软管将充灌台上的充液口和瓶充装接口相连，回气软管与瓶气相口连接即可开始充液。当瓶中的压力升高时，打开气相阀（放空）V1。当充灌台上的磅称显示的重量达到最大充装量时，停止充装（在气瓶铭牌上标记有气瓶的净重和最大充装量）。

When filling liquid nitrogen, liquid argon, liquid oxygen and liquefied natural gas, a charging hose can be used to connect the liquid discharging nozzle on the filling station to the cylinder filling nozzle, and the gas return hose can be connected to gas phase nozzle of cylinder to start filling liquid. When the pressure in the cylinder rises, open the gas phase valve (vent) V1. Stop filling when the weight shown on the weighing scale reaches the maximum filling capacity (net weight and maximum filling capacity of the cylinder shall be marked on the cylinder nameplate).

注意：一只完全充满的瓶其压力上升十分迅速，可能导致安全阀迅速开启。

Note: The pressure in a fully filled cylinder will rise very rapid, which may result in relief valve opening rapidly.

5.3 热瓶充装 Hot cylinder filling

通常我们将首次充装低温介质和停止工作两周以上的空瓶称为“热瓶”。下面是热瓶充装程序：

Usually we call the empty cylinder that is filled with cryogenic medium for the first time and has stopped working for more than two weeks as "hot cylinder". The following is the hot cylinder filling procedure:

- 首先向瓶内充入大约 20L 的液氮或液氩或液氧或液化二氧化碳或液化天然气，将气瓶预冷静置，在瓶内液体气化升压的过程中，瓶内胆也得到冷却；
- First fill the cylinder with about 20L liquid nitrogen or liquid argon or liquid oxygen or liquefied carbon dioxide or liquefied natural gas, pre-cool the cylinder, and cool the cylinder during the process of liquid gasification and pressure boost;

- 当瓶内压力达到正常工作压力后，进行管路系统的检漏；
- When the pressure in the cylinder reaches the normal working pressure, check the pipe system for leaks;
- 通过放空降低压力后即可按常规充装程序进行操作；
- Normal filling procedures can be carried out after the pressure is lowered by venting;
- 另外，放空充装程序也适用于一个已知的“热瓶”；
- Additionally, the vent-filling procedure applies to a known "hot cylinder";

注意：充装时应先将瓶内的空气排出。

Note: the air in the cylinder should be discharged before filling.

5.4 液态供给 Liquid supply

打开出液阀 V3，瓶内的液体将从瓶底部压出进入汽化器，经气化和升温后供给用户。

Open the outlet valve V3, the liquid in the cylinder will be pressed out from the bottom of the cylinder into the heat exchanger, supply to user after gasification and heating up.

当使用液化二氧化碳气瓶时，建议将所有的液体排放管用尿脘泡沫隔热。管道可以有效地将液体输往使用源，并使压力提升量处于最低程度。正常液化二氧化碳排放操作需在压力大于 1.3Mpa 时进行，以减少凝固成干冰的可能性。在高压状态下输送液化二氧化碳可能会导致液体过度飞溅，从而造成操作人员和/或附近人员灼伤。所有人员应完全遵守有关低温液体输送注意事项，并穿上相应的防护服，使用防护设施。

When using liquefied carbon dioxide cylinders, it is recommended that all liquid discharges be insulated with urethane foam. The pipe efficiently transfers the fluid to the service source and minimizes pressure increase. Normal liquefied co2 emission operations should be performed at pressures greater than 1.3Mpa to reduce the possibility of freezing into dry ice. Transportation of liquefied carbon dioxide at high pressure may result in excessive splashing of liquid, resulting in burns to the operator and/or nearby personnel. All personnel should fully comply with the relevant cryogenic liquid transportation precautions, and wear appropriate protective clothing, use protective facilities.

