# AIGA 2007 MEETING

# *PACKAGED GASES SAFETY*

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# Cylinder Valve Connections

## A Brief Review of Global Best Practices

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# History 1841 to the Present

- Diameter-Pitch System Dates to June 1841 by Sir Joseph Whitworth
- American Screw Thread System Dates to April 1864 by William Sellers
- The US Navy adopts the Sellers System in 1868
- ASME develops modified standards in 1905 & 1907
- Society of Automotive Engineers adopted in 1911
- By 1926 standards in place

# Valve Inlets

- Connecting the Valve to the Cylinder
- Straight or Parallel Threads & Their Applications
- Tapered Threads & Their Applications
- Types of Tapered Threads
- Valving a Cylinder

# Straight or Parallel Threads

- Usually identified by no threads being visible.
- Seal is made between the O-Ring on the valve inlet sealing against a ledge in the cylinder.
- Tape on the valve threads is not needed!
- Generally used for non-corrosive and non-toxic gases.
- Torques required specified by manufacturer.  Lower for aluminium cylinders than steel cylinders.

# The Unique Requirements for Oxygen Packaged in Aluminium Cylinders

- In the United States, aluminium cylinders packaged with oxygen must have straight threads.
- In Europe, the use of tapered threads for aluminium cylinders in oxygen service has been allowed.
- With the advent of the new UN cylinders, the US DOT has approved the use of tapered threaded aluminium cylinders.
- Valves for straight threaded and tapered threaded cylinders should be coded to be sure that the correct valve thread type is matched to the aluminium cylinder.
- It is important to follow the manufacturer's recommendations for torques. Generally, aluminium cylinders use lower torques than tapered threads.

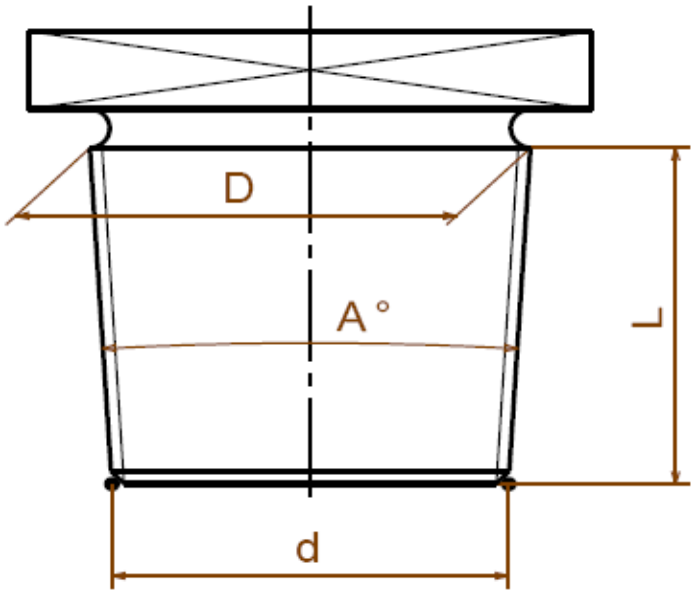
# Tapered Valve Inlets

- Usually identified by valve threads being visible.
- Seal is made at the flank of the valve and cylinder thread, rather than at the root and crest.
- A form of lubrication is used such as PTFE tape. Care must be taken for oxidizers if a secondary lubricant is used.
- Tapered threads are used for toxic, corrosive, flammable, oxidizers, & non-corrosives.

