

Specification for O-Ring Face Seal Connectors: Part 3—Requirements, Dimensions, and Tests for Steel Unions, Bulkheads, Swivels, Braze Sleeves, Connectors, Caps, and Connectors with SAE J1926-2 Inch Stud Ends

RATIONALE

Not applicable.

FOREWORD

The JUN2002 edition of SAE J1453 was published as a single document covering the requirements for Inch O-ring face seal connectors with SAE J1926-2 inch stud ends. In 1995 ISO 8434-3 was published covering the requirements for O-ring face seal connectors to ISO 6149-2 metric stud ends. This revision of SAE J1453 adopts the parts covered within ISO 8434-3 and the rationalized dimensions from ISO 8434-3 for both the inch and metric stud end face seal connectors. SAE J1453 has been organized into three sections as follows:

1. SAE J1453-1—Specifications for O-ring Face Seal Connectors: Part 1—Tube Connection Details and Common Requirements for Performance and Test
2. SAE J1453-2—Specifications for O-ring Face Seal Connectors: Part 2—Requirements, Dimensions and Tests for Steel Unions, Bulkheads, Swivels, Braze Sleeve Connectors, Caps, and Connectors with ISO 6149-2 Metric Stud Ends
3. SAE J1453-3—Specifications for O-ring Face Seal Connectors: Part 3—Requirements, Dimensions and Tests for Steel Unions, Bulkheads, Swivels, Braze Sleeve Connectors, Caps, and Connectors with SAE J1926-2, Inch Stud Ends

SAE J1453-2 parts are technically equivalent to ISO 8434-3 parts; SAE J1453-3 parts are technically equivalent to SAE J1453 JUN2002 parts, with this exception this edition includes the half-dovetail as the standard groove design. Parts supplied to SAE J1453 JUN2002 shall now be supplied to SAE J1453-3.

A typical O-ring face seal connection is shown in Figure 1, and typical tube and hose connections are shown in Figure 2.

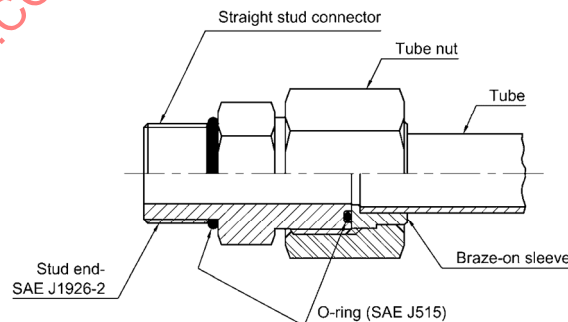


FIGURE 1 - TYPICAL REPRESENTATION OF O-RING FACE SEAL (ORFS) CONNECTION
(SEE SAE J1453-2 FOR ISO 6149-2 METRIC STUD ENDS)

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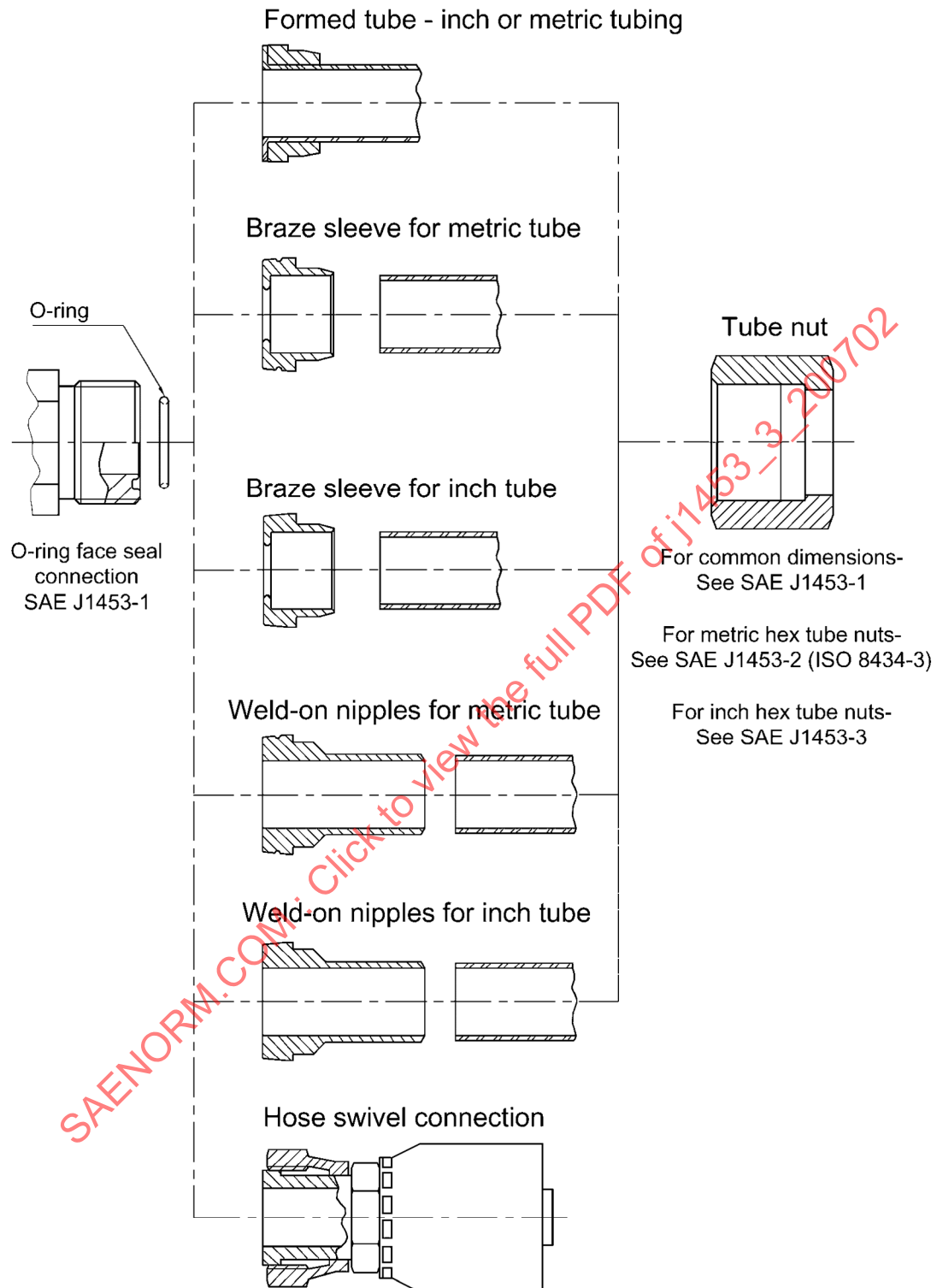


FIGURE 2 - TYPICAL O-RING FACE SEAL CONNECTION TO INCH OR METRIC TUBING OR HOSE

TABLE 1 - QUICK REFERENCE CHART: TUBE OD TO INCH PORT STUD END SIZES, HEX NUT SIZES, QUALIFICATION TEST TORQUES AND WORKING PRESSURES

(CAUTION: In case of conflict, values shown in the body of SAE J1453-3 and SAE J1926-2 take precedence)

Nominal Inch Tube OD Or Hose ID Dash Size ⁽¹⁾	Nominal Inch Tube OD in	Nominal Inch Tube OD mm	Nominal Tube Metric	O-Ring Face Seal End		O-Ring Face Seal and Swivel End Tube Nut Hex in		O-Ring Seal End Qualification ⁽³⁾ Test Torque N·m		Port Stud End SAE J1926-2 (ISO 11926-2) Adjustable Inch Hex in		Port Stud End SAE J1926-2 (ISO 11926-2) Qualification ⁽³⁾ Test Torque N·m		Connector Working Pressure ⁽⁴⁾ , Face Seal and Nonadjustable Stud End MPa	
				Face Seal End in ref.	Thread ⁽²⁾ in ref.	Face Seal End in ref.	Nut Hex in	Face Seal End in ref.	Thread ⁽³⁾ in ref.	Face Seal End in ref.	Hex in	Face Seal End in ref.	Test Torque N·m	Face Seal End in ref.	Stud End MPa
- 4	0.250	6.35	6	9/16-18	11/16	11/16	11/16	25	7/16-20	5/8	5/8	20 ⁽⁵⁾	63	63	41.3
- 5	0.312	7.94	8	5/8-18	3/4	3/4	3/4	30	1/2-20	11/16	11/16	40	63	63	41.3
- 6	0.375	9.52	10	11/16-16	13/16	13/16	13/16	40	9/16-18	3/4	3/4	45	63	63	41.3
- 8	0.500	12.70	12	13/16-16	15/16	15/16	15/16	55	3/4-16	15/16	15/16	85	63	63	41.3
-10	0.625	15.88	16	1-14	1-1/8	1-1/8	1-1/8	60	7/8-14	1-1/16	1-1/16	100	41.3	41.3	41.3
-12	0.750	19.05	20	1-3/16-12	1-3/8	1-3/8	1-3/8	90	1-1/16-12	1-3/8	1-3/8	170	41.3	41.3	41.3
-14	0.875	22.22	22	1-5/16-12	1-1/2	1-1/2	1-1/2	115	1-3/16-12	1-1/2	1-1/2	235	41.3	41.3	38.0
-16	1.000	25.40	25	1-7/16-12	1-5/8	1-5/8	1-5/8	125	1-5/16-12	1-5/8	1-5/8	270	41.3	41.3	34.5
-20	1.250	31.75	30	1-11/16-12	1-7/8	1-7/8	1-7/8	170	1-5/8-12	1-7/8	1-7/8	285	27.5	27.5	27.5
-24	1.500	38.10	38	2-12	2-1/4	2-1/4	2-1/4	200	1-7/8-12	2-1/8	2-1/8	370	27.5	27.5	20.7

1. The dash size symbol applicable to all tube ends and straight thread O-ring boss ends shall consist of the number of sixteenth inch increments contained in the outside diameter of the tubing (nominal OD) or inside diameter of the hose (nominal hose ID).

For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size or hose, or corresponding port.

2. See SAE J1453-1 for Screw Thread information.

3. Torque values listed in Table 1 are for controlled testing to establish compliance to the performance requirements set forth in Part 3. Recommended assembly torques by manufacturers may vary from those shown in Part 3.

4. This covers unions, caps, bulkheads and swivels, and plugs.

5. For -4 only, adjustable torque is given. For nonadjustable torque is 35 N·m.

TABLE 2 - QUICK REFERENCE CHART: TUBE OD TO METRIC PORT STUD END SIZES, HEX NUT SIZES, QUALIFICATION TEST TORQUES AND CONNECTOR WORKING PRESSURES

(NOTE: In cases of conflict, values shown in the body of this document and ISO 6149-2 take precedence)

Inch Tube OD or Hose ID	Nominal Tube OD Inch	Nominal Tube OD mm	O-Ring Face Seal End Thread ⁽²⁾ in	O-Ring Face Seal End Tube Nut Hex in	O-Ring Face Seal End Qualification ⁽³⁾ Test Torque N·m	Port Stud End SAE J1926-2 (ISO 11926-2) Adjustable Nut Hex in	Port Stud End SAE J1926-2 (ISO 11926-2) Adjustable Nut Hex in	Port Stud End Test Torque N·m	Connector Working Pressure, Face ⁽⁴⁾ Seal and Nonadjust- able Stud End MPa	Connector Working Pressure, Adjustable Stud End MPa
- 4	6.35	6	9/16-18	11/16	25	7/16-20	5/8	20 ⁽⁵⁾	63	41.3
- 5	7.94	8	5/8-18	3/4	30	1/2-20	11/16	40	63	41.3
- 6	9.52	10	11/16-16	13/16	40	9/16-18	3/4	45	63	41.3
- 8	12.70	12	13/16-16	15/16	55	3/4-16	15/16	85	63	41.3
-10	15.88	16	1-14	1-1/8	60	7/8-14	1-1/16	100	41.3	41.3
-12	19.05	20	1-3/16-12	1-3/8	90	1-1/16-12	1-3/8	170	41.3	41.3
-14	22.22	22	1-5/16-12	1-1/2	115	1-3/16-12	1-1/2	235	41.3	38.0
-16	25.40	25	1-7/16-12	1-5/8	125	1-5/16-12	1-5/8	270	41.3	34.5
-20	31.75	30	1-11/16-12	1-7/8	170	1-5/8-12	1-7/8	285	27.5	27.5
-24	38.10	38	2-12	2-1/4	200	1-7/8-12	2-1/8	370	27.5	20.7

1. The dash size symbol applicable to all tube ends and straight thread O-ring boss ends shall consist of the number of sixteenth inch increments contained in the outside diameter of the tubing (nominal OD) or inside diameter of the hose (nominal hose ID).
For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size or hose, or corresponding port.
2. See SAE J1453-1 Screw Thread Specifications.
3. Torque values listed in Table 2 are for controlled testing to establish compliance to the performance requirements set forth in Table 3. Recommended assembly torques by manufacturers may vary from Table 7.
4. This includes unions, swivels, bulkheads, plugs, and caps.
5. For -4 only, adjustable torque is given. For nonadjustable torque is 35 N·m.
6. Screw threads on the part end of the connectors shall be metric per ISO 261.

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1. SCOPE

1.1 Purpose

The three parts of SAE J1453 cover material, dimensional, and performance requirements of steel O-ring face seal (ORFS) connectors for tubing and the O-ring face seal interface and nut portion of hose stem assemblies for nominal tube diameters of 6 mm through 38 mm and for nominal hose diameters 6.3 mm through 38 mm. SAE J1453-3 covers the requirements for "inch based" O-ring face seal connectors to inch stud ends along with the associated adapters, bulkhead and union connectors. Inch hex wrenching flats are predominantly used throughout this standard.

1.2 Field of Application

These connectors are intended for general application (see Figures 3, 4, and 5) and hydraulic systems on industrial equipment and commercial products, where elastomeric seals are acceptable to overcome leakage and variations in assembly procedures. These connectors are capable of providing leak proof full flow connections in hydraulic systems operating from 95 kPa vacuum to working pressures shown in Table 4. Since many factors influence the pressure at which a hydraulic system will or will not perform satisfactorily, these values should not be construed as guaranteed minimums. For any application, it is recommended that sufficient testing be conducted and reviewed by both the user and manufacturer to ensure that required performance levels are met.

For use of these connectors in conditions outside the pressure and temperature limits specified, the manufacturers must be consulted.

Both metric and inch tubing can be accommodated by changing only the sleeve to match the tube diameters. In the past, these connectors have been used predominantly with inch tubing. For new designs metric tubing should be considered.

