

Assembly, Installation and Torque for Flareless and
Straight Thread Fluid Fittings and Tube Assemblies

RATIONALE

AS5148 has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE:

This SAE Aerospace Standard (AS) describes the assembly, installation and torque values for flareless and straight thread fluid fittings and tube assemblies.

1.1 Product Classification:

This procedure covers the assembly and installation of the following:

- a. Flareless fittings, bite type sleeves and components with NAS1760 fitting ends (see Section 3)
- b. Bulkhead fittings (see Section 4)
- c. Straight thread boss fittings (see Section 5)

2. APPLICABLE DOCUMENTS:

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AS1792	Nut, Fitting, Lightweight, Flareless
AS4375	Fitting End, External Thread, Flareless Design Standard
AS4377	Fitting End, Bulkhead, Flareless, Design Standard

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<http://www.sae.org/technical/standards/AS5148>**

2.2 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

AN924	Nut, Tube, Bulkhead and Universal Fitting
AN960	Washer, Flat
MS9385	Packing, Preformed, AMS 7267, O-Ring
MS3393	Packing, Preformed, Straight Thread Tube Fitting Boss, Hydraulic, Minus 65 Deg. F to Plus 275 Deg. F
MS21921	Nut, Sleeve, Coupling, Flareless
MS21922	Sleeve, Coupling, Flareless
MS28778	Packing, Preformed, Straight Thread Tube Boss
MS33649	Bosses, Fluid Connection, Internal Straight Thread
MIL-G-4343	Grease, Pneumatic Systems
MIL-R-83248/1	Rubber, Fluorocarbon Elastomer, High Temperature, Fluid and Compression Set Resistant, O-rings, Class 1, 75 Hardness
VV-P-236	Petrolatum, Technical

2.3 NAS Publications:

Available from Aerospace Association of America, 1725 DeSales Street, N.W., Washington, DC 20036.

NAS1149	Washer, Flat
NAS1760	Fitting End, Flareless Acorn, Standard Dimensions for

3. FLARELESS TUBE FITTINGS AND BITE TYPE SLEEVE (FIGURE 1):

3.1 Presetting of Bite Type Sleeve:

- 3.1.1 Sleeves must be preset on tubing prior to assembly. Sleeve presetting may be accomplished by machine or by hand on aluminum, 304 1/8H corrosion resistant steel or annealed corrosion resistant steel tube.
- 3.1.2 Tube End Preparation: Tube ends shall be cut square within 0.5° and burrs removed from inside and outside of tube end. The break or chamfer on either the outside or inside corner shall not exceed 25% of the thickness of the tube wall.
- 3.1.3 Machine Presetting:
 - 3.1.3.1 Use the appropriate dies for the sleeve size to be preset on the tube.
 - 3.1.3.2 Use machine preset forces recommended by the manufacturer and/or sufficient to produce a satisfactory preset (see 3.1.5).