警 告：如不小心使皮肤或眼睛接触到液态二氧化碳或固态二氧化碳会导致类似烧伤的冷灼伤。搬运液体要注意不要使其溅落或溢出。要对眼睛、皮肤等易与液态二氧化碳、冷冻管和冷冻设备或冷冻气体接触的地方进行保护。如会产生液体喷射或飞溅，或者冷冻气体会从设备内强烈喷出，要戴上防护镜或面罩。建议戴上易于脱下的干净绝热手套并穿上保护胳臂的长套袖。要穿上无箍口长裤，裤管要盖住鞋子以挡住溢出的液体。

Warning: Cold burns similar to burns may occur if the skin or eyes are accidentally exposed to liquid or solid carbon dioxide. Handling liquid should be careful not to make it splash or overflow. Protect eyes, skin and other areas that easy to come into contact with liquid carbon dioxide, cryogenic pipes, cryogenic equipment or cryogenic gases. Wear protective goggles or masks if liquid spray or splashes occur, or if frozen gas is strongly ejected from the equipment. It is

recommended to wear clean insulated gloves that can be easily removed and long arm-protective sleeves. Wear long trousers with no hoop, which cover your shoes to prevent spills.

5.5 气态供给 Gas supply

当瓶的压力较高时或准备关机前，打开气相阀 V1，瓶内的气相介质从瓶的顶部压出进入汽化器。在汽化器内被气化、加温后供给用户。这种方式对降低瓶内的压力具有显著的作用,同时也是提高气体利用率、延长气瓶使用寿命的最佳方法。

When the pressure of the cylinder is high or before shutting down, open the gas phase valve V1 and the gas phase medium in the cylinder is pressed out from the top of the cylinder into the heat exchanger. It is vaporized and heated in the heat exchanger and supplied to users. This method has a significant effect on reducing the pressure in the cylinder, and is also the best method to improve the utilization rate of gas and prolong the service life of the cylinder.

5.6 液体保留 Liquid remain

瓶内的液体应遗留 2~3L 为宜，使瓶处于冷态，不会转变为“热瓶”。

It is advisable to leave 2~3L of liquid in the cylinder, so that the cylinder is in a cold state and will not be transformed into a "hot cylinder".

注意：在刚进行液化天然气的作业之后，由于衣服中很可能浸有 LNG 故请注意不要马上便吸烟或靠近有火的地方。

Note: please be careful not to smoke or go near a fire immediately after a liquefied natural gas operation as there may be LNG in the clothes.

6.气瓶存放 Storage for cylinder

瓶应存放在通风良好的地方，不得在烈日下长时间曝晒。除符合下列要求，气瓶一般不能置于室内：

The cylinder should be stored in a well-ventilated place and not exposed to the hot sun for a long time. Cylinders should not be kept indoors unless they meet the following requirements:

1）气瓶内液态介质最大量小于 15L；

The maximum amount of liquid medium in the cylinder is less than 15L;

2）当气瓶内液态介质在 15L 和 430L 之间时，有专门设计的房间（例如：有通风控制系统）；

When the liquid medium in the cylinder is between 15L and 430L, there is a specially designed room (for example: there is a risk control system);

3）液化天然气瓶存放时，所有安全阀和泄压阀的出口均应连接一个安全的外部的排泄点，并且注意排泄点材料应防火；

When storing liquefied natural gas cylinders, the outlet of all relief valves should be connected to a safe external discharge point, and the discharge point material should be fireproof

4）液化天然气瓶存放时，在室内应放置一个气体探测仪，当达到 25%的爆炸极限时，发出警报。

When storing liquefied natural gas cylinders, a gas detector should be placed indoors to give an alarm when 25% of the explosion limit is reached.

7 装卸 Loading and unloading

7.1 起吊 Lifting

瓶的设计和制造经得起常规搬运，但是，它们会因粗暴搬运而受损。

Cylinders are designed and manufactured to withstand conventional handling; however, they can be damaged by rough handling.

谨慎：起吊中应保持设备平稳，避免与其它物体进行碰撞，以免损坏设备。

Caution: Keep the equipment stable during lifting and avoid collision with other objects to avoid damage to the equipment.