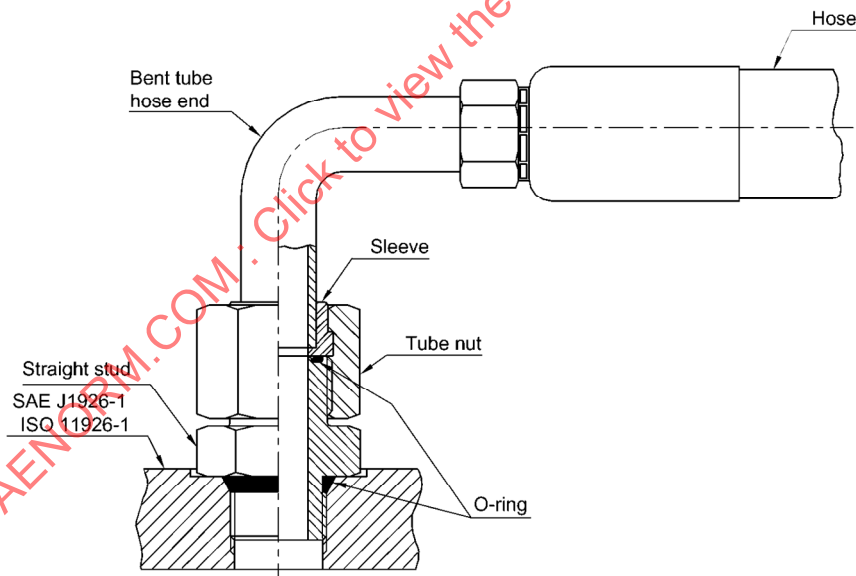


FIGURE 3 - TYPICAL CONNECTION NONADJUSTABLE CONNECTOR TO HYDRAULIC HOSE

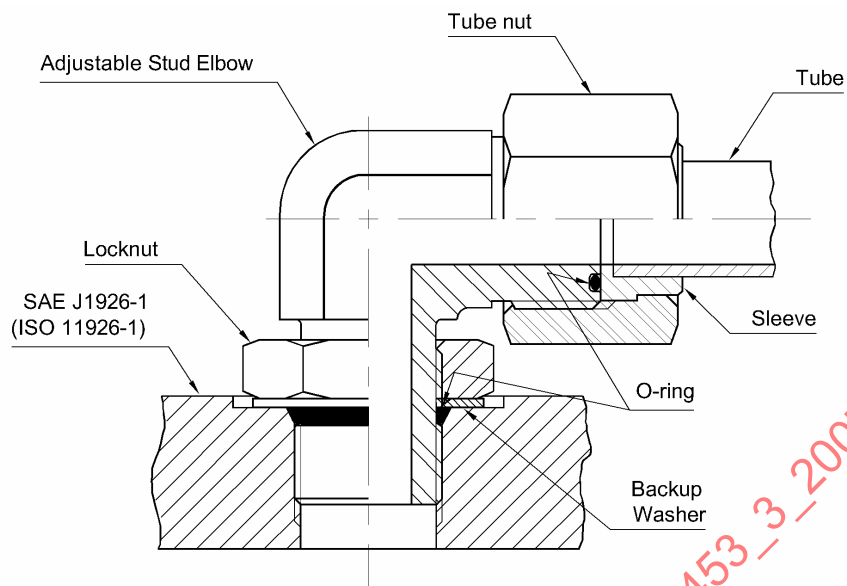
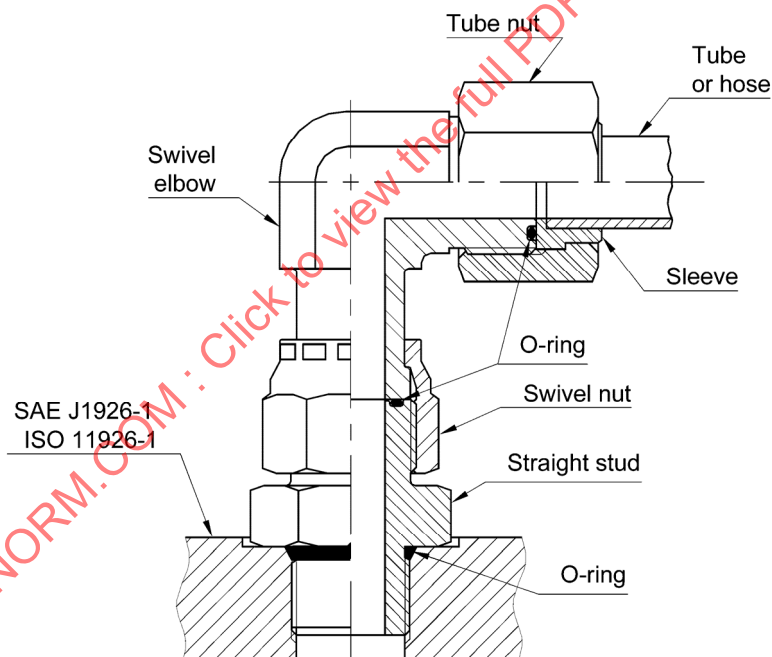


FIGURE 4 - TYPICAL CONNECTION ADJUSTABLE STYLE CONNECTOR TO TUBE

FIGURE 5 - TYPICAL CONNECTION STRAIGHT STUD WITH 90 DEGREE SWIVEL ELBOW
OPTIONAL CONFIGURATION TO GAIN FULL PERFORMANCE RATING

2. REFERENCES

2.1 Applicable Publications

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest version of SAE publications shall apply. For a complete list of all references, see SAE J1453-1.

2.1.1 SAE Publications

Available from SAE, 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 J356	Welded Flash Controlled Low-Carbon Steel Tubing Normalized for Bending, Double Flare and Beading
SAE J515	Specifications for Hydraulic O-Ring Materials, Properties and Sizes for Metric and with Stud Ends, Face Seal Connectors and Four-Screw Flange Tube Connections
SAE J524	Seamless Low-Carbon Steel Tubing Annealed for Bending and Flaring
SAE J525	Welded and Cold Drawn Low-Carbon Steel Tubing Annealed for Bending and Flaring
SAE J846	Coding Systems for Identification of Fluid Conductors and Connectors
SAE J1453-1	Specification for O-Ring Face Seal Connectors: Part 1—Tube Connection Details and Common Requirements for Performance and Tests
SAE J1453-2	Specification for O-Ring Face Seal Connectors: Part 2—Requirements, Dimensions, and Tests for Steel Unions, Bulkheads, Swivels, Braze Sleeves and Connectors with SAE J2244-2 Metric Stud Ends
SAE J1644	Metallic Tube Connections for Fluid Power and General Use—Test Methods for Threaded Hydraulic Fluid Power Connectors
SAE J1926-2	Connections for General Use and Fluid Power—Ports and Stud Ends with ISO 725 Threads and O-Ring Sealing—Part 2: Heavy Duty (S series) Stud Ends
SAE J2593	Information Report for the Installation of Fluid Conductors and Connectors

2.1.2 ISO Publications

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

ISO 68-2	ISO general purpose screw threads—Basic profile—Part 2: Inch screw threads
ISO 3304	Plain end seamless precision steel tubes—Technical conditions for delivery
ISO 3305	Plain end welded precision steel tubes—Technical conditions for delivery
ISO 5598	Fluid power systems and components—Vocabulary
ISO 5864	ISO inch screw threads—Allowance and tolerances
ISO 8434-3	Metallic tube connections for fluid power and general use—Part 3: O-ring face seal connections
ISO 10763	Hydraulic fluid power—Plain-end, seamless and welded precision steel tubes—Dimensions and nominal working pressures

3. DEFINITIONS

For this part of SAE J1453, the definitions given in ISO 5598 and the following shall apply:

3.1 Fluid Power

(From ISO 5598) Means whereby energy is transmitted, controlled and distributed using a pressurized fluid as the medium.

3.2 Connector

(From ISO 5598) Leakproof device to connect pipelines (conductors) to one another, or to equipment.

3.3 Fastening Thread

Terminal thread of a complete connector.

3.4 Run

Two principal, axially aligned outlets of a tee or cross. See Figure 6.

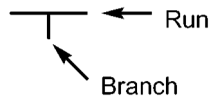


FIGURE 6 - ILLUSTRATION OF TEE CONNECTOR
SHOWING RUN AND BRANCH

3.5 Branch

Side outlet(s) of a tee, or cross. See Figure 6.

3.6 Chamfer

Removal of a conical portion at the entrance of a thread to assist assembly and prevent damage to the start of the thread.

3.7 Torques

3.7.1 Assembly Torque

The torque to be applied in order to achieve a satisfactory final assembly.

3.7.2 Qualification Test Torque

The torque used to verify conformance of the connector to the requirements of this document.

3.7.3 Over Torque

The torque the nut shall withstand without deformation that renders it unusable.

3.8 Working Pressure

Pressure at which the apparatus is being operated in a given application as shown in SAE J1453-2 and SAE J1453-3. (From ISO 5598)

3.9 Adjustable Stud End

A stud end connector that allows for connector orientation before final tightening of the locknut to complete the connection. This type of stud end is typically used on shaped connectors (e.g., tees, crosses and elbows).

3.10 Nonadjustable Stud End

A stud end connector that does not require specific orientation before final tightening of the connection because it is only used on straight connectors.

3.11 Preferred

Commonly used readily available parts.

3.12 Nonpreferred

Parts which are low volume, considered specials and their use requires special consideration. Dimensions for nonpreferred parts are given to provide standardization within the industry.

3.13 Jump Size Connector

Connectors with unpaired end connections, for example, M14 stud end with 12 mm tube end.

4. REQUIREMENTS

4.1 General

All connectors shall meet or exceed the requirements outlined in SAE J1453-1.

4.2 Dimensional Specifications

Connectors shall conform to their respective dimensional specifications listed for each style of connector. Dimensions specified apply to finished part. Tolerances on all untoleranced dimensions are ± 0.4 mm.

For jump size connectors, the larger end is considered standard and is the basis for dimensions and tolerances (overall, end to center, stock size, etc.). The tolerance on centerline to end of nonstandard shaped connectors shall be ± 1.5 mm. See SAE J1453-3 Appendix on how to calculate jump size connectors.

For jump connectors, at manufacturer's option the drill through passages in straights and in run ends of tees and crosses of special size connectors may conform to the smaller diameter specified, or the appropriate end may be counterbored to the larger diameter up to the middle of the hex for straight connectors and just past the drill of the branch end for tees and crosses.

4.3 Stud End Dimensions

Stud ends shall be in accordance with SAE J1926-2.

4.4 Across Flats

The across flat dimensions of elbows, tees, bulkhead, and swivel connectors given in this standard are intended to be for nominal wrench sizes with minus tolerance only. Tolerances for across flats dimensions for forgings shall be $+0/-0.8$ mm for sizes up to and including 25.4 mm and $+0/-1$ mm for sizes larger than 25.4 mm. The basic forging size may be increased up to the maximum size shown for barstock, but the size selected shall be a nominal inch wrench size across flats with minus tolerance only. For optional metric stock sizes, see Appendix D.

4.5 Hex Tolerances Across Flats

Hex tolerances across flats are listed in Table 3. Minimum across corner hex dimensions are 1.092 times the nominal width across flats. The minimum side flat is 0.43 times the nominal width across flats. See Figure 7.

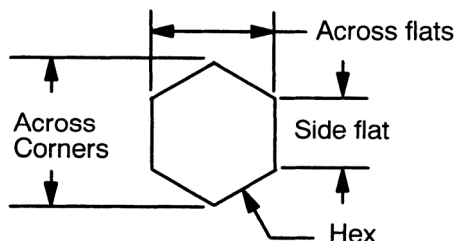


FIGURE 7 - HEX DETAILS

TABLE 3 - DIMENSIONS FOR HEX TOLERANCES

Units in millimeters (mm)

Nominal Hex Size Across Flats	Nominal Hex Size Across Flats	Tolerance (Minus Only)
Over	Inclusive	
—	19.05	0.3
19.05	25.40	0.4
25.40	34.92	0.5
34.92	and up	0.8

4.6 Hex Chamfer

See SAE J1453-1.

4.7 Screw Threads

The screw threads on the stud end and face seal end shall be inch (UN/UNF/UNS) per ASME B1.1, See SAE J1453-1 Screw Thread Requirements.

4.8 Working Pressure

The connectors shall meet or exceed the working pressure shown in Table 4.

TABLE 4 - WORKING PRESSURES FOR O-RING FACE SEAL CONNECTORS

Inch Tube OD ⁽¹⁾ Dash Size	Inch Tube OD mm	Nominal Metric OD mm	Connector Working Pressure ⁽²⁾⁽³⁾⁽⁴⁾ Face Seal and Nonadjustable Stud End MPa	Connector Working ⁽²⁾⁽⁴⁾ Pressures Adjustable Stud End MPa
- 4	6.35	6	63	41.3
- 5	7.94	8	63	41.3
- 6	9.52	10	63	41.3
- 8	12.70	12	63	41.3
-10	15.88	16	41.3	41.3
-12	19.05	20	41.3	41.3
-14	22.22	22	41.3	38.0
-16	25.40	25	41.3	34.5
-20	31.75	30	27.5	27.5
-24	38.10	38	27.5	20.7

1. Metric tubing shall be considered. See ISO 10763 for sizes.
2. These pressures were established using connectors made of low carbon steel and tested according to SAE J1644.
3. This includes unions, bulkheads, plugs, swivels, and caps.
4. 1 bar = $10^5 \text{ N/m}^2 = 10^5 \text{ Pa} = 0.1 \text{ MPa} = 14.5 \text{ psi}$. (To convert from MPa to psi, multiply by 145, for example, 63 MPa equals 9135 psi.)

4.9 Tube Sizes

Hydraulic tubes used with O-ring face seal connectors shall meet the size requirements shown in Table 5. Carbon steel inch tubes shall comply with SAE J356, J524, or J525. Metric tubes shall comply with ISO 3304 or ISO 3305.

TABLE 5 - INCH AND METRIC TUBE SIZE LIMITS

Units in millimeters (mm)

Inch Tube ⁽¹⁾⁽²⁾ OD Dash Size in	Nominal Inch Tube OD ⁽³⁾	Inch Tube OD ⁽⁴⁾ Minimum	Inch Tube OD ⁽⁴⁾ Maximum	Nominal Metric Tube OD mm	Metric Tube OD Minimum	Metric Tube OD Maximum
- 4	6.35	6.25	6.45	6	5.9	6.1
- 5	7.94	7.84	8.04	8	7.9	8.1
- 6	9.52	9.42	9.62	10	9.9	10.1
- 8	12.70	12.60	12.80	12	11.9	12.1
-10	15.88	15.78	15.98	16	15.9	16.1
-12	19.05	18.95	19.15	20	19.9	20.1
-14	22.22	22.12	22.32	22	21.9	22.1
-16	25.40	25.30	25.50	25	24.9	25.1
-20	31.75	31.60	31.90	30	29.85	30.15
-24	38.10	37.95	38.25	38	37.85	38.15

1. Metric tubing shall be considered. See SAE J1453-1 for sleeve dimensions.
2. The dash size symbol applicable to all tube ends and straight thread O-ring boss ends shall consist of the number of sixteenth inch increments contained in the outside diameter of the tubing (nominal OD) or inside diameter of the hose (nominal hose ID). For example: -4 = $4/16 = 0.25 = 6.35 \text{ mm}$ inch tube size or hose, or corresponding port.
3. Equivalent dimension in millimeters.
4. SAE J524 may require sizing to meet these limits for brazing.

4.10 Plating

See SAE J1453-1 plating requirements.

4.11 Passage Tolerance

See SAE J1453-1.

4.12 Angular Tolerance

See SAE J1453-1.

5. TEST REQUIREMENTS AND QUALITY PROCEDURES

5.1 Test Requirements

Connectors shall be tested per SAE J1453-1.

5.2 Performance Tests

The connector assembly shall meet or exceed all applicable test pressures shown in Table 6 when tested at the torques shown in Table 7. Connectors shall pass the burst, cyclic endurance (impulse), vacuum and overtorque tests when tested per SAE J1644. Torque values listed in Table 7 are for controlled testing to establish compliance to the performance requirements for face seal connectors. Recommended assembly torques by manufacturer may vary from the torques in Table 7.

5.3 Test Pressures

The connector assembly shall meet or exceed all applicable test pressures shown in Table 6.

NOTE: The performance test should be conducted on each of the following types and sizes of connectors to ensure overall performance of all configurations: Figure 12 (520115), Figure 13 (520110), Figure 14 (520220), Figure 20 (520120), Figure 33 (520221), and Figure 38 (520104).

TABLE 6 - TEST PRESSURES FOR O-RING FACE SEAL CONNECTORS
WITH SAE J1926-2 STUD ENDS

Units in megapascals (MPa)⁽¹⁾

Nominal Inch Tube OD Dash Size	Nominal Inch Tube OD mm	Nominal Metric Tube OD mm	Face Seal ⁽²⁾ and Nonadjustable Stud End Connectors Test Proof	Face Seal ⁽²⁾ and Nonadjustable Stud End Connectors Test Burst	Face Seal and Nonadjustable Stud End Connectors Test ⁽²⁾⁽³⁾ Impulse	Connectors With Adjustable Stud End Test Proof	Connectors With Adjustable Stud End Test Burst	Connectors With Adjustable Stud End Test Impulse ⁽³⁾
- 4	6.35	6	126	252	83.8	82.5	165	55
- 5	7.94	8	126	252	83.8	82.5	165	55
- 6	9.52	10	126	252	83.8	82.5	165	55
- 8	12.70	12	126	252	83.8	82.5	165	55
-10	15.88	16	82.5	165	55	82.5	165	55
-12	19.05	20	82.5	165	55	82.5	165	55
-14	22.22	22	82.5	165	55	76	152	51
-16	25.40	25	82.5	165	55	69	138	46
-20	31.75	30	55	110	36.6	55	110	36.6
-24	38.10	38	55	110	36.6	41.3	82.5	27.5

1. 1 bar = 10^5 N/m² = 10^5 Pa = 0.1 MPa = 14.5 psi.

2. These are applicable to unions, swivels, bulkheads, plugs, and caps.

3. Cyclic endurance test pressure.

TABLE 7 - CONNECTOR QUALIFICATION TEST TORQUES

Nominal Metric Tube OD mm	Nominal Tube OD or Hose ID Inch Dash Size ⁽²⁾	Nominal Inch Tube OD mm	Port Stud End Thread SAE J1926-2 (ISO 11926-2) in	Port Stud End Torque SAE J1926-2 (ISO 11926-2) +10% 0 N·m	Face Seal End Thread ⁽¹⁾ In	Face Seal End Torque +10% 0 N·m	Face Seal End Over Torque N·m
6	- 4	6.35	7/16-20	25 ⁽³⁾	9/16-18	25	32
8	- 5	7.94	1/2-20	40	5/8-18	30	45
10	- 6	9.52	9/16-18	45	11/16-16	35	54
12	- 8	12.70	3/4-16	85	13/16-16	55	81
16	-10	15.88	7/8-14	100	1-14	60	136
20	-12	19.05	1-1/16-12	170	1-3/16-12	90	180
22	-14	22.22	1-3/16-12	235	1-5/16-12	115	230
25	-16	25.40	1-5/16-12	270	1-7/16-12	125	270
30	-20	31.75	1-5/8-12	285	1-11/16-12	170	380
38	-24	38.10	1-7/8-12	370	2-12	200	450

1. See SAE J1453-1 Screw Thread Requirements.

2. The dash size symbol applicable to all tube ends and straight thread O-ring boss ends shall consist of the number of sixteenth inch increments contained in the outside diameter of the tubing (nominal OD) or inside diameter of the hose (nominal hose ID).
For example: -4 = $4/16 = 0.25 = 6.35$ mm inch tube size or hose, or corresponding port.

