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# Cylinder Valve Outlet Connections

## 钢瓶阀门排气口接头

### Introduction

#### 引言

The Connections Standards Committee of the Compressed Gas Association (CGA) is responsible for assigning standard connections for specific gases and establishing detailed dimensions for the manufacture of these connections. The main purpose for establishing such standards is to prevent interconnection with non-compatible gases and to provide continuity among manufacturers. Assigned connections also prevent interconnection of the same gas at incompatible pressures.

压缩气体协会（CGA）的接头标准委员会负责为特殊气体指定标准接头和为这些接头的制造确定详细的尺寸。建立这些标准的主要目的是防止不相容气体的相互连接和在制造商之间提供连续性。指定接头还防止了在不相容压力下同样气体的交叉连接。

There are four basic groups of valve outlet connections: (1) connections for general, industrial compressed gas service; (2) connections for self-contained breathing apparatus (SCBA) service; (3) connections for ultra-high-integrity service; and (4) pin-indexed connections for medical gas service. Although this Safetygram addresses connections only for industrial compressed gas service and ultra-high-integrity gas service, much of this information also applies to the other two groups.

有四组基本的阀门排气口接头：（1）用于普通的工业气体设施的接头；（2）用于自给式呼吸器（SCBA）装置的接头；（3）用于超高完整性装置的接头；和（4）用于医疗气体设施的指度针接头。尽管本安全程序只说明用于工业压缩气体设施和超高纯度气体设施的接头，这些资料中的许多也适用于其它两组接头。

In North America, outlet connections are usually designated by a three-digit number preceded by the letters CGA, the acronym for the Compressed Gas Association, for example, CGA 350. Sometimes an ultra-high-integrity connection is preceded by a "DISS" designation rather than the more common CGA designation. DISS is the acronym for Diameter Index Safety System.

在北美，排气口接头通常由在字母CGA之后的三位数字指定名称，例如CGA 350。CGA是压缩气体协会的只取首字母的缩写。有时候超高完整性接头的指定名称的前面是"DISS"，而不是更常用的CGA。DISS是直径指数安全系统的只取首字母的缩写。

### Typical Connections

#### 典型的接头

A typical connection consists of three or four parts depending on whether it is a bullet-nose or a gasketed connection. A bullet-nose connection consists of a valve outlet, a nut, and a nipple. The nut is placed on the nipple so the shoulder of the

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nipple rests against the pushing surface of the nut. The nut has straight threads that engage the mating threads on the valve outlet and pull the nipple against the sealing surface of the valve outlet. No sealing takes place at the threads. The gas-tight seal takes place between the nipple and the valve outlet seat at a very small contact circle where they touch. The success of this connection depends on the surface condition of both the nipple and the valve outlet sealing area at the point of contact.

根据它是弹头接头还是衬垫接头，一个典型的接头由三个或四个零件组成。一个弹头接头由一个阀门排气口、一个螺母和一个管接口组成。螺母放在管接口的上面，因而管接口靠在螺母的螺纹正面。螺母有直螺纹，直螺纹咬合阀门排气口上的配合螺纹，拉动管接口靠在阀门排气口的密封面上。在螺纹上不形成密封。不漏气的密封形成在管接口和阀门排气口座之间，在它们接触的一个非常小的接触圆周处。这种接头的成功依赖于管接口和阀门排气口密封在接触点的表面状况。

Some bullet-nose connections have a soft tipped nipple or an O-ring on the nipple to improve the seal. This allows the connection to be made without a wrench, using a nut equipped with a hand wheel. These connections are called hand-tight connections.

