

# Cylinder Valves

## 钢瓶阀门

Most compressed gas cylinders require the installation of at least one valve. This valve allows the cylinder to contain gases and allows gas to be filled into or emptied from the cylinder. The cylinder valve is the most vulnerable part of the compressed gas package and requires a thorough understanding in order to maximize its performance. There are three basic valves used in the compressed gas industry. They are the pressure seal valve, the packed valve, and the diaphragm valve. There are several versions or designs within each of the three basic types. This pamphlet will address the more common valves in today's industry.

大多数压缩气体钢瓶要求安装至少一个阀门。这个阀门使钢瓶可以容纳气体，允许气体灌装进或提取出钢瓶。钢瓶阀门是压缩气体包装的最脆弱的部分。为了最大程度发挥它的作用，要求彻底地理解阀门。在压缩气体工业中有三种基本的阀门。它们是压力密封阀、衬垫阀和隔膜阀。三个基本类型中地每一个还有几个版本或设计。本手册将介绍当代工业中最常用的阀门。

A working knowledge of cylinder valves can improve processes, save time and money, prevent problems, and improve the safety of your operation. This document must not be used as a guide for valve modification or repair. No modifications to valves are permitted and any repairs shall only be made by or under direction of the supplier.

钢瓶阀门的应用知识能够改善工艺、节约时间和金钱、预防问题和改进你的操作的安全性。本文件不能用作阀门修改或修理的指南。禁止对阀门作任何修改。任何修理只能由供应商或在其指导下进行。

## Basic Valve Rules

### 基本的阀门规则

#### **ALWAYS**

#### 总是

- open valves slowly to control pressures urges and heat of compression!  
慢慢打开阀门，以控制压力负荷和压缩热。
- use the correct CGA connection for hook-up!  
连接时使用正确的CGA接头。
- inspect the valve for damage and foreign materials before connecting it to your equipment!  
在把阀门连接到你的设备之前，检查阀门是否有损伤或不相容材料。
- ensure when the cylinder is not in use, even when empty, that the valve is in the closed position with the outlet seal in place and the transport cap installed!  
当没有使用钢瓶时，甚至当钢瓶空着的时候，确保阀门处在关闭位置，排气口密封处在原位，安

装了运输帽。

- consult your supplier if you have any questions regarding cylinder valves!

如果你有任何关于钢瓶阀门的问题，请教你的供应商。

- make packing nut adjustments with the valve outlet depressurized!

在阀门排气口减压时，进行衬垫螺母调节。

- restrain cylinders!

固定钢瓶！

When returning any cylinder, ensure that the cylinder valve is properly closed, any outlet seals are in place and properly tightened, and the transport cap is correctly installed.

当任何钢瓶返还时，确保钢瓶阀门已经正确关闭，任何排气口密封都在适当的位置而且已经正确上紧，运输帽已经正确安装。

## **NEVER**

### **禁止**

- tamper with pressure relief devices!

堵塞减压装置！

- attempt to tighten or loosen the valve into or out of the cylinder!

试图上紧或放松钢瓶阀门！

- use a damaged valve where integrity may have been affected!

在完整性可能已经受到影响的地方使用损坏的阀门。

- continue to use a valve that operates abnormally, i.e., becomes noisy or progressively harder to operate!

继续使用运转不正常的阀门，如有噪声的或越来越难以操作的！

- use an automatic operator, adapter, wrenches, or other tools to obtain a mechanical advantage on hand-wheel-operated valves without consulting your supplier first!

没有首先同你的供应商商量就使用自动操作手、接头、扳手或其它工具，来获得在手轮操作阀门上的机械便利！

- lubricate valves or their connections!

润滑阀门或它们的接头！

- drag, lift, or move a cylinder using the valve or the hand wheel as a handle!

把阀门或手轮作为手柄来拉拽、提举或移动钢瓶！

- remove packing nuts on packed valves!

去掉衬垫阀门上的衬垫螺母！

- adjust or tamper with retainer or bonnet nuts on diaphragm or pressure seal valves!

调整或篡改隔膜阀或压力密封阀上的固定器或阀帽螺母！

- use the cylinder valve to regulate flow or pressure!

使用钢瓶阀门来控制流速或压力！

- move cylinders without the transport cap installed!

没有安装运输帽就移动钢瓶！

- interchange transport caps between cylinders!

在钢瓶之间交换运输帽！

## Pressure Seal Valve

### 压力密封阀

Products: Inerts, Oxygen, Hydrogen

产品: 惰性气体, 氧, 氢

Operating Principle: The pressure seal valve is a hand wheel-operated valve using a two-piece valve stem. The upper and lower stems interface with either a key arrangement or a slot and blade configuration. The threads are located on the lower stem and the upper stem is free floating. The sealing mechanism for the valve stem is provided by a Teflon packing ring that makes contact with a ridge on the upper stem. The force that provides this contact is a spring located in the hand-wheel. This spring provides an upward force to the upper stem and pulls the stem's sealing ridge into the packing ring.

运转原理: 压力密封阀是使用两个阀杆的手轮操作阀门。上下阀杆的接合或者采用钥匙配置或者或者狭缝和刀片的结构。螺纹位于下阀杆上, 上阀杆是自由浮动的。阀杆的密封结构由一个同上阀杆的凸起接触的特氟纶垫圈提供。提供这种接触的力是手轮里的弹簧。弹簧提供一个向上的力给上阀杆, 把阀杆的密封凸起推进垫圈。

## Identifying Features

### 鉴别特征

1. Spring in hand wheel can be detected by wiggling hand wheel. If a spring is present, the hand wheel will pivot on the spring.

通过扭动手轮可以察觉到手轮里的弹簧。如果有弹簧, 手轮的枢轴会装在弹簧上。

2. The valve has a non-rising hand-wheel. The hand wheel is always in the same position relative to the valve body regardless of whether the valve is in the open or closed position.