3. For -4 nonadjustable use 35 N·m.

6. PACKAGING AND MARKING

6.1 Marking

All connector bodies and tube nuts shall be permanently marked with individual supplier's trademark or code identifier, unless otherwise agreed upon by user and manufacturer.

6.2 Protection

By agreement between purchaser and supplier, the face of the O-ring connectors and threads (both internal and external) must be protected by the manufacturer from nicks and scratches detrimental to their function. All passages must be securely covered to prevent entrance of dirt or other contaminants prior to assembly and for parts distribution, handling, and storage. Paper caps and plugs are not permitted.

6.3 SAE J846 Ordering Designation, Part Identification Number (PIN)

By agreement between the manufacturer and user, the ordering designation from SAE J846 may be used to abbreviate the ordering of O-ring face seal connectors.

6.3.1 Connector Designation Code

Connectors are designated according to SAE J846. The connector designation consists of a basic code symbolizing in sequence the following: (a) the connector type, (b) the connector shape, and (c) the connector connecting ends. Connector basic code example, see Figure 8.

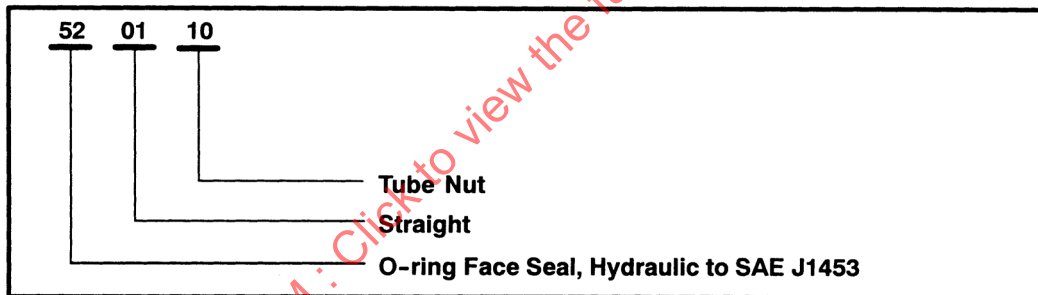
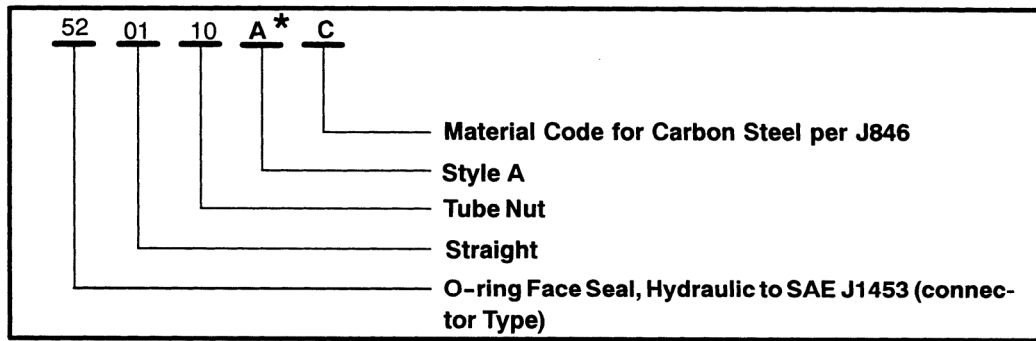


FIGURE 8 - CONNECTOR STYLE DESIGNATION

6.3.2 Style and Material Modifiers

Modifiers are added to the code to provide additional information. A 'M' is inserted after the connector type to indicate a metric hex or wrench flat. Suffixes are to be added to indicate the style and material. (See SAE J846 for more complete information.) An example of a complete code follows, see Figure 9:



* 'A' modifies the basic code

FIGURE 9 - CONNECTOR STYLE AND MATERIAL DESIGNATION

6.3.3 Size Designation

The size is indicated by the nominal outside diameter of the tubing or nominal inside diameter of the hose and the port end size for stud connectors. These are added to the connector designation and modifiers. Example using a dash 12 ORFS to a dash 12 inch O-ring stud end on a straight connector in steel, use the following designation. NOTE: For parts to SAE J1453-3 inch tubing is assumed. The ordering designation follows, see Figure 10 and Table 8 for additional samples:

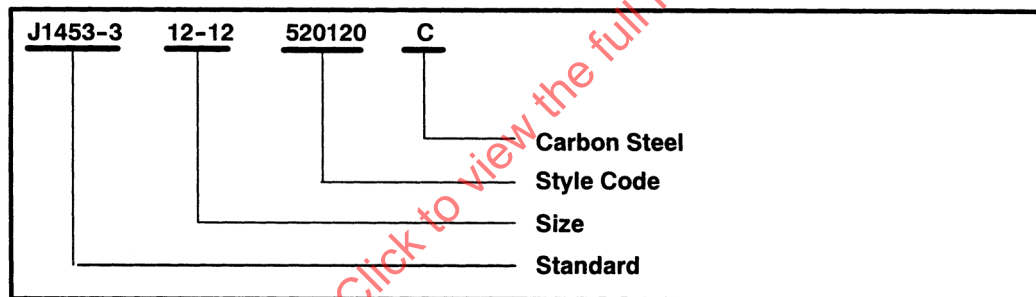


FIGURE 10 - CONNECTOR STYLE, MATERIAL, AND SIZE DESIGNATION

TABLE 8 - ORDERING CODE EXAMPLES

(See SAE J846 for Complete Details)

Connector Description		SAE Part Identification Number
a	To order a size 16 standard Style A tube nut (Figure 13) made from carbon (C) steel:	J1453-3 16 520110A C
b	To order a size 16 bulkhead elbow connector (Figure 24) made from carbon (C) steel	J1453-3 16-16 520701 C
c	To order a jump size (16 with a 12 branch) swivel tee connector (Figure 34) made from carbon (C) steel	J1453-3 16-16-12 520433 C
d	To order a O-ring face seal stud elbow with a -12 face seal and -16 stud end per SAE J1926-2 made from carbon steel with 90 durometer Nitrile O-ring on both ends	J1453-3 12-16 520220 CN

7. NOTES

7.1 Assembly Information

The assembly of the connectors with the connecting tubes shall be carried out free from external loads. The manufacturer shall provide assembly instructions for the proper use of the connectors. These instructions shall include at least the following details:

- a. Details relating to material and quality of suitable tube.
- b. Details concerning the preparation of selected tube.
- c. Details concerning the attachment of the braze sleeve and weld nipple to the tube.
- d. Instructions regarding the assembly of the connector, such as number of wrenching turns or assembly torque.
- e. Recommendations regarding the tools to be used for assembly.

NOTE: See SAE J2593.

7.2 Identification Statement

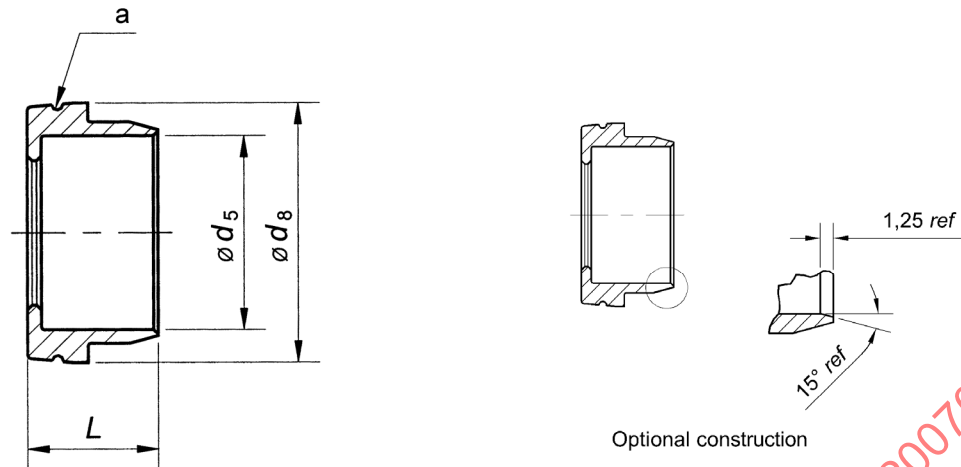
Use the following statement in test reports, catalogues and sales literature when electing to comply with this part of SAE J1453-3:

O-ring face seal connectors conform to SAE J1453-3: Specification for O-ring face seal connectors: Part 3—Requirements, Dimensions, and Tests for Steel Unions, Bulkheads, Swivels, Braze Sleeves, Connectors, Caps, and Connectors with SAE J1926-2, Inch Stud Ends.

7.3 Procurement Information

The following information should be supplied by the purchaser when making an inquiry or placing an order:

- a. Description of connector
- b. Material of connector
- c. Material and size of tube
- d. Fluid to be conveyed
- e. Working pressure
- f. Working temperature



NOTE 1: See SAE J1453-1 for manufacturing dimensions not shown.

a. Identification groove for sleeve with metric tube only, (see SAE J1453-1 Figure 5).

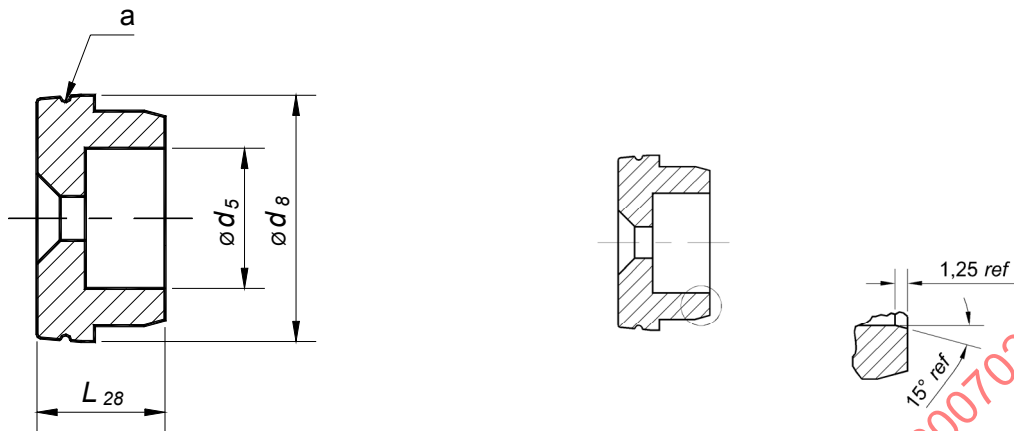
FIGURE 11A - DIMENSIONS OF BRAZE-ON
SLEEVE – STYLE A
(520115A)

FIGURE 11B - DIMENSIONS OF BRAZE-ON
SLEEVE – STYLE B
(520115B)

TABLE 9 - DIMENSIONS OF BRAZE-ON SLEEVE FOR INCH AND METRIC TUBING
Dimensions in millimeters (mm)

Inch Tubing ⁽¹⁾⁽²⁾ Ordering Size Code	Inch Tubing Tube OD mm ⁽³⁾	Inch Tubing d ₅ ⁽⁴⁾	Metric Tubing ⁽⁵⁾ Ordering Face Tube Seal x Side	Metric Tubing Tube OD	Metric Tubing d ₅ ⁽⁴⁾ ref.	d ₈ ref.	L ref.
4-4	6.35	6.5	6x6	6	6.15	12.75	9.5
5-5	7.94	8.09	8x8	8	8.15	14.35	9.5
6-6	9.52	9.68	10x10	10	10.15	15.75	9.5
8-8	12.7	12.85	12x12	12	12.15	18.9	9.5
10-10	15.88	16.03	16x16	16	16.15	23.45	10.5
12-12	19.05	19.23	20x20	20	20.18	27.85	14
14-14	22.23	22.41	22x22	22	22.18	31	14
16-16	25.4	25.58	25x25	25	25.18	34.2	15.5
20-20	31.75	31.95	30x30	30	30.2	40.55	15.5
24-24	38.1	38.3	38x38	38	38.2	48.5	15.5

1. Metric tubing shall be considered.
2. The dash size symbol applicable to all tube ends and straight thread O-ring boss ends shall consist of the number of sixteenth inch increments contained in the outside diameter of the tubing (nominal) OD or inside diameter of the hose (nominal hose ID)
For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size or hose, or corresponding port.
3. Equivalent dimensions in millimeters.
4. Actual bore size and depth depends upon joining process. Dimensions given are for silver braze.
5. Ordering size code for metric tube sleeve is based on millimeter sizing used in SAE J1453-2.



NOTE 1: See SAE J1453-1 for manufacturing dimensions not shown.

a. Identification groove for sleeve with metric tube only, (see SAE J1453-1 Figure 5).

FIGURE 12A - BRAZE-ON REDUCING AND
EXPANDING SLEEVE (520115A)

FIGURE 12B - BRAZE-ON REDUCING AND
EXPANDING SLEEVE (520115B)

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TABLE 10 - DIMENSIONS OF BRAZE-ON REDUCING AND EXPANDING SLEEVES

Dimensions in millimeters (mm)

Inch Nominal ⁽³⁾ Tube Reduction Ordering Size Code		Inch Nominal Tube Reduction	Metric Nominal Tube Reduction Ordering ⁽²⁾ Size Code		Metric Nominal Tube Reduction	Metric Nominal Tube Reduction	L ₂₈ ref.
Face Seal	Tube Side	d ₅ ⁽¹⁾ ref.	Face Seal	Tube Side	d ₅ ⁽¹⁾ ref.	d ₈ ref.	
5-4	6.35	6.5	8 x 6	6	6.15	14.35	10.5
6-4	6.35	6.5	10 x 6	6	6.15	15.75	10.5
6-5	7.94	8.09	10 x 8	8	8.15	15.75	10.5
8-4	6.35	6.5	12 x 6	6	6.15	18.90	12.0
8-5	7.94	8.09	12 x 8	8	8.15	18.90	12.0
8-6	9.52	9.68	12 x 10	10	10.15	18.90	12.0
10-4	6.35	6.5	16 x 6	6	6.15	23.45	13.5
10-5	7.94	8.09	16 x 8	8	8.15	23.45	13.5
10-6	9.52	9.68	16 x 10	10	10.15	23.45	13.5
10-8	12.70	12.85	16 x 12	12	12.15	23.45	13.5
12-4	6.35	6.5	20 x 6	6	6.15	27.85	14.5
12-5	7.94	8.09	20 x 8	8	8.15	27.85	14.5
12-6	9.52	9.68	20 x 10	10	10.15	27.85	14.5
12-8	12.70	12.85	20 x 12	12	12.15	27.85	14.5
12-10	15.88	16.03	20 x 16	16	16.13	27.85	14.5
14-5	7.94	8.09	22 x 8	8	8.15	31.00	14.5
14-6	9.52	9.68	22 x 10	10	10.15	31.00	14.5
14-8	12.70	12.85	22 x 12	12	12.15	31.00	14.5
14-10	15.88	16.03	22 x 16	16	16.15	31.00	14.5
14-12	19.05	19.23	22 x 20	20	20.18	31.00	15.5
16-8	12.70	12.85	25 x 12	12	12.15	34.20	15.5
16-10	15.88	16.03	25 x 16	16	16.15	34.20	15.5
16-12	19.05	19.23	25 x 20	20	20.18	34.20	17.0
16-14	22.22	22.4	25 x 22	22	22.18	34.20	17.0
EXPANDING SLEEVE							
12-14 ⁽⁵⁾	22.23	22.40	20 x 22	22	22.18	27.85	16.5

1. Actual bore size and depth depends on joining process; dimensions shown are for silver braze.

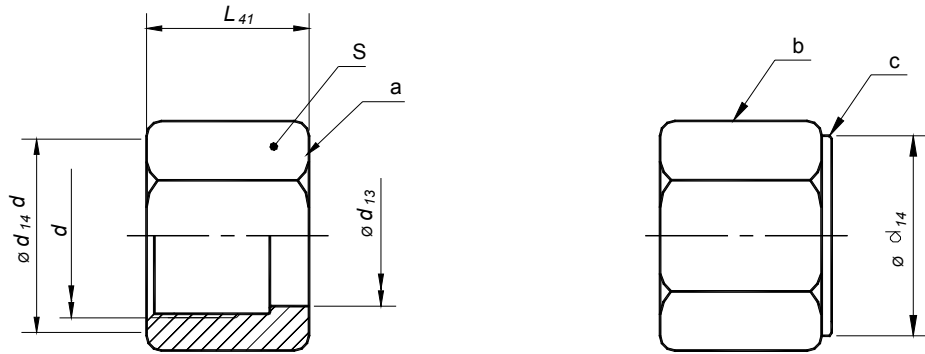
2. Ordering size code for metric tube sleeve is based on millimeter sizing as used in SAE J1453-2.