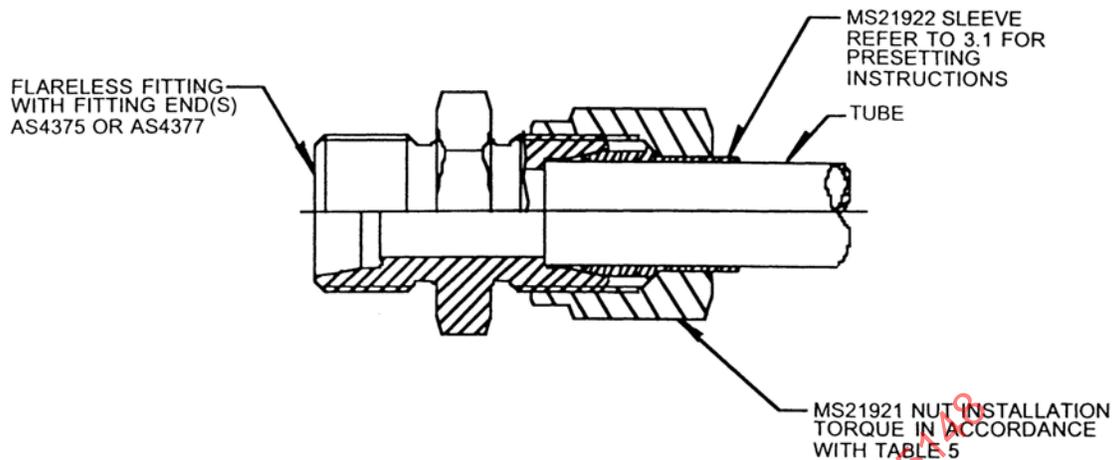


FIGURE 1 - Bite Type Flareless Sleeve Tube Assembly

- 3.1.3.3 The sleeve and working surfaces of the tooling shall be lubricated with the approved system lubricant (see Table 1).

TABLE 1 - Thread Lubricant Selection

Application	Appropriate Lubricant
Coolant (Ethylene Glyco)	None
Coolant (Silicate Esters)	None
Engine Fuel	System Fluid
Engine Lubricant (Petroleum Base)	System Fluid
Engine Lubricant (Phosphate Base)	System Fluid
Hydraulic (Petroleum Base)	System Fluid
Hydraulic (Phosphate Base)	System Fluid
Oxygen	None
Pneumatic	MIL-G-4343 Grease
Vacuum	None
Water	VV-P-236 Petrolatum

- 3.1.4 Hand Presetting: Hand presetting may be accomplished with either a hardened hand tool or a flareless fitting. Presetting of the sleeve is accomplished by turning the coupling nut to the specified number of turns (see Table 2, 3, or 4 as applicable) past the point of ring grip.
- 3.1.4.1 Lubricate the sleeve shoulder, sealing surface of fitting (24° cone) and mating fitting threads with system fluid (see Table 1). Nut threads and fitting sealing surface (24° cone) with solid film lubricant shall not be lubricated with system fluid.
- 3.1.4.2 With the tube end held firmly against the bottom of the seat of the tool, using a wrench, slowly screw the nut onto the tool until the cutting edge of the sleeve grips the tube sufficiently to prevent rotation of the tube by the thumb and fingers. When the sleeve first grips the tube, you have reached the starting position. From this point, tighten the nut the number of turns specified in Tables 2, 3, or 4 as applicable.

TABLE 2 - Number of Turns for Presetting Flareless Sleeves With Mandrels

Tube Size	.125	.188	.25	.312	.375	.50	.625	.75	1.00	1.25	1.50
No. of Turns	1 1/6	1 1/6	1	1	5/6	5/6	2/3	2/3	2/3	2/3	2/3

TABLE 3 - Number of Turns for Presetting Flareless Sleeves Without Mandrels on 304 1/8 Hard Corrosion Resistant Tubing

Wall Thickness	Tube Size .125	Tube Size .188	Tube Size .25	Tube Size .312	Tube Size .375	Tube Size .50	Tube Size .625	Tube Size .75	Tube Size 1.00
.012	1 1/6								
.018	1 1/6	1 1/6	1 1/6	1 1/6					
.020	1 1/6	1 1/6	1 1/6	1 1/6	(a)				
.022	1 1/6	1 1/6	1 1/6	1 1/6	1 1/6				
.025	1 1/6	1 1/6	1 1/6	1 1/6	1 1/6	(a)	(a)		
.028	1 1/6	1 1/6	1	1 1/6	1	1 1/6	1 1/6	(a)	
.035		1 1/6		1	1	1 1/6	1 1/6	1 1/6	(a)
.042				1	1	1	1 1/6	1 1/6	1 1/6
.049				1	5/6	1	1	1	1 1/6
.058						5/6	1	5/6	1
.065						5/6	5/6	5/6	1
.072								5/6	5/6
.083									5/6

(a) Use mandrel for this size and thinner wall tubing.