阀门有一个不能上升的手轮。不管阀门是在开启或是关闭位置, 手轮总是处在相对于阀体的同样的位置。

Recommended Opening Procedure: Air Products recommends that pressure seal valves be used in the fully open or back seated position. Opening the valve fully causes the lower stem to ride upward on its threads until it contacts the upper stem and mechanically drives the upper stems seal ridge into the packing ring. This improves the seal around the stem and helps to prevent packing leaks. Valves in the back seated position can be mistaken as closed by inexperienced or untrained operators. When an operator checks a valve to insure its position, he should always check by attempting to close the valve, never by trying to open the valve. If the valve was back seated using substantial effort, it is possible that the operator could think the valve is closed, when in fact it is fully open. Operators must be trained to use pressure readings or an equally reliable indicator to insure the cylinder valve is closed or open.

推荐的开启程序: Air Products推荐把压力密封阀用在充分开启或反向固定的位置。阀门的完全开启使得下阀杆沿着螺纹上升, 直到它物理上接触到上阀杆, 机械驱动上阀杆密封凸起进入垫圈。这改善了阀杆附近的密封, 有助于防止衬垫泄漏。没有经验或未经训练的操作人员会误认为

反向固定位置的阀门是关闭的。当操作人员检查阀门以确保其位置时，他应该总是通过试图关闭阀门，而不是试图开启阀门来检查。当事实上阀门是完全开启的时候，如果经过努力阀门还是不动的话，有可能操作人员认为阀门是关闭的。必须训练操作人员，使他们学会通过使用压力表或同样可靠的指示器来确定钢瓶阀门是关闭或是开启。

**Recommended Closing Procedure:** Close the cylinder valve tightly using a gloved hand. Always wearing gloves when operating cylinder valves. NEVER use wrenches or other persuaders to operate the valve.

推荐的关闭程序：用戴手套的手紧紧地关闭阀门。推荐操作钢瓶阀门时总是戴手套。禁止用扳手或其它强制性的工具来操作阀门。

**Valve Advantages:** The pressure seal valve is extremely reliable, very strong (used at pressures up to 6000 psig), economical, and user friendly.

阀门的优点：压力密封阀是非常可靠、非常坚固（可用于高达6000 psig的压力）、经济和易于使用的。

**Valve Disadvantages:** The valve is prone to leakage around the stem, especially in-board leakage when a vacuum is pulled on the valve outlet. Back seating helps minimize outboard leakage when the valve is in the open position. The threads on the lower valve stem are in the wetted gas stream. These threads are lubricated and these lubricants can be an unwanted contaminant in high purity applications.

阀门的缺点：当阀门排气口处是真空时，阀门在阀杆附近容易泄漏，特别是内部泄漏。当阀门处在开启位置时，反向固定有助于将外部泄漏减到最小。下阀杆上的螺纹是处在潮湿气流中的。这些螺纹被润滑了，而且这些润滑剂在高纯度应用中可能是有害的污染物。

**Comments:** This is a very reliable valve for non-corrosive and high purity products. However, the design makes this valve inappropriate for corrosives and ultrahigh-purity products.

评论：对于非腐蚀性和高纯度产品，这是一种非常可靠的阀门。但是，它的设计使得它不适合用于腐蚀物和超高纯度产品。

**WARNING:** Improper use of cylinder valves may result in serious injury!

警告：不正确使用钢瓶阀门会导致严重伤害！

## **The Wrench-Operated Packed Valve**

### **扳手型衬垫阀**

**Products:** Corrosives and Reactive Gases

产品：腐蚀物和活泼气体

**Operating Principle:** The wrench-operated valve is a packed valve with a one piece stem. The seat to stem seal is a metal to metal seal. The manufacturer's minimum recommended closing torque is 35 ft-lbs. This is much more than can be applied with hand force; therefore, the valve requires a wrench to provide sufficient closing force. The stem seal is accomplished by compressing a large ring of Teflon between the



valve body and packing nut which forces the Teflon to grip the stem.

运转原理: 扳手型衬垫阀是有一个阀杆的衬垫阀门。阀座到阀杆的密封是一个金属到金属的密封。制造商的最小推荐关闭转矩是35 ft-lbs。这远远超过了手所能施加的力; 因此, 阀门要求一个扳手来提供足够的关闭力量。阀杆密封是这样实现的: 把一个大特氟纶环压在阀体和衬垫螺母之间, 衬垫螺母迫使特氟纶紧抓住阀杆。

## Identifying Features

### 鉴别特征

1. The valve does not have a hand-wheel. The top of the stem is machined square to accommodate a wrench.

阀门没有手轮。阀杆顶部加工成方形, 以容纳扳手。

2. The top of the valve has a large, internally-threaded nut screwed onto the body, where the valve stem exits. This is the packing nut.

阀门顶部有一个拧进阀杆处阀体的内螺纹大螺母。这是衬垫螺母。

Recommended Opening Procedure: The wrench-operated valve has a very large flow capacity. It is not necessary to open this valve to the full open position to provide full flow to the process. Opening this valve fully poses two serious problems. The first problem is safety-related. In many applications, cylinders with these valves are used in tight quarters (e.g., gas cabinets) or behind barricades. These space constraints often prohibit the stem from being fully rotated when operating the valve. This valve requires approximately three full turns from full open to full close. In the case of an emergency, it can take 15 to 30 seconds to close the valve, depending on space and operator stress. However, if the valve is opened to the recommended  $1/4$  to  $1/2$  turn, the valve can be quickly closed with minimal operator exposure. The second benefit of only opening the valve the recommended  $1/4$  to  $1/2$  turn is the protection of the upper section of threads.