3. The dash size symbol applicable to all tube ends and straight thread O-ring boss ends shall consist of the number of sixteenth inch increments contained in the outside diameter of the tubing (nominal) OD or inside diameter of the hose (nominal hose ID).

For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size or hose, or corresponding port.

4. For use with special nut for expanding -12 connector to -14 tubing. See 12-14 nut. Figure 13.

5. Diameter d₇ for 12-14 sleeve is 24.69±0.1 and d₂₇ is 1.5±0.15.



NOTE 1: For dimensions not shown, see SAE J1453-1.

- a. Style 'A' - Not suitable for copper braze assemblies.
- b. Style 'B' - Suitable for all assemblies.
- c. Required identification for style B (High Strength) nut
- d. d_{14} applies to both sides

FIGURE 13A - STANDARD TUBE NUT –
STYLE A (520110A)

FIGURE 13B - HIGH STRENGTH TUBE NUT –
STYLE B (520110B)

TABLE 11 - DIMENSIONS OF INCH HEX TUBE NUT

Dimensions in millimeters

Ordering Size Code	Inch Tube OD Dash Size ⁽³⁾	Inch Tube OD	Metric Tube OD	d Thread	d ₁₃ ref.	d ₁₄ ±0.3	d ₁₄ Tol.	L ₄₁ ⁽¹⁾ ref.	S Hex
4	– 4	6.35	6	9/16 - 18	10.5	17	+0 –1	15	17.46
5	– 5	7.94	8	5/8-18	12	18.5	+0 –1	16	19.05
6	– 6	9.52	10	11/16 - 16	13.55	20.1	+0 –1	17	20.64
8	– 8	12.70	12	13/16 - 16	16.6	23.3	+0 –1.5	20	23.81
10	–10	15.88	16	1 - 14	21.1	28	+0 –1.5	24	28.58
12	–12	19.05	20	1-3/16 - 12	24.15	34.4	+0 –1.5	26.5	34.92
14	–14	22.23	22	1-5/16 -12	27.3	37.6	+0 –1.5	26.5	38.10
16	–16	25.40	25	1-7/16 - 12	29.1	40.7	+0 –2	27.5	41.28
20	–20	31.75	30	1-11/16 - 12	36	47	+0 –2	27.5	47.63
24	–24	38.10	38	2 - 12	44	56.6	+0 –2	27.5	57.15
12-14 ⁽²⁾	–14	22.23	22	1-3/16 - 12	25.04	34.4	+0 –1.5	30.5	34.92

1. Reference per ISO 8434-3; see SAE J1453-1 Appendix A for interim dimensions.

2. For use with –12 connector and 12-14 and 20-22 mm sleeves.

3. The dash size symbol applicable to all tube ends and straight thread O-ring boss ends shall consist of the number of sixteenth inch increments contained in the outside diameter of the tubing (nominal) OD or inside diameter of the hose (nominal hose ID) For example: –4 = 4/16 = 0.25 = 6.35 mm inch tube size or hose, or corresponding port.

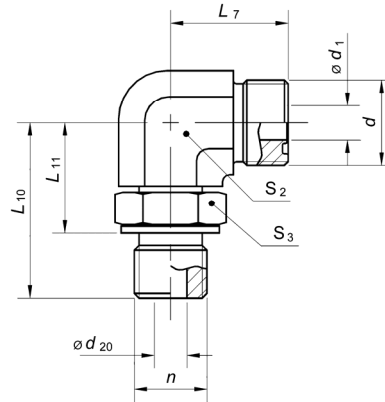


FIGURE 14 - 90 DEGREE ADJUSTABLE STUD ELBOW
(520220)
REFER TO TABLE 12

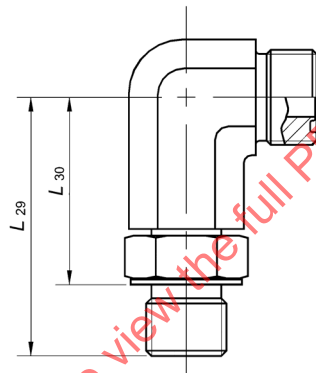


FIGURE 15 - 90 DEGREE ADJUSTABLE STUD ELBOW, LONG
(521520)
REFER TO TABLE 12

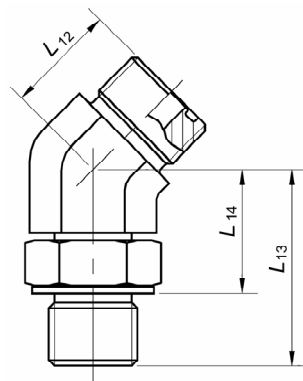


FIGURE 16 - 45 DEGREE ADJUSTABLE STUD ELBOW
(520320)
REFER TO TABLE 12

TABLE 12 - DIMENSIONS OF SAE INCH STRAIGHT THREAD ADJUSTABLE STUD CONNECTORS

Dimensions in millimeters

Ordering ⁽⁴⁾ Size Code	Inch Tube OD	Inch Tube OD	Metric Tube OD	Thread ⁽³⁾ Thread	Thread SAE J1926-2 Stud End	d ₁ ⁽¹⁾ ref.	d ₂₀ ⁽¹⁾ ref.	L ₇ ±1	L ₁₀ ±1	L ₁₁ ref.	L ₁₂ ±1	L ₁₃ ±1	L ₁₄ ref.	L ₂₀ ±1	L ₃₀ ref.	S ₂ ⁽²⁾ Forging min.	S ₂ Bar- stock max	S ₃ Hex
4 - 4	- 4	6.35	6	9/16-18	7/16-20	4.5	4.5	21.5	33	22	16	30	19	56.5	45.5	14.29	19.05	15.88
5 - 5	- 5	7.94	8	5/8-18	1/2-20	5.5	6	23.5	35.5	24.5	17.5	31.5	20.5	56.5	45.5	17	25.4	17.46
6 - 6	- 6	9.52	10	11/16-16	9/16-18	6.5	7.5	25	37	25	19	33	21	66.5	54	17	25.4	19.05
8 - 8	- 8	12.7	12	13/16-16	3/4-16	9.5	10.0	28	40.5	26.5	20.5	36.5	23	75	61	19.05	30.16	23.81
10 - 10	-10	15.88	16	1-14	7/8-14	12.5	12.5	33.5	50	34	23.5	44.5	28.5	89	73	26.99	33.34	26.99
12 - 12	-12	19.05	20	1-3/16-12	1-1/16-12	15.5	15.5	37.5	55	36.5	26	50	31.5	101	82.5	30.16	38.1	34.93
14 - 14	-14	22.2	22	1-5/16-12	1-3/16-12	18	17	41.5	59.5	41.5	30	52.5	34	108	89.5	36.51	47.62	38.1
16 - 16	-16	25.4	25	1-7/16-12	1-5/16-12	20.5	21.5	41.5	59.5	41.5	30	52.5	34	114.5	96	36.51	47.62	41.28
20 - 20	-20	31.75	30	1-11/16-12	1-5/8-12	26	27.5	44.5	62	44	32	53.5	35	126.5	107.5	41.28	57.15	47.63
24 - 24	-24	38.10	38	2-12	1-7/8-12	32	33.5	49	66	47.5	37	53.5	35	139	120.5	47.62	63.50	53.98

1. The smaller of d₁ or d₂₀ may be used on both ends.

2. See Table D1, Appendix D for optional metric forging sizes as agreed between user and supplier.

3. See SAE J1453-1 for screw thread specifications.

4. The dash size symbol applicable to all tube ends and straight thread O-ring boss ends shall consist of the number of sixteenth inch increments contained in the outside diameter of the tubing (nominal OD) or inside diameter of the hose (nominal hose ID).
For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size or hose, or corresponding port

SAE J1453-3_200702

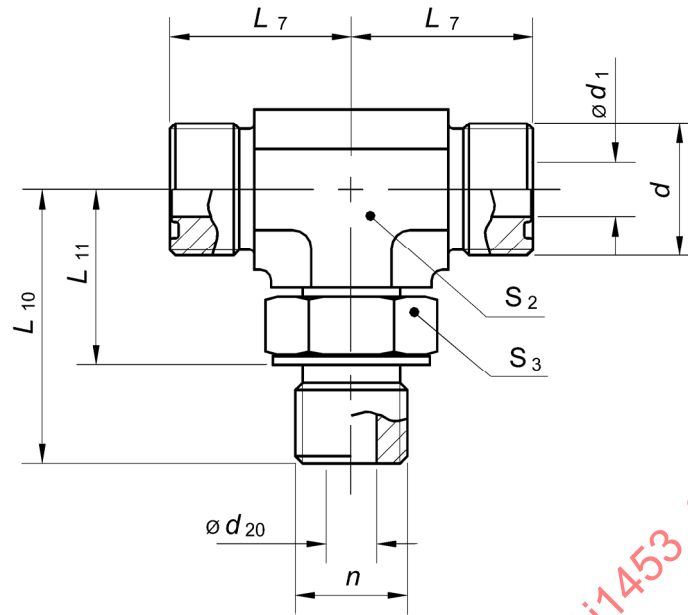


FIGURE 17 - ADJUSTABLE STUD BRANCH TEE
(520429)
REFER TO TABLE 13

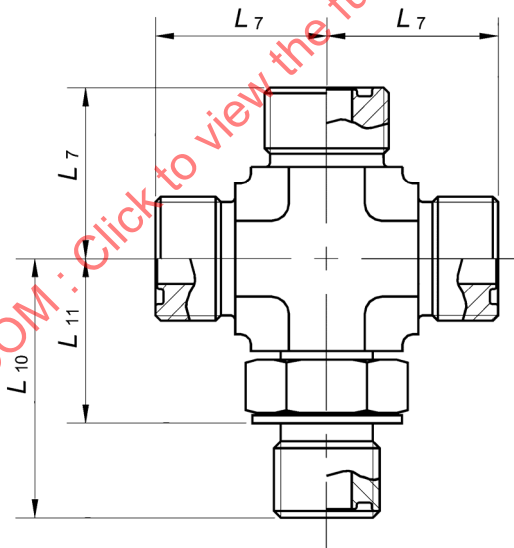


FIGURE 18 - ADJUSTABLE STUD CROSS
(520520)
REFER TO TABLE 13

NOTE: For dimensions not shown, see SAE J1453-1 for the face seal end and SAE J1926-2 for the stud end.

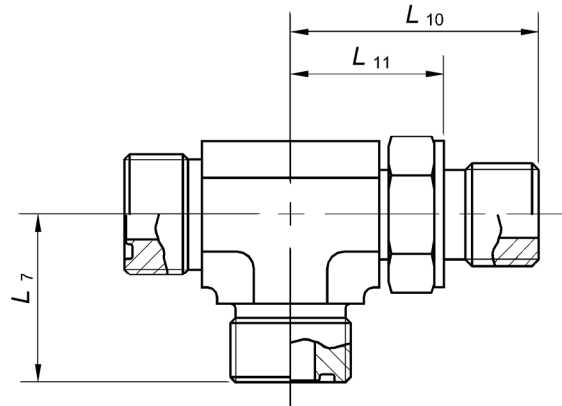


FIGURE 19 - ADJUSTABLE STUD RUN TEE
(520428)
REFER TO TABLE 13

NOTE: For dimensions not shown see SAE J1453-1 for the face seal end and SAE J1926-2 for the stud end.

TABLE 13 - DIMENSIONS OF SAE INCH STRAIGHT THREAD ADJUSTABLE
STUD CONNECTORS WITH SAE J1926-2 STUD ENDS

Dimensions in millimeters (mm)

Ordering Size Code ⁽¹⁾⁽⁴⁾	Nom. Tubing OD Inch Dash ⁽⁴⁾ Size	Nom. Tube OD Inch Tubing	Nom. Tube OD Metric Tubing	d ⁽³⁾ Thread	n Thread SAE J1926-2 Stud Ends	d ₁ ⁽²⁾ ref.	d ₂₀ ⁽²⁾ ref.	L ₇ ±1	L ₁₀ ±1	L ₁₁ ref.	S ₂ Forging min	S ₂ Barstock max	S ₃ ref.
4 - 4 - 4	-4	6.35	6	9/16-18	7/16-20	4.5	4.5	21.5	33	22	14.29	19.05	15.88
5 - 5 - 5	-5	7.94	8	5/8-18	1/2-20	5.5	6	23.5	35.5	24.5	17	25.4	17.46
6 - 6 - 6	-6	9.52	10	11/16-16	9/16-18	6.5	7.5	25	37	25	17	25.4	19.05
8 - 8 - 8	-8	12.7	12	13/16-16	3/4-16	9.5	10.0	28	40.5	26.5	19.05	30.16	23.81
10 - 10 - 10	-10	15.88	16	1-14	7/8-14	12.5	12.5	33.5	50	34	26.99	33.34	26.99
12 - 12 - 12	-12	19.05	20	1-3/16-12	1-1/16-12	15.5	15.5	37.5	55	36.5	30.16	38.1	34.93
14 - 14 - 14	-14	22.22	22	1-5/16-12	1-3/16-12	18	18	41.5	59.5	41.5	36.51	47.62	38.1
16 - 16 - 16	-16	25.4	25	1-7/16-12	1-5/16-12	20.5	21.5	41.5	59.5	41.5	36.51	47.62	41.28
20 - 20 - 20	-20	31.75	30	1-11/16-12	1-5/8-12	26	27.5	44.5	62	44	41.28	57.15	47.63
24 - 24 - 24	-24	38.10	38	2-12	1-7/8-12	32	33.5	49	66	47.5	47.62	63.50	53.98

- Ordering size code as shown are for the branch tee and run tee; add fourth end size for cross; the ordering sequence is: Left - Right - Up - Down, for example a dash 4 cross ordering size code is: 4-4-4-4.
- The smaller of d₁ or d₂₀ may be used in both ends.
- See SAE J1453-1 Screw Thread Specifications.
- The dash size symbol applicable to all tube ends and straight thread O-ring boss ends shall consist of the number of sixteenth inch increments contained in the outside diameter of the tubing (nominal) OD or inside diameter of the hose (nominal hose ID).
For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size or hose, or corresponding port.

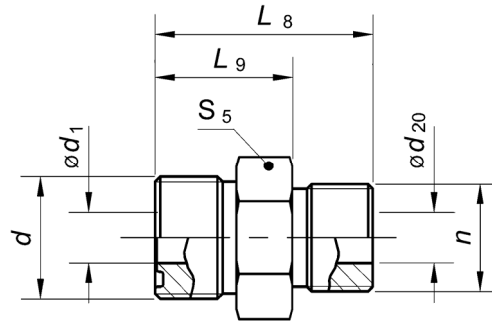


FIGURE 20 - STUD STRAIGHT
(520120)
REFER TO TABLE 14

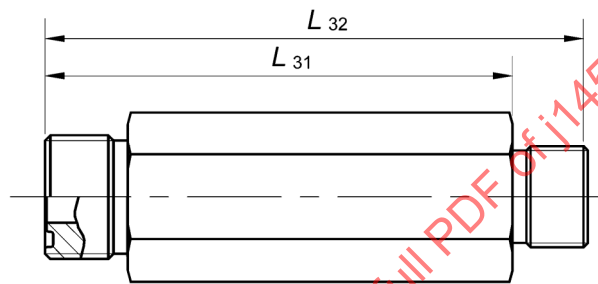


FIGURE 21 - STUD STRAIGHT LONG - LONG HEX
(521820)
REFER TO TABLE 14

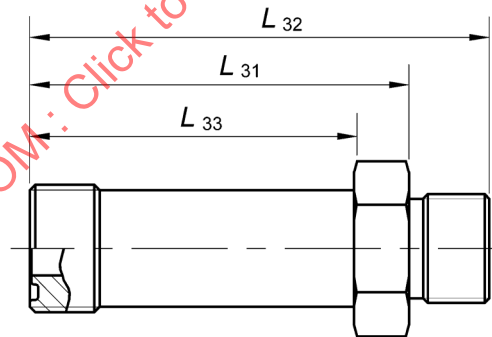


FIGURE 22 - STUD STRAIGHT LONG
(521720)
REFER TO TABLE 14

NOTE: For dimensions not shown see SAE J1453-1 for the face seal end and SAE J1926-2 for the stud end.