一些弹头接头具有一个软头管接口或在管接口上有一个O形圈，以改善密封。这使得不用扳手，而是使用带手轮的螺母就可以进行连接。这些接头称为手紧接头。

A gasketed connection has four parts: the valve outlet, a nipple, a nut, and a gasket (or washer). The nipple of the gasketed connection is not bullet-shaped as in the bullet-nose connections, but is flat to compress the gasket. The valve outlet sealing area is also flat. The nut fits on the nipple so the shoulder of the nipple rests on the pushing surface of the nut. The washer is placed on the flat surface of the nipple inside the nut. The straight threads of the nut engage with the mating threads of the valve outlet and are tightened to compress the gasket between the two sealing surfaces.

一个衬垫接头有四个零件：一个阀门排气口、一个管接口、一个螺母和一个衬垫（或垫圈）。衬垫接头的管接口不是象弹头接头那样的子弹形，而是平的，以便压缩衬垫。阀门排气口密封区域也是平的。螺母配合在管接口上，因而管接口靠在螺母的螺纹正面。垫圈放在螺母内的管接口的平面上。螺母的直螺纹同阀门排气口的配合螺纹咬合在一起并上紧，来压缩在两个密封表面之间的衬垫。

Standard industrial valve outlet connections are designed to provide a "bubble-tight" connection, which refers to leak-checking the connection with a soap solution or by immersing it in water. Bubbles indicate a leak. Leak detection solutions vary in their ability to detect leaks. However, leakage rates for standard connections range from  $1 \times 10^{-3}$  to  $1 \times 10^{-5}$  cc of helium per second. Slower leak rates can be obtained with these connections depending on surface finishes, gasket materials, and mechanical condition. However, achieving slower leak rates can be difficult and inconsistent, one of the primary reasons why the ultra-high-integrity outlet connections were developed.

标准工业阀门排气口接头设计得可以提供一种“不冒泡”接头。这是指用肥皂水溶液或把它浸在水中来对接头检漏。起泡说明有泄露。检漏溶液的检漏能力是不同的。但是，标准接头的泄露率在

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每秒 $1 \times 10^{-3}$  到 $1 \times 10^{-5}$  毫升氦范围内。依赖于表面光洁度、衬垫材料和机械状况，用这些接头可以获得更慢的泄露率。但是，获得更慢的泄露率可能是困难和不协调的，这是为什么发展超高完整性排气口接头的一个主要原因。

## Force Required for Seal

### 密封要求的力

One of the most confusing issues concerning outlet connections is how much force one should apply to achieve a seal without damaging the connection. There are many variables that affect the force required to achieve an acceptable seal. For bullet-nose connections, the variables include materials of construction, contact surface conditions, thread condition, and machining quality. Materials of construction influence several aspects of the connection. Harder materials, such as stainless steel, have less lubricity than other metals, which causes higher friction in the thread engagement. Lubricity also affects the durability of the sealing surfaces, as well as the ability of those surfaces to mate and seal, i.e., harder materials of construction are much harder to seal. These materials are also often harder to machine making it more difficult to produce smooth threads.

应该用多大的力来完成密封而又不损坏接头，这是关于排气口接头的最混乱的问题之一。影响完成合格的密封所要求的力的变量有很多。对于弹头接头，变量包括建材、接触表面的状态、螺纹的状态和加工质量。建材影响接头的几个方面。较硬的材料，如不锈钢没有其它金属光滑，这导致了螺纹咬合的更大的摩擦。光滑性还影响了这些密封表面的耐久力，以及那些表面配合和密封的能力，也就是说，越硬的建材越难以密封。这些材料通常还难以加工，难以制造出光滑的螺纹。

The surface finish and condition at the point of sealing contact are also critical. Softer materials, such as brass, are more easily damaged, yet are also more malleable, so they can actually deform to minimize imperfections. Machining quality is usually not a problem with the sealing surfaces of outlet connections, but it may impact the threads. This is especially true for the harder materials of construction. Their thread surfaces may be rough and can cause higher-than-normal friction or even galling when making and breaking connections. Damaged or badly worn threads can also cause problems with sealing.