推荐的开启程序: 扳手型阀门流量非常大。必须把阀门开到完全开启的位置, 以提供完全的流通。完全开启阀门引起两个严重问题。第一个问题同安全有关。在许多应用中, 使用这种阀门的钢瓶用在狭窄空间(如气体室)或隔板后面。这些空间限制经常禁止操作阀门时阀杆充分旋转。这种阀门从完全开启到完全关闭需要大约三圈。在紧急情况下, 根据空间和操作人员的压力, 关闭阀门需要15到30秒。但是, 如果阀门开启到推荐的 $1/4$ 到 $1/2$ 圈, 阀门就可以迅速关闭, 操作人员的暴露也减少到最小。仅仅开启阀门到推荐的 $1/4$ 到 $1/2$ 圈的第二个好处是保护了螺纹的上面部分。

The threads are in the wetted gas stream and, due to the corrosive nature of many of the products where these valves are used, the threads can become jammed with corrosion by-products. If the valve is opened to the recommended  $1/4$  to  $1/2$  turn and the threads become jammed, the upper threads usually remain clear. This allows the operator to further open the valve and to free the threads. The proper operation of this valve requires the use of the proper wrench. Recommends using the square stem valve wrench, commodity code E99-P-38WRENCH to operate these valves (except on highly reactive gases such as fluorine,  $\text{ClF}_3$ , etc.). This wrench



has a square hole sized to fit the stem and an open-end wrench on opposite end that fits the packing nut. The recommended opening procedure for this valve is as follows:

螺纹处在潮湿气流中，同时由于使用阀门的地方的许多产品的腐蚀性，螺纹可能被腐蚀产生的副产品堵塞。如果阀门开启到推荐的1/4到1/2圈，同时螺纹被堵塞，上螺纹通常保持着清洁。这就允许操作人员进一步开启阀门和松开螺纹。这种阀门的正确操作要求使用正确的扳手。推荐使用商品代码为E99-P-38WRENCH方形杆阀扳手来操作这些阀门（除了对于非常活泼气体，如氟、ClF<sub>3</sub>等）。这种扳手有一个尺寸同阀杆配合的方孔，另一端有一个同衬垫螺母配合的开口扳手。推荐的这种阀门的开启程序如下：

1. connect cylinder to system

把钢瓶连接到系统上

2. snug packing nut with wrench (35 ft-lbs)

用扳手拧紧衬垫螺母(35 ft-lbs)

3. place wrench on stem and slap valve open by striking the wrench with the palm of the hand

把扳手放在阀杆上，通过用手掌击打扳手把阀门拍开。

4. continue opening the valve until it is 1/4 to 1/2 turn open.

继续把阀门开启到1/4到1/2圈。

Where possible, leave the wrench on the valve so a quick closing of the valve can be made in the event of an emergency.

在可能的地方，把扳手留在阀门上，以便在紧急情况下可以迅速的关闭阀门。

Recommended Closing Procedure: Using an appropriate wrench, tighten the stem by pulling the wrench to the closed position. When the valve is closed as tight as the wrench can be pulled, give the wrench a closing slap with the gloved palm of the hand. The minimum closing torque for this valve is 35 ft-lbs. but it is not uncommon for some valves to require as much as 60 to 80 ft-lbs. to fully seal.

推荐的关闭程序：使用一个合适的扳手，通过把扳手推到关闭位置拧紧阀杆。当阀门关闭到扳手能够拧到的最紧程度时，用戴手套的手掌朝拧紧的方向拍一下扳手。这种阀门的最小关闭转矩是35 ft-lbs，也有一些阀门要求大到60到80 ft-lbs的转矩来完全密封。

Valve Advantages: The valve is extremely rugged and its one piece stem provides positive operation. This strength and the metal sealing allow this valve to be used in the most severe services. The simple design makes this valve very reliable.

阀门的优点：阀门非常结实，它的单阀杆提供了确定的操作。这种强度和金属密封使这种阀门可以用于最严格的应用中。简单的设计使阀门非常可靠。

Valve Disadvantages: The nature of the products for which this valve is used are the main cause of problems with this valve. Corrosion products often deposit at the



valve seat, preventing a seal, or they collect in the threads, making operation difficult or impossible. As the seat wears, increasing closing torques are required to seal the valve. The packing is also susceptible to both inboard and outboard leakage. This is caused by the same property that makes Teflon such an ideal packing: its ability to flow. When the Teflon is squeezed, it responds by "cold flowing." This means the Teflon pushes into every void in an effort to relieve the pressure. When this happens, a packing leak often develops. The packing should be checked frequently for leaks. The leaks can usually be fixed by depressurizing the valve outlet and retorquing the packing nut. These weak points make this valve a poor choice for cylinders used in critical applications where cleanliness and ultra-high leak integrity are crucial.

阀门的缺点：应用这种阀门的产品的本质是这种阀门出现问题的主要原因。腐蚀性产品经常堆积在阀座上，妨碍了密封，或者积累在螺纹里，造成操作困难或无法操作。在阀座磨损后，要密封阀门就要求增加关闭转矩。密封环也容易受到内部和外部泄漏的影响。这是由使得特氟纶成为这样一种理想的衬垫的性质：流动性造成的。当特氟纶受到挤压时，它的反应是“冷变形”。这意味着特氟纶要挤进每一寸空间以释放压力。当这种情况发生时，经常发展为衬垫的泄漏。应该经常检查密封是否泄漏。通常可以通过对阀门排气口减压和重新调整衬垫螺母来阻止泄漏。

Comments: A simple preventative maintenance program and good operating procedures can address and limit the disadvantages of this valve. Preventative maintenance in the form of weekly cycling to keep the threads clear and frequent checking of the packing for leaks are very beneficial. Good procedures for cylinder and proper operation are also key in minimizing problems with this valve. The right wrench for valve operation also makes the operator's job easier and safer. Some wrench-operated valves, specifically those used in ammonia and amines service, have packing nuts with notches machined into the flats. This indicates that the nut has left handed threads. Make sure you tighten these nuts in the counter-clockwise direction.