TABLE 14 - DIMENSIONS OF STRAIGHT STUD CONNECTORS
WITH SAE J1926-2 STUD END

Dimensions in millimeters (mm)

Ordering ⁽²⁾ Size Code	Inch Tube OD	Inch Tube OD	Metric Tube OD	n Thread SAE J1926-2 Stud End	d ⁽³⁾ Thread	d ₁ ⁽¹⁾ ref.	d ₂₀ ⁽¹⁾ ref.	L ₈ ±0.8	L ₉ ref.	L ₃₁ ref.	L ₃₂ ±0.8	L ₃₃ ±0.8	S ₅ Hex
Face Seal — End	Dash ⁽²⁾ Size	Tube OD	Tube OD										
4 - 4	- 4	6.35	6	9/16-18	7/16-20	4.5	4.5	29	18	41.5	52.5	34	15.88
5 - 5	- 5	7.94	8	5/8-18	1/2-20	5.5	6	29.5	18.5	41.5	52.5	34	17.46
6 - 6	- 6	9.52	10	11/16-16	9/16-18	6.5	7.5	32	20	45.5	57.5	37	19.05
8 - 8	- 8	12.7	12	13/16-16	3/4-16	9.5	10.0	36.5	22.5	54	68	44.5	22.23
10 - 10	- 10	15.88	16	1-14	7/8-14	12.5	12.5	43	27	63.5	79.5	52.5	26.99
12 - 12	- 12	19.05	20	1-3/16-12	1-1/16-12	15.5	15.5	48.5	30	77.0	95.5	64.0	31.75
14 - 14	- 14	22.22	22	1-5/16-12	1-3/16-12	18	18	50	32	81.5	100	67.5	34.93
16 - 16	- 16	25.4	25	1-7/16-12	1-5/16-12	20.5	21.5	50	32	86.5	105	73	38.10
20 - 20	- 20	31.75	30	1-11/16-12	1-5/8-12	26	27.5	52.5	34	102.5	121	86.5	47.63
24 - 24	- 24	38.10	38	2-12	1-7/8-12	32	33.5	54	35.5	115	133.5	97	53.98

1. The smaller of d₁ or d₂₀ may go all the way through.
2. The dash size symbol applicable to all tube ends and straight thread O-ring boss ends shall consist of the number of sixteenth inch increments contained in the outside diameter of the tubing (nominal) OD or inside diameter of the hose (nominal hose ID).
For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size or hose, or corresponding port.
3. See SAE J1453-1 Screw Thread Specifications.

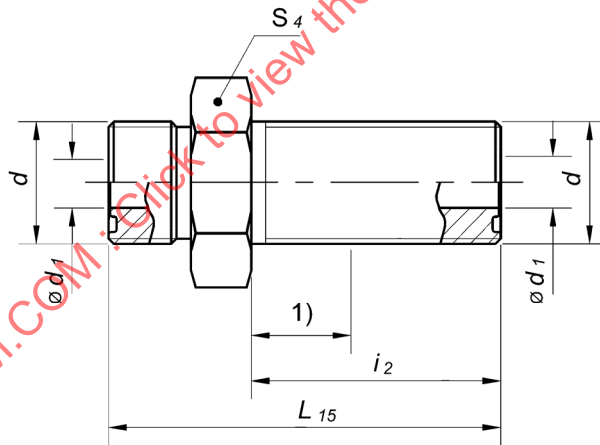


FIGURE 23 - BULKHEAD STRAIGHT
(520601)
REFER TO TABLE 15

NOTE: For dimensions not shown, see SAE J1453-1.

- 1) Maximum Bulkhead Thickness—14 mm; for minimum bulkhead thickness see i₃ and i₄ in SAE J1453-1. Recommended clearance hole for bulkhead connectors is 0.4 mm over major thread diameter.

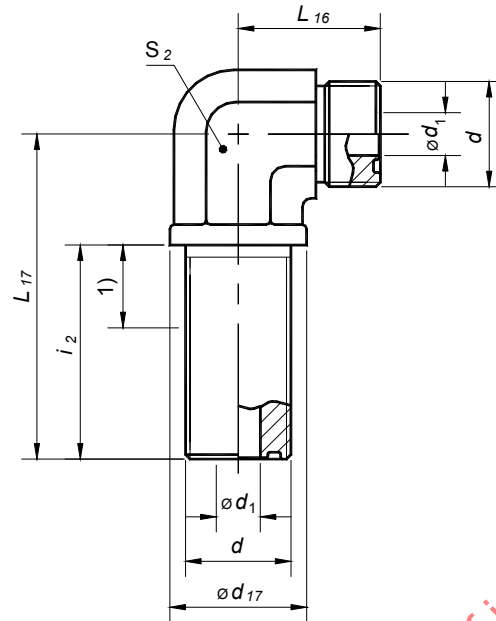


FIGURE 24 - 90 DEGREE BULKHEAD ELBOW
(520701)
REFER TO TABLE 15

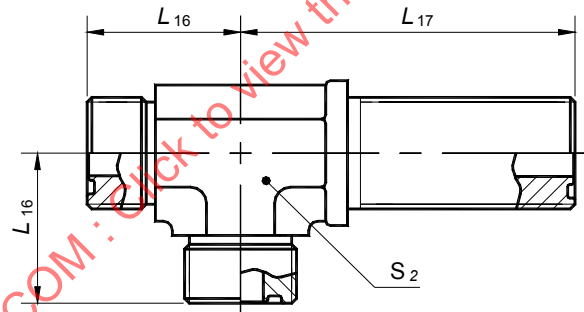


FIGURE 25 - BULKHEAD RUN TEE
(520958)
REFER TO TABLE 15

NOTE: For dimensions not shown, see SAE J1453-1.

- 1) Maximum Bulkhead Thickness—14 mm; for minimum bulkhead thickness see i_3 and i_4 in SAE J1453-1. Recommended clearance hole for bulkhead connectors is 0.4 mm over major thread diameter.

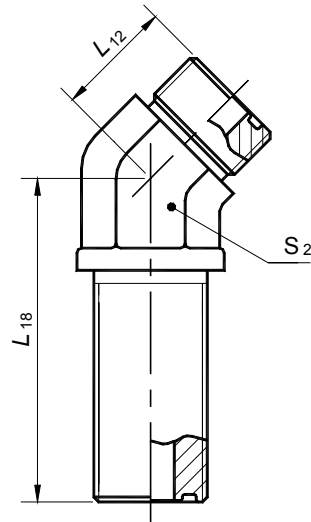


FIGURE 26 - 45 DEGREE BULKHEAD ELBOW
(520801)
REFER TO TABLE 15

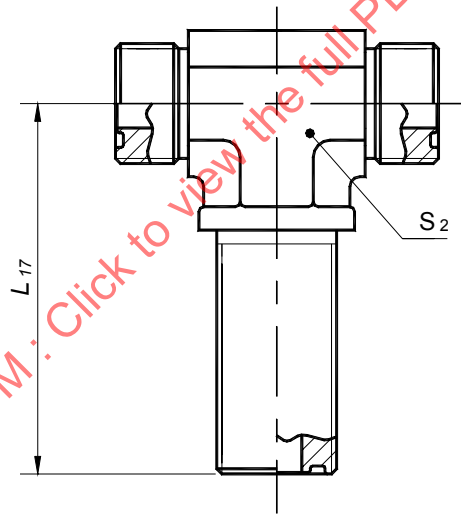


FIGURE 27 - BULKHEAD BRANCH TEE
(520959)
REFER TO TABLE 15

NOTE: For dimensions not shown, see SAE J1453-1.

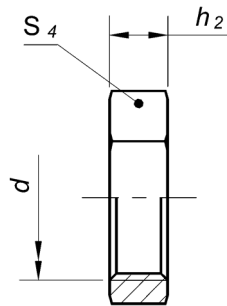


FIGURE 28 - BULKHEAD LOCKNUT
(520118)
REFER TO TABLE 15

NOTE: For dimensions not shown see SAE J1453-1.

TABLE 15 - DIMENSIONS OF INCH HEX BULKHEAD CONNECTORS

Dimensions in millimeters (mm)

Ordering ⁽¹⁾ Size Code	Inch Tube OD Dash ⁽²⁾ Size	Inch Tube OD	Metric Tube OD	d Thread	d ₁ ref.	d ₁₇ min	h ₂ ref.	i ₂ ref.	L ₁₂ ±1	L ₁₅ ±0.8	L ₁₆ ±1	L ₁₇ ±1	L ₁₈ ±1	S ₂ Forging min	S ₂ ⁽³⁾ Bar- stock max	S ₄ Hex
4 - 4	- 4	6.35	6	9/16-18	4.5	16.5	7	31.5	16	48	22.5	47	44	14.29	19.05	20.64
5 - 5	- 5	7.94	8	5/8-18	5.5	19	7	31.5	18	49.5	25	49.5	46	17.00	25.40	22.23
6 - 6	- 6	9.52	10	11/16-16	6.5	21	8	34	19	53	26	52	48.5	17.00	25.40	25.40
8 - 8	- 8	12.70	12	13/16-16	9.5	24.5	9	36.5	20.5	58.5	29	55.5	51	19.05	30.16	28.58
10 - 10	- 10	15.88	16	1-14	12.5	29	10.5	40.5	23.5	66.5	34.5	63	56.5	26.99	33.34	33.34
12 - 12	- 12	19.05	20	1-3/16-12	15.5	34	10.5	41.5	26	69	38.5	67	60.5	30.16	38.10	38.10
14 - 14	- 14	22.23	22	1-5/16-18	18	38	10.5	42	30	70	42.5	71	65	36.51	47.62	41.28
16 - 16	- 16	25.40	25	1-7/16-12	20.5	40.5	10.5	42	30	70	42.5	71	65	36.51	47.62	44.45
20 - 20	- 20	31.75	30	1-11/16-12	26	46.5	10.5	42	32	70	45.5	75.5	67	41.28	57.15	50.80
24 - 24	- 24	38.10	38	2-12	32	54.5	10.5	42	37	70	49.5	79.5	67	47.62	63.50	60.33

- Ordering size code as shown are for bulkhead straight, bulkhead elbow and 45 degrees bulkhead elbow; add third end size for run and branch tee; the ordering sequence is: Left - Right - Up - Down, for example a dash 4 run tee ordering size code is: 4-4-4.
- The dash size symbol applicable to all tube ends and straight thread O-ring boss ends shall consist of the number of sixteenth inch increments contained in the outside diameter of the tubing (nominal) OD or inside diameter of the hose (nominal hose ID).
For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size or hose, or corresponding port.
- See Table C₁, Appendix C for optional metric forging sizes as agreed between user and supplier.

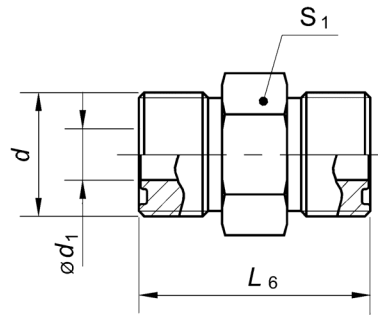


FIGURE 29 - UNION STRAIGHT
(520101)
REFER TO TABLE 16

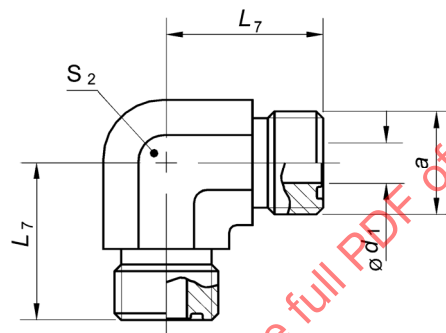


FIGURE 30 - 90 DEGREE UNION ELBOW
(520201)
REFER TO TABLE 16

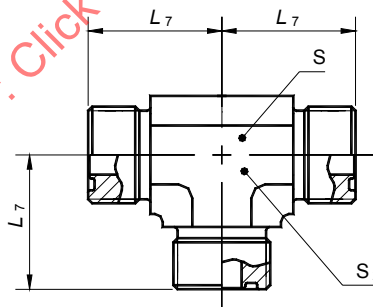


FIGURE 31 - UNION TEE
(520401)
REFER TO TABLE 16

NOTE: For dimensions not shown, see SAE J1453-1.

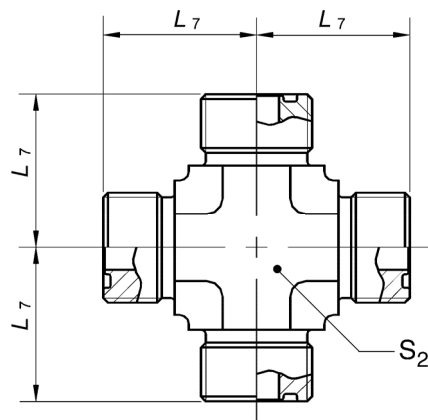


FIGURE 32 - UNION CROSS
(520501)
REFER TO TABLE 16

NOTE: For dimensions not shown see SAE J1453-1.

TABLE 16 - DIMENSIONS OF INCH HEX UNION STRAIGHT,
90 DEGREE UNION ELBOW, UNION TEE AND UNION CROSS

Dimensions in millimeters (mm)

Ordering ⁽¹⁾ Size Code	Inch Tube OD Dash ⁽²⁾ Size	Inch Tube OD	Metric Tube OD	Thread	d_1 ref.	L_6 ± 0.8	L_7 ref.	S_1 Hex	$S_2^{(3)}$ Forging min	S_2 Barstock max
4 - 4	-4	6.35	6	9/16-18	4.5	27.5	21.5	15.88	14.29	19.05
5 - 5	-5	7.94	8	5/8-18	5.5	29	23.5	17.46	17.00	25.40
6 - 6	-6	9.52	10	11/16-16	6.5	31	25	19.05	17.00	25.40
8 - 8	-8	12.70	12	13/16-16	9.5	35.5	28	22.22	19.05	30.16
10 - 10	-10	15.88	16	1-14	12.5	42.5	33.5	26.99	26.99	33.34
12 - 12	-12	19.05	20	1-3/16-12	15.5	47	37.5	31.75	30.16	38.10
14 - 14	-14	22.23	22	1-5/16-12	18	47.5	41.5	34.93	36.51	47.62
16 - 16	-16	25.40	25	1-7/16-12	20.5	49.5	41.5	38.10	36.51	47.62
20 - 20	-20	31.75	30	1-11/16-12	26	51.5	44.5	44.45	41.28	57.15
24 - 24	-24	38.10	38	2-12	32	53	49	53.98	47.62	63.50

- Ordering size code as shown are for straight and elbow; add third and fourth end size for union tee and cross, respectively. The ordering sequence is: Left - Right - Up - Down, for example a dash 4 union tee ordering size code is: 4-4-4.
- The dash size symbol applicable to all tube ends and straight thread O-ring boss ends shall consist of the number of sixteenth inch increments contained in the outside diameter of the tubing (nominal) OD or inside diameter of the hose (nominal hose ID).
For example: -4 = $4/16 = 0.25 = 6.35$ mm inch tube size or hose, or corresponding port.
- See Table C₁, Appendix C for optional metric forging sizes as agreed between user and supplier.

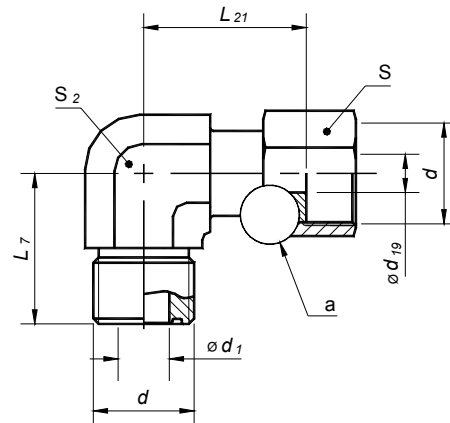


FIGURE 33 - SWIVEL 90 DEGREE ELBOW
(520221)
REFER TO TABLE 17

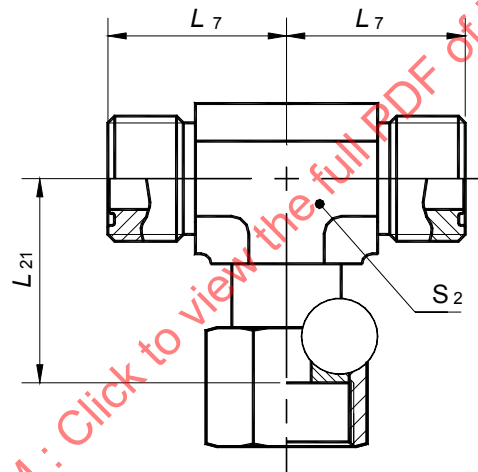


FIGURE 34 - SWIVEL BRANCH TEE
(520433)
REFER TO TABLE 17

NOTE: For dimensions not shown, see SAE J1453-1.

