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8484 WESTPARK DRIVE, SUITE 220,
MCLEAN, VA 22102
(703) 788-2700 | www.cganet.com

POSITION STATEMENT

USE OF TAPERED AND PARALLEL (STRAIGHT) THREADS IN ALUMINUM ALLOY CYLINDERS

Question

What is the recommended valve thread type, tapered or parallel (straight), for aluminum alloy cylinders?

Answer

Each valve thread type has its own advantages. If there are no regulatory requirements that specify the valve thread type, the choice of valve thread type is up to the individual or organization (packager) doing the valve installation.

Background

For decades throughout the world, aluminum alloy cylinders have been successfully manufactured using the cold extrusion or hot extrusion process to produce both tapered and parallel (straight) thread designs. However, aluminum alloy cylinders manufactured from 6351 or 6082 alloys can exhibit sustained load cracking (SLC) in the shoulder and the neck of the cylinder. The use of shrunk-on neck rings provides additional reinforcement to the cylinder neck and can reduce the chance for neck crack growth.

Aluminum alloys cylinders are no longer permitted to be manufactured from 6351 or 6082 alloys. Today, 6061 and certain 7000 series alloys are the most commonly used aluminum alloys as cylinders manufactured from these aluminum alloys do not develop SLC.

Cylinders manufactured from 6351 or 6082 aluminum alloys may still be in service and have additional regulatory limitations and/or requirements. In the United States, see Title 49 of the U.S. *Code of Federal Regulations* (49 CFR) Parts 173 and 180 [1]. In Canada, see CSA B339-18, *Cylinders, spheres, and tubes for the transportation of dangerous goods*, Clause 24.2.10 [2].

Valves properly installed, whether with parallel (straight) or tapered inlet thread design, have proven to be reliable.

Comparisons of tapered and parallel (straight) threads

Table 1 lists the characteristics of each thread design as they relate to various aspects of the compressed gas industry.

Table 1—Thread design comparisons for high pressure aluminum alloy cylinders

Aspect	Parallel (Straight)	Tapered
History	Stresses in the neck/threaded region are less, which is an important design consideration if the cylinder alloy is susceptible to stress cracking (for example, SLC).	Stresses in the neck/threaded region are greater due to use of mechanical torque on threads to achieve a leak-tight cylinder/valve connection. This is an important design consideration if the cylinder alloy is susceptible to stress cracking (for example, SLC). NOTE—Tapered threads have been the preferred thread design worldwide for toxic, flammable, and corrosive gases.

Aspect	Parallel (Straight)	Tapered
Variation within design	Parallel (straight) thread profiles and sizes differ throughout the world. Differences are: • diameter; • pitch; and • thread form (profile).	Tapered thread profiles and sizes differ throughout the world. Differences are: • diameter; • pitch; • thread form (profile); • taper angle; and • thread form normal to the cone surface or parallel to the cone axis.
Production variation	It is easier to achieve machining within gauge limits. It is required that the sealing O-ring contact area on either the valve or the cylinder be free of irregularities that can be the source of an improper seal. It is required that the top surface (face) of the cylinder be held to tight tolerance.	It is more difficult to manufacture for dimensional control. Thread chatter is more relevant. Dimensions on opposite ends of tolerance limits of valves and cylinders can be the source of a difficult installation. Minimizing thread <u>ovality</u> is important for this design.
Installation	<u>Parallel (straight) valves shall be installed by trained operators following established procedures.</u> There are O-ring/flange installation concerns including defective O-rings and damaging of the O-ring during installation (see O-ring). Torque (versus number of turns) is the primary method of ensuring proper installation. An overtorqued valve can cause hidden damage to the valve flange. Mismatches of straight into tapered designs are known (see CGA V-19, <i>Marking Requirements to Mitigate Potential Cylinder and Cylinder Valve Thread Mismatches</i>) [3].	<u>Tapered valves shall be installed by trained operators following established procedures.</u> Skills for the application of lubricants such as tape are needed (see Lubricants). An overtorqued valve causes excessive distortion of the thread form and development of a pitch error. <u>Overtorquing can also cause galling or shearing of the threads.</u> Mismatches of tapered into straight designs are known [3].
Seal	The seal is created by O-ring compression.	The seal is created by a combination of thread sealant and metal deformation.
O-ring	Material compatibility, size, lack of flaws, and hardness are critical to a proper seal. It is required that a suitably specified O-ring be chosen for the gas service (see Leak). <u>Caution shall be used when selecting polymeric or elastomeric components such as O-rings in oxygen service. Nonmetallic materials such as polymers and elastomers can leach plasticizers that could react with oxygen. Polymers and elastomers vary greatly in chemical composition and curing processes and, as such, should be evaluated for use in their specific application.</u>	No O-rings are needed (see Leak).