7.2 移动 Moving

气瓶的下部安装有四只轮子，其中安装在靠近阀门一侧的是万向轮，另一端为单向轮，可灵活地进行各个方向的移动。

The bottom part of the cylinder is equipped with four wheels, of which the universal wheel is installed on the side near the valve, and the one-way wheel is installed on the other end, which can be flexibly moved in all directions.

谨慎：气瓶移动时应关好所有阀门。

Caution: Close all valves when moving cylinders.

7.3 运输 Transport

除非容器中开始的压力小于最大工作压力的 50%，否则不能运输，并且每个出口处要封住。

The cylinder shall not be transported unless the initial pressure in the cylinder is less than 50% of the maximum working pressure and each outlet shall be sealed.

为防止瓶在运输过程中移动或相互碰撞，应用绳索将设备进行相应的固定，确保运输安全。

In order to prevent the cylinders from moving or colliding with each other during transportation, the equipment should be fixed with ropes to ensure transportation safety.

警告：不能用电梯或升降机运输；在人员密集的地方或在封闭的车厢内不能运输。

Warning: Do not transport by elevator or lift; Should not be transported in crowded areas or in closed compartments.

8．维修保养 Maintenance

当容器需要保养和修理时，应采取安全的措施，充入惰性气体,排出瓶内介质气体。（当介质为液化天然气时，充入惰性气体直到在惰性气体中天然气的含量低于这种易燃气体含量的爆炸极限的 50%）

When the cylinder needs to be maintained or repaired, safe measures should be taken to fill inert gas and discharge the medium gas in the cylinder. (When the medium is liquefied natural gas, inert gas is filled until the content of natural gas in inert gas is less than 50% of the explosive limit of this flammable gas content)

8.1 检漏 Leakage test

为确保瓶正常运行，应定期的进行管路系统检漏，如果发现漏点应立即进行维修。在一些特殊条件下用探测器难以准确判断泄漏点时，可以借助肥皂液检查漏点。（当检测天然气气瓶时，可使用甲烷探测器对瓶系统的天然气泄漏点进行检查）

In order to ensure the normal operation of the cylinder, the pipe system should be checked regularly, and if any leakage point is found, it should be repaired immediately. In some special conditions with the detector is difficult to accurately determine the leak point, you can use soap to check the leak point. (When testing natural gas cylinders, methane detectors can be used to check the gas leakage points of the cylinder system)

8.2 泄漏 Leakage

任何泄漏，一经发现必须维修：

Any leakage, once found, must be repaired:

如果是管螺纹泄漏应拆开连接、清洁连接面、使用规定的密封胶再组装。

If the pipe thread leaks, disassemble the connection, clean the connecting surface, and reassemble with specified sealant.

如果是管件泄漏应对其解体并严格检查，如果螺母和卡套外观没有损伤则可继续使用，重新安装管线并拧紧螺母，最后进行压力检漏。

If the pipe fitting is leaking, it should be disassembled and strictly checked. If the nut and clamp sleeve are not damaged, they can continue to be used. Reinstall the pipe and tighten the nut, and finally conduct pressure leak detection.

如果在安全阀根部或回路发现漏点，必须在开始维修之前将瓶内的压力放空至零，并完全吹除瓶内的介质气体。

If a leak is found at the root of the relief valve or in the loop, the pressure in the cylinder must be emptied to zero and the medium gas in the cylinder must be completely blown out before service begins.

如果在充液回路上发现漏点，必须在开始维修之前将瓶内的压力放空至零，并完全吹除瓶内的介质气体。

If a leak is found on the filling circuit, the pressure in the cylinder must be emptied to zero and the medium gas in the cylinder must be completely blown out before service begins.

8.3 零件更换 Parts replacement

此部分包括瓶维护和保养的知识。在按以下程序进行操作前，应当首先查阅设备运转记录和零部件装配图，根据图纸确定其正确位置。

This section covers cylinder maintenance and maintenance knowledge. Before following the procedure, check the equipment operation record and parts assembly drawing and determine the correct position according to the drawing.