密封接触点的表面光洁度和状态也是很关键的。较软的材料，如黄铜，更容易受到损伤，但是也更具有延展性，因此它们实际上可以通过变形来最大限度减少缺陷。排气口接头的密封表面的加工质量通常不是问题，但它会影响螺纹。对于较硬的建材更是如此。它们的螺纹表面可能是粗糙的，当进行和断开连接时，它们会引起大于正常情况的摩擦或者甚至金属表面磨损。被损坏的或严重磨损的螺纹也会引起关于密封的问题。

Some bullet-nose connections have soft tips or O-rings on the nipples. The nuts on these connections usually have hand wheels mounted on them. These connections are sometimes referred to as "hand-tights" because they are designed to be connected and sealed without the use of tools.

一些弹头接头具有一个软头或在管接口上有O形圈。这些接头上的螺母上通常装有手轮。因为它们不使用工具进行连接和密封，有时候这些接头称为手紧接头。

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If your connection requires more force than the values suggested in Table 1, inspect the connection for marred, dirty, or worn sealing surfaces or worn or damaged threads. Replace any damaged or worn connections.

如果你的接头要求比表1建议的值更大的力，检查接头，看密封表面是否有损伤、肮脏或磨损，或螺纹是否磨损或损伤。替换任何损伤或磨损的接头。

## Washer Materials for Gasketed Connections

### 用于衬垫接头的垫圈材料

With gasketed connections, the material of construction of the washer is important, both for compatibility with the gases in use and for its mechanical properties.

Washer materials are non-metallic or metallic. Non-metallic gaskets can be made from many different materials. The most common CGA washers are made from fiber, nylon, PTFE (Teflon®) or CTFE. A typical metallic washer is made from lead or softened copper. Each material has its advantages and disadvantages. The first requirement for a gasket is compatibility with the product being handled. Some of the other properties to be considered are leak integrity, permeation, cold flow, off-gassing, particle shedding, and cost. The tightening force required for gasketed connections is somewhat dependent on the washer material being used.

对于衬垫接头，垫圈的结构材料对于使用的气体的相容性和垫圈的机械性能都是很重要的。垫圈材料是非金属性的或金属性的。非金属衬垫可以由许多不同材料制成。最普通的CGA垫圈用纤维、尼龙、PTFE（特氟纶）或CTFE制造。典型的金属垫圈用铅或软铜制作。每种材料都由它的优点和缺点。对于衬垫的第一个要求是同正在操作的产品相容性。要考虑的一些其它性质是泄露完整性、渗透、冷变形、排气、颗粒脱落和成本。对于衬垫接头，所要求的上紧的力量稍微依赖于正在使用的垫圈材料。

Recommends specific washer materials for certain applications. Nylon gaskets are recommended for medical yoke connections, while fiber washers are commonly used in carbon dioxide service. PTFE is compatible with most gases and is the most common washer material used with specialty gases. However, PTFE has some properties that can make it a poor choice for a washer material. It has a tendency to cold-flow. Cold flow occurs when pressure is applied to the material, and it flows away from the pressure. This can cause leaks to develop as the washer moves, reducing the sealing pressure on the washer. The flowing washer material can also restrict flow paths and jam in the connection threads. PTFE is also permeable to moisture and oxygen, which can cause micro contamination in sensitive processes. 为特定的应用推荐专门的垫圈材料。尼龙衬垫被推荐用于医用卡箍接头，而纤维垫圈一般用于二氧化碳设施。PTFE同大多数气体相容，是用于特种气体的最常用的垫圈材料。但是，PTFE有一些使它成为垫圈材料的较差选择的性质。它有冷变形的倾向。当压力施加到材料上时，冷变形发生，材料向远离压力的方向流动。当垫圈移动时，垫圈上的密封压力减小，可能导致逐步发展为泄露。正在流动的垫圈材料还会限制气体流程和堵塞在接头螺纹内。PTFE还能透过水蒸汽和氧气，在敏感过程中这会导致微小污染。

When PTFE washers are used in systems using water-reactive acidic or basic gases,

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their moisture can cause the formation of corrosive acids or alkaline liquids in the system. For most specialty gases, CTFE is recommended over PTFE because it is less permeable to oxygen and moisture, and evidences less cold flow. This leads to better leak integrity and allays contamination concerns. In some applications, PTFE mixed with a solid filler material—such as calcium fluoride or brass—is used to reduce the cold flow and permeation rates of the PTFE. This is especially important when PTFE washers are being used in acid gas service where the elimination of moisture contamination is critical. Lead or annealed copper washers are most often used in fluorine and other reactive fluoride service.

