

## USAGE OF ¼" O.D. HIGH PRESSURE TUBING WITH 9/16-18 UNF-2B PROCESS PRESSURE CONNECTIONS

High pressure is a relative term. From the user's perspective, it may be defined as low as 200 or as high as 60,000 psi. For this discussion, we'll define high pressure as 20,000 psi or greater. With NPT connections unable to contain higher pressures, a stronger, better sealing fitting designed specifically for high pressure is required.

The most commonly used connection in North America is the National Pipe Thread (NPT). NPT creates a seal by the intermeshing of the threads along a tapered thread line. The application of a thread sealer is required in the form of Teflon tape or a hardening liquid chemical compound referred to as pipe dope. Process interface requirements, dynamic forces and differing international standards often preclude the use of NPT fittings in favor of more sophisticated pressure connections. Among the various alternatives are fittings that form the pressure seal through the use of an O-ring, gasket or metal-to-metal compression assembly.

### High Pressure Process Connection:

For high pressure process connection Ashcroft uses the 9/16-18 UNF-2B female port for ¼" O.D. high pressure tubing often designated by the brand reference "Autoclave F-250-C." The inlet itself is a female straight-thread port, flat bottom with a counter-sink pressure passage hole in the center. The mating connection is not a single fitting, but a three-part assembly. Special high pressure, thick walled ¼" O.D. tubing often serves as the necessary conduit. To form a seal capable of containing high pressures, a metal-to-metal seal must be established. The tip of the tubing is forced into a counter-sink at the opening of the pressure passage hole inside at the bottom of the female port. A compression fit must be created through the use of three components:

1. ¼" O.D. high pressure tubing, prepared with a 59° chamfered tip and left hand thread.
2. Collar (sleeve).
3. Gland nut.

Assembled properly, tightening the gland into the female port will exert pressure on the collar, forcing the tip of the tubing into the seat at the bottom of the female port and creating the high pressure seal (see Figures 2 and 3 for reference).

Solid adaptors designed to simulate the tubing/collar/gland assembly are available to generate a ¼ NPT male or female inlet (See Figure 1 for suppliers and part numbers).

### Tube Preparation and Assembly

To create the mating tube/collar/gland assembly, the tubing tip must first be formed and the fitting components must be assembled per the following steps:

- 1- To prepare the tubing, two operations are required.
  - A- The tip of the high pressure tubing must first be coned or beveled to a 59° angle to produce the tube's sealing surface (See Figure 2 for reference). That can be accomplished by using a lathe or special coning tools offered by the component suppliers (see figure 1).
  - B- Threading the tubing. ¼-28 UNF-2A left hand thread must be turned on the end of the tubing (See Figure 2 for reference). Special tools and dies are also available specifically for this operation.

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Applicable to:  
Ashcroft  
Instruments with  
9/16-18 UNF-2B  
Process  
Connections

- 2- Slide the gland nut over the tubing so that the male threads face the open end of the tube.
- 3- Thread the female collar into the left hand threads in the tubing.
- 4- Slide the gland nut down over the collar.
- 5- Insert the entire assembly into the female port of the gauge so that the coned end of the tubing seats into the countersink (seat) inside the female port.
- 6- Engage the 9/16" male threads of the gland nut into the female threads of the instrument's port. As the gland nut is tightened, it will exert pressure upon the collar, forcing the coned tip of the tubing into the seat.
- 7- If the tubing appears to be loose inside the assembly, back out the gland nut and remove the assembly from the instrument port. Turn the collar counter-clockwise so that it is positioned farther up the tubing away from the tip so that the coned end of the tubing to protrudes farther out away from the gland nut. In contrast, if the tube is protruding out too far that the gland nut cannot engage at least 4 complete threads, turn the collar clockwise to shorten the distance that the tubing tip protrudes away from the gland nut. When properly adjusted, return to step 6.

### **Suppliers Listed Below for Reference:**

Tubing, gland nuts, collars, adaptors and tools are offered by the following suppliers.

Parker Autoclave Engineers Erie, PA  
814-860-5700 Fax: 814-838-5855  
[www.autoclave.com](http://www.autoclave.com)

Newport Scientific, Inc.  
(Formerly AMINCO), "Super pressure" Line Jessup, MD  
301-498-6700 Fax: 301-490-2313  
[www.newport-scientific.com](http://www.newport-scientific.com)

BuTech Pressure Systems Erie, PA  
814-833-4904 Fax: 814-833-2612  
[www.butech-valve.com](http://www.butech-valve.com)

High Pressure Equipment Company (HIP) Erie, PA  
800-289-7447 Fax: 814-838-6075  
[www.highpressure.com](http://www.highpressure.com)

The Swagelok Company (Sno-Trik<sup>®</sup>)  
Solon OH  
See website for local distributor [www.swagelok.com](http://www.swagelok.com)

| FIGURE 1<br>PART NUMBER CROSS REFERENCE GUIDE FOR 1/4" HIGH PRESSURE<br>TUBING FITTING COMPONENTS AND ACCESSORIES |           |                           |         |             |            |
|---|-----------|---------------------------|---------|-------------|------------|
| Item  | Autoclave | Newport                   | BuTech  | HIP         | Sno-Trik®  |
| Gland Nut or  | AGL 40    | 45-11313 or<br>45-11314   | 60G4    | 60-2HM4     | -          |
| Collar (Sleeve)   | ACL 40    | 45-11316 or<br>45-11317   | 60C4    | 60-2H4      | -          |
| Coning Tool   | MC TH4    | 48-15013                  | 60CT4   | 2-HF4       | MS-469-CT  |
| Threading Tool  | 402A      | 48-15025                  | THT4-H  | 2-MHF4      | -          |
| HP Male to 1/4 NPT-M Adapter  | 15MA H4P4 | 45-16370                  | MA4H4P  | 30-21HM4NMB | SS-44M-1-4 |
| HP Male to 1/4 NPT-F Adapter  | 15M94B8   | 45-16071<br>with 45-11064 | 10A4H4P | 30-21NFBHM4 | SS-44M-7-4 |
| Also sells HP Tubing  | Yes       | Yes                       | Yes     | Yes         | Yes        |