# Types of Tapered Threads

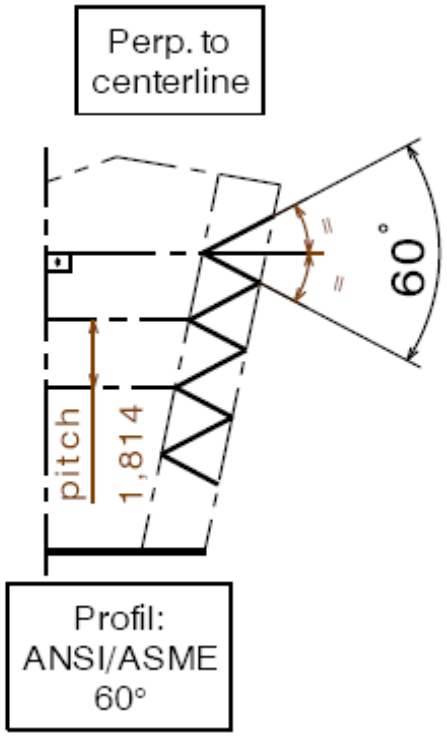
- The Whitworth System dating back to 1841 forms the basis for the 25E and 8246V2 thread used in Asia and Europe
- In 1917, the Compressed Gas Manufacturer's Association improved the NPT thread and developed what we know today as the NGT (National Gas Taper).
- The NGT was an enhancement over the NPT thread in that it not only had two additional threads, but gave attention to the roots and crests of the threads which impact the sealing.
- Gauging was developed for the NGT threads. Designs were based on brass valves and steel cylinders commonly used before 1920.

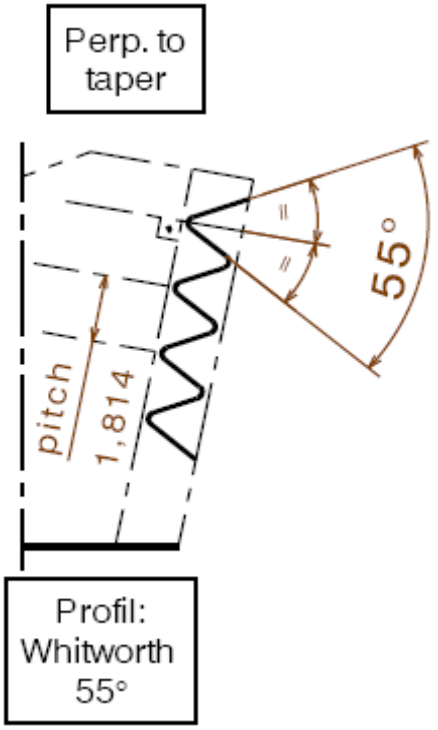
# Comparison of NGT & 25E Tapered Threads




- NGT ANSI Approved CGA V-1 Taper is 1 in 16 Marking is “12N”
- 25E ISO 10920 Taper is 3 in 25 Marking is “25E”
- The 25E tapered inlet reflects identical thread types approved by DIN, BS, and AFNOR.
- The JIS Equivalent is the 8246B2 thread which is similar but not identical to the 25E.

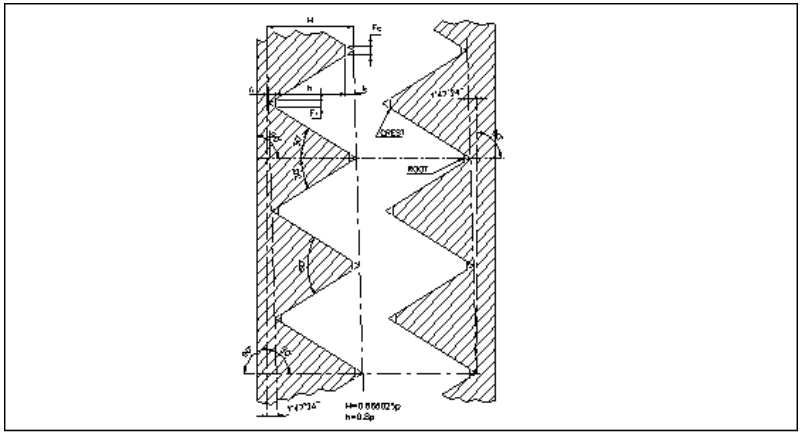
# Comparison of NGT & 25E Tapered Threads



