

Gaugeable Alloy 400/R-405 Mechanically Attached Pipe and Tube Fittings



- For use with MIL-T-16420K 70/30 and 90/10 copper-nickel tubing and pipe
- Excellent corrosion resistance in chloride-containing environments
- ASTM F1387-qualified for shipboard use
- Easy installation using hand tools
- Available in sizes for 1/8 to 1/2 in. pipe and 1/4 to 1 in. tubing

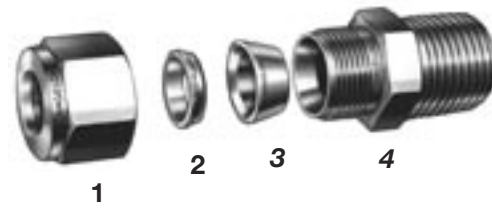
Features

Swagelok Company has qualified the Swagelok alloy 400/R-405 fitting product line in sizes from 1/8 to 1/2 in. pipe and 1/4 to 1 in. tubing based on ASTM F1387, "Standard Specification for Performance of Piping and Tubing Mechanically Attached Fittings" and received U.S. Navy approval for use on surface ships (see table footnote ①, below).

This standard establishes the performance characteristics required for mechanically attached fittings (MAF), such as the Swagelok tube fitting. The Swagelok alloy 400/R-405 mechanically attached pipe and tube fittings are rated for use to the working pressures listed in the table below.

The ASTM F1387 qualification tests included:

- Examination of Specimen
- Hydrostatic Proof
- Flexure Fatigue
- Hydrostatic Burst
- Rotary Flexure
- Elevated Temperature Soak
- Torsion
- Fire
- Pneumatic Proof
- Impulse
- Tensile
- Repeated Assembly
- Thermal Cycling
- Stress Corrosion
- Shock
- Vibration



Materials of Construction

Component	Material	Material Specification	
		Bar Stock	Forgings
1 Nut	Alloy 400/ R-405	ASTM B164, ASME SB164	ASTM B564, ASME SB564
2 Back ferrule			
3 Front ferrule			
4 Body			

Wetted components listed in *italics*.

For improved performance, fitting components of alloy 400 are coated with a hydrocarbon film.

Pressure Ratings

Pressure ratings listed in the tables below are in accordance with the pressure classes listed in MIL-T-16420K, "Military Specifications, Tube, Copper-Nickel Alloy, Seamless and Welded (Copper Alloy Numbers 715 and 706)" for the applicable copper-nickel alloy tubing and pipe grades.

Swagelok alloy 400/R-405 mechanically attached pipe and tube fittings, used with MIL-T-16420K copper-nickel alloy tubing and pipe, are rated for general use to these pressures.

Temperature Rating

-65 to 600°F (-53 to 315°C)

Suggested Allowable Working Pressures^① for Swagelok Alloy 400/R-405 Tube Fittings

With Copper-Nickel Alloy 715^② (70/30) Tubing

Fitting	Outside Diameter in.	Tube Wall Thickness, in.								
		0.035	0.049	0.058	0.065	0.072	0.095	0.109	0.120	0.134
		Working Pressure, psig (bar)								
1/8 in. pipe	0.405	—	—	3300 (227)	—	—	—	—	—	—
1/4 in. pipe	0.540	—	—	—	700 (48.2)	3300 (227)	—	—	—	—
3/8 in. pipe	0.675	—	—	—	200 (13.7)	700 (48.2)	3300 (227)	—	—	—
1/2 in. pipe	0.840	—	—	—	—	700 (48.2)	—	—	3300 (227)	—
1/4 in. tube	0.250	3300 (227)	—	6000 (413)	—	—	—	—	—	—
3/8 in. tube	0.375	—	3300 (227)	—	—	—	—	—	—	—
1/2 in. tube	0.500	—	—	—	700 (48.2)	3300 (227)	—	—	—	—
3/4 in. tube	0.750	—	—	—	—	—	—	3300 (227)	—	—
1 in. tube	1.00	—	—	—	—	—	—	—	—	3300 (227)

With Copper-Nickel Alloy 706^③ (90/10) Tubing

Copper-nickel alloy 706 (90/10) purchased to MIL-T-16420K may be used up to 200 psig (13.7 bar).