当PTFE用于使用可以同水反应的酸性或碱性气体气体的系统时，它们的水蒸汽会在系统内导致腐蚀性酸性或碱性液体的生成。对于大多数特种气体，推荐使用CTFE，而不是PTFE，这是因为CTFE对氧气和水蒸汽的渗透性更差，冷变形也较小。这导致了更好的泄露完整性，减少了对污染的担心。在一些应用中，在PTFE中混合了固体填充材料，如氟化钙或黄铜，用于减少冷变形和PTFE的渗透率。当PTFE垫圈用于去除水蒸汽污染十分关键的酸性气体设施时，这是特别重要的。铅或退火铜垫圈最经常用于氟和其它活泼氟化物设施。

For best results, install a new washer with every cylinder change.

要得到最好的成效，每次换钢瓶的时候装一个新的垫圈。

For many gasketed connections, overtightening can result in the washer being compressed into the bore of the connection, limiting or even stopping the flow of gas. Overtightened washers can be distorted into the connection's threads, making disassembly or washer removal difficult. To prevent this from happening, avoid excessive tightening force and install a new gasket with every cylinder change. Gasketed connections do not mechanically bond the valve and connection with the same force as bullet-nose connections. This means if the downstream equipment twists or vibrates, these connections are more likely to develop leaks than bullet-nose connections.

对于许多衬垫接头，上的过紧会导致垫圈被压进接头孔，限制或甚至阻断气流。过紧的垫圈会扭曲到接头的螺纹里，使拆卸或取掉垫圈变得很困难。为了防止这种情况发生，避免用过大的上紧力，并且每次换钢瓶的时候装一个新的垫圈。衬垫接头把阀门和接头机械地连接在一起的力比弹头接头的力小。这意味着如果下游设备扭动或震动，这些接头比弹头接头更容易产生泄露。

## **DISS Connections**

### **DISS接头**

Ultra-high-integrity service or DISS connections are designed for applications where the requirements for system leak integrity are very high, primarily in the semiconductor industry. A DISS connection is a gasketed type that consists of the valve outlet, nut, nipple, and gasket. The sealing contact surfaces are much more sophisticated than those of a general, industrial connection. The washer is usually made of annealed nickel and has a highly polished surface. The sealing points on the nipple and valve outlet are comprised of highly polished toroidal beads. When the nut is screwed to the valve threads, it pulls the nipple into the valve outlet compressing the washer between the two beads. The beads are driven into the

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washer allowing the polished beads to form a crush seal onto the washer.

超高完整性装置或DISS接头设计用于对于系统的泄露完整性要求非常高的应用，主要是在半导体工业中。DISS接头是一种衬垫型接头，由阀门排气口、螺母、管接口和衬垫组成。密封接触面比一般工业接头的密封接触面复杂得多。垫圈通常用退火镍制成，具有非常光滑的表面。管接口和阀门排气口上的密封点由非常光滑的I垫珠组成。当螺母拧到阀门螺纹上时，它把管接口推进阀门排气口，压缩在两个垫珠之间的垫圈。垫珠被压进垫圈里，使得非常光滑的垫珠在垫圈里形成压扁密封。