评论：一个简单的预防性的维护程序和良好的操作程序能够限制这种阀门的缺点。每周保持螺纹清洁和经常检查衬垫是否泄漏的形式的预防性维护是非常有益的。钢瓶更换和正确操作的良好程序在最大程度减少这种阀门的问题方面也是很关键的。用于阀门操作的正确的扳手也会使操作者的工作更加容易和安全。一些扳手型阀门，特别是那些用于氨和胺设施的扳手型阀门的衬垫螺母带有加工进平面的凹槽。这说明螺母带有左手螺纹。确定沿反时针方向紧固螺母。

**WARNING: Improper use of cylinder valves may result in serious injury!**

警告：不正确使用钢瓶阀门会导致严重伤害！

## **The Hand wheel-Operated Packed Valve**

### **手轮型衬垫阀**

Products: Corrosives and Reactive Gases

产品：腐蚀物和活泼气体

Operating Principle: The hand wheel-operated packed valve can use metal to metal seats like the wrench-operated valve or elastomeric seats like the pressure seal valve. Unlike the wrench-operated valve, the sealing mechanism in this valve is



designed to seal with only hand force. The packing is typically a filled Teflon. The packing is usually smaller and better contained than the packing in the wrench-operated valve. This helps to eliminate the hand wheel-operated packing leak problem associated with the wrench-operated valve. The packed valves used by Air Products employ a two- or three-piece stem in which the lower stem or spindle connects to the upper stem via a slip joint. In these valves the stem tip seals against the seat without rotating. This reduces some of the wear and particle generation, as compared to the wrench-operated design. This sealing motion and a considerable reduction in seat size allow this valve to be operated using hand torque. The packing nut of this valve is secured by a lock nut with left-handed threads which prevents accidental loosening of the packing nut.

操作原理: 手轮型衬垫阀可以象扳手型阀门那样使用金属到金属阀座, 或者象压力密封阀那样使用人造橡胶阀座。同扳手型阀门不一样, 这种阀门的密封机制设计得仅用手的力量来密封。衬垫典型是填充特氟纶。密封环通常比扳手型阀门的密封环小和容纳得更好。这有助于排除手轮型密封的泄漏问题, 而扳手型阀门具有这个问题。Air Products使用的密封阀采用两个或三个阀杆。下阀杆或轴通过伸缩接头同上阀杆连接在一起。在这些阀门里, 阀杆尖端没有旋转地同阀座密封在一起。同扳手型设计相比, 这减少了磨损和颗粒的产生。这种密封动作和阀座尺寸的相当大的减小使得可以用手的转矩来操作阀门。通过一个锁定螺母来固定密封螺母。锁定螺母带有左手螺纹, 可以防止密封螺母的意外松动。

## Identifying Features

### 鉴别特征

1. The valve is equipped with a hand-wheel. The hand wheel does not hold a spring and does not wiggle like the hand wheel of a pressure seal valve.

阀门配有手轮。手轮内没有装弹簧, 不会象压力密封阀的手轮那样扭动。

2. The stem rises when the hand wheel is turned to the open position.

当手轮转动到开启位置时, 阀杆上升。

3. Beneath the hand wheel are two nuts attached to the valve body. The upper set of wrench flats belong to the packing nut, which is threaded into the valve body. The lower set of wrench flats belong to the locking nut. Note that these flats have notches machined into them. This indicates the locking nut has left-handed threads.

在手轮下面是两个附在阀体上的螺母。扳手面上面的那个属于衬垫螺母, 它是通过螺纹旋进阀体的。扳手面下面的那个属于锁定螺母。注意这些平面带有加工进平面的凹槽。这说明锁定螺母带有左手螺纹。

Recommended Opening Procedure: The slip joint interface of the upper and lower stems creates a free play of about 1 / 2 turn with this valve. When opening, the hand wheel will give an initial resistance, then suddenly turn about 1 / 2 turn with little resistance. At this point the valve is still closed. When the hand wheel hits resistance again this is the sealing force at the seat. The hand wheel must be turned at least another 1 / 2 turn, or a full turn from initial start, for the valve to be opened. This hand wheel rotates three full turns from closed to fully open. The flow capacity of





this valve is much smaller than that of the wrench operated valve, therefore it may be desirable to open this valve fully. DO NOT backseat this valve. Open the valve fully then rotate the hand wheel clockwise about 1 /2 turn. As when initially opening the valve, no resistance will be encountered for about 1 /2 turn. This is again the free play of the stem assembly. When closing resistance is encountered, stop. This position will provide maximum flow and allow the quickest closing in the event of an emergency. It will also eliminate the chance of an opened valve being mistaken for a closed valve.

推荐的开启程序：上下阀杆的伸缩接头接触面使这种阀门可以有大约1 /2圈的自由运动。开启的时候，手轮会引起一个最初的阻力，接着在这个小阻力下突然旋转大约1 /2圈。在该点阀门仍然是关闭的。当手轮再次碰到阻力的时候，这是阀座上的密封力。在最初启动时，要打开阀门，手轮必须再旋转至少1 /2圈或一整圈。这种阀门的流量比扳手型阀门的流量小得多，因此有必要彻底打开阀门。禁止反向固定阀门。彻底打开阀门，接着顺时针旋转手轮1 /2圈。象最初开启阀门时一样，大约1 /2圈时不会遇到阻力。这又是阀杆装置的自由运动。当遇到关闭阻力时，停止旋转。这个位置将提供最大的流量，并允许在紧急情况下最快地关闭阀门。它还排除了把开启的阀门误认为关闭的阀门的可能性。

**Recommended Closing Procedure:** Close the cylinder valve tightly using a gloved hand. Air Products recommends always wearing gloves when operating cylinder valves. NEVER use wrenches or other persuaders to operate the valve.

推荐的关闭程序：用戴手套的手紧紧地关闭钢瓶阀门。Air Products推荐操作钢瓶阀门时总是戴手套。禁止用扳手或其它强制性的工具来操作阀门。

**Valve Advantages:** The valve can be used in many of the same services as the wrench-operated valve. No threads or lubricants are in the wetted gas stem. The valve effectively seals at higher pressures with less closing torque than the wrench-operated design. The packing design provides greater seal integrity than other packed valves. The valve is hand operated, thereby eliminating the need for special wrenches. The non-rotating lower stem eliminates much of the particle generation and wear associated with the wrench-operated packed valves.

