SURFACE VEHICLE RECOMMENDED PRACTICE

J1453-2 APR2015

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Superseding J1453-2 MAY2013

(R) Specification for O-Ring Face Seal Connectors: Part 2 - Requirements, Dimensions, and Tests for Steel Unions, Bulkheads, Swivels, Braze Sleeves, Braze-on Tube Ends, Caps, and Connectors with ISO 6149-2 Metric Stud Ends and ISO 6162 4-Bolt Flange Heads

RATIONALE

SAE J1453-2 art was revised for the following figures due to faint or missing lines (Figures 14A, 14B, 41, 42A, 42B) and to agree more closely to International Standards style format for the following Figures: 44A through 50.

Additionally, Figures 44A thru 46B were redimensioned to the International Standards style of short, medium and long for drop dimensions.

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 with ISO 6149-2 metric stud ends. This revision of SAE J1453-2 adopts the parts covered within ISO 8434-3, the rationalized dimensions from ISO 8434-3 for metric stud end face seal connectors and three additional configurations listed above in rationale. 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 Tests

2. SAE J1453-2 - Specifications for O-ring Face Seal Connectors - Part 2: Requirements, Dimensions and Tests for Steel Unions, Bulkheads, Swivels, Braze Sleeves, Braze-on Connectors Caps, 4-bolt to ORFS Flange Head Connectors and Connectors with ISO 6149-2, Metric Stud Ends.

   This document will become increasingly more important as the use of metric base connectors increases. When metric hex option for connectors was added to J1453-3, this document was referenced for all connectors other than those with SAE J1926-2 inch thread 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 Sleeves, Caps, and Connectors with SAE J1926 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. Parts supplied to SAE J1453 JUN2002 shall now be supplied to SAE J1453-3.

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

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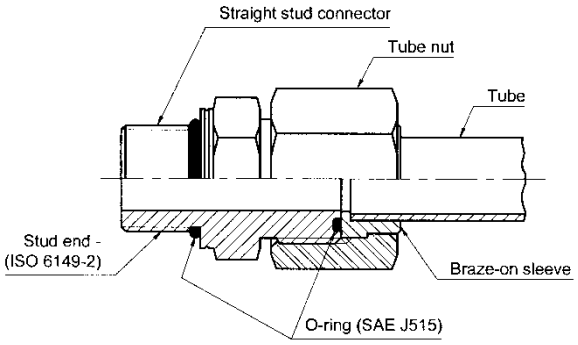

Figure 1 - Typical Representation of O-ring face seal (ORFS) connection (See SAE J1453-3 for SAE J1926-2 inch stud end parts.)