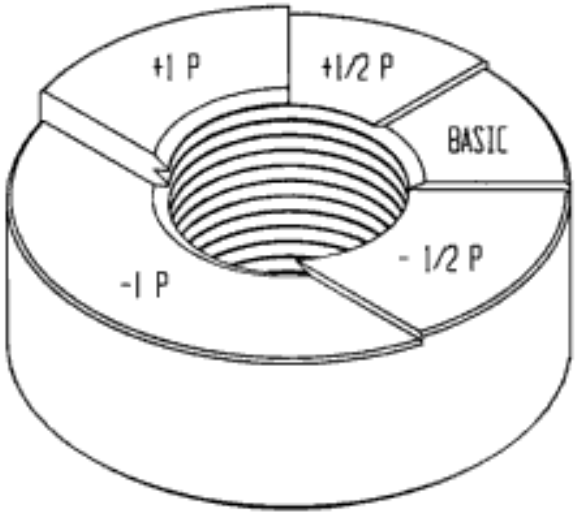



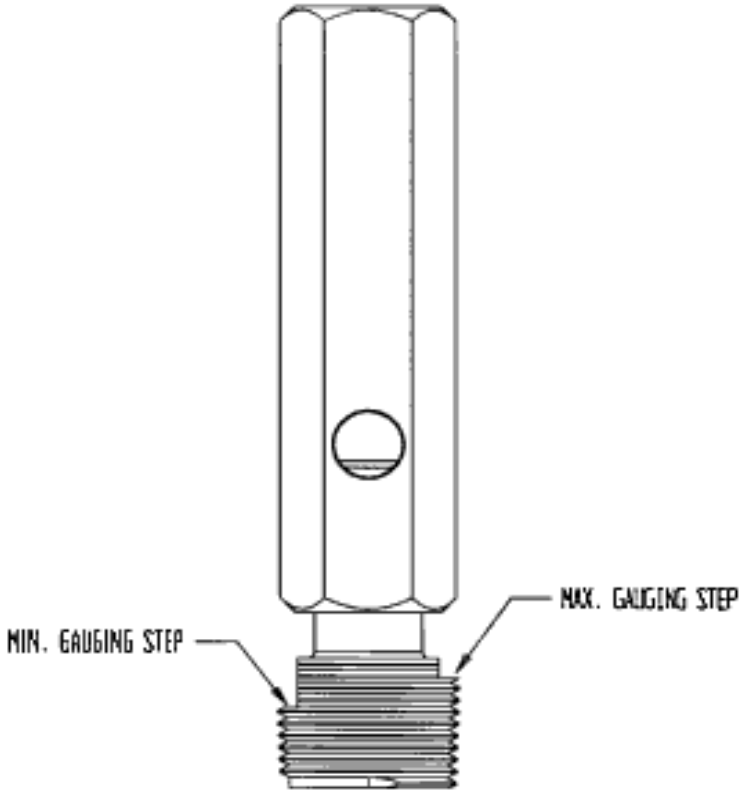
# Valving a Tapered Cylinder

- Handtight engagement occurs when the pitch diameters are equal and sealing takes place on the flanks
- New valve and cylinder should be gauged first to be sure they are in spec
- Gauging older valves can damage gauges
- Apply tape and torque to manufacturer's specs.
- For brass, handtight + 3
- For SS, special care is needed
- Important that a minimum number of threads are engaged and a minimum torque is achieved.



# Typical Gauges



# Why Some Installed Valves Show More Threads Than Others

- A ¾”-14NGT thread has 14 threads per inch
- The L1 hand tight engagement is 0.3390 inch
- 0.3390 x 14 = ~ 4.750 threads engaged
- Both the cylinder and valve have a tolerance of + or – 1 thread
- Therefore between 2.75 and 6.75 threads are engaged hand-tight. Add three threads for wrenching and as few as 5.75 threads or as many as 9.75 threads are engaged.
- There are only 10.75 threads available.
- In this case between 1 and 5 threads may be visible when the valving is completed
- Removing and revalving consumes one additional thread

# Cylinder Valve Outlet Connections

The outlet connection refers to the specific thread configuration, the mating nut and nipple, and any sealing gasket that affords a leak tight connection from the valve to the filling or use line.