Figure 1 – Part Number Cross Reference Guide for 1/4" High Pressure Tubing Fitting Components and Accessories

Notes:

1. High Pressure (HP).
2. All gland nuts, collars and adapters identified above are 316 SS except Newport. Top part number designates 416 SS. Bottom Part number designates 316 SS. HIP, standard material for gland nuts and collars are 17-4PH Nickel. 316 SS is optionally available under the same part number.
3. Newport (AMINCO) also offers the gland nut and collar set under a single part number 44-11310.
4. All coning and threading tools are complete sets which include all necessary dies and cutting bits.
5. Autoclave also sells tube bending equipment.
6. Autoclave and BuTech also sell motorized threading machines.
7. When ordering gland nuts, collars, adapters and tubing, be sure to specify your maximum working pressure requirement because maximum allowable working pressure ratings for components may vary among manufacturers.

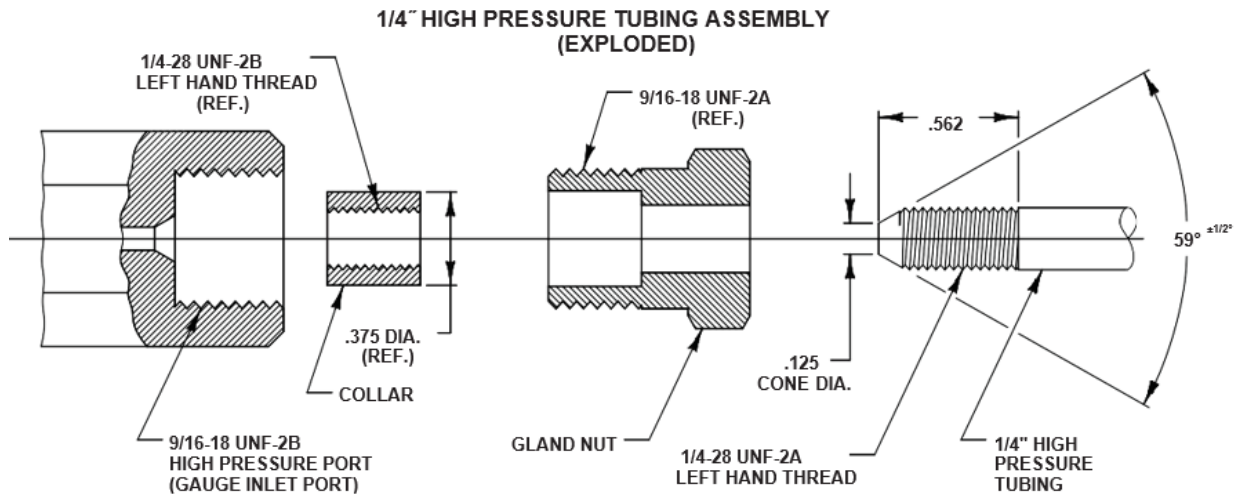


Figure 2 - Exploded View of 1/4" High Pressure Tubing Assembly

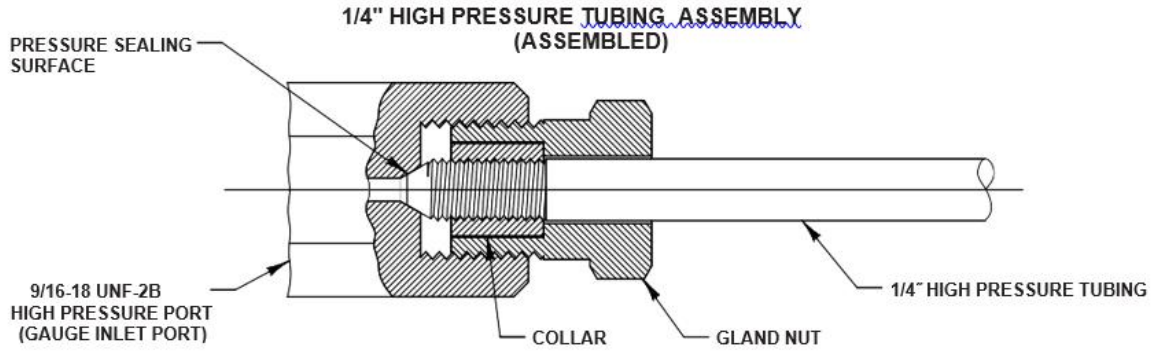


Figure 3 - 1/4" High Pressure Tubing Assembled

| High Pressure Tubing Specification<br>(Typical) 316 Stainless Steel |      |         |
|---|------|---------|
| Max. Working Pressure @ 72°F  | O.D. | I.D.    |
| 20,000 psi  | 1/4" | 0.109"  |
| 60,000 psi  | 1/4" | 0.083"  |
| 100,000 psi   | 1/4" | 0.0625" |

Figure 4 - 316 Stainless Steel Pressure Rating

Notes:

- 1) Some vendors offer alternate tubing materials. I.D. dimension may vary with material.
- 2) Some manufacturers classify 20,000 psi as "medium" pressure tubing.