



SURFACE VEHICLE STANDARD	J514™	NOV2024
	Issued 1950-05 Revised 2012-01 Cancelled 2024-11	
Superseded by J514-1, J514-2, J514-3		
Hydraulic Tube Fittings		

RATIONALE

SAE J514-1, SAE J514-2, and SAE J514-3 have been published which replace the original SAE J514.

CANCELLATION NOTICE

This technical report has been declared "CANCELLED" as of November 2024 and has been superseded by SAE J514-1, SAE J514-2, and SAE J514-3. By this action, this document will remain listed in the respective index, if applicable. Cancelled technical reports are available from SAE.

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1. SCOPE

This SAE Standard covers complete general and dimensional specifications for 37 degree flared and flareless types of hydraulic tube fittings and O-ring plugs. Also included are pipe fittings and adapter unions for use in conjunction with these tube fittings. These fittings are intended for general application in hydraulic systems on industrial equipment and commercial products.

These fittings are capable of providing leakproof, full flow connections in hydraulic systems operating at working pressures as specified in Table 1 for respective sections.

Since many factors influence the pressure at which a hydraulic system will or will not perform satisfactorily, the values shown in SAE J1065 should not be construed as a guaranteed minimum.

For any application, it is recommended that sufficient testing be conducted and reviewed by both the user and fitting manufacturer to assure that performance levels will be safe and satisfactory.

TABLE 1 - WORKING PRESSURE RATINGS^(d) CAPABLE OF 4 TO 1 MINIMUM BURST

Nom SAE Dash Size	Nom Tube OD mm	Nom Tube OD in	Straight Thread Size	Nom Pipe Size	Rigid ^(a) SAE St. Threads Unions and Bulkheads MPa	Rigid ^(a) SAE St. Threads Unions and Bulkheads psi	Adjustable ^(b) SAE St. Threads and Female Swivels MPa	Adjustable ^(b) SAE St. Threads and Female Swivels psi	Fittings ^(c) With Pipe Threads MPa	Fittings ^(c) With Pipe Threads psi
2	3.18	0.125	5/16-24	1/8	34.5	5000	34.5	5000	34.5	5000
3	4.76	0.188	3/8 -24	1/8	34.5	5000	34.5	5000	34.5	5000
4	6.35	0.250	7/16-20	1/8	34.5	5000	31	4500	34.5	5000
5	7.94	0.313	1/2 -20	1/8	34.5	5000	27.5	4000	34.5	5000
6	9.52	0.375	9/16-18	1/4	34.5	5000	27.5	4000	27.5	4000
8	12.70	0.500	3/4 -16	3/8	31	4500	27.5	4000	21	3000
10	15.88	0.625	7/8 -14	1/2	24	3500	21	3000	21	3000
12	19.05	0.750	1-1/16-12	3/4	24	3500	21	3000	17	2500
14	22.22	0.875	1-3/16-12	3/4	21	3000	17	2500	17	2500
16	25.40	1.000	1-5/16-12	1	21	3000	17	2500	14	2000
20	31.75	1.250	1-5/8 -12	1-1/4	17	2500	14	2000	8	1150
24	38.10	1.500	1-7/8 -12	1-1/2	14	2000	10.5	1500	7	1000
32	50.80	2.000	2-1/2 -12	2	10.5	1500	8	1125	7	1000

(a) For fittings in Sections 1, 2, and 3.

(b) For fittings in Sections 1 and 2.

(c) For fittings in Sections 1, 2, and 4.

(d) Working pressures given are for low carbon steel fittings only. Consult the manufacturer for values for other materials.

The standard is divided into six sections as follows:

Section 1—37 Degree Flare Tube Fittings

Section 2—Flareless Tube Fittings

Section 3—O-ring Plugs (for O-ring Ports see SAE J1926)

Section 4—Hydraulic Pipe Fittings (formerly SAE J926)

Section 5—Adapter Unions (formerly in SAE J516)

Section 6—Tables for Calculating Dimensions on Special Sizes

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J343 Test and Test Procedures for SAE 100R Series Hydraulic Hose and Hose Assemblies

SAE J405 Chemical Compositions of SAE Wrought Stainless Steels

SAE J476 Dryseal Pipe Threads

SAE J533 Flares for Tubing

SAE J1065 Nominal Reference Working Pressures for Steel Hydraulic Tubing

2.1.2 ANSI Publication

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ANSI B1.20.1 American Standard Straight Pipe Thread for Mechanical Joints

ANSI B1.20.3 Dryseal Pipe Threads (Inch)

2.1.3 ASTM Publication

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B 117 Method of Salt Spray (Fog) Testing

3. GENERAL SPECIFICATIONS

The following general specifications supplement the dimensional data contained in Tables 3 to 21 with respect to all unspecified detail.

3.1 Size Designations

Fitting sizes are designated by the corresponding outside diameter of the tubing for the various types of tube ends and by the corresponding standard nominal pipe size for pipe thread ends.

See SAE J846 for proper coding and call-out.

3.2 Dimensions and Tolerances

Except for nominal sizes and thread specifications, dimensions and tolerances are given in both SI Units and U.S. Customary as designated. Tabulated dimensions shall apply to the finished parts, plated or otherwise processed, as specified by the purchasers. Hex tolerances across flats are listed in Table 1A. The minimum across-corners dimensions of hexagons shall be 1.092 times the nominal width across flats, but shall not result in a side-flat width less than 0.43 times the nominal width across flats. The minimum across-corners dimensions of external squares shall be 1.25 times the nominal width across flats, but shall not result in a side-flat width less than 0.75 times the nominal width across the flats.

TABLE 1A - HEX TOLERANCES

	Nominal Hex Size Across Flats mm Over	Nominal Hex Size Across Flats mm Include	Nominal Hex Size Across Flats in Over	Nominal Hex Size Across Flats in Include	Tolerance (Minus Only) mm	Tolerance (Minus Only) in
	—	19.05	—	0.750	0.3	0.012
	19.05	25.40	0.750	1.000	0.4	0.016
	25.40	34.92	1.000	1.375	0.5	0.020
	34.92	AND UP	1.375	AND UP	0.8	0.031

Tolerance on all dimensions not otherwise limited shall be ± 0.4 mm (± 0.016 in). Fitting seats shall be concentric with straight thread pitch diameters within 0.25 mm (0.010 in) full indicator movement (FIM).

Unless otherwise specified, tolerance on hole diameters designated drill in the dimensional tables shall be as tabulated in Table 1B:

TABLE 1B - DRILL TOLERANCES

Drill Size Range mm	Drill Size Range in	Tolerance, mm Plus	Tolerance, mm Minus	Tolerance, in Plus	Tolerance, in Minus
0.00 – 6.00	0.000 – 0.236	0.1	0.1	0.004	0.004
over 6.00 – 30.0	0.237 – 1.181	0.2	0.2	0.008	0.008
over 30.0	over 1.181	0.3	0.3	0.012	0.012

Angular tolerance on axis of ends on elbows, tees, and crosses shall be ± 2.50 degrees for 1/8 to 3/8 in tube fittings or 1/8 and 1/4 pipe fittings; ± 1.50 degrees for 1/2 to 2 in O.D. tube fittings or 3/8 to 2 in pipe fittings.

Where so illustrated and not otherwise specified, hexagon corners shall be chamfered 15 to 30 degrees to a diameter equal to the width across flats, with a minus tolerance of 0.4 mm (0.016 in); or where design permits, corners may be chamfered to the diameter of the abutting surface providing the length of chamfer does not exceed that produced by the 30 degree chamfer previously described.

Alternatively, on connections other than SAE straight thread, a 5 degree chamfer starting at the undercut diameter behind the threads or outside diameter of the threads shall be allowed, providing the hex width at corners is not reduced below that produced by the 30 degree chamfer previously described.

3.3 Passages

Where passages in straight fittings are machined from opposite ends, the offset at the meeting point shall not exceed 0.4 mm (0.016 in). The cross-sectional area at the junction of passages in angle fittings shall not be less than that of the smallest passage.

3.4 Wall Thickness

Unless otherwise designated, the wall thickness at any point on fittings shall not be less than the thickness established by the specified dimensions, tolerances, and eccentricities for inner and outer surfaces.

3.5 Contour

Details of contour shall be optional with manufacturer provided the tabulated dimensions are maintained and serviceability of the fittings is not impaired.

3.6 Straight Threads

Unified Standard Class 2A external and Class 2B internal threads with modified minor diameters, where specified, shall apply to plain finish (unplated) fittings of all types. For externally threaded parts with additive finish, the maximum diameters of Class 2A may be exceeded by the amount of the allowance, that is, the basic diameters (Class 2A maximum diameters plus the allowance) apply to an externally threaded part after plating. For internally threaded parts with additive finish, the Class 2B diameters and modified minor diameters apply after plating.