阀门的优点：该阀门可以用于许多使用扳手型阀门的应用中。在接触潮湿气体的阀杆上没有螺纹或润滑剂。同扳手型设计相比，这种阀门可以在更高的压力下使用更小的转矩有效地密封。这种衬垫设计提供了比其它密封阀门更大的密封完整性。阀门是手动的，因而不需要特殊的扳手。不旋转的下阀杆很大程度上排除了颗粒产生和磨损问题，而扳手型衬垫阀门具有这个问题。

**Valve Disadvantages:** Although this valve has better particle generation characteristics and leak integrity than other packed valves, diaphragm valves are superior to these valves in these attributes. The stem design makes this a very rapid opening valve and it should not be used in services where gas velocity and adiabatic heat of compression are a concern (such as in oxidizer service). The dead band in the stem prohibits the use of any presently available separate pneumatic openers.

阀门的缺点：尽管同其它衬垫阀门相比这种阀门具有更好的颗粒产生特性和泄漏完整性，但在这些特性方面，膜阀比这些阀门更好。阀杆设计使它成为一种可以迅速开启的阀门，但它不能用于关心气体速度和压缩隔热的场合（如氧化剂设施）。阀杆的无控制作用区禁止任何现有的分离的



气动开启工具的使用。

Comments: This valve is typically used to replace the wrench-operated valve in non-ultrahigh integrity applications.

评论：这种阀门典型用于在非超高纯度应用中代替扳手型阀门。

WARNING: Improper use of cylinder valves may result in serious injury!

警告：不正确使用钢瓶阀门会导致严重伤害！

## The Spring-Loaded Diaphragm Valve (First Generation)

### 弹簧隔膜阀（第一代）

Products: Highly Toxic Gases, High-Purity Gases, Rare Gases and Pyrophoric Gases

产品：剧毒气体，高纯度气体，稀有气体和自燃气体

Operating Principle: The diaphragm valve is a handwheel-operated valve, utilizing a two-piece stem separated by non perforated diaphragms. These diaphragms prevent leakage along the valve stem. The lower stem is encased in a spring which forces the stem away from the seat when the valve is opened. The upper stem is threaded into the diaphragm retainer nut. When the handwheel is rotated to the closed position the upper stem pushes on the diaphragms, which deflect downward, forcing the lower stem against the valve seat. When the handwheel is rotated toward the open position the upper stem is moved away from the diaphragms allowing the spring to push the lower stem away from the seat. The replacement of elastomeric seals with metal diaphragms gives this valve superior leak integrity to the atmosphere.

运转原理：膜板阀是一种手轮型阀门，它采用两个由非穿孔横隔膜隔开的阀杆。这些横隔膜防止了沿着阀杆的泄漏。下阀杆包裹在一个弹簧内部，当阀门开启时，弹簧迫使阀杆离开阀座。上阀杆通过丝口旋在横隔膜止动螺母里。当手轮旋转到关闭位置，上阀杆推动横隔膜，横隔膜下垂，迫使下阀杆接触阀座。当手轮象开启位置旋转时，上阀杆离开横隔膜，弹簧推动下阀杆离开阀座。用金属横隔膜代替人造橡胶密封给予了这种阀门更好的对空气的泄漏完整性。

### Identifying Features:

#### 鉴别特征：

1. The valve is equipped with a hand-wheel. The handwheel does not house a spring and does not wiggle or pivot.

阀门配有手轮。手轮内没有装弹簧，不会扭动或转动。

2. The stem rises and lowers as the valve is opened and closed.

当阀门开启或关闭时，阀杆上升或下降。

3. Beneath the handwheel is a hexheaded externally-threaded diaphragm-retaining nut.

手轮下面是一个六角形外螺纹横隔膜止动螺母。

Recommended Opening Procedure: The diaphragm valve handwheel rotates about



1 1 / 4 turns from fully open to closed. When opening a diaphragm valve, you will feel resistance for approximately one turn, at which point most or all resistance on the handwheel will disappear. At this point the upper stem has lost contact with the diaphragms. The valve should be opened to this point but not back seated. When the handwheel is free from resistance, the valve will provide maximum flow but will not be mistaken for a closed valve because the handwheel will turn freely.

推荐的开启程序：从彻底打开到关闭，隔膜阀手轮旋转大约1 1 / 4圈。当开启隔膜阀的时候，在大约一圈中，你会感觉到阻力，到了一圈时，大部分或所有阻力都会消失。在此时，上阀杆已经失去了同横膈膜的接触。阀门应该开启到这一点，但不能反向固定。当手轮没有阻力的时候，阀门将提供最大的流量，但因为手轮可以自由旋转，不会被误认为是关闭的阀门。

**Recommended Closing Procedure:** The diaphragm valve can be difficult to close. When the valve is open, full cylinder pressure is exerted on the diaphragms. The diaphragms have a surface area of about one square inch. The pressure on this large surface area makes it difficult to push the diaphragms down. When closing the valve against cylinder pressure, about 60% of the closing force goes toward overcoming the gas pressure, while only 40% of the force is transmitted to the seat. Therefore, when a pressurized diaphragm valve is closed to the recommended 10 ft-lbs. and the valve outlet is depressurized, the closing force on the seat is only 4 ft-lbs. Many diaphragm valves are either weeping through at this point or are just barely closed. Because of this effect, it is necessary to use a "double close procedure" on these valves. This procedure requires the operator to close the valve as tightly as possible by hand (gloved hands are recommended), to vent the pressure in the valve outlet, and then to re-tighten the valve immediately. This is commonly referred to as double closing. NEVER use wrenches or other persuaders to operate the valve. Use of these cheaters can permanently damage the valve components.