♦ 安全阀 Safety valve

瓶的内胆作为一种压力容器，其最大工作压力是根据相关规范进行设计和核定的，并经试验检测。在每个瓶的铭牌上都打有最高工作压力的数据。通常主安全阀开启压力为公称工作压力的1.0～1.2 倍（但不得大于 1.2 倍）。

As a kind of pressure vessel, the maximum working pressure of the cylinder inner vessel is designed and approved according to the relevant specifications, and tested. The maximum working pressure is printed on the nameplate of each cylinder. Usually the opening pressure of the main safety valve is 1.0 ~ 1.2 times of the nominal working pressure (but not more than 1.2 times).

安全阀的更换应按以下程序进行：

The replacement of the relief valve should follow the following procedure:

1) 打开放空阀（V1、V3），将罐内压力泄尽；

Open the vent valve (V1, V3) to release the pressure to zero in the cylinder

2) 拆下安全阀；

Remove the safety valve;

3) 清理阀座内螺纹上的密封胶等杂质；

Clean the sealant and other impurities on the inner thread of the seat;

4) 安装新的安全阀。

Install a new safety valve

5) 修复后，检漏参照 8.1 条。

After repair, refer to Article 8.1 for leak detection.

警告：不得维修或重新调整安全阀。

Warning: Safety valve shall not be repaired or readjusted.

♦ 手动截止阀的组装 Manual globe valve assembly

如果确认某个阀有问题，应按照以下程序进行检修：

If it is confirmed that there is a problem with a valve, it should be repaired according to the following procedures:

首先更换零件，打开放空阀（V1），将瓶内压力泄尽；

First replace the parts, open the vent valve (V1), release the pressure to zero in the cylinder;

1) 如果维修放空阀，在解体前应将其预热；建议用热氮气，不得敲击或强硬扳拧；

If the vent valve is repaired, it should be preheated before disassembly; It is recommended to use hot nitrogen, do not knock or hard wrench;

2) 如果维修液态供给阀（V3、V4），应将气瓶中的液化介质放至$\frac{1}{2}$以下，压力全部放空，并将其预热；（如果介质是液氧或液化天然气或液态二氧化碳，应将液态介质和压力全部放空）

If the liquid supply valve (V3, V4) is repaired, the liquefied medium in the cylinder should be release below 1/2, the pressure should be all emptied, and it should be preheated; (If the medium is liquid oxygen or liquefied natural gas or liquid carbon dioxide, the liquid medium and pressure should be completely empty)

3) 如果维修进液阀（V2）将瓶内压力放尽并对其预热，无需放液相；

If the inlet valve (V2) is repaired, release the pressure to zero in the cylinder and preheat it, there is no need to discharge liquid;

4) 拆下手柄固定螺钉、垫片、护帽；

Remove fixing screws, gaskets and caps from the handle;

5) 拧开阀帽，取出阀杆和阀杆密封；

Unscrew the bonnet and remove the stem and stem seal

6) 取出阀芯和衬套组件；

Remove the spool and bushing assembly

7) 清洗阀座；

Clean the seat

8) 更换受损零件并按与解体相反的步骤装回；

Replace the damaged parts and reinstall them according to the steps opposite to disassembly

9) 修复后检漏参照 8.1 条

Refer to Article 8.1 for leak detection after repair

注：系统中任何零部件绝对禁止采用火焰直接加热；禁止用金属工具、物件敲击，强硬扳动。具体程序可向本公司客户服务部联系咨询。

Note: Direct flame heating is absolutely prohibited for any parts in the system; Do not use metal tools, objects to knock, hard pull. For specific procedures, please contact our customer service department.