The pitch diameter tolerance shall be the same as the corresponding diameter-pitch combination and class of the Unified fine and 12 thread series. See SAE J475 (ISO R725).

Where external threads are produced by roll threading and body is not undercut, the unthreaded portion of body adjacent to the shoulder may be reduced to the minimum pitch diameter.

External threads shall be chamfered and internal threads shall be countersunk as specified in the dimensional tables.

3.7 Thread Eccentricity Tolerances

The various thread elements of Class 2A external and Class 2B, modified, internal threads on tube fittings shall be concentric within the following limitations:

3.7.1 External Thread (Screw)

- a. Where screw pitch diameter is maximum and screw major diameter is maximum, these two thread elements must be concentric. However, if the screw major diameter is out-of-round, undersize, these two thread elements may be eccentric at the point of out-of-roundness, a full indicator reading amount equal to the screw major diameter tolerance.
- b. Where screw pitch diameter is minimum and screw major diameter is maximum, these two thread elements may be eccentric a full indicator reading amount equal to the screw pitch diameter tolerance.
- c. Where screw pitch diameter is maximum and screw major diameter is minimum, these two thread elements may be eccentric a full indicator reading amount equal to the screw major diameter tolerance.
- d. Where screw pitch diameter is minimum and screw major diameter is minimum, these two thread elements may be eccentric a full indicator reading amount equal to the sum of the screw pitch diameter tolerance and the screw major diameter tolerance.

3.7.2 Internal Thread (Nut)

- a. Where nut pitch diameter is minimum and nut minor diameter is minimum, these two thread elements must be concentric. However, if the nut minor diameter is out-of-round, oversize, the two thread elements may be eccentric at the point of out-of-roundness, a full indicator reading amount equal to the nut minor diameter tolerance.
- b. Where nut pitch diameter is maximum and nut minor diameter is minimum, these two thread elements may be eccentric a full indicator reading amount equal to the nut pitch diameter tolerance.
- c. Where nut pitch diameter is minimum and nut minor diameter is maximum, these two thread elements may be eccentric a full indicator reading amount equal to the nut minor diameter tolerance.
- d. Where nut pitch diameter is maximum and nut minor diameter is maximum, these two thread elements may be eccentric a full indicator reading amount equal to the sum of the nut pitch diameter tolerance and the nut minor diameter tolerance.

3.8 Pipe Threads

Pipe threads, unless there is specific authorization to the contrary, shall conform to the Dryseal American Standard Taper Pipe Thread (NPTF). Specifications are given in detail in SAE J476 (ANSI B1.20.3).

The length of full form external thread shall not be shorter than L_2 plus one pitch (thread).

Where external pipe threads are produced by roll threading, the diameter of the unthreaded shank adjacent to shoulder may be reduced to the E_2 pitch diameter for brass fittings and to the root diameter on steel fittings.

External pipe threads shall be chamfered from the diameters tabulated below to produce the specified length of chamfer or partial thread. Internal pipe threads shall be countersunk 90 degrees, included angle, to the diameters tabulated in Table 2:

TABLE 2 - PIPE THREAD CHAMFER DIAMETERS

Nominal Pipe Thread Size	External Thread Chamfer Dia Max mm	External Thread Chamfer Dia Max in	External Thread Chamfer Dia Min mm	External Thread Chamfer Dia Min in	External Thread Length of Chamfer or Partial Thread Min mm	External Thread Length of Chamfer or Partial Thread Min in	External Thread Length of Chamfer or Partial Thread Max mm	External Thread Length of Chamfer or Partial Thread Max in	Internal Thread Counter- sink Dia Min mm	Internal Thread Counter- sink Dia Min in	Internal Thread Counter- sink Dia Max mm	Internal Thread Counter- sink Dia Max in
1/8	8.1	0.32	7.6	0.30	0.94	0.037	1.40	0.055	10.7	0.42	11.2	0.44
1/4	10.7	0.42	10.2	0.40	1.42	0.056	2.13	0.084	14.0	0.55	14.5	0.57
3/8	14.0	0.55	13.5	0.53	1.42	0.056	2.13	0.084	17.5	0.69	18.0	0.71
1/2	17.3	0.68	16.8	0.66	1.80	0.071	2.72	0.107	21.6	0.85	22.1	0.87
3/4	22.6	0.89	22.1	0.87	1.80	0.071	2.72	0.107	26.9	1.06	27.4	1.08
1	28.4	1.12	27.7	1.09	2.21	0.087	3.30	0.130	34.0	1.34	34.8	1.37
1-1/4	37.1	1.46	36.3	1.43	2.21	0.087	3.30	0.130	42.7	1.68	43.4	1.71
1-1/2	43.2	1.70	42.4	1.67	2.21	0.087	3.30	0.130	48.8	1.92	49.5	1.95
2	55.1	2.17	54.4	2.14	2.21	0.087	3.30	0.130	60.7	2.39	61.5	2.42

Tabulated diameters conform with Appendix A of SAE J476.

3.9 Material

Unless otherwise specified, fittings and ferrules shall be made from carbon steel. Flareless type ferrules in Figures 28 and 29 shall be made from SAE 1010, 1112, 1113, 1213, 12L14, or 1215 steel and cyanide hardened to a depth of 0.03 to 0.05 mm (0.0010 to 0.0019 in).

Stainless steel fittings shall be made from AISI Type 300 Series stainless steel of good quality.¹ Flareless type ferrules in Figures 28 and 29 shall be made from stainless steel of such hardness as to be capable of biting, fully annealed type 304 stainless steel tubing. Unless otherwise specified by the purchaser, stainless steel fittings shall be passivated. Carbon steel and stainless steel fittings fabricated from multiple components must be bonded together with materials having a melting point of not less than 996 °C (1825 °F).

Thirty-seven degree flared type and pipe type brass fittings shall be made from C36000 (CA360) one-half hard barstock or extruded shapes or C37700 (CA377) forgings.

3.10 Finish

The external surfaces and threads of all carbon steel parts shall be plated or coated with a suitable material that passes a 72 h salt spray test in accordance with ASTM B 117. Any appearance of red rust during the 72 h salt spray test shall be considered failure, except for the following:

- All internal fluid passages.
- Edges such as hex points, serrations, and crests of threads where there may be mechanical deformation of the plating or coating typical of mass-produced parts or shipping effects.
- Areas where there is mechanical deformation of the plating or coating caused by crimping, flaring, bending, and other post-plate metal forming operations.
- Areas where the parts are suspended or affixed in the test chamber where condensate can accumulate.

¹ See SAE J405.

NOTE: Cadmium plating is not preferred due to environmental reasons. Parts manufactured to this document after January 1, 1997, shall not be cadmium plated. Internal fluid passages shall be protected from corrosion during storage. Changes in plating may affect assembly torques and require requalification, when applicable.

3.11 Workmanship

Workmanship shall conform to the best commercial practice to produce high-quality fittings. Fittings shall be free from all hanging burrs, loose scale, and slivers which might become dislodged in usage and all other defects which might affect their serviceability. All sealing surfaces must be smooth except that annular tool marks up to 2.5 μm (100 μin) max A.A. shall be permissible.

3.12 Assembly Considerations

Use of a compatible lubricant is desirable in assembling dryseal pipe threads on hydraulic tube or pipe fittings to minimize galling and effect a pressure-tight seal.

The O-ring washer must be clinched to fitting with a tight slip fit to an interference fit. The slip fit shall be tight enough so that washer cannot be shaken loose to cause it to drop from its uppermost position by its own weight. The interference fit shall not require a locknut torque more than that indicated in Table 3 of SAE J1453. Position the washer farthest from the end of the fittings as shown in Figure 10A. Care must be taken not to clinch washer on the transition area between diameter Y and locknut thread which results in a loose washer when it is repositioned at assembly. Washer flatness allowance is given in Table 3 of SAE J1453. Any surface out of flatness must be uniform (not wavy) and concave with respect to the O-ring boss end of the fitting.

Torque values listed in Table 2A are for controlled testing to establish compliance to the performance requirements set forth in Table 1. Recommended assembly torques by manufacturers may vary from Table 2A.

Smaller sizes (–2 through –8) of 37 degree flare fittings are less tolerant to over torquing than the larger sizes. Over torquing in these sizes causes deformation of 37 degree cone of the male end. Excessive deformation of the cone results in loss of clamping force and, hence, loss of seal. It also reduces flow area.