推荐的关闭程序：隔膜阀的关闭是比较困难的。当阀门开启的时候，全部的钢瓶压力都施加在横膈膜上。横膈膜的表面积大约是1平方英寸。这样大面积上的压力使得向下推动横膈膜是很困难的。当在钢瓶压力下关闭阀门时，关闭力量的大约60%向下克服气体压力，而只有40%的力传递到阀座。因此，当使用推荐的10 ft-lbs力来关闭受压隔膜阀且阀门排气口压力下降时，在阀座上的关闭力量只有4 ft-lbs。许多隔膜阀在这一点或者泄漏，或者根本就关不上。由于这种作用，在这些阀门上有必要使用一个“二次关闭程序”。这个程序要求操作者用手（推荐用戴手套的手）尽可能紧地关闭阀门，排出阀门排气口的压力，接着马上重新关紧阀门。这一般称为二次关闭。禁止使用扳手或其它强制性工具来操作阀门。使用这些工具会永久性地损坏阀门组件。

**Valve Advantages:** The replacement of elastomeric packings by metal diaphragms gives this valve superior leak integrity at the top works of the valve and stem. This is why shipping regulations require diaphragm valves on most poisonous gas cylinders. The valve shave no threads or lubricants in the gas stream to generate particles or contaminate the gas.

阀门的优点：用金属横膈膜代替人造橡胶衬垫在阀门和阀杆的顶部机件处给予了这种阀门出众的泄漏完整性。这正是为什么运输规范要求在大多数有毒气体钢瓶上使用隔膜阀的原因。阀门没有螺纹或润滑剂处在气流中，不会产生颗粒或污染气体。



Valve Disadvantages: The valve is difficult to close and requires the operator to double close the valve. Because of this difficulty in closing, operators commonly use wrenches and other persuaders on the valves. To compound this problem the valves do not withstand this abusive treatment to any great extent. The diaphragms may become permanently inverted and the elastomeric stem tip can cold flow down the throat of the valve. This plug of extruded elastomer can be lodged in the throat so tightly that even 2000 psig of pressure will not dislodge it. This valve does not function well in corrosive service. Because of its design, materials of construction, and surface finish, the valve is very prone to corrosion. What usually happens is that the spring corrodes to the stem and valve body and becomes immovable. This can happen in both the open and closed positions. The valve is also prone to open when exposed to vibration and shock unless it is properly closed and secured.

阀门的缺点：阀门难以关闭，要求操作者二次关闭阀门。由于关闭困难，操作者一般都在阀门上使用扳手和其它强制性工具。使这个问题复杂化的是阀门不能承受任何程度的虐待。横隔膜会永久性的翻转，人造橡胶阀杆尖端会冷变形到阀门的喉管处。突出的人造橡胶会紧紧的堵在喉管处，即使2000 psig的压力也不能把它移走。这种阀门在腐蚀性设施中无法正常工作。由于它的设计、建材和表面加工，阀门很容易腐蚀。通常发生的是弹簧同阀杆和阀体腐蚀在一起，变得无法移动。在开启和关闭位置都可能发生这种情况。当暴露于震动和冲击时，除非阀门已经正确关闭和固定，否则它还很容易打开。

Comments: When using diaphragm valves or any valve with a soft seat material in a service where corrosion products can be produced, it is very important to take precautions to prevent those reactions. Corrosion products formed by these reactions can prevent normal valve operation and can become embedded in the elastomeric stem tip, preventing the valve from making a complete seal. When disconnecting cylinders with diaphragm valves, it is most important to double close the valve and to properly install the outlet seal. Failure to use this procedure can result in release of the product into the environment.

评论：当在可能产生腐蚀产物的设施处使用隔膜阀或任何带有软阀座材料的阀门时，采取防范措施来防止那些反应是非常重要的。这些反应产生的腐蚀产物会阻止正常的阀门运转，深入到人造橡胶阀杆顶端，造成阀门不能完全密封。当切断钢瓶和隔膜阀的连接时，两次关闭阀门和正确安装排气口密封是最重要的。不采用这个程序会导致产品泄漏入环境。

**WARNING: Improper use of cylinder valves may result in serious injury!**

警告：不正确使用钢瓶阀门会导致严重伤害！

## **The Spring-Loaded Diaphragm Valve(Second Generation)**

### **弹簧隔膜阀（第二代）**

Products: All Products except Fluorine, High Concentration Fluorine Mixtures (> 20%), and Strongly Oxidizing Fluorine Derivatives

产品：除了氟、高浓度氟混合物(> 20%)和强氧化氟衍生物以外的所有产品

Operating Principle, Identifying Features, Recommended Opening, and Closing Procedures:



运转原理，鉴别特征，推荐的开启和关闭程序：

Identical to those of the First Generation Diaphragm Valve.

与第一代隔膜阀相同

**Valve Advantages:** Along with the advantages of the earlier diaphragm design, the second generation valves incorporate features which provide additional benefits and flexibility. These valves are referred to as second generation diaphragm valves because basic changes in the valve design have been incorporated to resolve the deficiencies of the earlier diaphragm valves. These changes include design of the wetted gas house to provide better functioning, improved materials of construction, and improved surface finishes. These changes enable this generation to be used successfully in corrosive service. The valve's design prevents diaphragm inversion. The elastomeric stem tips are re-designed, usually in a "donut" configuration, to prevent the plugging extrusion problems of the earlier design. These changes also make this generation of valves cleaner from a standpoint of particle generation.

阀门的优点：除了较早的横隔膜设计的优点以外，第二代阀门还具备了提供另外的好处和适应性的特点。因为阀门设计产生了基本的变化，以克服较早的隔膜阀的缺点，这些阀门被称为第二代隔膜阀。这些变化包括设计潮湿气体室以更好地发挥功能、改进的建材和改进的表面加工。这些变化使得这一代隔膜阀可以成功地应用于腐蚀物设施。阀门的设计防止了横隔膜的倒置。重新设计了人造橡胶阀杆顶端，通常是“油炸圈饼”的构造，防止了较早的设计的阻塞性突起的问题。从颗粒产生的观点来看，这些变化还使这一代阀门成为了清洁剂。

**Valve Disadvantages:** Although the improvements to this generation of valves eliminate the more serious problems of damage from abusive closing, they are not totally immune to abuse. These valves will also sustain damage when excessively torqued. This damage could include stem breakage or internal damage which would preclude ongoing use. These valves, like the earlier diaphragm valve designs, still include relatively large volume interiors with complex surfaces and are not fully optimized for cleanliness or purgability.