- a. Method of attachment of swivel nut is optional with the manufacturer. Face shall be flush or exposed when nut is fully retracted.

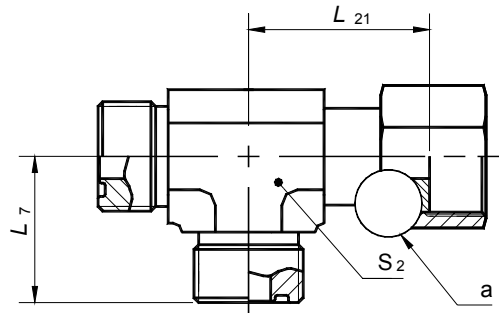


FIGURE 35 - SWIVEL RUN TEE
(520432)
REFER TO TABLE 17

NOTE: For dimensions not shown, see SAE J1453-1.

- a. Method of attachment of swivel nut is optional with the manufacturer. Face shall be flush or exposed when nut is fully retracted.

TABLE 17 - DIMENSIONS OF INCH HEX SWIVEL CONNECTORS
Dimensions in millimeters (mm)

Ordering ⁽¹⁾ Size Code	Inch Tube OD Dash ⁽²⁾ Size	Inch Tube OD	Metric Tube OD	d Thread	d ₁ ref.	d ₁₉ ref.	L ₇ ref.	L ₂₁ ±1.5	S Hex	S ₂ ⁽³⁾ Forging min	S ₂ Barstock max
4 - 4	- 4	6.35	6	9/16-18	4.5	4	21.5	26.5	17.46	14.29	19.05
5 - 5	- 5	7.94	8	5/8-18	5.5	5.5	23.5	28	19.05	17.00	25.40
6 - 6	- 6	9.52	10	11/16-16	6.5	6.5	25	29	20.64	17.00	25.40
8 - 8	- 8	12.70	12	13/16-16	9.5	9	28	38	23.81	19.05	30.16
10 - 10	-10	15.88	16	1-14	12.5	11.5	33.5	41	28.58	26.99	33.34
12 - 12	-12	19.05	20	1-3/16-12	15.5	14	37.5	46.5	34.92	30.16	38.10
14 - 14	-14	22.23	22	1-5/16-12	18	18	41.5	52.5	38.10	36.51	47.62
16 - 16	-16	25.40	25	1-7/16-12	20.5	20	41.5	53.5	41.28	36.51	47.62
20 - 20	-20	31.75	30	1-11/16-12	26	26	44.5	58	47.62	41.28	57.15
24 - 24	-24	38.10	38	2-12	32	32	49	61	57.15	47.62	63.50

1. Add additional tube end size for tees.

2. The dash size symbol applicable to all tube ends and straight thread O-ring boss ends shall consist of the number of sixteenth inch increments contained in the outside diameter of the tubing (nominal) OD or inside diameter of the hose (nominal hose ID).
For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size or hose, or corresponding port.

3. See Table C₁, Appendix C for optional metric forging sizes as agreed between user and supplier.

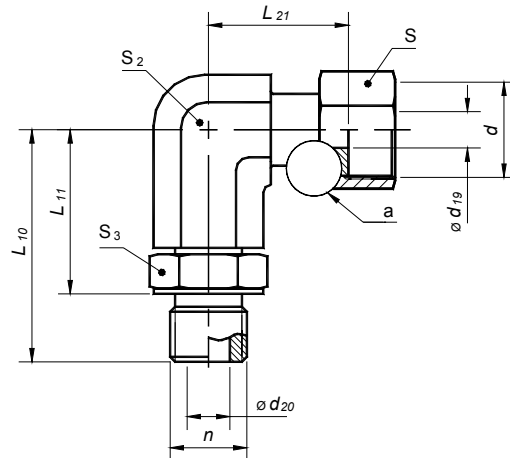


FIGURE 36 - SWIVEL 90 DEGREE ADJUSTABLE STUD ELBOW
(520281)
REFER TO TABLE 18

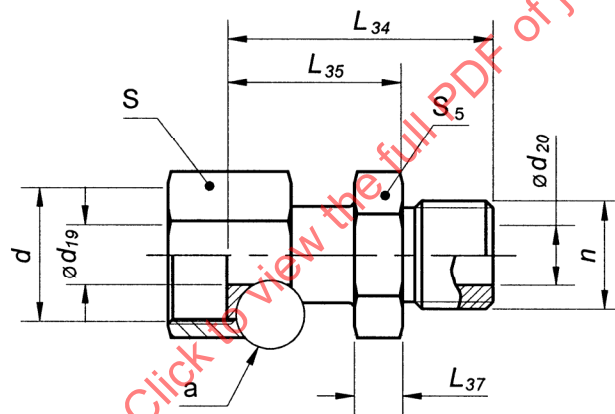


FIGURE 37 - STUD STRAIGHT SWIVEL
(520181)
REFER TO TABLE 18

NOTE: For dimensions not shown see SAE J1453-1 for face seal dimensions or SAE J1926-2 for stud end dimensions.

- a. Method of attachment of swivel nut is optional with manufacturer. Face shall be flush or exposed when nut is fully retracted.

TABLE 18 - DIMENSIONS OF SWIVEL STUD CONNECTORS

Dimensions in millimeters (mm)

Ordering Size ⁽²⁾ Code	Inch Tube		Metric Tube OD	Inch Tube OD	Dash Size ⁽²⁾	Thread	d ⁽³⁾ Thread	Stud End Thread	d ₁₉ ⁽¹⁾ ref.	d ₂₀ ⁽¹⁾ ref.	L ₁₀ ±1	L ₁₁ ref.	L ₂₁ ±1.5	L ₃₄ ±0.8	L ₃₅ ref.	L ₃₇ min	S Hex	S ₂ ⁽⁴⁾ Forging Barstock		S ₃ Hex	S ₅ Hex
4-4	-4	6.35	6	9/16-18	7/16-20	4	4.5	33	22	26.5	28	26.5	37	26	5	17.46	14.29	19.05	15.88	15.88	15.88
5-5	-5	7.94	8	5/8-18	1/2-20	5.5	6	35.5	24.5	28	27	35.5	38	27	5.5	19.05	17.00	25.40	17.46	17.46	17.46
6-6	-6	9.52	10	11/16-16	9/16-18	6.5	7.5	37	25	29	28	37	40	28	5.5	20.64	17.00	25.40	19.05	19.05	19.05
8-8	-8	12.70	12	13/16-16	3/4-16	9	10	40.5	26.5	38	35.5	40.5	49.5	35.5	6.5	23.81	19.05	30.16	23.81	22.22	22.22
10-10	-10	15.88	16	1-14	7/8-14	11.5	12.5	50	34	41	38	50	54	38	8	28.58	26.99	33.34	26.99	26.99	26.99
12-12	-12	19.05	20	1-3/16-12	1-1/16-12	14	15.5	55	36.5	46.5	41	55	59.5	41	9.5	34.92	30.16	38.10	34.93	31.75	31.75
14-14	-14	22.23	22	1-5/16-12	1-3/16-12	18	17	59.5	41.5	52.5	44.5	59.5	63	44.5	11.5	38.10	36.51	47.62	38.1	34.93	34.93
16-16	-16	25.40	25	1-7/16-12	1-5/16-12	20	21.5	59.5	41.5	53.5	49	59.5	67.5	49	11.5	41.28	36.51	47.62	41.28	38.10	38.10
20-20	-20	31.75	30	1-11/16-12	1-5/8-12	26	27.5	62	44	58	49	62	67.5	49	13	47.63	41.28	57.15	47.63	47.63	47.63
24-24	-24	38.10	38	2-12	1-7/8-12	32	33.5	66	47.5	61	49	66	67.5	49	15	57.15	47.62	63.50	53.98	53.98	53.98

1. The smaller of d₁₉ or d₂₀ may go all the way through.

2. The dash size symbol applicable to all tube ends and straight thread O-ring boss ends shall consist of the number of sixteenth inch increments contained in the outside diameter of the tubing (nominal) OD or inside diameter of the hose (nominal hose ID).

For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size or hose, or corresponding port.

3. See SAE J1453-1 for Screw Thread Specifications.

4. See Table C₁, Appendix C for optional metric forging sizes as agreed between user and supplier.

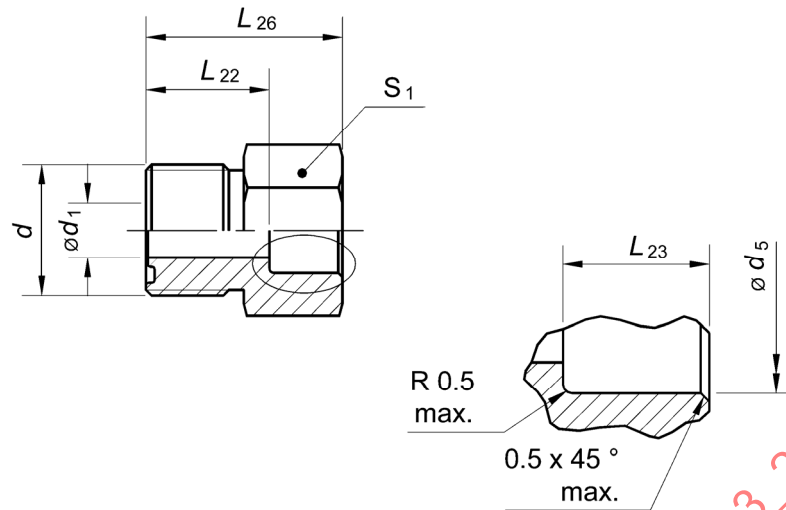


FIGURE 38 - BRAZE-ON STRAIGHT
(INCH TUBE 520104) (METRIC TUBE 5201M04)
REFER TO TABLE 19

NOTE: For dimensions not shown see SAE J1453-1.

TABLE 19 - DIMENSIONS OF INCH BRAZE-ON STRAIGHT CONNECTOR

Dimensions in millimeters (mm)

Inch ⁽³⁾ Tube Ordering Size Code 520104	Inch ⁽³⁾ Tube Dash Size	Inch Tube d ₅ ⁽¹⁾	Metric Tube Ordering Size Code ⁽²⁾ 5201M04	Metric Tube OD	Metric Tube d ₅ ⁽¹⁾ ref.	d Thread	d ₁ ref.	L ₂₂ ±0.8	L ₂₃ ±0.5	L ₂₆ ref.	S ₁ Hex
4 - 4	- 4	6.5	6x6	6	6.15	9/16-18	4.5	13.5	8.5	22	15.88
4 - 5	- 5	8.09	6x8	8	8.15	9/16-18	4.5	13.5	8.5	22	15.88
4 - 6	- 6	9.68	6x10	10	10.15	9/16-18	4.5	13.5	8.5	22	15.88
5 - 4	- 4	6.5	8x6	6	6.15	5/8-18	4.5 ⁽⁴⁾	13.5	8.5	22	17.45
5 - 5	- 5	8.09	8x8	8	8.15	5/8-18	5.5	13.5	8.5	22	17.45
5 - 6	- 6	9.68	8x10	10	10.15	5/8-18	5.5	13.5	8.5	22	17.45
5 - 8	- 8	12.85	8x12	12	12.15	5/8-18	5.5	13.5	8.5	22	17.45
6 - 4	- 4	6.5	10x6	6	6.15	11/16-16	4.5 ⁽⁴⁾	14.5	8.5	23	19.05
6 - 5	- 5	8.09	10x8	8	8.15	11/16-16	5.5 ⁽⁴⁾	14.5	8.5	23	19.05
6 - 6	- 6	9.68	10x10	10	10.15	11/16-16	6.5	14.5	8.5	23	19.05
6 - 8	- 8	12.85	10x12	12	12.15	11/16-16	6.5	14.5	8.5	23	19.05
6 - 10	-10	16.03	10x16	16	16.15	11/16-16	6.5	14.5	9	23.5	22.23
8 - 5	- 5	8.09	12x8	8	8.15	13/16-16	5.5 ⁽⁴⁾	16	8.5	24.5	22.23
8 - 6	- 6	9.68	12x10	10	10.15	13/16-16	6.5 ⁽⁴⁾	16	8.5	24.5	22.23
8 - 8	- 8	12.85	12x12	12	12.15	13/16-16	9.5	16	8.5	24.5	22.23
8 - 10	-10	16.03	12x16	16	16.15	13/16-16	9.5	16	9	25	22.23
10 - 6	- 6	9.68	16x10	10	10.15	1-14	6.5 ⁽⁴⁾	19	8.5	27.5	26.99
10 - 8	- 8	12.85	16x12	12	12.15	1-14	9.5 ⁽⁴⁾	19	8.5	27.5	26.99
10 - 10	-10	16.03	16x16	16	16.15	1-14	12.5	19	9	28	26.99
10 - 12	-12	19.23	16x20	20	20.18	1-14	12.5	19	12.5	31.5	26.99
12 - 8	- 8	12.85	20x12	12	12.15	1-3/16-12	9.5 ⁽⁴⁾	21	8.5	29.5	31.75
12 - 10	-10	16.03	20x16	16	16.15	1-3/16-12	12.5 ⁽⁴⁾	21	9	30	31.75
12 - 12	-12	19.23	20x20	20	20.18	1-3/16-12	15.5	21	12.5	33.5	31.75
12 - 16	-16	25.58	20x25	25	25.18	1-3/16-12	15.5	21	14	35	31.75
14 - 10	-10	16.03	22x16	16	16.15	1-5/16-12	12.5 ⁽⁴⁾	23	9	32	34.93
14 - 12	-12	19.23	22x20	20	20.18	1-5/16-12	15.5 ⁽⁴⁾	23	12.5	35.5	34.93
14 - 14	-14	22.41	22x22	22	22.18	1-5/16-12	18	23	12.5	35.5	34.93
14 - 16	-16	25.58	22x25	25	25.18	1-5/16-12	18	23	14	37	34.93
16 - 10	-10	16.03	25x16	16	16.15	1-7/16-12	12.5 ⁽⁴⁾	24.5	9	33.5	38.1
16 - 12	-12	19.23	25x20	20	20.18	1-7/16-12	15.5 ⁽⁴⁾	24.5	12.5	37.0	38.1
16 - 16	-16	25.58	25x25	25	25.18	1-7/16-12	20.5	24.5	14	38.5	38.1
16 - 20	-20	31.95	25x30	30	30.18	1-7/16-12	20.5	24.5	14	38.5	41.28

TABLE 19 - DIMENSIONS OF INCH BRAZE-ON STRAIGHT CONNECTOR (CONTINUED)

Dimensions in millimeters (mm)

Inch ⁽³⁾ Tube Ordering Size Code 520104		Inch ⁽³⁾ Tube Dash Size		Metric Tube Ordering Size Code ⁽²⁾ 5201M04		Metric Tube d ₅ ⁽¹⁾ ref.		d Thread	d ₁ ref.	L ₂₂ ±0.8	L ₂₃ ±0.5	L ₂₆ ref.	S ₁ Hex
Face Seal	Tube — Side		Inch Tube d ₅ ⁽¹⁾		Metric Tube OD								
20 - 12		-12	19.23	30x20	20	20.18		1-11/16-12	15.5 ⁽⁴⁾	24.5	12.5	37	44.45
20 - 16		-16	25.58	30x25	25	25.18		1-11/16-12	20.5 ⁽⁴⁾	24.5	14	38.5	44.45
20 - 20		-20	31.95	30x30	30	30.2		1-11/16-12	26 ⁽⁴⁾	24.5	14	38.5	44.45
20 - 24		-24	38.3	30x38	38	38.2		1-11/16-12	26 ⁽⁴⁾	24.5	14	38.5	50.8
24 - 16		-16	25.58	38x25	25	25.18		2-12	20.5 ⁽⁴⁾	24.5	14	38.5	53.98
24 - 20		-20	31.95	38x30	30	30.2		2-12	26 ⁽⁴⁾	24.5	14	38.5	53.98
24 - 24		-24	38.3	38x38	38	38.2		2-12	32	24.5	14	38.5	53.98

1. Dimensions given are for silver brazing. Other dimensions may apply for other joining methods.
2. 6x6 means a metric size 6 O-ring face seal end to a 6 mm tube, with an inch hex since the code 5201M04 is for an inch hex part with metric tubing.
3. The dash size symbol applicable to all tube ends and straight thread O-ring boss ends shall consist of the number of sixteenth inch increments contained in the outside diameter of the tubing (nominal) OD or inside diameter of the hose (nominal hose ID). For example:
-4 = 4/16 = 0.25 = 6.35 mm inch tube size or hose, or corresponding port.
4. d₁ diameter is smaller than the standard through hole passage for this size ORFS end. Accordingly, d₁ may be countersunk (90° angle) or counterbored to a diameter which equals the standard hole passage for the ORFS end. Counterbore depth shall be no greater than to the center of the undercut.