Plating combination, surface finish, lubrication, etc., influence fittings' propensity for deformation when assembled to a given torque value. For this reason, many manufacturers recommend assembly to a given number of turns or flats of nut from finger tight position. This method circumvents the influence of variables listed previously, eliminating possibility of excess deformation of 37 degree cone. It is recommended that this method be followed wherever possible.

4. PERFORMANCE REQUIREMENTS

See Appendix B for minimum number of samples required for testing.

4.1 Working Pressure (For All Sections)

Working pressures for fittings shall be as listed in Table 1 or as specified in respective section. Proof pressures shall be twice the working pressures, and minimum burst pressures shall be four times the working pressures.

4.2 Proof Test (For All Sections)

All fittings for tubing and adapters shall be capable of withstanding proof pressure for a period of 1 min without failure or leakage.

4.3 Burst Test (For All Sections)

Burst test shall be conducted at minimum torque values or minimum number of turns from finger tight position specified in assembly procedure by manufacturer. For testing only, all adapter to hose fittings or tube fitting threads and contact surfaces shall be lubricated with SAE 10W hydraulic oil prior to assembly. Test blocks for burst testing shall be hardened to 45 to 55 HRC and left unplated. Adjustable fittings shall be backed out one full turn from finger tight position. The test shall be conducted as specified in SAE J343.

4.4 Cyclic Endurance (Impulse) Test (For All Sections)

All tube fittings and adapters shall pass a cyclic endurance test for one million cycles at 133% of corresponding working pressures as established per 4.1. The cycle test shall be conducted at minimum torque or number of turns from finger tight assembly. For testing only, all threads and contact surfaces shall be lubricated with SAE 10W hydraulic oil prior to assembly. Cycle rate shall be uniform at –5 to 1.3 Hz and shall conform in magnitude and frequency to the wave pattern shown in Figure 1 of SAE J343.

4.5 Hose Coupling Interface

Along with over torque test per 4.7, adapter interface and nut portion of hose stem assemblies shall meet proof, burst, and cyclic endurance requirements of hose to which they are attached.

4.6 O-ring

The standard O-ring used on SAE straight thread end for testing shall be nitrile (NBR) rubber with a durometer “A” hardness of 90.

4.7 Over Torque Test (For Fittings in Section 1)

Fitting swivel nuts shall be capable of withstanding the overtorque qualification test with no indication of failure. For testing only, all threads and contact surfaces shall be lubricated with SAE 10W hydraulic oil prior to applying torque listed in respective sections. Test adapters for torque testing shall be hardened to 40 to 50 HRC and left unplated. The fitting shall be restrained during test and the wrench shall be located at the threaded end of the nut hex. Nuts that go through brazing in production shall be put through similar annealing cycle before testing.

Definition of failure after torque testing:

- a. Nut cannot be removed by hand after breakaway.
- b. Nut cannot swivel freely by hand.
- c. Any visible cracks or severe deformation that would render nut unuseable.

4.8 Repeated Assembly (For Fittings in Section 1)

Three samples each of male flare shaped fittings assembled to tube flare (with sleeve and nut) and female swivel end shall be tested. Samples shall be assembled and disassembled ten times. Fittings shall be tightened, with threads lubricated with 10W hydraulic oil, to maximum torque values shown in Table 2A. Proof test per 4.2 shall be conducted following the first, fifth, and tenth assembly. There shall be no leakage and the fitting nut shall remain free to swivel by hand after the tenth disassembly.

TABLE 2A - QUALIFICATION TEST TORQUE^(b) REQUIREMENTS

Nom SAE Dash Size	Nom Tube OD mm	Nom Tube OD in	Tube End and SAE O-Ring Port Thr'd Size	37 degree Flare End Swivel Nut Torque Nm	37 degree Flare End Swivel Nut Torque lb-ft	37 degree Flare End Swivel Nut Over Torque Nm	37 degree Flare End Swivel Nut Over Torque lb-ft	SAE O- Ring ^(a) Port End Torque Nm	SAE O- Ring ^(a) Port End Torque lb-ft
2	3.18	0.125	5/16-24	8- 9	6- 7	15	11	8- 9	6- 7
3	4.76	0.188	3/8 -24	11- 12	8- 9	19	14	11- 12	8- 9
4	6.35	0.250	7/16-20	15- 16	11- 12	24	18	18- 20	13- 15
5	7.94	0.313	1/2 -20	19- 21	14- 15	31	23	23- 26	17- 19
6	9.52	0.375	9/16-18	24- 28	18- 20	42	31	29- 33	22- 24
8	12.70	0.500	3/4 -16	49- 53	36- 39	80	59	49- 53	40- 43
10	15.88	0.625	7/8 -14	77- 85	57- 63	114	85	59- 64	43- 48
12	19.05	0.750	1-1/16-12	107-119	79- 88	160	118	93-102	68- 75
14	22.22	0.875	1-3/16-12	127-140	94-103	186	138	122-134	90- 99
16	25.40	1.000	1-5/16-12	147-154	108-113	214	158	151-166	112-123
20	31.75	1.250	1-5/8 -12	172-181	127-133	271	200	198-218	146-161
24	38.10	1.500	1-7/8 -12	215-226	158-167	339	250	209-231	154-170
32	50.80	2.000	2-1/2 -12	332-350	245-258	497	368	296-325	218-240

(a) This torque is applicable to fittings in Sections 1, 2, 3, and 5.

(b) Test torques given here are for low carbon steel fittings only. Consult the manufacturer for values for other materials.

5. SECTION 1—37 DEGREE FLARE TUBE FITTINGS

The 37 degree flared tube fittings shall be as shown in Figures 1 to 15 and Tables 3 to 7. Since the basic design of these fittings is derived from Air Force and Navy Standards for 37 degree flared fittings which meet a performance specification, any future changes should not be detrimental to the design or performance. Dimensions for double and single 37 degree flares on tubing to be used with these fittings are given in Figure 3 and Table 2 of SAE J533.

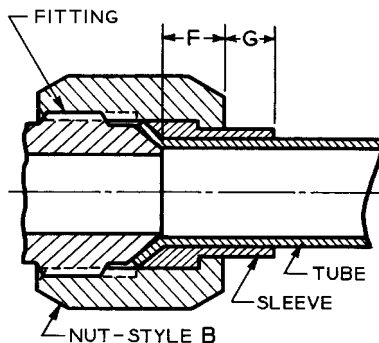


FIGURE 1A - THREE PIECE TUBE ASSEMBLY

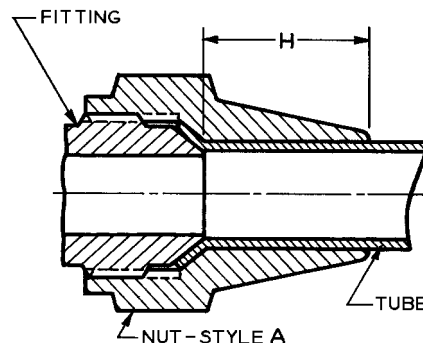
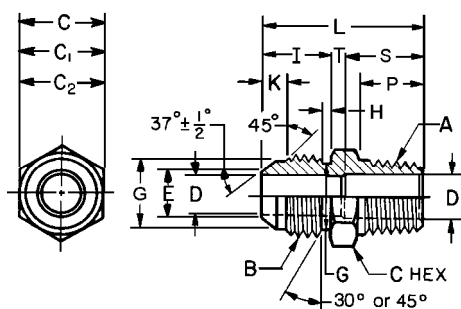
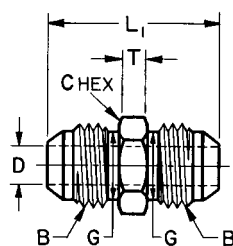
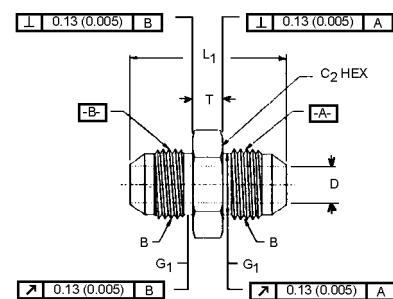
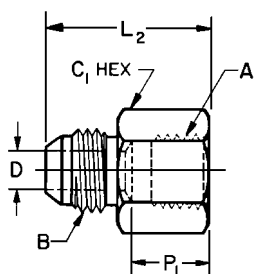
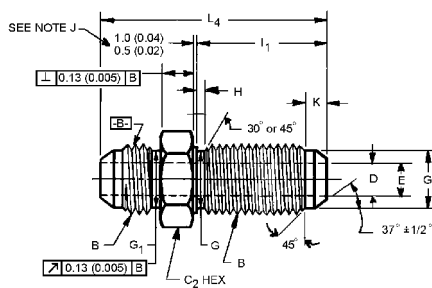
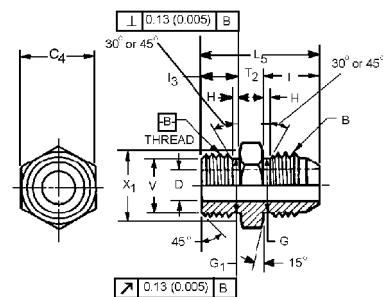