阀门的缺点：尽管对这一代阀门的改进排除了由于粗暴关闭造成的损害问题中比较严重的问题，但它们还不能完全防止机械损伤。当过分扭转时，这些阀门还是会受到损伤。这种损伤可能包括阀杆断裂或阻止继续使用的内部损伤。象较早的隔膜阀设计一样，这些阀门仍然包含相对容积较大的内部和复杂的表面，在清洁和净化方面也还没有充分优化。

**Comments:** When working with these valves it is very important to use good cylinder change out procedures. These procedures must incorporate adequate purge and evacuation times to allow the valve interior to be properly cleaned. This problem becomes more critical if the valve is equipped with a restrictive flow orifice. Rapid purge and evacuation cycles are often ineffective in the removal of contaminants from these valves.

评论：当与这些阀门一起工作时，使用良好的钢瓶更换程序是非常重要的。这些程序必须包括充分的净化和抽空时间，以允许适当清洁阀门内部。如果阀门配备有限制流速孔，这个问题就变得更加关键。过快的净化和抽空周期对于这些阀门内污染物的排除通常是无效的。



WARNING: Improper use of cylinder valves may result in serious injury!

警告：不正确使用钢瓶阀门会导致严重伤害！

## The Tied-Diaphragm Valve (Third Generation)

### 束缚隔膜阀（第三代）

Products: Same as Second Generation Spring-Loaded Diaphragm Valve

产品：同第二代弹簧隔膜阀相同

Operating Principle: The tied-diaphragm valve is a handwheel-operated valve, utilizing a two-piece stem connected through the diaphragms. The metal diaphragms act as the seal at the top of the valve. The primary improvement in this generation of valves is the elimination of the spring used to open the valve. The lower stem is physically pulled away from the seat instead of being lifted away by the spring. This is accomplished by piercing the diaphragms and mechanically connecting the upper and lower stems. The point of penetration through the diaphragms is sealed by E-beam welding. When the upper stem rides up and down on its threads it now moves the lower stem by a mechanical connection.

运转原理：束缚隔膜阀是采用通过横隔膜连接的两个阀杆的手轮型阀门。金属横隔膜在阀门的顶部作为密封。这一代阀门的主要的改进是取消了用于开启阀门的弹簧。下阀杆是被从阀座上物理地推开，而不是被弹簧举起来。这是通过穿透横隔膜，把上下阀杆机械地连接在一起来实现的。通过横隔膜的穿透点用电子束焊接来密封。当上阀杆沿着它的螺纹上下运动时，通过机械连接带着下阀杆一起运动。

### Identifying Features:

#### 鉴别特征：

1. The valve is equipped with a hand-wheel. The handwheel does not house a spring and does not wiggle or pivot.

阀门配有手轮。手轮内没有装弹簧，不会扭动或转动。

2. The stem rises and lowers as the valve is opened and closed.

当阀门开启或关闭时，阀杆上升或下降。

3. Beneath the handwheel is one set of wrench flats on a nut threaded into the valve body. This is the diaphragm-retaining nut.

在手轮下面，在一个旋进阀体的螺母上面是一套扳手面。这是横隔膜止动螺母。

4. The valve has a threaded leak check port located on the side of the valve. This allows the diaphragms to be leak checked.

在阀门的侧面有一个带有螺纹的泄漏检查口。可以对横隔膜检漏

Recommended Opening Procedure: The diaphragm valve handwheel travels about 3/4 turn from fully open to closed. Because the stems have a mechanical connection, tied-diaphragm valve shave a different feel than spring-loaded diaphragm valves. The upper stem is always attached to the diaphragms so there is no "free-spinning" point. The valve should be opened fully but not backseated. This will provide



maximum flow but will not be mistaken for a closed valve because it is easily moved. 推荐的开启程序：从完全开启到关闭，隔膜阀手轮旋转大约3/4圈。因为两个阀杆有机械连接，束缚隔膜阀与弹簧隔膜阀的操作感觉不一样。上阀杆总是和横隔膜连在一起，所以没有“自由旋转”点。阀门应该完全开启，但不能反向固定。这将提供最大的流量，但不会被误认为是关闭的阀门，因为可以很容易地移动它。

Recommended Closing Procedure: This new design does not solve the old difficulty in closing because the diaphragms are still affected by gas pressure. The diaphragm valve may be difficult to close. The reason for this difficulty lies in the design. When the valve is open, full cylinder pressure is exerted on the diaphragms. The diaphragms have a surface area of about one square inch. The pressure on this large surface area makes it difficult to push the diaphragms down. When closing the valve against cylinder pressure, about 60% of the closing force goes toward pushing the diaphragms down, while only 40% of the force is transmitted to the seat.

Therefore, when a pressurized diaphragm valve is closed to the recommended 10 ft-lbs. and the valve outlet is depressurized, the closing force on the seat is only 4 ft-lbs. Most diaphragm valves are either weeping through at this point or are just barely closed. Because of this phenomenon, it is necessary to use a “double close” procedure on these valves. This procedure requires the operator to close the valve as tightly as possible by hand (gloved hands are recommended), then vent the pressure in the valve outlet and reclose the valve immediately. This is commonly referred to as double closing. NEVER use wrenches or other persuaders to operate the valve. Use of these cheaters can permanently damage the valve internals.