① Swagelok alloy 400/R-405 tube fittings have been qualified for use on surface ships by the U.S. Navy as Type IV, Grade C, Class 8 (Class 10 for 1/4 in. size), 600°F, separable, 70/30 NiCu fittings, 3750 psig (6000 psig for 1/4 in. size) pressure ratings when used with 70/30 CuNi or 90/10 CuNi (400 psig max) tubing in accordance with MIL-T-16420K, Type 1, Grade 2, alloy 715, for size ranges 1/4 to 1 in. OD (0.035 to 0.134 in. wall thickness). Non-fire-hardened applications only. Pressure ratings in the tables above are in accordance with MIL-T-16420K pressure classes.

② Specified to Table III of MIL-T-16420K.

③ Specified to paragraph 1.2.1. of MIL-T-16420K.

Ordering Information

Select an ordering number.

Male Connectors



Tube

Tube OD in.	Pipe Size in.	Ordering Number
1/4	1/8	M-400-1-2
1/4	1/4	M-400-1-4
3/8	1/4	M-600-1-4
3/8	1/2	M-600-1-8
1/2	1/4	M-810-1-4
1/2	1/2	M-810-1-8
5/8	1/2	M-1010-1-8
3/4	3/4	M-1210-1-12
7/8	3/4	M-1410-1-12
1	1	M-1610-1-16

Pipe

Pipe Size in.	NPT Size in.	Ordering Number
1/8	1/8	M-2P0-1-2
1/4	1/8	M-4P0-1-2
1/4	1/4	M-4P0-1-4
3/8	1/4	M-6P0-1-4
3/8	1/2	M-6P0-1-8
1/2	1/4	M-8P0-1-4
1/2	1/2	M-8P0-1-8

Unions



Tube

Tube OD in.	Ordering Number
1/4	M-400-6
3/8	M-600-6
1/2	M-810-6
5/8	M-1010-6
3/4	M-1210-6
7/8	M-1410-6
1	M-1610-6

Pipe

Pipe Size in.	Ordering Number
1/8	M-2P0-6
1/4	M-4P0-6
3/8	M-6P0-6
1/2	M-8P0-6

Reducing Unions



Tube

Tube OD, in.		Ordering Number
T	Tx	
3/8	1/4	M-600-6-4
1/2	1/4	M-810-6-4
1/2	3/8	M-810-6-6
5/8	1/2	M-1010-6-8
3/4	1/2	M-1210-6-8
1	3/4	M-1610-6-12

Pipe

Pipe Size, in.		Ordering Number
P	Px	
1/4	1/8	M-4P0-6-2P
3/8	1/4	M-6P0-6-4P
1/2	1/4	M-8P0-6-4P
1/2	3/8	M-8P0-6-6P

90° Union Elbows



Tube

Tube OD in.	Ordering Number
1/4	M-400-9
3/8	M-600-9
1/2	M-810-9
5/8	M-1010-9
3/4	M-1210-9
1	M-1610-9

Pipe

Pipe Size in.	Ordering Number
1/8	M-2P0-9
1/4	M-4P0-9
3/8	M-6P0-9
1/2	M-8P0-9

Ordering Information

Select an ordering number.

Union Tees



Tube

Tube OD in.	Ordering Number
1/4	M-400-3
3/8	M-600-3
1/2	M-810-3
5/8	M-1010-3
3/4	M-1210-3
1	M-1610-3

Pipe

Pipe Size in.	Ordering Number
1/8	M-2P0-3
1/4	M-4P0-3
3/8	M-6P0-3
1/2	M-8P0-3

Union Branch Reducing Tees



Tube

Tube OD, in.		Ordering Number
Main	Branch	
3/8	1/4	M-600-3-6-4
1/2	1/4	M-810-3-8-4
1/2	3/8	M-810-3-8-6
5/8	3/8	M-1010-3-10-6
3/4	1/2	M-1210-3-12-8
1	3/4	M-1610-3-16-12

Pipe

Pipe Size, in.		Ordering Number
Main	Branch	
1/4	1/8	M-4P0-3-4P-2P
3/8	1/4	M-6P0-3-6P-4P
1/2	1/4	M-8P0-3-8P-4P
1/2	3/8	M-8P0-3-8P-6P

Male Adapters



Tube

Tube OD in.	NPT Size in.	Ordering Number
1/4	1/4	M-4-TA-1-4
3/8	1/4	M-6-TA-1-4
1/2	1/2	M-8-TA-1-8
3/4	3/4	M-12-TA-1-12
1	1	M-16-TA-1-16