FIGURE 1B - TWO PIECE TUBE ASSEMBLY

FIGURE 1 - DETAILS OF 37 DEGREE FLARED HYDRAULIC TUBE FITTING ASSEMBLIES (FIGURE 1)

TABLE 3 - DIMENSIONS OF 37 DEGREE FLARED HYDRAULIC TUBE FITTING ASSEMBLIES (FIGURE 1)

Nominal Tube OD	F (Ref) mm	F (Ref) in	G (Ref) mm	G (Ref) in)	H (Ref) mm	H (Ref) in
1-1/8	4.8	0.19	3.0	0.12	12.2	0.48
3/16	6.4	0.25	3.0	0.12	14.2	0.56
1/4	4.8	0.19	4.3	0.17	15.0	0.59
5/16	7.6	0.30	2.8	0.11	16.8	0.66
3/8	7.1	0.28	4.8	0.19	17.5	0.69
1/2	7.9	0.31	4.8	0.19	20.6	0.81
5/8	9.7	0.38	6.9	0.27	23.9	0.94
3/4	9.1	0.36	6.4	0.25	26.2	1.03
7/8	9.7	0.38	7.9	0.31	30.2	1.19
1	8.6	0.34	10.4	0.41	33.3	1.31
1-1/4	8.6	0.34	9.9	0.39	38.1	1.50
1-1/2	12.7	0.50	14.0	0.55	38.9	1.53
2	14.0	0.55	13.5	0.53	44.4	1.75

FIGURE 2A - MALE CONNECTOR
(070102)FIGURE 2B - UNION
(070101)FIGURE 2C - LARGE
HEX UNION* (070119)FIGURE 2D -
FEMALE CONNECTOR (070103)FIGURE 3A - BULKHEAD UNION
(070601) SEE NOTE JFIGURE 3B - STRAIGHT THREAD
CONNECTOR SHORT* (070120)

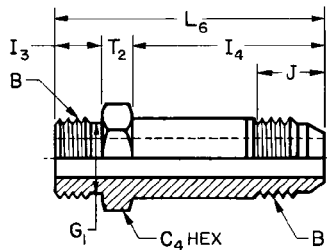


FIGURE 3C - STRAIGHT
THREAD CONNECTOR
LONG* (071720)

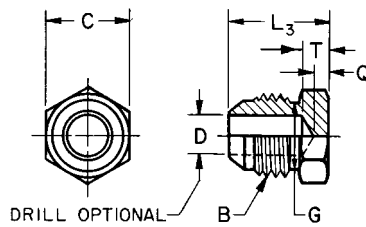


FIGURE 3D - PLUG (070109)

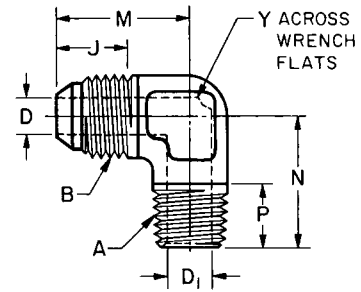


FIGURE 4A - 90 DEGREE
MALE ELBOW (070202)

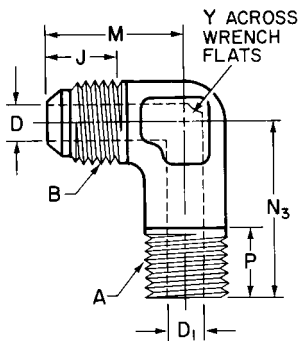


FIGURE 4B - 90 DEGREE MALE
LONG ELBOW (071502)

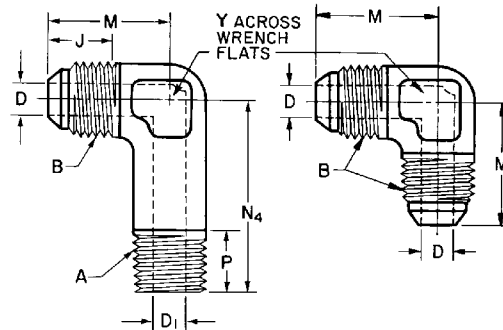


FIGURE 4C - 90 DEGREE
MALE EXTRA LONG
ELBOW (071602)

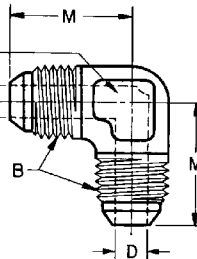


FIGURE 4D - 90
DEGREE UNION
ELBOW (070201)

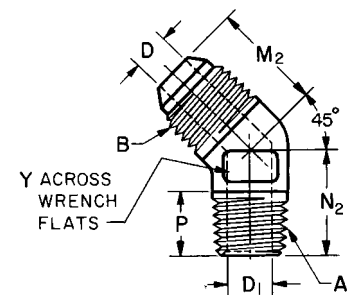


FIGURE 4E - 45 DEGREE
MALE ELBOW (070302)

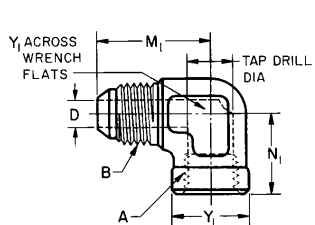


FIGURE 5A - 90 DEGREE
FEMALE ELBOW (070203)

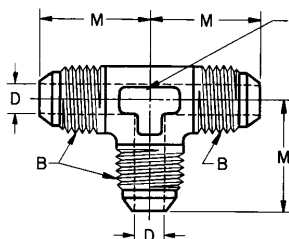


FIGURE 5B - UNION
TEE (070401)

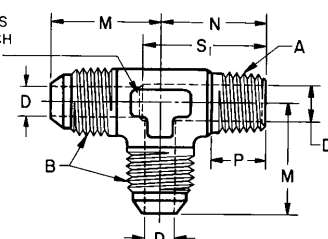


FIGURE 5C - MALE
RUN TEE (070424)

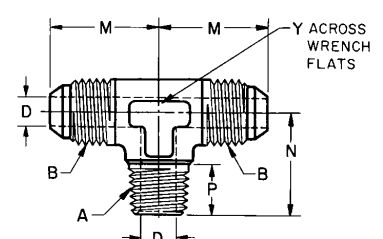


FIGURE 5D - MALE
BRANCH TEE (070425)

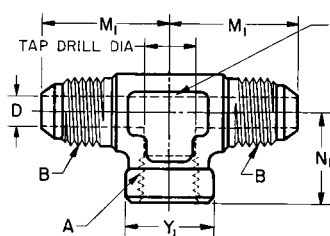


FIGURE 6A - FEMALE BRANCH
TEE (070427)

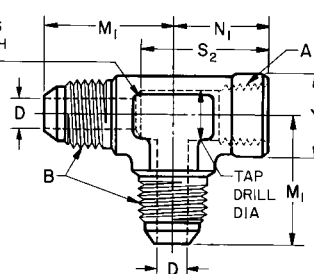


FIGURE 6B - FEMALE
RUN TEE (070426)

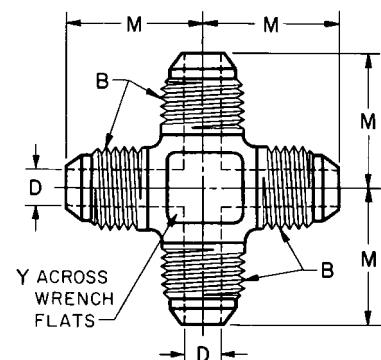


FIGURE 6C - CROSS (070501)

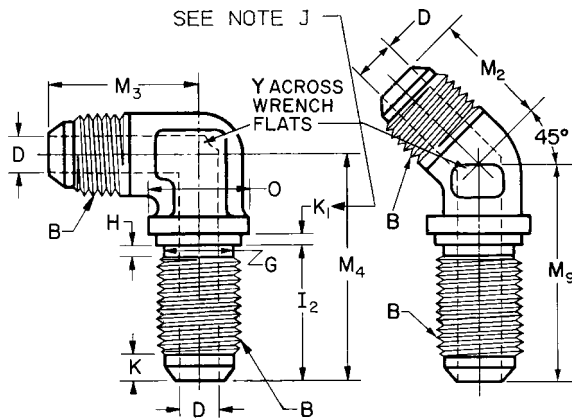


FIGURE 7A - 90 DEGREE BULKHEAD ELBOW (070701)