TABLE 4 - Number of Turns for Presetting Flareless Sleeves Without Mandrels on Aluminum Alloy and Annealed Corrosion Resistant Steel Tubing

Wall Thickness	Tube Size .125	Tube Size .188	Tube Size .25	Tube Size .312	Tube Size .375	Tube Size .50	Tube Size .625	Tube Size .75	Tube Size 1.00
.018	1 1/6	1 1/6							
.020	1 1/6	1 1/6							
.022	1 1/6	1 1/6	(a)						
.025	1 1/6	1 1/6	1 1/6	(a)					
.028	1 1/6	1 1/6	1 1/6	1 1/6	(a)	(a)			
.035		1	1 1/6	1 1/6	1 1/6	1 1/6	(a)	(a)	
.042			1	1	1 1/6	1 1/6	1 1/6	1 1/6	(a)
.049				1	1	1	1 1/6	1 1/6	1 1/6
.058				1	5/6	1	1	1	1 1/6
.065					5/6	5/6	1	1	1 1/6
.072								5/6	1
.083								5/6	5/6
.095								5/6	

(a) Use mandrel for this size and thinner wall tubing.

3.1.5 Inspection of Preset Sleeves:

- 3.1.5.1 After presetting, the sleeve may or may not rotate on the tube. Longitudinal movement of the sleeve is permissible but shall not exceed .020 in.
- 3.1.5.2 The preset instructions described above are intended to result in a depth of cut on the tube of .002 in minimum (see Figure 2). This is not to be construed as an inspection requirement.

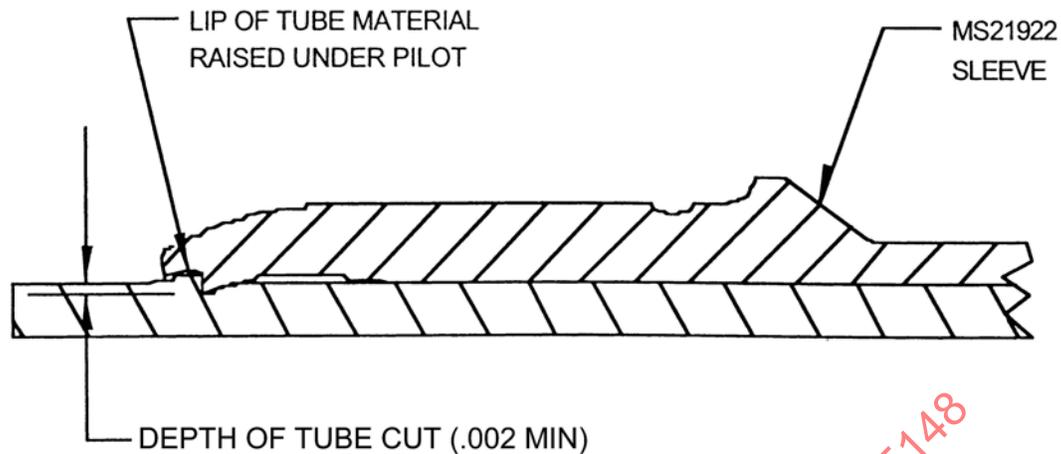


FIGURE 2 - Typical Tube Cut Produced by Bite Type Sleeve

- 3.1.6 Cleaning: If applicable, the tube assembly shall be cleaned by an approved method compatible with the system in which they are to be installed.
- 3.1.7 Installation of Tube Assembly Incorporating Bite Type Sleeve:
- 3.1.7.1 Fit Up: The tube assembly shall be aligned and the sleeve seated in the mating fitting without preload before threads of coupling nut and fitting are engaged by hand.
- 3.1.7.2 Lubrication: Unless otherwise noted, lubrication (see Table 1) shall be applied to the sleeve shoulder, sealing surface of fitting (24° cone) and nut threads prior to assembly. Nut threads and fitting sealing surface with dry film lubricant shall not be lubricated with system fluid.
- 3.1.7.3 Tightening:
- 3.1.7.3.1 Torque Method: When a torque wrench is used for assembly, the tightening torque in accordance with Table 5 shall be applied.