推荐的关闭程序：因为横隔膜仍然受到气体压力的影响，这种新设计没有解决在关闭上的老困难。隔膜阀还是难以关闭。该困难的原因在于设计。当阀门开启时，全部的钢瓶压力施加在横隔膜上。横隔膜的表面积大约是1平方英寸。这样大面积上的压力使得向下推动横隔膜是很困难的。当在钢瓶压力下关闭阀门时，关闭力量的大约60%向下克服气体压力，而只有40%的力传递到阀座。因此，当使用推荐的10 ft-lbs力来关闭受压隔膜阀且阀门排气口压力下降时，在阀座上的关闭力量只有4 ft-lbs。许多隔膜阀在这一点或者泄漏，或者根本就关不上。由于这种作用，在这些阀门上有必要使用一个“二次关闭程序”。这个程序要求操作者用手（推荐用戴手套的手）尽可能紧的关闭阀门，排出阀门排气口的压力，接着马上重新关紧阀门。这一般称为二次关闭。禁止使用扳手或其它强制性工具来操作阀门。使用这些工具会永久性地损坏阀门内部零件。

Valve Advantages: Along with the advantages of the spring-loaded diaphragm valves, tied-diaphragm valves incorporate features which provide additional benefits. A major benefit of the tied-diaphragm design is that it has a much lower internal volume, less surface area, and less complex surfaces in the gas path than other designs. These attributes make the tied diaphragm valve more appropriate and successful for corrosive gas service. In all services, the tied-diaphragm valve is the most easily purged, particle-free valve design now in use. Anti-extrusion stem tips and anti-inversion diaphragm configurations are incorporated in this design, eliminating those potential problems.

阀门的优点：除了弹簧隔膜阀的优点以外，束缚隔膜阀还具备了提供另外的好处的特点。束缚横隔膜设计的一个重大好处是它比其它设计具有更小的内部体积、更小的表面积和在气体路径上的



更简单的表面。这些特点使得束缚隔膜阀可以更合适和更成功地应用于腐蚀性气体设施。在所有应用中，束缚隔膜阀是现在正在使用的最容易净化的无颗粒阀门设计。这种设计里包含了抗突起的阀杆顶端和抗倒置横隔膜结构，排除了那些潜在的问题。

**Valve Disadvantages:** Like all diaphragm valves, tied-diaphragm valves can be difficult to properly close and require the same double closure techniques as are used with spring-loaded diaphragm valves. These valves can be damaged if significantly over torqued (> 20 ft-lbs) and should never be operated with wrenches or persuaders.

阀门的缺点：象所有的隔膜阀一样，束缚隔膜阀正确关闭比较困难，要求采用象弹簧隔膜阀一样的二次关闭技术。如果太过分扭转阀门(> 20 ft-lbs)，会损坏这些阀门。禁止用扳手或强制性工具来操作阀门。

**Comments:** Although these valves are the best available, they still require trained operators and good procedures to provide maximum benefit. Tied-diaphragm valves offer excellent performance potential for ultrahigh-integrity applications with corrosive, toxic, flammable, and mildly oxidizing gases. Like all cylinder valves, optimum performance requires knowledgeable operators and appropriate procedures.

评论：尽管这些阀门是现有最好的，它们仍然要求经过训练的操作员和良好的程序来发挥最大的作用。对于有腐蚀性、有毒、易燃和适度氧化性气体的超高纯度应用，束缚隔膜阀提供了卓越的表现潜力。象所有的钢瓶阀门一样，最佳的表现需要有知识的操作员和合适的程序。

**WARNING: Improper use of cylinder valves may result in serious injury!**

警告：不正确使用钢瓶阀门会导致严重伤害！

## Basic Valve Rules

### 基本的阀门规则

#### ALWAYS

##### 总是

- open valves slowly to control pressures urges and heat of compression!

慢慢打开阀门，以控制压力负荷和压缩热。

- use the correct CGA connection for hook-up!

连接时使用正确的CGA接头。

- inspect the valve for damage and foreign materials before connecting it to your equipment!

在把阀门连接到你的设备之前，检查阀门是否有损伤或不相容材料。

- ensure when the cylinder is not in use, even when empty, that the valve is in the closed position with the outlet seal in place and the transport cap installed!

当没有使用钢瓶时，甚至当钢瓶空着的时候，确保阀门处在关闭位置，排气口密封处在原位，安装了运输帽。

- consult your supplier if you have any questions regarding cylinder valves!





如果你有任何关于钢瓶阀门的问题，请教你的供应商。

- make packing nut adjustments with the valve outlet depressurized!

在阀门排气口减压时，进行衬垫螺母调节。

- restrain cylinders!

固定钢瓶！

When returning any cylinder, ensure that the cylinder valve is properly closed, any outlet seals are in place and properly tightened, and the transport cap is correctly installed.

当任何钢瓶返还时，确保钢瓶阀门已经正确关闭，任何排气口密封都在适当的位置而且正确上紧，运输帽已经正确安装。

## **NEVER**

### **禁止**

- tamper with pressure relief devices!

堵塞减压装置！

- attempt to tighten or loosen the valve into or out of the cylinder!

试图上紧或放松钢瓶阀门！

- use a damaged valve where integrity may have been affected!

在完整性可能已经受到影响的地方使用损坏的阀门。

- continue to use a valve that operates abnormally, i.e., becomes noisy or progressively harder to operate!

继续使用运转不正常的阀门，如有噪声的或越来越难以操作的！

- use an automatic operator, adapter, wrenches, or other tools to obtain a mechanical advantage on hand-wheel-operated valves without consulting your supplier first!

没有首先同你的供应商商量就使用自动操作手、接头、扳手或其它工具，来获得在手轮操作阀门上的机械便利！

- lubricate valves or their connections!

润滑阀门或它们的接头！

- drag, lift, or move a cylinder using the valve or the hand wheel as a handle!

把阀门或手轮作为手柄来拉拽、提举或移动钢瓶！

- remove packing nuts on packed valves!

去掉衬垫阀门上的衬垫螺母！

- adjust or tamper with retainer or bonnet nuts on diaphragm or pressure seal valves!

调整或篡改膜阀或压力密封阀上的固定器或阀帽螺母！

- use the cylinder valve to regulate flow or pressure!

使用钢瓶阀门来控制流速或压力！

- move cylinders without the transport cap installed!

没有安装运输帽就移动钢瓶！

- interchange transport caps between cylinders!

在钢瓶之间交换运输帽！

**WARNING: Improper use of cylinder valves may result in serious injury!**

警告：不正确使用钢瓶阀门会导致严重伤害！