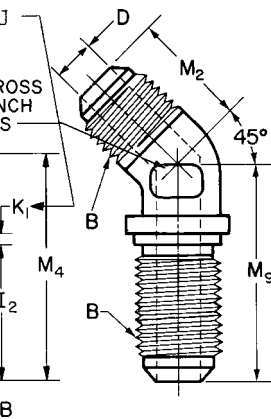


FIGURE 7B - 45 DEGREE BULKHEAD ELBOW (070801)

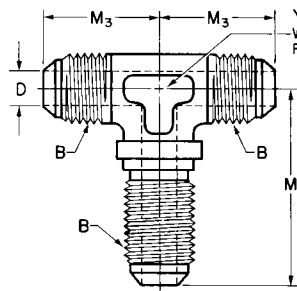


FIGURE 7C - BULKHEAD BRANCH TEE (070959)

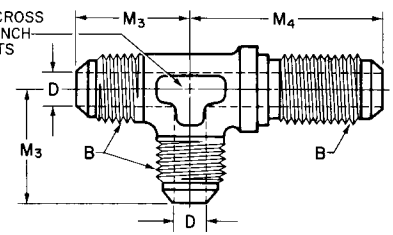


FIGURE 7D - BULKHEAD RUN TEE (070958)

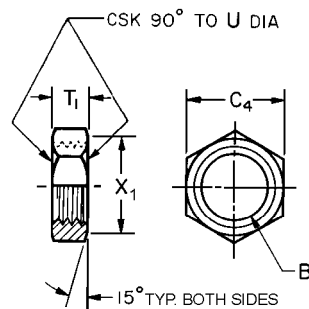


FIGURE 8A - STRAIGHT THREAD LOCKNUT* (070117)

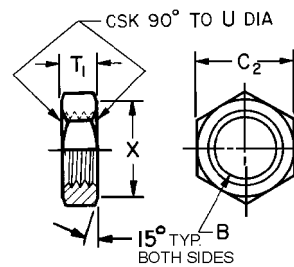


FIGURE 8B - BULKHEAD LOCKNUT (070118)

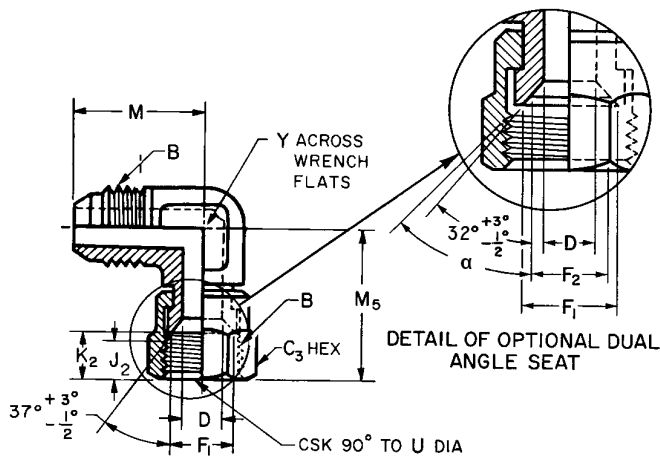


FIGURE 8C - 90 DEGREE SWIVEL ELBOW (070221)

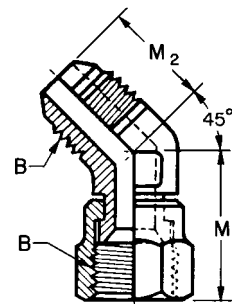


FIGURE 9A - 45 DEGREE SWIVEL ELBOW (070321)

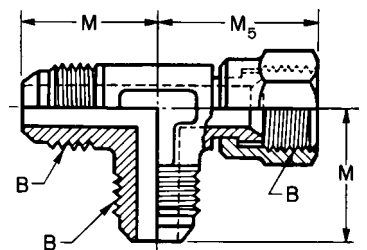


FIGURE 9B - SWIVEL RUN TEE (070432)

THE DESIGN AND METHOD OF ATTACHING THE SWIVEL NUT SHALL BE OPTIONAL WITH THE MANUFACTURER PROVIDING THE TABULATED DIMENSIONS ARE MAINTAINED AND THE NUT TURNS FREELY.

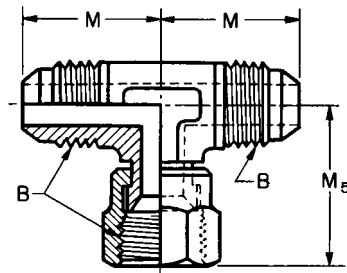


FIGURE 9C - SWIVEL
BRANCH TEE (070433)

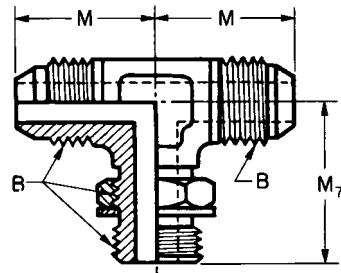


FIGURE 9D - STRAIGHT THREAD
BRANCH TEE† (070429)

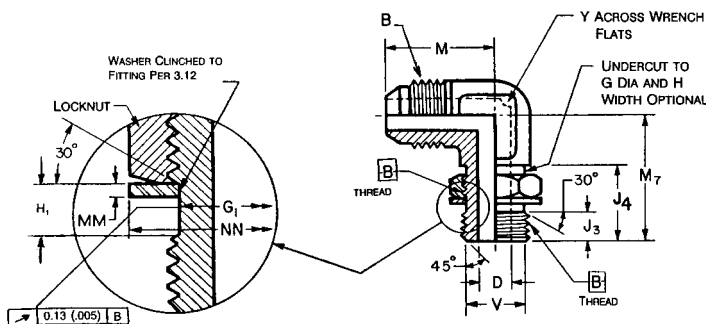


FIGURE 10A - 90 DEGREE STRAIGHT
THREAD ELBOW† (070220)

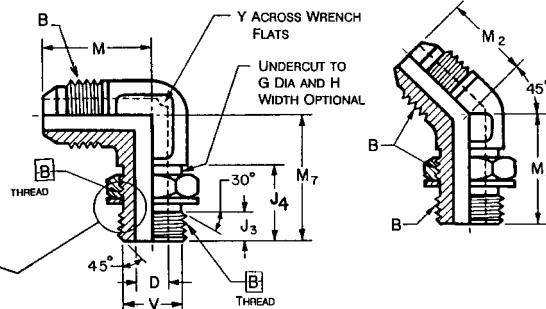


FIGURE 10B - 45 DEGREE STRAIGHT
THREAD ELBOW† (070320)

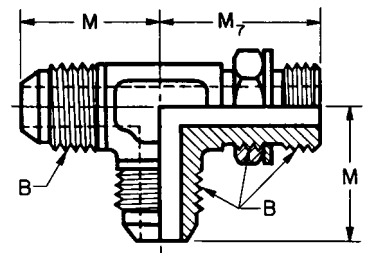


FIGURE 10C - STRAIGHT
THREAD RUN TEE† (070428)

NOTES: UNSPECIFIED DETAIL WITH RESPECT TO DIMENSIONS, TOLERANCES, CONTOURS, MATERIAL, WORKMANSHIP, ETC., MUST CONFORM TO GENERAL SPECIFICATIONS FOR HYDRAULIC TUBE FITTINGS. THE DIMENSIONAL DESIGNATIONS FOR TUBE ENDS IN FIGURES 2A TO 10F, FOR SWIVEL ENDS IN FIGURES 8C TO 9C, FOR O-RING BOSS ENDS IN FIGURES 3B AND 3C, AND FOR ADJUSTABLE STRAIGHT THREAD ENDS IN FIGURES 9D TO 10F SHALL APPLY TO CORRESPONDING ENDS OF OTHER FIGURES ON THIS AND PRECEDING PAGE UNLESS SHOWN OTHERWISE. FIGURES 2A TO 10F ON THIS AND PRECEDING PAGE APPLY TO TABLE 4. CODES SHOWN IN BRACKETS ADJACENT TO FIGURE NUMBERS REPRESENT RESPECTIVE FITTING IDENTIFICATION IN ACCORDANCE WITH SAE J846.