♦ 真空失效 Vacuum failure

通常，伴随着真空失效盛装有液体的瓶会出现瓶体“发汗”、结霜或瓶内压力急剧升高等现象。但是对于一个新瓶或者一个久置未用的瓶而言，由于其内胆温度较高，在充装液体时压力上升也较快，这种现象应属正常。

Usually, with vacuum failure, cylinders containing with liquid will appear "sweating", frost, or rapid increase of pressure in the cylinder. However, for a new cylinder or a long time unused cylinder, due to the higher temperature of the inner tank, when filling the liquid pressure rises faster, this phenomenon should be normal.

过度的压力上升可以作为判断瓶真空失效的依据之一。瓶的外壳装有一个真空塞，当瓶真空失效时，真空塞会脱落。平时，真空塞外套着一个塑料护帽。不要打开护帽或真空塞。如果发现瓶真空失效，请送回厂家维修。

Excessive pressure rise can be used to judge the vacuum failure of the cylinder. The cylinder outer shell is fitted with a vacuum plug that will fall off when the cylinder vacuum fails. Normally, the vacuum plug is covered with a plastic cap. Do not open the cap or vacuum plug. If the cylinder is found to have vacuum failure, please return it to the manufacturer for repair.

总之，真空失效是一个很少见的现象，通常瓶的真空能够保持若干年，在这期间瓶的真空是（以很慢的速度）逐渐下降的。在固定式瓶上出现的所谓“软”真空可以通过压力的快速升高来判断。

In summary, vacuum failure is a very rare phenomenon, usually the cylinder vacuum can be maintained for several years, during which the cylinder vacuum is gradually decreased (at a very slow rate). A so-called "soft" vacuum on a stationary cylinder can be judged by a rapid increase in pressure.

如果瓶真空塞未现异常，但又怀疑真空失效，就必须通过检查压力升高时间来判断。

If the cylinder vacuum plug is not abnormal, but the vacuum failure is suspected, it must be determined by checking the time of pressure rise.

在测试瓶的压力升高时，首先向瓶充液，然后放掉瓶内的液还剩 3/4 或 1/2 时停止。瓶静置至少 12 小时，系统的压力升高率低于约 0.3MPa/d 为正常。需要注意的是热瓶首次充装或瓶超量充装也会引起压力的急剧升高。

When the pressure of the test cylinder is raised, fill the cylinder with liquid first and then drain the cylinder until 3/4 or 1/2 of the liquid is left. It is normal for the pressure rise rate of the system to be lower than about 0.3MPa/d when the cylinder is left standing for at least 12 hours. It should be noted that the first filling of hot cylinders or over-filling of cylinders will also cause a sharp increase in pressure.

一个真空失效的瓶，其夹套压力将以近约 0.07MPa/h 的速率上升，这种压力的变化非常明显。瓶外壳尤其是管路较为集中的部位和支撑附近的温度比其它部位的温度低，外壳结霜或“发汗”与否取决于周围环境的温度和湿度。这种冷凝现象的存在并不能作为判断一个瓶真空度存在与否的可靠指标，而瓶压力升高率的测试才是最可靠、有效的判断方法。

For a vacuum failed cylinder, the jacket pressure will rise at a rate of approximately 0.07MPa/h, and this pressure change is very obvious. The temperature of the cylinder shell, especially near the concentrated part of the pipe and the support, is lower than that of other parts. Whether the shell frosts or sweats depends on the temperature and humidity of the surrounding environment. The presence of such condensation is not a reliable indicator of the presence or absence of a cylinder vacuum, and the test of the cylinder pressure rise rate is the most reliable and effective way to determine.

一个已经真空失效的瓶必须通过专用设备再次抽真空，这种操作可以就地进行，也可将瓶卸下后进行。具体操作详情请与我公司客户服务联系。

A cylinder that has failed to be vacuumed must be vacuumed again with special equipment, either in place or after the cylinder has been unloaded. Please contact our customer service for details.

