
	SURFACE VEHICLE STANDARD		J514 JAN2012
		Issued	1950-05
		Revised	2012-01
		Superseding J514 SEP2004	
Hydraulic Tube Fittings			

RATIONALE

Optional dual angle seat for 37 degree flare swivel connection is expanded to all sizes to provide consistent performance. Drill tolerance is changed according to ISO 2768-1, tolerance class m.

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.

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2012 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)

SAE values your input. To provide feedback on this Technical Report, please visit http://standards/J514_201201

SAE WEB ADDRESS:

This is a preview. Click here to purchase the full publication.

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

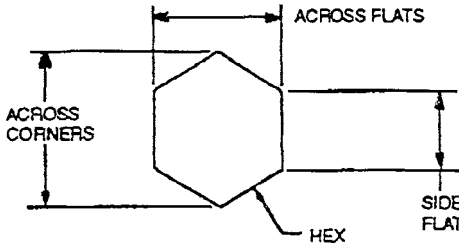
Fitting sizes are designated by the corresponding outside diameter of the tubing for the various types of tube ends and by the corresponding standard nominal pipe size for pipe thread ends.

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.