* MODIFICATION OF 1/8-1 IN SIZES IN THESE TYPES OF FITTINGS FOR USE WITH MS 33649 (OR SUPERSEDED AND 10050) BOSSES IS SHOWN IN FIGURE 35 AND TABLE 15.

† IF DESIRED BY THE PURCHASER AND SO SPECIFIED, THESE FITTINGS MAY BE FURNISHED WITH LARGE HEXAGON LOCKNUT SHOWN IN FIGURE 8B.

TABLE 4 - DIMENSIONS OF ALL BODIES AND LOCKNUTS (FIGURES 2A TO 10C)

Nom Tube OD, in	A Dryseal Pipe Thread SAE J476 (ANSI B1.20.3)	B ^(g) Thread Size, in SAE J425 (ISO R725) Class 2A Ext Class 2B Int	C ^(h) Hex Nom in	C ₁ ^(h) Hex Nom in	C ₂ ^(h) Hex Nom in	C ₃ ^(h) Hex Min in	C ₄ ^(h) Hex Nom in	D ^{(l)(m)}				E Dia mm ±0.08	E Dia in ±0.003	F ₁ Dia mm ±0.25	F ₁ Dia in ±0.010	F ₂ Dia mm ±0.13	F ₂ Dia in ±0.005
								Metric Drill Size mm	D ^(l) Drill in	D ₁ ^{(b)(l)} Drill mm	D ₁ ^{(b)(l)} Drill in						
1/8	1/8-27	5/16-24	7/16	9/16	9/16	7/16	7/16	1.6	0.062	4.8	0.188	2.11	0.083	4.85	0.190	2.67	0.105
3/16	1/8-27	3/8-24	7/16	9/16	5/8	1/2	1/2	3.2	0.125	4.8	0.188	3.71	0.146	6.20	0.245	4.32	0.170
1/4	1/8-27	7/16-20	1/2	9/16	11/16	9/16	9/16	4.4	0.172	4.8	0.188	4.90	0.193	7.35	0.290	6.35	0.250
5/16	1/8-27	1/2-20	9/16	9/16	3/4	5/8	5/8	6.0	0.234	4.8	0.188	6.48	0.255	8.90	0.350	7.93	0.312
3/8	1/4-18	9/16-18	5/8	3/4	13/16	11/16	11/16	7.5	0.297	7.0	0.281	8.08	0.318	10.90	0.430	8.89	0.350
1/2	3/8-18	3/4-16	13/16	7/8	1	7/8	7/8	9.9	0.391	10.3	0.406	10.82	0.426	14.35	0.565	12.70	0.500
5/8	1/2-14	7/8-14	15/16	1-1/8	1-1/8	1	1	12.3	0.484	13.5	0.531	13.69	0.539	17.15	0.675	15.88	0.625
3/4	3/4-14	1-1/16-12	1-1/8	1-3/8	1-3/8	1-1/4	1-1/4	15.5	0.609	18.3	0.719	16.87	0.664	21.45	0.845	17.65	0.695
7/8	3/4-14	1-3/16-12	1-1/4	1-3/8	1-1/2	1-3/8	1-3/8	18.3(18.0)	0.719	18.3	0.719	20.02	0.788	24.65	0.970	20.83	0.820
1	1-11-1/2	1-5/16-12	1-3/8	1-5/8	1-5/8	1-1/2	1-1/2	(21.5)21.4	0.844	23.8	0.938	23.19	0.913	27.80	1.095	24.00	0.945
1-1/4	1-1/4-11-1/2	1-5/8-12	1-11/16	2	1-7/8	2	1-7/8	(27.5)27.4	1.078	31.7	1.250	29.13	1.147	35.70	1.405	29.85	1.175
1-1/2	1-1/2-11-1/2	1-7/8-12	2	2-3/8	2-1/8	2-1/4	2-1/8	(33.5)33.3	1.312	38.0	1.500	35.08	1.381	41.15	1.620	35.81	1.410
2	2-11-1/2	2-1/2-12	2-5/8	2-7/8	2-3/4	2-7/8	2-3/4	45.2(45.0)	1.781	49.0	1.938	47.75	1.880	56.75	2.235	48.51	1.910

Nom Tube OD in	G Dia mm +0.05 -0.25	G Dia in +0.002 -0.010	G ₁ ^(a) Dia mm +0.05 -0.08	G ₁ ^(a) Dia in +0.002 -0.003	H mm +0.8 -0.0	H in +0.030 -0.000	H ₁ mm +0.3 -0.0	H ₁ in +0.010 -0.000	I mm ±0.4	I in ±0.016	I ₁ mm ±0.5	I ₁ in ±0.02	I ₂ mm ±0.5	I ₂ in ±0.02	I ₃ mm ±0.13	I ₃ in ±0.005	I ₄ mm ±0.5	I ₄ in ±0.02	J ^(k) Full Thread Min mm	J ^(k) Full Thread Min in
1/8	6.35	0.250	6.35	0.250	1.6	0.063	3.2	0.125	11.4	0.448	28.2	1.11	23.4	0.92	7.54	0.297	29.7	1.17	11.00	0.433
3/16	7.92	0.312	7.95	0.313	1.6	0.063	3.3	0.131	12.2	0.479	28.2	1.11	23.4	0.92	7.54	0.297	31.8	1.25	11.81	0.464
1/4	9.25	0.364	9.25	0.364	1.9	0.075	4.0	0.156	14.0	0.550	30.5	1.20	25.9	1.02	9.14	0.360	35.3	1.39	13.59	0.535
5/16	10.82	0.426	10.85	0.427	1.9	0.075	4.0	0.156	14.0	0.550	30.5	1.20	25.9	1.02	9.14	0.360	36.8	1.45	13.59	0.535
3/8	12.22	0.481	12.24	0.482	2.1	0.083	4.0	0.156	14.1	0.556	32.5	1.28	27.7	1.09	9.93	0.391	39.6	1.56	13.74	0.541
1/2	16.74	0.659	16.76	0.660	2.4	0.094	4.8	0.187	16.7	0.657	36.6	1.44	31.8	1.25	11.13	0.438	47.8	1.88	16.31	0.642
5/8	19.61	0.772	19.63	0.773	2.7	0.107	5.6	0.219	19.3	0.758	40.1	1.58	35.3	1.39	12.70	0.500	53.1	2.09	18.87	0.743
3/4	23.95	0.943	24.00	0.945	3.2	0.125	5.9	0.234	21.9	0.864	44.4	1.75	39.6	1.56	15.09	0.594	63.5	2.50	21.56	0.849
7/8	27.13	1.068	27.18	1.070	3.2	0.125	5.9	0.234	22.6	0.890	44.4	1.75	39.6	1.56	15.09	0.594	68.3	2.69	22.22	0.875
1	30.30	1.193	30.35	1.195	3.2	0.125	5.9	0.234	23.1	0.911	44.4	1.75	39.6	1.56	15.09	0.594	72.1	2.84	22.76	0.896
1-1/4	38.25	1.506	38.28	1.507	3.2	0.125	5.9	0.234	24.3	0.958	45.7	1.80	40.9	1.61	15.09	0.594	88.1	3.47	23.95	0.943
1-1/2	44.58	1.755	44.60	1.756	3.2	0.125	5.9	0.234	27.5	1.083	46.0	1.81	41.1	1.62	15.09	0.594	98.6	3.88	27.13	1.068
2	60.45	2.380	60.48	2.381	3.2	0.125	5.9	0.234	33.9	1.333	53.1	2.09	48.5	1.91	15.09	0.594	122.9	4.84	33.48	1.318

Continued on next page.