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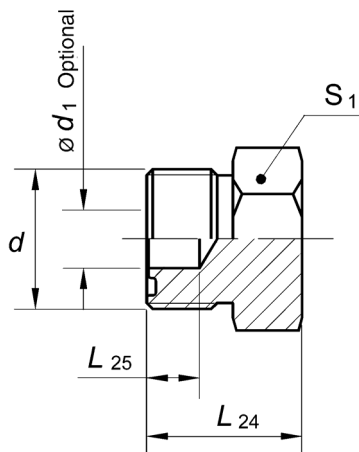


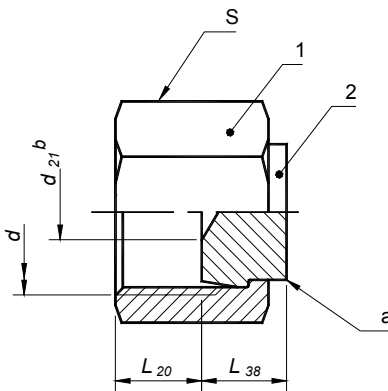
FIGURE 39 - PLUG
(520109)
REFER TO TABLE 20

NOTE: For dimensions not shown see SAE J1453-1.

TABLE 20 - DIMENSIONS OF PLUG
Dimensions in millimeters (mm)

Ordering Size Code	Inch Tube ⁽¹⁾ OD Dash Size	Inch Tube OD	Metric Tube OD	d ⁽²⁾ Thread	d ₁ ref.	L ₂₄ ±0.8	L ₂₅ max	S ₁ Hex
4	-4	6.35	6	9/16-18	4.5	16.5	7.1	15.88
5	-5	7.94	8	5/8-18	5.5	16.5	7.1	17.46
6	-6	9.52	10	11/16-16	6.5	19	8.2	19.05
8	-8	12.7	12	13/16-16	9.5	22	9.8	22.23
10	-10	15.88	16	1-14	12.5	26	12.2	26.99
12	-12	19.05	20	1-3/16-12	15.5	27.5	13.2	31.75
14	-14	22.23	22	1-5/16-12	18	28	13.2	34.93
16	-16	25.40	25	1-7/16-12	20.5	28	13.7	38.10
20	-20	31.75	30	1-11/16-12	26	28	13.7	44.45
24	-24	38.10	38	2-12	32	28	13.7	53.98

1. The dash size symbol applicable to all tube ends and straight thread O-ring boss ends shall consist of the number of sixteenth inch increments contained in the outside diameter of the tubing (nominal) OD or inside diameter of the hose (nominal hose ID).
For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size or hose, or corresponding port.
2. See SAE J1453-1 Screw Thread Specifications.



1. 520110A Nut
2. Cap Insert

NOTE: For dimensions not shown, see SAE J1453-1.

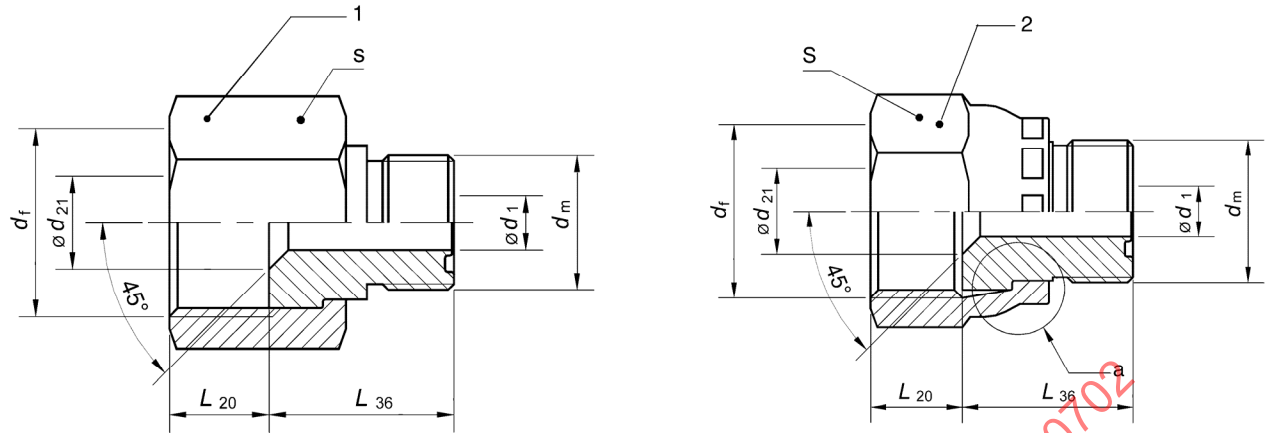
- a. Stake insert must be free to turn.
- b. Optional drill point permitted.

FIGURE 40 - CAP ASSEMBLY
(520112)
REFER TO TABLE 21

TABLE 21 - DIMENSIONS OF CAP ASSEMBLY
Dimensions in millimeters (mm)

Ordering Size Code	Inch ⁽¹⁾ Tube OD Dash Size	Inch Tube OD	Metric Tube OD	d Thread	d ₂₁ max.	L ₂₀ ref.	L ₃₈ ±0.8	S Hex
4	-4	6.35	6	9/16-18	4.5	7.8	9	17.46
5	-5	7.94	8	5/8-18	5.5	7.8	10	19.05
6	-6	9.52	10	11/16-16	6.5	8.3	10.5	20.64
8	-8	12.7	12	13/16-16	9.5	10	12	23.81
10	-10	15.88	16	1-14	12.5	12.5	13.5	28.58
12	-12	19.05	20	1-3/16-12	15.5	13.5	15	34.93
14	-14	22.23	22	1-5/16-12	18	13.5	15	38.10
16	-16	25.40	25	1-7/16-12	20.5	13.5	16	41.28
20	-20	31.75	30	1-11/16-12	26	13.5	16	47.63
24	-24	38.10	38	2-12	32	13.5	16	57.15

1. The dash size symbol applicable to all tube ends and straight thread O-ring boss ends shall consist of the number of sixteenth inch increments contained in the outside diameter of the tubing (nominal) OD or inside diameter of the hose (nominal hose ID).
For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size or hose, or corresponding port.



1. Style 'A' (520123)
2. Style 'B' (520123B)

NOTE 1: For dimensions not shown see SAE J1453-1.

- a. Crimped nut design optional

FIGURE 41 - REDUCER WITH NUT
REFER TO TABLE 22

TABLE 22 - DIMENSIONS OF FACE SEAL REDUCER WITH NUT

Dimensions in millimeters (mm)

Ordering Size ⁽³⁾ Code		d _f Thread	d _m Thread	d ₁ ref.	d ₂₁ ref.	L ₂₀ ⁽¹⁾ ref.	L ₃₆ ±0.8	S Hex
Female ORFS	Male ORFS							
5 - 4		5/8-18	9/16-18	4.5	5.5	7.8	17	19.05
6 - 4 ⁽²⁾		11/16-16	9/16-18	4.5	6.5	8.3	19.5	20.64
6 - 5 ⁽²⁾		11/16-16	5/8-18	5.5	6.5	8.3	19.5	20.64
8 - 4		13/16-16	9/16-18	4.5	9.5	10	22	23.81
8 - 5		13/16-16	5/8-18	5.5	9.5	10	22	23.81
8 - 6 ⁽²⁾		13/16-16	11/16-16	6.5	9.5	10	22.5	23.81
10 - 4		1-14	9/16-18	4.5	12.5	12.5	23	28.58
10 - 5		1-14	5/8-18	5.5	12.5	12.5	23	28.58
10 - 6		1-14	11/16-16	6.5	12.5	12.5	24	28.58
10 - 8		1-14	13/16-16	9.5	12.5	12.5	25.5	28.58
12 - 4		1-3/16-12	9/16-18	4.5	15.5	13.5	25	34.92
12 - 5		1-3/16-12	5/8-18	5.5	15.5	13.5	25	34.92
12 - 6		1-3/16-12	11/16-18	6.5	15.5	13.5	26	34.92
12 - 8		1-3/16-12	13/16-16	9.5	15.5	13.5	27.5	34.92
12 - 10 ⁽²⁾		1-3/16-12	1-14	12.5	15.5	13.5	29.5	34.92
14 - 5		1-5/16-12	5/8-18	5.5	18	13.5	25	38.1
14 - 6		1-5/16-12	11/16-16	6.5	18	13.5	26	38.1
14 - 8		1-5/16-12	13/16-16	9.5	18	13.5	27.5	38.1
14 - 10		1-5/16-12	1-14	12.5	18	13.5	29.5	38.1
14 - 12 ⁽²⁾		1-5/16-12	1-3/16-12	15.5	18	13.5	32	38.1
16 - 8		1-7/16-12	13/16-16	9.5	20.5	13.5	29	41.28
16 - 10		1-7/16-12	1-14	12.5	20.5	13.5	32	41.28
16 - 12 ⁽²⁾		1-7/16-12	1-3/16-12	15.5	20.5	13.5	33	41.28
16 - 14 ⁽²⁾		1-7/16-12	1-5/16-12	18	20.5	13.5	33.5	41.28
20 - 12		1-11/16-12	1-3/16-12	15.5	26	13.5	33.5	47.63
20 - 14		1-11/16-12	1-5/16-12	18	26	13.5	34	47.63
20 - 16 ⁽²⁾		1-11/16-12	1-7/16-12	20.5	26	13.5	34 ⁽⁴⁾	47.63
24 - 14		2-12	1-5/16-12	18	32	13.5	34	57.15
24 - 16		2-12	1-7/16-12	20.5	32	13.5	34	57.15
24 - 20		2-12	1-11/16-12	26.0	32	13.5	34	57.15

1. See SAE J1453-1 swivel end connection.

2. Permanently attached Nut Design

3. The dash size symbol applicable to all tube ends and straight thread O-ring boss ends shall consist of the number of sixteenth inch increments contained in the outside diameter of the tubing (nominal) OD or inside diameter of the hose (nominal hose ID).

For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size or hose, or corresponding port.

4. Longstanding this has been 38.5 in the published document, but has been corrected in this edition.

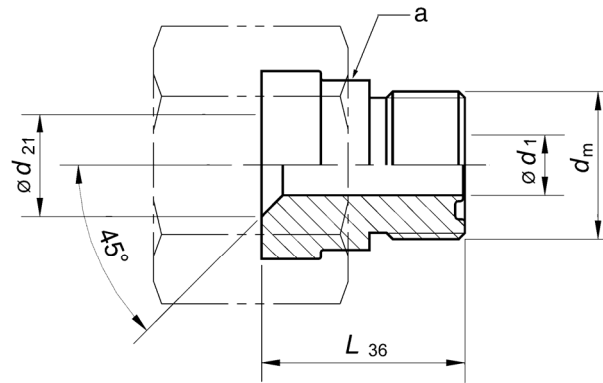


FIGURE 42 - REDUCER WITHOUT NUT
(520123)
REFER TO TABLE 23

NOTE: For dimensions not shown see SAE J1453-1.

a. For use with tube nut 520110A

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TABLE 23 - DIMENSIONS FOR FACE SEAL REDUCER WITHOUT NUT

Dimensions in millimeters (mm)

Ordering Size ⁽¹⁾ Code		d ⁽²⁾ m	d ₁ ref.	d ₂₁ ref.	L ₃₆ ref.
Female ORFS	Male ORFS	Thread			
5 - 4		9/16-18	4.5	5.5	17
8 - 4		9/16-18	4.5	9.5	22
8 - 5		5/8-18	5.5	9.5	22
10 - 4		9/16-18	4.5	12.5	23
10 - 5		5/8-18	5.5	12.5	23
10 - 6		11/16-16	6.5	12.5	24
10 - 8		13/16-16	9.5	12.5	25.5
12 - 4		9/16-18	4.5	15.5	25
12 - 5		5/8-18	5.5	15.5	25
12 - 6		11/16-18	6.5	15.5	26
12 - 8		13/16-16	9.5	15.5	27.5
14 - 5		5/8-18	5.5	18	25
14 - 6		11/16-16	6.5	18	26
14 - 8		13/16-16	9.5	18	27.5
14 - 10		1-14	12.5	18	29.5
16 - 8		13/16-16	9.5	20.5	29
16 - 10		1-14	12.5	20.5	32
20 - 12		1-3/16-12	15.5	26	33.5
20 - 14		1-5/16-12	18.0	26	34
24 - 14		1-5/16-12	18.0	32	34
24 - 16		1-7/16-12	20.5	32	34
24 - 20		1-11/16-12	26.0	32	34

1. The dash size symbol applicable to all tube ends and straight thread O-ring boss ends shall consist of the number of sixteenth inch increments contained in the outside diameter of the tubing (nominal) OD or inside diameter of the hose (nominal hose ID). For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size or hose, or corresponding port.
2. See SAE J1453-1 Screw Thread Specifications.

APPENDIX A - INSTRUCTIONS AND EXAMPLES FOR CALCULATING THE DIMENSIONS FOR SPECIAL SIZE (JUMP) CONNECTORS

A.1 SCOPE

A.1.1 Purpose

Appendix A explains how to calculate the special size (jump) connector dimensions using the factors in Appendix B. The reduction factors and examples are explained using inch connectors.

A.2 DEFINITIONS

A.2.1 Definitions

For this part of SAE J1453, the definitions given in ISO 5598 and SAE J1453-1 shall apply.

A.2.1.1 Special (Jump) size

A special size (jump) connector is one where the end sizes are not equal, that is they either do not have the same tube size and/or commonly paired (equal) end sizes.

Table A1 list the paired (standard) Port Stud Ends to Face Seal connections for inch and metric stud ends for a given tube or hose ID.

A.2.1.2 Nonpreferred

Parts which are low volume, considered specials or nonstandard and the use of which requires special consideration. Dimensions for nonpreferred connectors are given to provide standardization within the industry. A majority of special size (jump) connectors are nonpreferred and carry a higher cost due to low volumes.

TABLE A1 - STANDARD PART SIZE FOR TUBE AND/OR STUD SIZE CONNECTIONS

Dash Size	Nominal Tube OD or Hose ID			Port Stud Ends		Face Seal
	Inch in	mm	Metric mm	SAE J1926-2 (ISO 11926-2)	ISO 6149-2	ISO 8434-3 SAE J1453
				Thread in	Thread mm	Thread in
- 2	0.125	3.18	4	5/16-24	M8X1	
- 3	0.188	4.76	5	3/8-24	M10X1	
- 4	0.250	6.35	6	7/16-20	M12X1.5	9/16-18
- 5	0.312	7.94	8	1/2-20	M14X1.5	5/8-18
- 6	0.375	9.52	10	9/16-18	M16X1.5	11/16-16
- 8	0.500	12.70	12	3/4-16	M18X1.5	13/16-16
-10	0.625	15.88	16	7/8-14	M22X1.5	1-14
-12	0.750	19.05	20	1-1/16-12	M27X2	1-3/16-12
-14	0.875	22.22	22	1-3/16-12	M30X2	1-5/16-12
-16	1.000	25.40	25	1-5/16-12	M33X2	1-7/16-12
-20	1.250	31.75	30	1-5/8-12	M42X2	1-11/16-12
-24	1.500	38.10	38	1-7/8-12	M48X2	2-12
-32	2.000	50.80	50	2-1/2-12	M60X2	

A.3 INSTRUCTIONS ON HOW TO CALCULATE DIMENSIONS ON SPECIAL SIZE CONNECTORS

- A.3.1 Appendix B contains tables with various factors or length dimensions to be used in determining the connector dimensions for special size combination connectors (reduction or enlarging) not contained in SAE J1453-3.
- A.3.2 No factors are given for certain multiple jump (over two jump sizes) connectors. When specifying these jump connectors consult the manufacturer for availability.
- A.3.3 For any nonstandard size connector (a connector where the tube ends are not the same, for example: (6,-6,-4), be it a straight, 45 degrees or 90 degrees elbow, tee or cross, one end is always standard conforming to SAE J1453 dimensions. Considering this to be the largest end of the connector, it may then be used as a basis for establishing the stock size and length (either overall or end to center) for all other parts by subtracting the factors equivalent to the reduction in machining requirements from the appropriate standard lengths. The factors applicable to various end configurations and size reductions tabulated in Appendix B were determined on this basis.