# Connection Configurations Parameters

- Provides separation of connections by different pressure ranges
- Provides separation of connections by properties of the gases
- Provides separation of connections by thread specification including left hand vs. right hand, external vs. internal, and specific thread form.
- Provides separation by type of mating connection

# A Brief History of Connection Systems in the USA

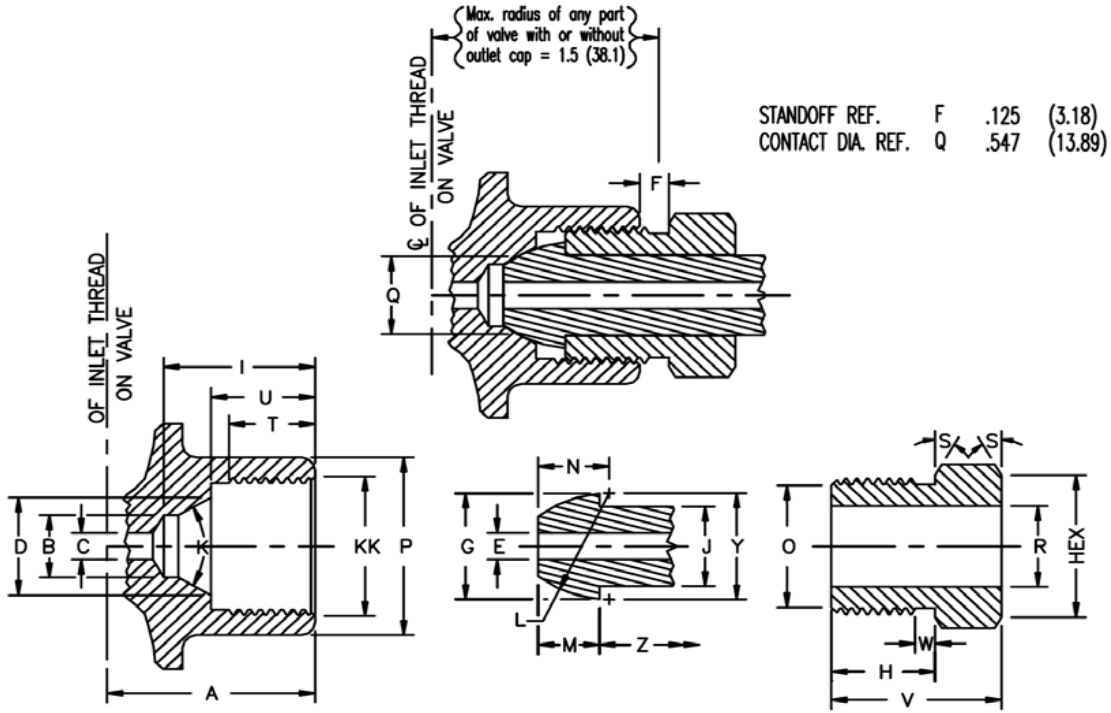
- In early & mid 1900's standardization was limited.
- Oxygen and some medical gases had outlets that were agreed upon such as the CGA 540, 320, and 870
- By the mid 1950's, left handed threads used for more hazardous gases
- External threaded outlets were more commonly used.
- These outlet threads engage to become leak tight
- These outlet  threads do not seal.

# Factors Used in the Design of Outlets

- Metal to metal seating of a nipple to the valve is popular
- Variations in the seat angle, shape of the nose of the nipple, and seal location allow for varied outlets
- Flat seats on the nipples require the use of a washer or gasket.
- Less desirable for pressures over 3000 psig since a large seating area must be attained.

# CGA Publications

- CGA V-1 The repository for well over 100 different approved outlets. Provides outlet assignments for nearly 200 pure gases. Additionally provides detailed drawings that allow a manufacturer to provide the components of a connection. The publication was first released in 1977.
- CGA V-7 Provides a protocol for assigning a V-1outlet to a gas mixture based on the physical properties of the individual components in the mixture. The publication was first released in 1987. CGA V-7 references ISO 10692-1:2001 for UHP mixtures using the DISS series of connections.