TABLE 4 - DIMENSIONS OF ALL BODIES AND LOCKNUTS (FIGURES 2A TO 10C) (CONTINUED)

Nom Tube OD, in	J ₂ Full Thread Min in	J ₂ Full Thread Min in	J ₃ Full Thread Min in	J ₃ Full Thread Min in	J ₄ Min in	J ₄ Min in	K mm +0.4 -0.0	K in +0.016 -0.000	K ₁ ⁽¹⁾ mm ±0.5	K ₁ ⁽¹⁾ in ±0.02	K ₂ mm +0.8 -0.4	K ₂ in +0.030 -0.016	L mm ±0.5	L in ±0.02	L ₁ mm ±0.5	L ₁ in ±0.02	L ₂ mm ±0.5	L ₂ in ±0.02	L ₃ mm ±0.5	L ₃ in ±0.02	L ₄ mm ±0.5	L ₄ in ±0.02
1/8	6.38	0.251	5.94	0.234	15.0	0.59	4.5	0.177	2.4	0.094	7.9	0.312	28.2	1.11	29.7	1.17	28.4	1.12	17.8	0.70	47.5	1.87
3/16	7.16	0.282	5.94	0.234	15.0	0.59	4.5	0.177	2.4	0.094	8.3	0.328	29.0	1.14	31.2	1.23	28.7	1.13	18.5	0.73	48.3	1.90
1/4	7.62	0.300	6.73	0.265	18.5	0.73	4.9	0.193	2.4	0.094	8.7	0.344	31.0	1.22	34.8	1.37	30.2	1.19	20.3	0.80	52.6	2.07
5/16	8.41	0.331	6.73	0.265	18.5	0.73	4.9	0.193	2.4	0.094	9.5	0.375	31.0	1.22	34.8	1.37	29.7	1.17	20.3	0.80	52.6	2.07
3/8	8.46	0.333	7.92	0.312	19.1	0.75	5.0	0.198	2.4	0.094	9.5	0.375	36.3	1.43	35.8	1.41	35.6	1.40	21.3	0.84	55.4	2.18
1/2	9.52	0.375	8.74	0.344	21.9	0.86	6.4	0.253	3.2	0.125	10.7	0.422	38.9	1.53	41.1	1.62	39.6	1.56	23.9	0.94	62.0	2.44
5/8	11.71	0.461	9.93	0.391	25.4	1.00	6.8	0.266	3.2	0.125	12.7	0.500	48.0	1.89	47.8	1.88	48.0	1.89	27.9	1.10	69.6	2.74
3/4	11.91	0.469	11.91	0.469	29.0	1.14	8.0	0.315	3.2	0.125	14.3	0.562	52.3	2.06	54.9	2.16	52.3	2.06	32.5	1.28	78.5	3.09
7/8	13.11	0.516	11.91	0.469	29.0	1.14	8.0	0.315	3.2	0.125	14.7	0.578	53.1	2.09	56.1	2.21	52.3	2.06	33.3	1.31	79.2	3.12
1	14.30	0.563	11.91	0.469	29.0	1.14	8.0	0.315	3.2	0.125	15.1	0.594	58.4	2.30	57.2	2.25	59.7	2.35	33.8	1.33	79.8	3.14
1-1/4	14.30	0.563	11.91	0.469	29.0	1.14	9.3	0.367	3.2	0.125	15.9	0.625	62.2	2.45	61.7	2.43	63.2	2.49	36.8	1.45	84.1	3.31
1-1/2	16.79	0.661	11.91	0.469	29.0	1.14	9.6	0.378	3.2	0.125	18.6	0.734	68.1	2.68	69.8	2.75	66.5	2.62	41.9	1.65	89.4	3.52
2	21.44	0.844	11.91	0.469	29.0	1.14	11.7	0.461	3.2	0.125	23.8	0.938	79.0	3.11	86.4	3.40	75.4	2.97	52.1	2.05	106.7	4.20

Nom Tube OD, in	L ₅ mm ±0.5	L ₅ in ±0.02	L ₆ mm ±0.5	L ₆ in ±0.02	M mm ±0.8	M in ±0.03	M ₁ mm ±0.8	M ₁ in ±0.03	M ₂ mm ±0.8	M ₂ in ±0.03	M ₃ mm ±0.8	M ₃ in ±0.03	M ₄ mm ±0.8	M ₄ in ±0.03	M ₅ mm ±1.5	M ₅ in ±0.06	M ₆ mm ±1.5	M ₆ in ±0.06	M ₇ mm ±0.8	M ₇ in ±0.03	M ₈ mm ±0.8	M ₈ in ±0.03	M ₉ mm ±0.8	M ₉ in ±0.03
1/8	26.9	1.06	45.5	1.79	19.6	0.77	25.4	1.00	17.5	0.69	22.4	0.88	38.1	1.50	24.6	0.97	23.9	0.94	23.9	0.94	22.4	0.88	36.1	1.42
3/16	27.9	1.10	47.5	1.87	21.1	0.83	26.2	1.03	17.5	0.69	23.9	0.94	38.1	1.50	25.4	1.00	23.9	0.94	23.9	0.94	22.4	0.88	36.1	1.42
1/4	31.2	1.23	52.8	2.08	22.6	0.89	27.4	1.08	18.3	0.72	24.6	0.97	40.4	1.59	25.4	1.00	23.9	0.94	26.2	1.03	26.7	1.05	38.9	1.53
5/16	31.2	1.23	54.4	2.14	24.1	0.95	27.4	1.08	19.6	0.77	26.9	1.06	43.7	1.72	26.9	1.06	25.4	1.00	28.7	1.13	26.7	1.05	42.2	1.66
3/8	33.0	1.30	58.7	2.31	26.9	1.06	31.2	1.23	21.1	0.83	27.7	1.09	46.0	1.81	31.8	1.25	28.4	1.12	31.8	1.25	29.0	1.14	42.4	1.67
1/2	37.6	1.48	68.6	2.70	31.8	1.25	36.1	1.42	24.9	0.98	34.5	1.36	53.6	2.11	35.1	1.38	32.5	1.28	36.8	1.45	33.0	1.30	49.3	1.94
5/8	43.2	1.70	77.2	3.04	36.8	1.45	41.7	1.64	28.2	1.11	39.6	1.56	60.7	2.39	41.1	1.62	36.6	1.44	43.2	1.70	38.6	1.52	55.1	2.17
3/4	50.0	1.97	91.7	3.61	42.2	1.66	48.0	1.89	32.5	1.28	45.2	1.78	67.8	2.67	44.4	1.75	38.1	1.50	49.3	1.94	43.9	1.73	62.0	2.44
7/8	50.5	1.99	96.5	3.80	45.7	1.80	47.2	1.86	36.8	1.45	48.8	1.92	71.1	2.80	45.2	1.78	41.1	1.62	50.8	2.00	47.2	1.86	63.5	2.50
1	51.8	2.04	101.1	3.98	46.0	1.81	55.1	2.17	37.3	1.47	49.3	1.94	71.1	2.80	50.8	2.00	44.4	1.75	52.1	2.05	47.2	1.86	65.0	2.56
1-1/4	55.1	2.17	119.1	4.69	52.3	2.06	59.2	2.33	40.4	1.59	55.1	2.17	79.2	3.12	58.7	2.31	51.6	2.03	57.2	2.25	48.5	1.91	67.3	2.65
1-1/2	60.2	2.37	131.3	5.17	59.2	2.33	73.4	2.89	45.2	1.78	59.4	2.34	86.9	3.42	65.8	2.59	57.2	2.25	60.7	2.39	48.5	1.91	67.8	2.67
2	70.6	2.78	159.8	6.29	77.7	3.06	83.8	3.30	56.4	2.22	73.4	2.89	104.4	4.11	85.9	3.38	73.9	2.91	73.4	2.89	47.2	1.86	73.9	2.91