TABLE 5 - Installation Wrench Torque, Bite Type Sleeve, in-lb, $\pm 5\%$

Tube OD	Tube Wall Thickness	Aluminum Fitting, Aluminum Tube	Steel Fitting, Annealed Cres Tube	Steel or Titanium Fitting, Cres 1/8 Hard Tube
.125	.012			55
.188	.016			100
.188	.020		100	
.188	.028	80		
.250	.020		140	140
.250	.028	110	140	
.312	.020		190	190
.312	.028	140	190	
.375	.028	170		270
.375	.035		270	
.500	.028	280		
.500	.035	360		500
.500	.042		500	
.625	.028	360		
.625	.035	415		
.625	.042			700
.625	.058		700	
.750	.028	450		
.750	.049	450		
.750	.058			900
.750	.065		900	
1.000	.035	750		
1.000	.049	800		
1.000	.065	1200		1200
1.000	.083		1200	

- 3.1.7.3.2 Nut Turn Method: When standard open end wrenches are used for assembly, tighten the coupling nut until a distinct increase in torque occurs, then tighten the nut an additional 1/6 to 1/3 turn. Do not exceed 1/3 turn total tightening beyond the sharp torque rise position.
- 3.1.7.4 Leaking Joints: After installation, if leakage is encountered at the fitting joint, loosen the coupling nut and remove the tube end from the fitting. Do not attempt to prevent the leakage by overtorquing. Instead, inspect the seal areas of the sleeve and mating fitting for scratches, nicks, dents, foreign material, etc. Reassemble the joint with new parts, if necessary.
- 3.1.8 Installation of Tube Assembly Incorporating Component With NAS1760 Fitting End (Figure 3):

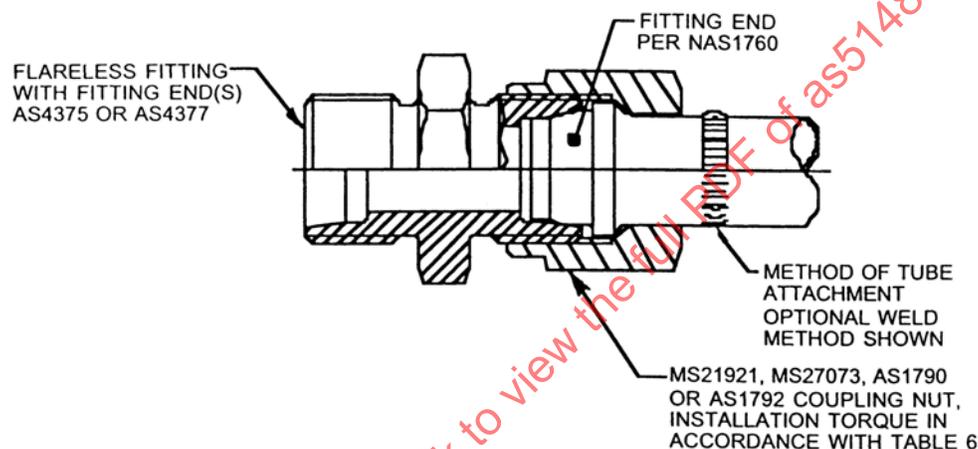


FIGURE 3 - Tube Assembly Incorporating Fitting With NAS1760 Fitting End

- 3.1.8.1 Fit Up: The tube assembly shall be aligned and the sleeve seated in the mating fitting without preload before threads of coupling nut and fitting are engaged by hand.
- 3.1.8.2 Lubrication: Unless otherwise noted, lubrication (see Table 1) shall be applied to the sleeve shoulder, sealing surface of fitting (24° cone) and nut threads prior to assembly. Nut threads and fitting sealing surface with dry film lubricant shall not be lubricated with system fluid.
- 3.1.8.3 Tightening:
- 3.1.8.3.1 Torque Method: When a torque wrench is used for assembly, the tightening torque in accordance with Table 6 shall be applied.