Female ISO Parallel (RG, Gauge) Thread



Tube

Tube OD in.	ISO Pipe Size in.	Ordering Number
1/4	1/4	M-400-7-4RG
3/8	3/8	M-600-7-6RG
1/2	1/2	M-810-7-8RG

Pipe

Pipe Size in.	ISO Pipe Size in.	Ordering Number
1/8	1/8	M-2P0-7-4RG
1/4	1/4	M-4P0-7-4RG
3/8	3/8	M-6P0-7-6RG
1/2	1/2	M-8P0-7-8RG

Female VCO® Fittings



Tube

1/4 in. size only; fluorocarbon FKM O-ring standard (other O-ring materials available).

Ordering number:

M-4-FVCO-6-400

Ordering Information

Select an ordering number.

Caps



Tube

Tube OD in.	Ordering Number
1/4	M-400-C
3/8	M-600-C
1/2	M-810-C
5/8	M-1010-C
3/4	M-1210-C
7/8	M-1410-C
1	M-1610-C

Pipe

Pipe Size in.	Ordering Number
1/8	M-2P0-C
1/4	M-4P0-C
3/8	M-6P0-C
1/2	M-8P0-C

Plugs



Tube

Tube OD in.	Ordering Number
1/4	M-400-P
3/8	M-600-P
1/2	M-810-P
5/8	M-1010-P
3/4	M-1210-P
7/8	M-1410-P
1	M-1610-P

Pipe

Pipe Size in.	Ordering Number
1/8	M-2P0-P
1/4	M-4P0-P
3/8	M-6P0-P
1/2	M-8P0-P

Back Ferrules



Tube

Tube OD in.	Ordering Number
1/4	M-404-1
3/8	M-604-1
1/2	M-814-1
5/8	M-1014-1
3/4	M-1214-1
7/8	M-1414-1
1	M-1614-1

Pipe

Pipe Size in.	Ordering Number
1/8	M-2P4-1
1/4	M-4P4-1
3/8	M-6P4-1
1/2	M-8P4-1

Front Ferrules



Tube

Tube OD in.	Ordering Number
1/4	M-403-1
3/8	M-603-1
1/2	M-813-1
5/8	M-1013-1
3/4	M-1213-1
7/8	M-1413-1
1	M-1613-1

Pipe

Pipe Size in.	Ordering Number
1/8	M-2P3-1
1/4	M-4P3-1
3/8	M-6P3-1
1/2	M-8P3-1

Nuts



Tube

Tube OD in.	Ordering Number
1/4	M-402-1
3/8	M-602-1
1/2	M-812-1
5/8	M-1012-1
3/4	M-1212-1
7/8	M-1412-1
1	M-1612-1

Pipe

Pipe Size in.	Ordering Number
1/8	M-2P2-1
1/4	M-4P2-1
3/8	M-6P2-1
1/2	M-8P2-1

Additional Products

Other Swagelok pipe and tube fitting configurations and adapters, such as tailpiece adapters in accordance with MIL-F-1183, "Military Specifications, Fittings, Pipe, Cast Bronze, Silver Brazing," are available. Contact your authorized Swagelok sales and service representative.

Cleaning and Packaging

Fitting components are cleaned to remove machine oil, grease, and loose particles. For more information, see Swagelok standard cleaning and packaging specification (SC-10), MS-06-62.

Tools for Use with Alloy 400/R-405 Tube Fittings

Gap Inspection Gauges

Swagelok gap inspection gauges assure the installer or inspector that the fitting has been sufficiently pulled up on initial installation.



Tube

Tube OD in.	Ordering Number
1/4	MS-IG-400
3/8	MS-IG-600
1/2	MS-IG-810
5/8	MS-IG-1010
3/4	MS-IG-1210
7/8	MS-IG-1410
1	MS-IG-1610

Pipe

Pipe Size in.	Ordering Number
1/8	MS-IG-810
1/4	MS-IG-1010
3/8	MS-IG-1210
1/2	MS-IG-1410

Pre-Swaging Tool



For Swagelok tube fitting installations in close quarters, the Swagelok pre-swaging tool is a convenient accessory.