♦ 液位表 Liquid level gauge

用于这种瓶的电容式液位计由三部分组成：电容传感器、变送器和液位表。安装在瓶内的电容传感器是一种可变电容，当瓶内液面上升时，液体也将充入传感器，随着液面的变化（传感器的）电容值也随之改变。传感器的一极与瓶体接地，另一极通过一根电缆穿过陶瓷封头与瓶外的BNC（同轴电缆）接头相连。变送器是安装在瓶外的一个盒子，其功能是：接收电容信号并将其转换成液位表能够接收的信号（如电流或电压信号）。变送器有两个接口：其一与瓶电容传感器的BNC 输出插座相连；另一个通过火线、地线和信号线组成的三芯防水电缆连接到液位表。

The capacitive level gauge for this cylinder consists of three parts: capacitance sensor, transmitter and level gauge. The capacitance sensor installed in the cylinder is a variable capacitance. As the liquid level rises in the cylinder, the liquid will also be filled into the sensor, and the capacitance value will change as the level changes. One pole of the sensor is grounded to the cylinder body and the other pole is connected to the BNC (coaxial cable) connector outside the cylinder by a cable passing through the ceramic head. A transmitter is a box mounted on the outside of the cylinder. Its function is to receive capacitor signals and convert them into signals (such as current or voltage signals) that the level gauge can receive. The transmitter has two interfaces: one is connected to the BNC output socket of the cylinder capacitance sensor; The other is connected to the level gauge through a three-core waterproof cable consisting of live wire, ground wire and signal wire.

液位计安装：The installation of liquid level gauge

按液位计说明书的安装图接好直流电源到 BSQ12A-1 变送器电源电缆，再将 BSQ12-1 变送器 Q9 插头插入专用电容传感器 Q9 插座。

Connect the DC power supply to the POWER cable of BSQ12A-1 transmitter according to the installation diagram of the level meter instruction manual, and then insert the plug of BSQ12-1 transmitter Q9 into the socket of special capacitor sensor Q9.

确认上述工作完成后可接通防爆开关。

The explosion-proof switch can be switched on after confirming the completion of the above work.

注意：1、同轴电缆是每个计量装置的组成部分，如果需要更长的电缆，请向本公司品咨询如何操作。

Note: 1, coaxial cable is an integral part of each metering device, if longer cable is required, please consult our company on how to operate.

2、电容式液位计使用的电源是交流 220V，因此在小区气化站内应配置该电源并且防爆。

The power supply used by the capacitive level meter is AC 220V, so the power supply and explosion-proof should be configured in the gasification station in the community.

故障诊断 fault diagnosis

计量系统的故障通常都来自电器线路，大部分故障能通过手持式万用表检查出来。

Faults in metering systems are usually caused by electrical wiring, and most faults can be detected by a handheld multimeter.

注意：液位表采用了模块化设计，在出厂前就已调整到位，用户无须调整。如果表的计量精度出了问题，请与本公司服务部联系。

Note: the level gauge adopts modular design and has been adjusted in place before delivery. Users do not need to adjust it. If there is any problem with the accuracy of the meter, please contact our service department.

9. 应急处理方案 Emergency treatment plan

9.1 应急处理人员的着装要求：Dress code for emergency responders

皮肤或眼睛接触到液化介质会导致类似烧伤的冷灼伤；要对眼睛、皮肤等易与液体接触的部位进行保护；戴上防护镜或面套，建议戴上易于脱下的防护手套和长套袖，保护胳膊；穿上无箍口长裤，裤管要盖住鞋子，以挡住溢出的液体；应急处理人员的衣服应为棉制，最好是没有口袋也没有卷起的部分，严禁穿戴可能引起静电的化纤衣物，脚部应穿没有铁钉的皮鞋。

Contact with liquid media on the skin or eyes can cause cold burns similar to burns; Protect eyes, skin and other parts easy to contact with liquid; Wear protective goggles or face covers. It is recommended to wear protective gloves and long sleeves that can be easily removed to protect your arms. Wear long trousers without hoop bottoms that cover your shoes to prevent spills; The clothes of emergency personnel should be made of cotton, preferably without pockets or rolled-up parts. It is forbidden to wear chemical fiber clothes that may cause static electricity, and shoes without nails should be worn.