TABLE 6 - Installation Wrench Torque, NAS1760 Fitting Ends, in-lb, $\pm 5\%$

Tube OD	Aluminum Fitting	Steel and Titanium Fitting
.125	---	55
.188	80	100
.250	110	140
.312	140	190
.375	170	270
.500	280	500
.625	360	700
.750	450	900
1.000	750	1200
1.250	900	1600
1.500	900	2000
2.000	---	2000

- 3.1.8.3.2 Nut Turn Method: When standard open end wrenches are used for assembly, tighten the coupling nut until a distinct increase in torque occurs, then tighten the nut an additional 1/6 to 1/3 turn.
- 3.1.8.4 Leaking Joints: After installation, if leakage is encountered at the fitting joint, loosen the coupling nut and remove the tube end from the fitting. Do not attempt to prevent the leakage by overtorquing. Instead, inspect the seal areas of the sleeve and mating fitting for scratches, nicks, dents, foreign material, etc. Reassemble the joint with new parts, if necessary.

4. BULKHEAD FLARELESS FITTINGS:

- 4.1 Refer to Figure 4 for example of installation.

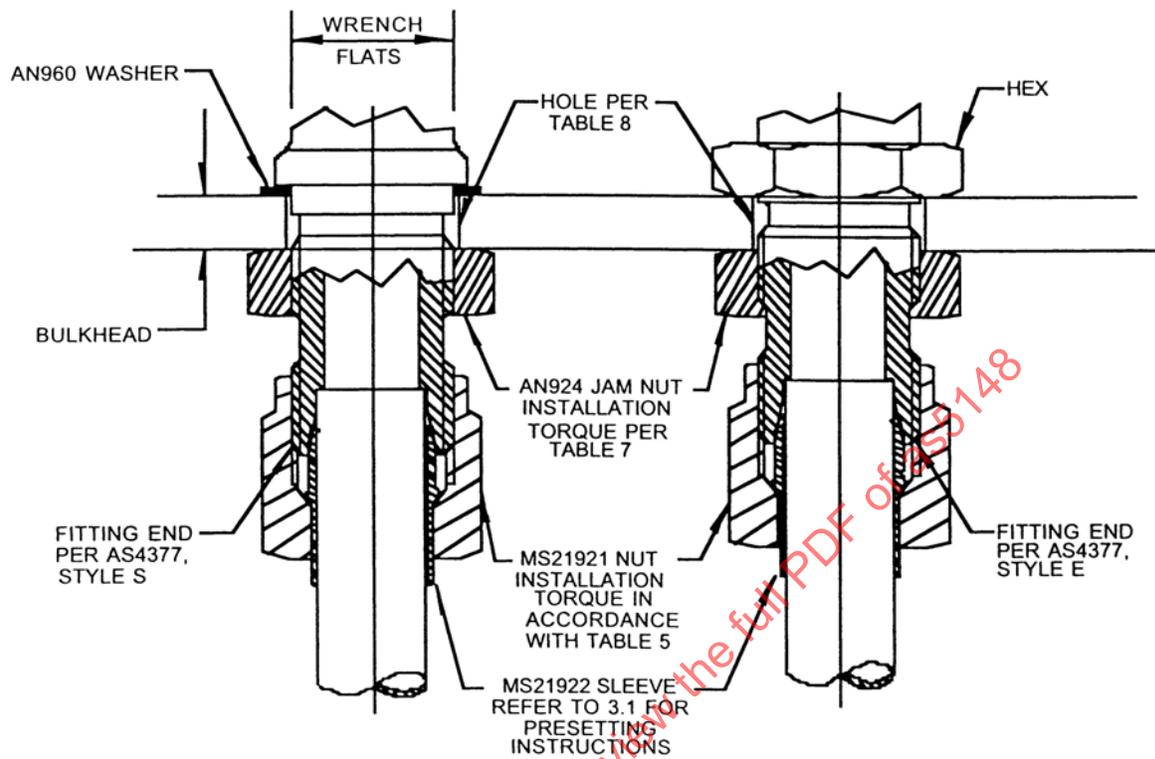


FIGURE 4 Bulkhead Fitting Installation

4.2 Installation Procedure for Style S End (With Shoulder):

- 4.2.1 A washer is not required when the bulkhead is thicker than .188 in provided the hole in the bulkhead is equal to the hole diameter in the applicable washer.
- 4.2.2 Install washer if applicable onto bulkhead fitting shoulder prior to installation through the bulkhead hole.
- 4.2.3 Position the bulkhead fitting through the bulkhead hole and coat the threads on the fitting sparingly with lubricant listed in Table 1.

- 4.2.4 Install the jam nut finger tight until the nut contacts the bulkhead. Tighten the fitting assembly using a torque wrench and a backup wrench. Hold the wrench flats of the fitting stationary in the orientation desired while torquing the jam nut to the torque values listed in Table 7.

TABLE 7 - Torque Values for Installation of Jam Nuts, in-lb, $\pm 5\%$

Fitting Size	Tube OD	Thread	Aluminum Fitting	Steel and Titanium Fitting
2	.125	.3125-24 UNJF	40	50
3	.188	.3750-24 UNJF	80	100
4	.250	.4375-20 UNJF	110	140
5	.312	.5000-20 UNJF	140	190