Nom Tube OD, in	N mm ±0.8	N in ±0.03	N ₁ mm ±0.8	N ₁ in ±0.03	N ₂ mm ±0.8	N ₂ in ±0.03	N ₃ mm ±0.8	N ₃ in ±0.03	N ₄ mm ±0.8	N ₄ in ±0.03	O mm ±0.8	O in ±0.03	P Min mm	P Min in	P ₁ Max mm	P ₁ Max in	Q Min mm	Q Min in	S ^(b) Max mm	S ^(b) Max in	S ₁ ^{(b)(c)} Min mm	S ₁ ^{(b)(c)} Min in	S ₂ ^(c) Min mm	S ₂ ^(c) Min in
1/8	18.3	0.72	16.8	0.66	13.2	0.52	25.4	1.00	32.5	1.28	11.1	0.438	9.7	0.38	11.7	0.46	2.8	0.11	12.4	0.49	20.1	0.79	18.5	0.73
3/16	18.3	0.72	16.8	0.66	13.2	0.52	26.4	1.04	34.3	1.35	12.7	0.500	9.7	0.38	11.7	0.46	2.8	0.11	12.4	0.49	20.8	0.82	19.3	0.76
1/4	19.8	0.78	16.8	0.66	16.3	0.64	29.7	1.17	39.6	1.56	14.3	0.562	9.7	0.38	11.7	0.46	2.8	0.11	12.4	0.49	23.1	0.91	20.1	0.79
5/16	19.8	0.78	16.8	0.66	16.3	0.64	29.7	1.17	41.4	1.63	15.9	0.625	9.7	0.38	11.7	0.46	3.0	0.12	16.3	0.64	28.2	1.11	20.8	0.82
3/8	27.7	1.09	22.4	0.88	21.8	0.86	40.1	1.58	52.6	2.07	17.5	0.688	14.2	0.56	17.0	0.67	3.0	0.12	17.0	0.67	31.8	1.25	27.2	1.07
1/2	31.0	1.22	25.9	1.02	24.1	0.95	46.2	1.82	61.5	2.42	22.2	0.875	14.2	0.56	17.3	0.68	4.1	0.16	17.3	0.68	37.1	1.46	32.0	1.26
5/8	37.3	1.47	31.2	1.23	29.7	1.17	55.1	2.17	72.9	2.87	25.4	1.000	19.0	0.75	22.9	0.90	4.1	0.16	23.1	0.91	44.4	1.75	38.4	1.51
3/4	40.4	1.59	34.5	1.36	30.5	1.20	62.0	2.44	83.3	3.28	30.2	1.188	19.0	0.75	23.1	0.91	4.8	0.19	23.9	0.94	49.3	1.94	43.4	1.71
7/8	42.9	1.69	36.1	1.42	33.02	1.30	65.8	2.59	88.9	3.50	33.3	1.312	19.0	0.75	23.1	0.91	4.8	0.19	—	—	—	—	46.2	1.82
1	50.0	1.97	41.1	1.62	37.6	1.48	76.5	3.01	102.9	4.05	36.5	1.438	23.9	0.94	29.0	1.14	4.8	0.19	28.7	1.13	61.7	2.43	52.8	2.08
1-1/4	60.5	2.38	43.2	1.70	42.4	1.67	93.7	3.69	127.0	5.00	44.4	1.750	24.6	0.97	29.5	1.16	5.8	0.23	30.5	1.20	75.2	2.96	57.9	2.28
1-1/2	67.1	2.64	52.8	2.08	45.0	1.77	104.1	4.10	141.0	5.55	50.8	2.000	25.4	1.00	29.5	1.16	5.8	0.23	32.3	1.27	84.8	3.34	70.6	2.78
2	76.2	3.00	60.7	2.39	53.6	2.11	122.2	4.81	168.4	6.63	66.7	2.625	26.2	1.03	30.0	1.18	8.4	0.33	34.8	1.37	100.1	3.94	84.6	3.33

Continued on next page.



TABLE 4 - DIMENSIONS OF ALL BODIES AND LOCKNUTS (FIGURES 2A TO 10C) (CONTINUED)

Nom Tube OD, in	T ^(d) Ref mm	T ^(d) Ref in	T ₁ mm ±0.5	T ₁ in ±0.02	T ₂ ^(d) Ref mm	T ₂ ^(d) Ref in	U Dia mm +0.4 -0.0	U Dia in +0.016 -0.000	V Dia mm ±0.25	V Dia in ±0.010	X Dia mm ±0.13	X Dia in ±0.005	X ₁ Dia mm ±0.13	X ₁ Dia in ±0.005
1/8	5.6	0.22	5.6	0.22	7.1	0.28	8.1	0.317	6.25	0.245	14.27	0.562	11.13	0.438
3/16	5.6	0.22	5.6	0.22	7.1	0.28	9.7	0.380	7.75	0.305	15.88	0.625	12.70	0.500
1/4	5.6	0.22	7.1	0.28	7.1	0.28	11.3	0.443	9.15	0.360	17.48	0.688	14.30	0.563
5/16	5.6	0.22	7.1	0.28	7.1	0.28	12.8	0.505	10.65	0.420	19.05	0.750	15.88	0.625
3/8	6.4	0.25	6.9	0.27	7.9	0.31	14.4	0.567	12.05	0.475	20.62	0.812	17.48	0.688
1/2	6.4	0.25	7.9	0.31	8.6	0.34	19.2	0.755	16.65	0.655	25.40	1.000	22.22	0.875
5/8	7.9	0.31	9.1	0.36	10.2	0.40	22.4	0.880	19.55	0.770	28.58	1.125	25.40	1.000
3/4	9.7	0.38	10.4	0.41	11.9	0.47	27.1	1.067	23.90	0.940	34.92	1.375	31.75	1.250
7/8	9.7	0.38	10.4	0.41	11.9	0.47	30.3	1.193	27.05	1.065	38.10	1.500	34.92	1.375
1	9.7	0.38	10.4	0.41	12.7	0.50	33.5	1.317	30.25	1.190	41.28	1.625	38.10	1.500
1-1/4	11.7	0.46	10.4	0.41	14.7	0.58	41.4	1.630	38.10	1.500	47.62	1.875	47.62	1.875
1-1/2	13.5	0.53	10.4	0.41	16.5	0.65	47.8	1.880	44.45	1.750	53.98	2.125	53.98	2.125
2	17.3	0.68	10.4	0.41	20.6	0.81	63.6	2.505	60.35	2.375	69.85	2.750	69.85	2.750

Nom Tube OD, in	Y Forging ^(f) , mm +0.0	Y Forging ^(f) , in +0.000	Y ^(f) Barstock Max mm	Y ^(f) Barstock Max in	Y ₁ ^{(e)(f)} mm +0.0	Y ₁ ^{(e)(f)} in +0.000	MM mm ±0.08	MM in ±0.003	NN Dia mm ±0.4	NN Dia in ±0.016	PP Dia mm ±0.25	PP Dia in ±0.010	α ° +3.0° -0.5°
1/8	11.1-0.8	0.438-0.030	—	—	14.3-0.8	0.562-0.030	0.76	0.030	12.8	0.504	6.25	0.245	47
3/16	11.1-0.8	0.438-0.030	—	—	14.3-0.8	0.562-0.030	0.76	0.030	14.6	0.575	7.75	0.305	47
1/4	11.1-0.8	0.438-0.030	14.3	0.562	14.3-0.8	0.562-0.030	0.89	0.035	16.5	0.650	9.15	0.360	47
5/16	14.3-0.8	0.562-0.030	15.9	0.625	14.3-0.8	0.562-0.030	0.89	0.035	18.3	0.722	10.65	0.420	47
3/8	14.3-0.8	0.562-0.030	20.6	0.812	19.0-0.8	0.750-0.030	0.89	0.035	20.2	0.794	12.05	0.475	47
1/2	19.0-0.8	0.750-0.030	22.2	0.875	22.2-0.8	0.875-0.030	1.04	0.041	25.7	1.010	16.65	0.655	47
5/8	22.2-0.8	0.875-0.030	28.6	1.125	27.0-0.8	1.062-0.030	1.27	0.050	29.3	1.155	19.55	0.770	47
3/4	27.0-1.0	1.062-0.040	34.9	1.375	33.3-1.0	1.312-0.040	1.27	0.050	36.7	1.444	23.90	0.940	42
7/8	33.3-1.0	1.312-0.040	38.1	1.500	33.3-1.0	1.312-0.040	1.27	0.050	40.4	1.589	27.05	1.065	42
1	33.3-1.0	1.312-0.040	41.3	1.625	41.3-1.0	1.625-0.040	1.27	0.050	44.0	1.732	30.25	1.190	42
1-1/4	41.3-1.0	1.625-0.040	54.0	2.125	47.6-1.0	1.875-0.040	1.27	0.050	55.0	2.165	38.10	1.500	42
1-1/2	47.6-1.0	1.875-0.040	57.2	2.250	65.1-1.0	2.562-0.040	1.27	0.050	62.3	2.454	44.45	1.750	42
2	63.5-1.0	2.500-0.040	82.6	3.250	71.4-1.0	2.812-0.040	1.27	0.050	80.3	3.160	—	—	42

(a) O-ring groove undercut must be smooth and free from tool marks.

(b) At manufacturer's option, through passages in Figures 2A and 5C may conform with the smaller diameter specified or the appropriate end may be counterbored to the larger diameter for depths S and S₁, respectively.

(c) Maximum depth shall be optional with manufacturer providing wall thickness is controlled with General Specifications.

(d) Minimum design thickness, not subject to inspection.

(e) The basic dimensions shown shall apply as minimum for boss diameters.

(f) For optional metric fitting flats see Appendix A.

(g) Unified class 2B thread shall apply to swivel nuts Figures 8C to 9C and with minor diameter modified to class 3B limits for locknuts Figures 8A and 8B.

(h) Across flat widths must fit standard wrench openings. See ANSI B18.2.2.

(j) Diameter of bulkhead pilot is the same as major thread diameter. Recommended pilot hole for bulkhead fittings is 0.4 mm (0.016 in) over major thread diameter.

(k) J full thread minimum with thread runout. If undercut to G diameter and H width. Length of thread and undercut must not be less than I.

(l) See Table 1A for tolerance.

(m) At Manufacturers option, alternate metric drills shown in brackets with corresponding tolerances may be used.