Tube OD in.	Ordering Number
1/4	MS-ST-400
3/8	MS-ST-600
1/2	MS-ST-810
5/8	MS-ST-1010
3/4	MS-ST-1210

Depth Marking Tool



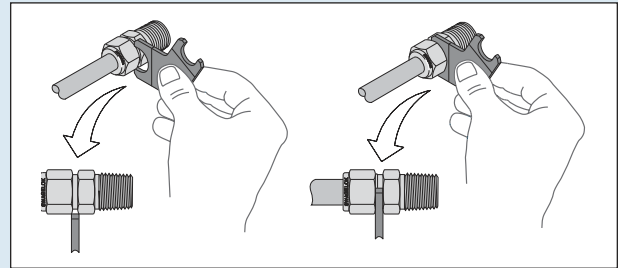
Swagelok depth marking tools help ensure that tubing is bottomed on the shoulder inside the Swagelok tube fitting body.

Tube OD in.	Ordering Number
1/4	MS-DMT-400
3/8	MS-DMT-600
1/2	MS-DMT-810
5/8	MS-DMT-1010
3/4	MS-DMT-1210
7/8	MS-DMT-1410
1	MS-DMT-1610

Gaugeability

On initial installation, the Swagelok gap inspection gauge assures the installer or inspector that a fitting has been sufficiently tightened.

Position the Swagelok gap inspection gauge next to the gap between the nut and body.



If the gauge **will not** enter the gap, **the fitting is sufficiently tightened.**

If the gauge **will** enter the gap, **additional tightening is required.**

⚠ Always depressurize a system before adjusting the tightness of a tube fitting connection.

Interchangeability

Intermixing and interchanging tube fitting components of different manufacturers can be dangerous. Leak-tight seals that will withstand high pressure, vibration, vacuum, and temperature changes depend on close tolerances and consistent, exacting quality control in conjunction with good design principles.

Components of other manufacturers may look like Swagelok tube fitting components—but they cannot be manufactured in accordance with Swagelok engineering standards, nor do they benefit from innovations in design and manufacture defined by active Swagelok tube fitting patents.

Installation Instructions

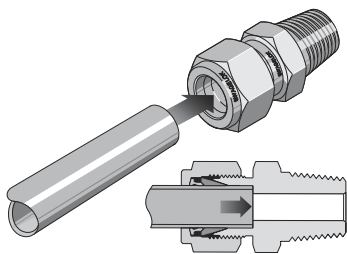
Swagelok alloy 400/R-405 tube fittings can be installed quickly, easily, and reliably.

Safety Precautions

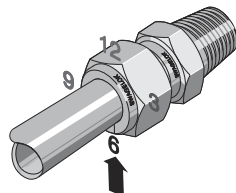
- Do not bleed system by loosening fitting nut or fitting plug.
- Do not make up and tighten fittings when system is pressurized.
- Make sure that the tubing rests firmly on the shoulder of the tube fitting body before tightening the nut.
- Use Swagelok gap inspection gauge to ensure sufficient pull-up upon initial installation.
- Always use proper thread sealants on tapered pipe threads.
- Do not mix materials or fitting components from various manufacturers—ferrules, nuts, and fitting bodies.
- Never turn fitting body. Instead, hold fitting body and turn nut.
- Avoid unnecessary disassembly of unused fittings.
- Use only long reducers in female Swagelok end connections.

Installation Instructions

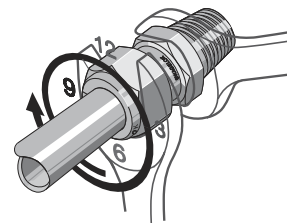
Swagelok Mechanically Attached Pipe and Tube Fittings



Fully insert the tubing or pipe into the fitting and against the shoulder; rotate the nut finger-tight.



Mark the nut at the 6 o'clock position.



While holding the fitting body steady, tighten the nut one and one-quarter turns to the 9 o'clock position.

For 1/16, 1/8, and 3/16 in.; 2, 3, and 4 mm tube fittings, tighten the nut three-quarters turn to the 3 o'clock position

Installation in High-Pressure Applications and High Safety-Factor Systems

1. Fully insert the tubing or pipe into the fitting and against the shoulder; rotate the nut finger-tight.
2. Due to the variations of tubing and pipe diameters, a common starting point is desirable. Therefore, tighten the nut until the tubing will not turn by hand or move axially in the fitting.
3. Mark the nut at the 6 o'clock position.
4. While holding fitting body steady, tighten the nut one and one-quarter turns to the 9 o'clock position.