6	.375	.5625-18 UNJF	170	270
8	.500	.7500-16 UNJF	280	500
10	.625	.8750-14 UNJF	360	700
12	.750	1.0625-12 UNJ	450	900
16	1.000	1.3125-12 UNJ	750	1200
20	1.250	1.6250-12 UNJ	900	1600
24	1.500	1.8750-12 UNJ	900	2000
32	2.000	2.500-12 UNJ		2000

TABLE 8 - Bulkhead Hole Size and Washer Thickness

Nominal Tube OD	Bulkhead Hole Dia Min	Bulkhead Hole Dia Max	AN960/ NAS1149		Bulkhead Hole Dia Min	Bulkhead Hole Dia Max	AN960/ NAS1149 Nominal Washer Thickness
			Nominal Washer Thickness	Nominal Tube OD			
.125	.318	.338	.062	.625	.880	.900	.094
.188	.380	.400	.062	.750	1.068	1.088	.094
.250	.443	.463	.062	1.000	1.318	1.338	.094
.312	.505	.525	.062	1.250	1.630	1.650	.094
.375	.568	.588	.062	1.500	1.880	1.900	.094
.500	.755	.775	.094	2.000	2.505	2.525	.094

NOTE: Bulkhead hole size based on AN960 washer hole size.

- 4.2.5 The tube assembly shall be aligned and the sleeve seated in the mating fitting end without preload before threads of the coupling nut and fitting are engaged by hand.
- 4.2.6 Tighten the fitting assembly using a torque wrench and backup wrench. Hold the wrench flats of the fitting stationary while torquing the coupling nut to the value listed in Table 5. For fitting end per NAS1760, use torque value per Table 6.
- 4.3 Installation Procedure for Style E End (Hex and Reducer Bulkhead Legs):
- 4.3.1 Refer to Figure 4 for example of installation.
- 4.3.2 A washer is not required provided the hole in the bulkhead is equal to the hole diameter in the applicable washer.
- 4.3.3 Position the bulkhead fitting through the bulkhead hole and coat both threads on the fitting sparingly with lubricant as listed in Table 1.
- 4.3.4 Install the jam nut fingertight until the nut contacts the bulkhead. Tighten the fitting assembly using a torque wrench and a backup wrench. Hold the wrench flats of the fitting stationary and in the orientation desired. Torque the jam nut to the torque values listed in Table 7.
- 4.3.5 The tube assembly shall be aligned and the sleeve seated in the mating fitting end without preload before threads of the coupling nut and fitting are engaged by hand.