## VALVE OUTLET

| | | | |
|---|---|---|---|
| THREAD | | .965–14NGO–RH–INT | |
| MINOR DIA. | | .8877–.8954 | (22.548–22.743) |
| PITCH DIA. | | .9186–.9222 | (23.333–23.423) |
| MAJOR DIA. | | .9650 Min. | (24.511) Min. |
| LENGTH | A | 1.375 Max. | (34.93) Max. |
| C'BORE DIA. | B | .437 Max. | (11.10) Max. |
| DRILL DIA. | C | .187 ±.060 | (4.75 ±1.52) |
| SEAT DIA. | D | .687 ±.015 | (17.45 ±0.38) |
| C'BORE DEPTH | I | 1.00 Min. | (25.4) Min. |
| ANGLE | K | 60° | |
| BOSS DIA. | P | 1.25 Min. | (31.8) Min. |
| FULL THREAD | T | .562 Min. | (14.27) Min. |
| BORE DEPTH | U | .687 ±.015 | (17.45 ±0.38) |
| C'SINK DIA. | KK | 90° x .984 | (24.99) |

## NIPPLE ②

| | | | |
|---|---|---|---|
| DRILL DIA. | E | .187 ±.060 | (4.75 ±1.52) |
| NOSE DIA. | G | .745 | (18.92) |
| SHANK DIA. | J | .562–.557 | (14.27–14.15) |
| NOSE RADIUS | L | .750 | (19.05) |
| NOSE LENGTH | M | .406 ±.015 | (10.31 ±0.38) |
| CENTER LINE | N | .469 ±.015 | (11.91 ±0.38) |
| RADIUS L CENTERS | Y | .750 | (19.05) |
| SHANK LENGTH | Z | 1.12 Min. | (28.4) Min. |

All dimensions are in inches (millimeters).

① Also used for gas mixtures: see CGA V–7.

② Nipple may be made from 11/16 (17.5) hex material.

## HEXAGON NUT

| | | | |
|---|---|---|---|
| THREAD | | .960–14NGO–RH–EXT | |
| MAJOR DIA. | | .9600–.9550 | (24.384–24.257) |
| PITCH DIA. | | .9136–.9100 | (23.205–23.114) |
| MINOR DIA. | | .8724 Max. | (22.158) Max. |
| HEX | | 1 or 1–1/8 | (25.4 or 28.6) |
| SHANK LENGTH | H | .687 ±.015 | (17.45 ±0.38) |
| CHAMFER DIA. | O | 45° X .859 | (21.82) |
| HOLE DIA. | R | .567–.572 | (14.40–14.53) |
| CHAMFER DIA. | S | 30° x 1.00 | (25.4) |
| | | or | |
| | | 30° x 1.125 | (28.58) |
| LENGTH | V | 1.125 Min. | (28.58) Min. |
| UNDERCUT DIA. | W | .16 ±.03 x .86 | (4.1 ±0.8 x 21.8) |

# Other International Outlet Standards

We will use Nitrogen as a typical example:

| | | |
|---|---|---|
| USA | CGA V-1 | CGA 580 |
| UK | BS 341 and BS EN 850 | 3 |
| Germany | DIN 477 | 10 |
| France | AFNOR NF-E 29 650 | C |
| Japan | JIS 8246 | A(W22R)&B |
| China | GB 15383-94 | |
| Thailand | CGA V-1 | CGA 580 |

Note: CGA V-1 provides a compilation and comparison of the outlet selections for nearly 200 gases in the above noted standards.

# The DISS Series of Connections

- DISS stands for Diameter Indexed Safety System
- Designed by the CGA at the request of SEMI from 1984-1989 initially for hydride gases and mixtures
- Provided a series of right handed connections that are capable of an inboard leak rate of 1.00EE-09 ccHe/sec.
- The connections are rated at 1.00EE-07 ccHe/sec at 3000 psig. Gasket seals on a toroid.
- Embraced as a worldwide standard

# Thank You for Your Kind Attention!

- It was a pleasure to be with you at the 2007 AIGA Meeting on Packaged Gas Safety!