For 1/16, 1/8, and 3/16 in.; 2, 3, and 4 mm tube fittings, tighten the nut three-quarters turn to the 3 o'clock position.

Reassembly

You may disassemble and reassemble Swagelok tube fittings many times.

Fig. 1



1. Insert tubing or pipe with preswaged ferrules into the fitting body until the front ferrule seats (Fig. 1).
2. Rotate the nut with a wrench to the previously pulled-up position; at this point, a significant increase in resistance will be encountered.

Fig. 2



3. Tighten slightly with a wrench (Fig. 2).
- Do not use the Swagelok gap inspection gauge with reassembled fittings.*

Caps and Plugs



Caps

See Swagelok tube fitting installation and reassembly, above.



Plugs

While holding fitting body steady, tighten the plug one-quarter turn from the finger-tight position.

For 1/16, 1/8, and 3/16 in.; 2, 3, and 4 mm tube fittings, tighten the plug one-eighth turn.

Reassembly

You may disassemble and reassemble Swagelok plugs many times. Make subsequent connections by slightly tightening with a wrench after snugging the nut by hand.

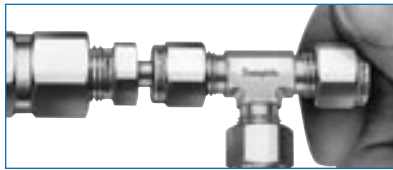
Tube Adapters

Fig. 1



Female pipe port
on existing equipment

Fig. 2



1. Install the end opposite the tube adapter end (Fig. 1).
2. Insert the tube adapter into the Swagelok tube fitting. Make sure that the tube adapter rests firmly on the shoulder of the tube fitting body and that the nut is finger-tight (Fig. 2).
3. Mark the nut at the 6 o'clock position.

4. While holding fitting body steady, tighten the nut one and one-quarter turns to the 9 o'clock position.

For 1/16, 1/8, and 3/16 in.; 2, 3, and 4 mm tube fittings, tighten the nut three-quarters turn to the 3 o'clock position.

Reassembly

See Swagelok tube fitting reassembly, page 7.

Depth Marking Tool

Fig. 1



Fig. 2



1. Insert cleanly cut, fully deburred tubing into the depth marking tool (DMT) until the tubing is fully bottomed into the tool. Using a pen or pencil, mark the tubing at the top of the DMT (Fig. 1).
2. Remove the tubing from the DMT and insert it into the Swagelok

fitting until it is bottomed inside the fitting body (Fig. 2). If any portion of the mark on the tubing can be seen above the fitting nut, the tubing is not fully bottomed inside the fitting.

3. While holding the fitting body steady, follow Swagelok tube fitting installation instructions, page 7.

Preswaging Tool

Fig. 1



Fig. 2



Fig. 3



1. Install the Swagelok nut and ferrules onto the preswaging tool.
2. Insert tubing into the preswaging tool.
3. Make sure that the tubing rests firmly on the shoulder of the preswaging tool body and that the nut is finger-tight.
4. Mark the nut at the 6 o'clock position.
5. While holding the preswaging tool steady, tighten the nut one and one-quarter turns to the 9 o'clock position.
For 1/16, 1/8, and 3/16 in.; 2, 3, and 4 mm tube fittings, tighten the nut three-quarters turn to the 3 o'clock position (Fig. 1).

6. Loosen the nut.

7. Remove the tubing with preswaged ferrules from the preswaging tool.

If the tubing sticks in the preswaging tool, remove the tubing by gently rocking it back and forth. Do not turn the tubing (Fig. 2).

8. Insert tubing with preswaged ferrules into the fitting body until the front ferrule seats.
9. Rotate the nut with a wrench to the previously pulled-up position; at this point, a significant increase in resistance will be encountered.
10. Tighten slightly with a wrench (Fig. 3)

Do not use the Swagelok gap inspection gauge with fittings that were assembled using the preswaging tool.

Safe Product Selection

When selecting a product, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user.

Caution: Do not mix or interchange parts with those of other manufacturers.

Warranty Information

Swagelok products are backed by The Swagelok Limited Lifetime Warranty. For a copy, visit swagelok.com or contact your authorized Swagelok representative.