The key to successful sealing of the DISS connection is the extremely smooth finish of the sealing surfaces. These surfaces must be protected to maintain high leak integrity. It is essential to use a new gasket each time the connection is tightened because the softened nickel washer becomes hardened after each compression. DISS接头成功密封的关键是密封表面的极端平滑。必须保护这些表面，以维持高度的泄露完整性。因为在每次压缩之后软化的镍垫圈会变硬，每次接头上紧时必须使用新衬垫。

Controlled tightening torque or force is another critical element with successful DISS connections. Sufficient force is required to push the metal sealing surfaces into the washer; too much force will damage the bead surfaces. Thus, torque wrenches should be used for tightening DISS connections. The recommended tightening torque is 35 foot-pounds with a nickel DISS washer and 12 to 15 foot-pounds for a CTFE washer. Slightly higher forces maybe used without immediate damage to the connection components, but nickel washers should never be tightened with more than 45 foot-pounds of force. If a required seal can be achieved without exceeding 45 foot-pounds of force, the connection can be used. If an adequate seal cannot be made, try a new washer. If the new washer does not work, replace the connection.

DISS接头成功密封的的另一个关键因素是控制上紧的转矩或力。要求足够的力量来把金属密封表面推进垫圈，但太大的力量会损伤垫珠表面。因此，应该使用扭矩扳手来上紧DISS接头。推荐的上紧转矩对于镍DISS垫圈是35英尺-磅，对于CTFE垫圈是12到15英尺-磅。可以用稍微大一点的力，不会立刻损伤接头零件，但是禁止用大于45英尺-磅的力来上紧镍垫圈。如果用不超过45英尺-磅的力能够达到要求的密封，这种接头就可以使用。如果不能达到充分的密封，试一个新垫圈。如果新垫圈还是不行，换接头。

## **CGA Technical Support**

### **CGA技术支持**

The CGA has published two technical bulletins: "TB-14: Torque Guidelines for CGA Outlet Connections" and "Guidelines for the Proper Handling and Use of Ultra-High-Integrity Service Connections." Both are available without cost. Order them from CGA through the association's Fax-on-Demand System at +1 (800) 827-5242 or from their web site at [www.cganet.com](http://www.cganet.com) or by calling +1 (703) 412-0900.

CGA已经出版了两个技术报告：“TB-14：CGA排气口接头的转矩指导”和“超高完整性设施接头的正确操作和使用指南”。两个报告都是免费的。从CGA预定它们可以通过协会的应要求传真系统+1 (800) 827-5242，或者通过他们的网址[www.cganet.com](http://www.cganet.com)，或者打电话+1 (703)

## **Outlet Seals Critical**

### **排气口密封的关键**

Outlet seals are an important part of many valve outlets. They are designed to provide a secondary seal in the event the cylinder valve develops leakage through the valve seat. The outlet seals are designed to safely contain full cylinder pressure. 排气口密封是许多阀门排气口的重要零件。它们是设计用来在钢瓶阀门通过阀座产生泄露的情况下提供一个二次密封。排气口密封设计得可以安全地承受全部钢瓶压力。

Remember, Department of Transportation (DOT) regulations require that outlet seals be installed on many products. It is also extremely important that they be reinstalled when the cylinder is removed from service. Outlet seals are as important as the outlet connection; make sure that any gaskets required are present and in good condition. Make sure that any outlet seal is properly tightened to the same torque requirement as the CGA connection for the particular valve outlet. If the gasket is not present or must be replaced, select a replacement compatible for the product involved. If you do not have a gasket, contact your supplier for a replacement.

记住，交通部规范要求在许多产品上安装排气口密封。当钢瓶从设施上拆卸下来时，要重新安装排气口密封，这也是极端重要的。排气口密封同排气口接头一样重要；要确保所要求的所有垫圈都在正确的位置而且状态良好。对于特定的阀门排气口，确保所有排气口密封都按与CGA接头同样的扭矩要求正确上紧。如果垫圈不在或者垫圈必须更换，选择一个同相关的产品相容的替代品。如果你没有垫圈，同你的供应商联系，要求一个替代品。