The factors applicable to various end configurations and size reductions tabulated in this appendix were determined on the following basis:

- Length dimensions were derived by maintaining the standard hexagon thickness for straight union connectors, and the standard centerline to start of machining point for shaped connectors as seen in Figures A1 and A2. For straight stud connectors the total width of hex and the identification collar (ring) for the larger sizes is held constant.
- Factors given in Tables B1, B3 and B5 were derived by subtracting the standard machining length required for the smaller end from that required for the larger standard end and rounding the result to the nearest half millimeter.
- The factors given in Tables B2 and B4 were derived by subtracting the standard machining length (minimum full thread length, with thread run out, plus an allowance of 1-1/2 pitches for imperfect thread length) required for the smaller end from the same value required for the larger end and rounding the result to nearest half millimeter (see Figure A1).

A.3.4 Basis for Calculating a Reduced Stud End or a Reduced Tube End for Connectors

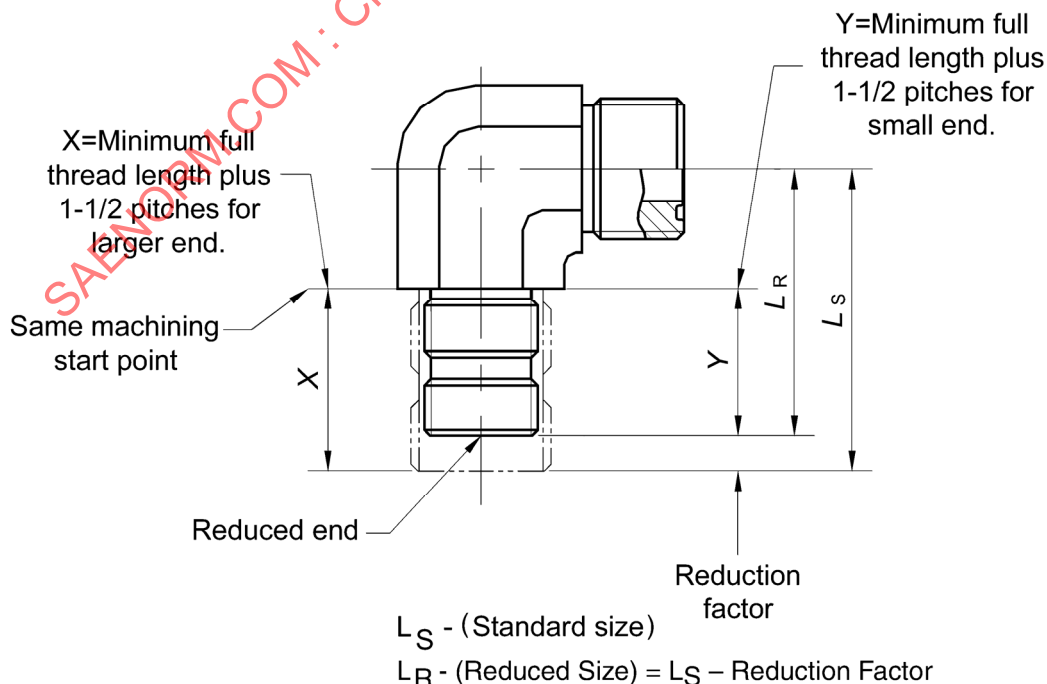


FIGURE A1 - STUD END REDUCTION

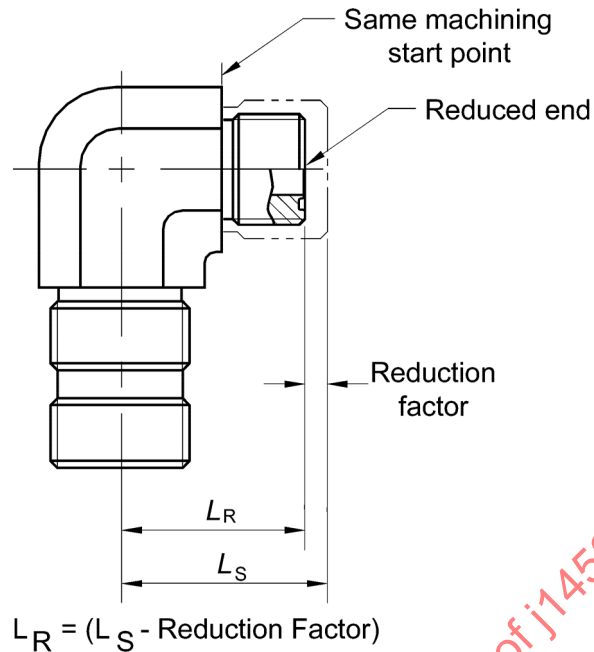


FIGURE A2 - TUBE END REDUCTION

A.3.5 Drill Passages

At manufacturer's option, drill through passages in straight special size (jump) connectors may conform to the smaller diameter specified for up to two step size differences, or conform to one of the following for any size difference:

- The appropriate end may be countersunk to the larger diameter, or
- The appropriate end may be drilled to the larger diameter up to the middle of the hex.

A.3.6 Tolerances

The following tolerances apply to special size (jump) connectors:

- Overall length of straight connectors = ± 0.8 mm
- Centerline to end on shaped connectors = ± 1.5 mm

A.4 EXAMPLES—JUMP CONNECTOR CALCULATIONS

A.4.1 Straight Thread Connector Short - (520120)

ORFS End > O-ring Stud End - See Figure A3 and Table 14 for standard connector dimensions.

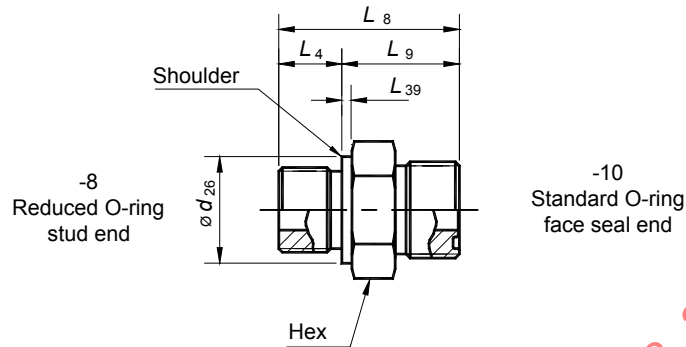


FIGURE A3 - STUD STRAIGHT CONNECTOR WITH REDUCED O-RING STUD END
(520120)
REFER TO TABLE B2

EXAMPLE: -10 ORFS and -8 O-ring stud end - (How factors in Table B2 are used.)

Read length L_9 in Table B2 for -10 = 31.2 mm and read Hex from Table B2 = 26.99 mm.

Note, the hex is determined by the largest end diameter to machine the connector.

Also, note a shoulder is required since the port spotface diameter, 30 mm, is less than the hex size across corners, calculated to be 36.03 mm.

Read L_{39} and d_{26} dimensions from Table B2 for the -8 stud end, $L_{39} = 5.6$ mm, and $d_{26} = 23.9$ mm.

All remaining dimensions conform to the face seal end size for -10 shown in SAE J1453-1 or conform to the stud end standard, SAE J1926-2 for -8.

To calculate L_8 , add the stud end length for -8 found in SAE J1926-2, and provided for reference in Table B2, to L_9 , therefore, $L_8 = 31.2 + 14 = 45.2$ mm. Tolerances for the standard dimensional specifications apply.

NOTE: See Table B2 footnote for long connector jump factors.

A.4.2 Straight Thread Connector Short - (520120)

O-ring Stud End > ORFS End - See Figure A4 and Tables 14 and B1.

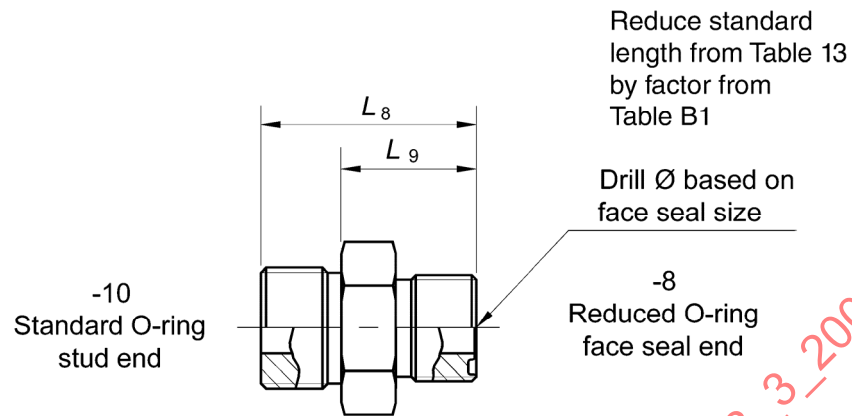


FIGURE A4 - STUD STRAIGHT CONNECTOR WITH REDUCED FACE SEAL END (520120)

EXAMPLE: -10 O-ring boss end and -8 O-ring face seal end - (Factors from Table B1)

Read dimensions given for -10 ORFS in Table 14 even though the ORFS end is -8.

-10 is the largest end and the connector (thread size is larger, 7/8-14 versus 13/16-16 for -8 ORFS) will be manufactured from this stock size.

Read dimension L_8 from Table 14 for size 10-10 = 43 mm.

Since the connector has a -8 ORFS end, using Table 14, subtract the factor 2.8 mm from 43 mm, thus the revised $L_8 = 43 - 2.8 = 40.20$ mm, and $L_9 = 27 - 2.8 = 24.2$ mm.

A.4.3 90 Degree Elbow - (520220)

O-ring Face Seal End > O-ring Stud End - See Figure A5 and Tables 12 and B4.

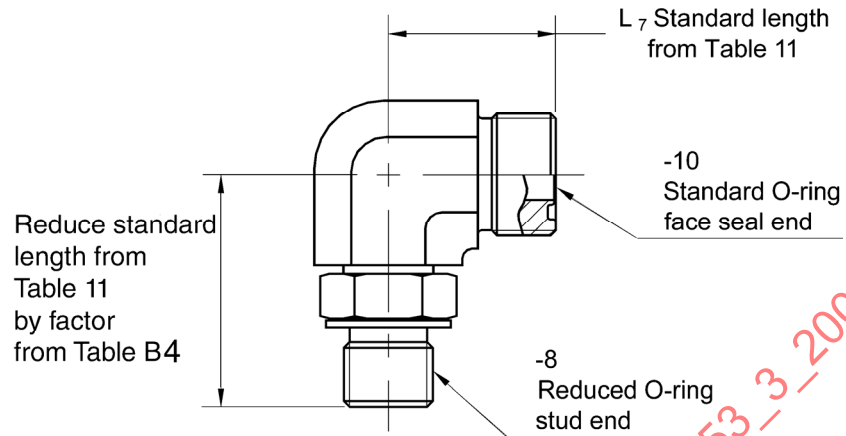


FIGURE A5 - SHAPED FACE SEAL CONNECTOR WITH REDUCED O-RING STUD END (520220)

EXAMPLE: -10 O-ring face seal end and -8 O-ring boss end -

Read dimension for size 10-10 ORFS, $L_{10} = 50.0$ mm from Table 12.

From Table B4 read the reduction factor of 4.3 mm.

Subtract 4.3 mm from 50 mm length, thus the adjusted drop length $L_{10} = 45.70$ mm.

For the adjusted L_{11} length, use Table B4, thus the adjusted $L_{11} = 34 - 4.3 = 29.7$ mm.

All remaining dimensions for the face seal end are per SAE J1453-1, and the stud end dimensions are per SAE J1926-2.

A.4.4 90 Degree Elbow - (520220)

O-ring Stud End > O-ring Face Seal End - See Figure A6 and Tables 12 and B3.

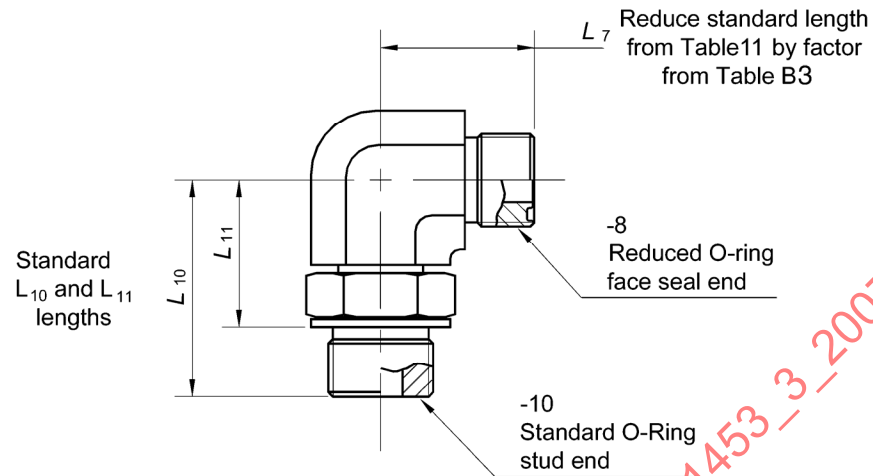


FIGURE A6 - SHAPED FACE SEAL CONNECTOR WITH REDUCED FACE SEAL END (520220)

EXAMPLE: -10 O-ring stud end and -8 O-ring face seal -

The O-ring stud end is the standard end of the connector, and L_{10} and L_{11} come from Table 12.

L_7 dimension must be adjusted since the O-ring face seal is a -8 end.

Read from Table 12 L_7 for size 10-10 = 33.5 mm and read from Table B3 the reduction factor of 2 mm.

Adjusted $L_7 = 33.5 - 2 = 31.5$ mm.

All remaining dimensions for the face seal end are per SAE J1453-1, and the stud end dimensions come from SAE J1926-2.

APPENDIX B - REDUCTION FACTOR TABLES FOR JUMP FITTINGS

B.1 SCOPE

Appendix B provides metric, rounded reduction factors for jump fittings in agreement with ISO 8434-3 and SAE J1453-2. It also includes additional jump factors for non-preferred multiple jumps. These factors are provided for standardization within the industry.

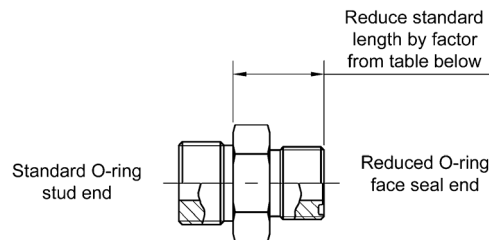


FIGURE B1 - STUD STRAIGHT CONNECTOR WITH REDUCED O-RING FACE SEAL END
(520120)

REFER TO TABLE B1

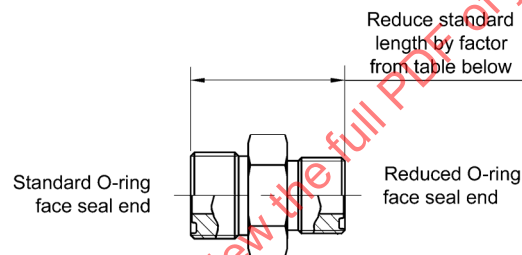


FIGURE B2 - REDUCER UNION
(520101)

REFER TO TABLE B1

TABLE B1 - REDUCTION FACTORS FOR STRAIGHT CONNECTORS WITH SMALLER
O-RING FACE SEAL END⁽¹⁾

Dimensions in millimeters (mm)
Standard Machining Size (Largest End of Connector)

Dash Size Small ORFS End	Nominal Tube OD Small ORFS End	-5 7.92	-6 9.52	-8 12.70	-10 15.88	-12 19.05	-14 22.22	-16 25.40	-20 31.75	-24 38.10
-4	6.35	0	1	3	5.5	7	7.5	7.5 ⁽³⁾	7.5 ⁽³⁾	7.5 ⁽³⁾
-5	7.92		1	3	5.5	7	7.5	7.5 ⁽³⁾	7.5 ⁽³⁾	7.5 ⁽³⁾
-6	9.52			2	4.5	6	6.5	6.5	6.5 ⁽³⁾	6.5 ⁽³⁾
-8	12.70				2.5	4	4.5	4.5	4.5	4.5 ⁽³⁾
-10	15.88					1.5	2	2	2	2
-12	19.05			SEE NOTE ⁽²⁾			0.5	0.5	0.5	0.5
-14	22.22							0	0	0
-16	25.40								0	0
-20	31.75									0
-24	38.10									0
Minimum Stud Hex		15.88	17.46	22.23	25.4	31.75	34.93	38.1	47.63	53.98
Minimum Union Hex		17.46	19.05	22.23	26.99	31.75	34.90	38.10	44.45	53.98

1. To be used when nominal tube OD of at least one face seal end is smaller than the nominal tube OD or O-ring boss of the other end.
2. No factor required for connector with same end sizes. For stud connectors with O-ring face seal end larger than other end, see Table B2.
3. These jump sizes are not preferred.

NOTES: For any nonstandard size connector, be it a straight, 45 or 90 degree elbow, tee, or cross, one end is always standard. Considering this to be the largest end on the connector, it may then be used as a basis of establishing the stocksize and length (either overall or end to center) for all other ends by deducting the previous factors equivalent to the reduction in machining requirements from the appropriate standard lengths shown for a nonreduction (no jump) connector. See Appendix A for more information on calculating the reduction sizes for connector.