注意：不要使其溅落或溢出。

Note: Do not let it splash or overflow.

9.2 处于火灾环境时（充装介质为液氧、液化天然气时）：

When in the fire environment (when the filling medium is liquid oxygen and liquefied natural gas)

此时，应及时关闭所有与气、液相相通的阀门。当阀门无法关闭或泄漏处无法堵塞时，切不可用水直接喷淋液体泄漏处，推荐使用干粉（最好是碳酸钾）灭火器。应急处理人员应经过使用干粉灭火器的训练。

At this time, all valves connected to the gas, liquid phase should be closed in time. When the valve cannot be closed or the leak cannot be blocked, do not spray the liquid leakage directly with

water. Dry powder (preferably potassium carbonate) fire extinguisher is recommended. Emergency responders should be trained to use dry powder fire extinguishers.

9.3 处于超压泄放时：When in the overpressure relief

此时，应及时打开放气阀（V1），将瓶内超压气体尽快泄放到安全阀正常回座时为止。在向空气排放气体时，应事先确定附近确实无明火、易燃物以及无行人通过。如果开启放空阀压力降压效果较差，可将气瓶移动至空旷处，连接软管，由进液阀（V2）放空。（当瓶内介质为液化二氧化碳时，应事先接上汽化器升温后进行）

In the case of overpressure relief, the air valve (V1) should be opened in time, and the overpressure gas in the cylinder should be discharged as soon as possible until the safety valve returns to the seat normally. When discharging into the air, make sure there are no open fires, inflammable objects and no pedestrians in the vicinity. If the effect of pressure reduction is not good after opening the vent valve, move the cylinder to an open place, connect the hose, and empty the inlet valve (V2). (When the medium in the cylinder is liquefied carbon dioxide, it should be connected to the heat exchanger and heating up first.)

注意：放空的液体不允许往地下排水沟内排放。

Note: Liquid vented is not allowed to drain into underground drains.

9.4 内胆意外泄漏时：When the inner vessel is accidentally leaking

此时，因内部液体泄漏而使内容器处于过剩压力状态下，易导致并造成事故，应尽快小心地将瓶内的液体排放出来或卸到其他完好的同类瓶内。在条件许可的情况下，应尽快将损坏的瓶转移至无明火、易燃物以及无行人通过的场所进行应急处理。

At this point, the internal liquid leakage causes the internal vessel to be under excess pressure, which is easy to cause accidents. The liquid in the cylinder should be carefully discharged or unloaded into other intact cylinders of the same kind as soon as possible. If conditions permit, the damaged cylinder should be transferred to a place with no open fire, inflammable materials and no pedestrians for emergency treatment as soon as possible.

9.5 阀门冻住时：When the valve is frozen

若阀门冻住，应使用清洁无油的温水或热氮气解冻后方可操作。不得用锤或其他物件敲击。绝对禁止采用火焰直接加热；禁止用金属工具、物件敲击，强硬扳动。具体程序可向本公司客户服务部联系咨询。

If the valve is frozen, use clean, oil-free warm water or hot nitrogen to thaw before operation. Do not strike with hammers or other objects. Direct flame heating is absolutely prohibited; Do not use metal tools, objects to knock, hard pull. For specific procedures, please contact our customer service department.

10．售后服务 after-sales service

为了不断提高产品的质量和更好地为用户服务，我们恳切希望用户能对产品在设计、制造、

外观质量等方面存在的不足提高宝贵的意见和建议，若您收到本产品时，请及时填写《低温气瓶保修卡》，以便您的意见和建议能及时反馈给我公司，并得到及时改进。

In order to continuously improve the quality of the products and better serve the users, we sincerely hope that users can put forward valuable opinions and suggestions on the shortcomings of the products in design, manufacturing, appearance quality and other aspects. if you receive this product, please fill in the warranty card for cryogenic cylinder on time, so that your opinions and suggestions can timely feedback to our company, and get the improvement in time.

您可以按下列通讯地址与我公司联系：

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