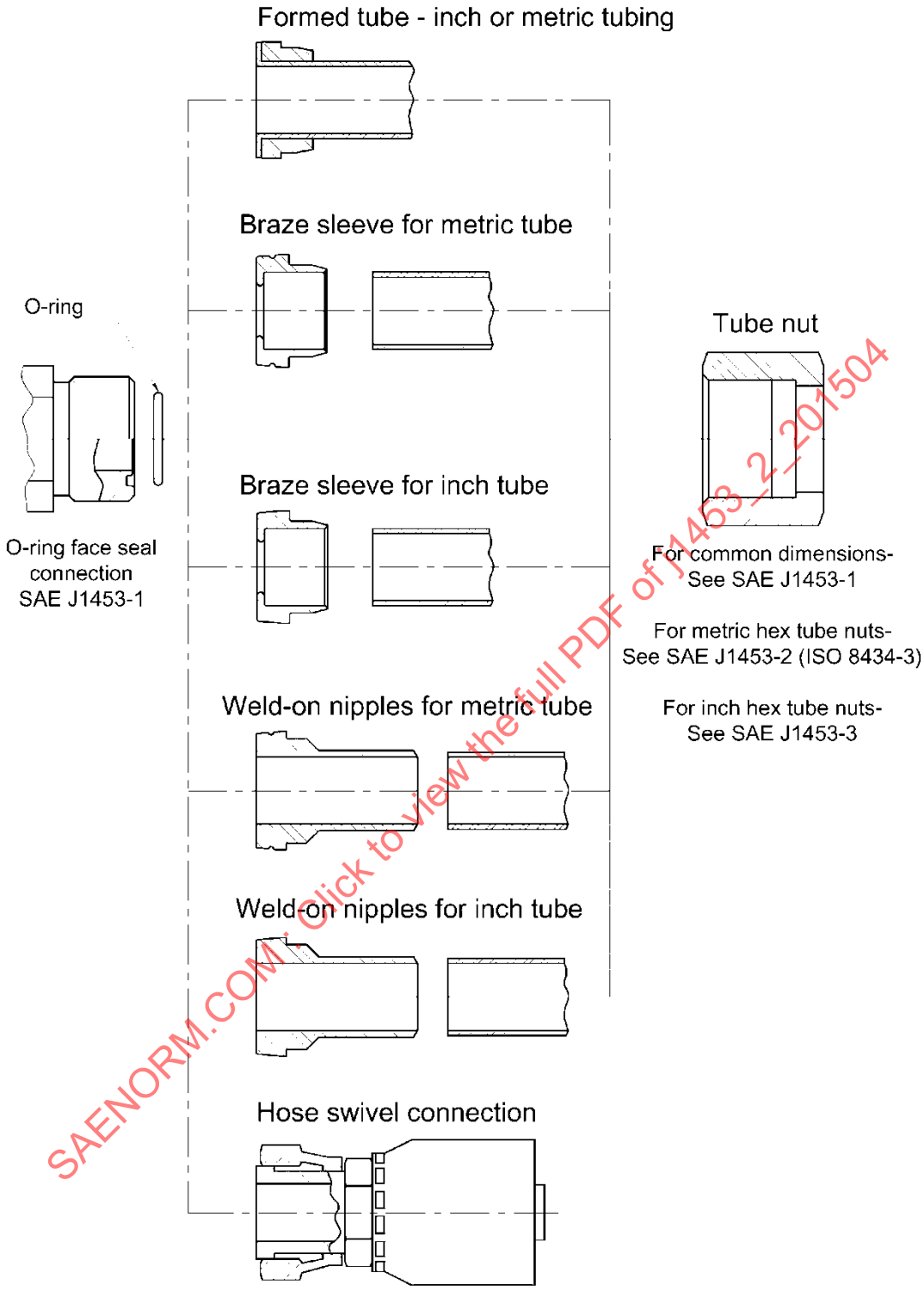

Figure 2 - Typical O-Ring face seal connection to inch or metric tubing or hose

Table 1 - 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 SAE J1453-2 and ISO 6149-2 take precedence)

Nominal Metric Tube OD[1] mm	Inch Tube OD or Hose ID Dash Size[1]	Nominal Inch Tube OD mm	O-Ring Face Seal End Thread[2] In	O-Ring Face Seal and Swivel End Tube Nut Hex mm	O-Ring Face Seal End Qualification Test[3] Torque N·m	Port Stud End ISO 6149-2 Thread mm[5]	Port Stud End ISO 6149-2 Nut Hex mm	Port Stud End ISO 6149-2 Qualification Test Torque[3] N·m	Connector Working Pressure, Face Seal[4] and Nonadjustable Stud End MPa	Connector Working Pressure, Adjustable Stud End MPa
6	– 4	6.35	9/16-18	17	25	M12X1.5	17	35	63	40
8	– 5	7.94	5/8-18	19	30	M14X1.5	19	45	63	40
10	– 6	9.52	11/16-16	22	40	M16X1.5	22	55	63	40
12	– 8	12.70	13/16-16	24	55	M18X1.5	24	70	63	40
16	–10	15.88	1-14	30	60	M22X1.5	27	100	40	40
20	–12	19.05	1-3/16-12	36	90	M27X2	32	170	40	40
22	–14	22.23	1-5/16-12	41	115	M30X2	36	235	40	35
25	–16	25.40	1-7/16-12	41	125	M33X2	41	310	40	35
30	–20	31.75	1-11/16-12	50	170	M42X2	50	330	25	25
38	–24	38.10	2-12	60	200	M48X2	55	420	25	20

1. The size symbol for all tube sizes shall be the tube OD or nominal hose ID in millimeters, except dash size symbols may be used for braze sleeve and weld nipple for inch tubing.
2. See SAE J1453-1 for Screw Thread Specifications.
3. Torque values listed in Table 1 are for controlled testing to established compliance to the performance requirements set forth in Part 2. Recommended assembly torques by manufacturers can vary from Table 5.
4. This covers unions, caps, bulkheads and swivels.
5. Screw threads on the port end of the connectors shall be metric per ISO 261.

Table 2 - 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 Tube OD Inch Dash Size[1]	Nominal Inch Tube OD in	Nominal Inch Tube OD mm	Nominal Metric Tube OD mm	O-Ring Face Seal End Thread[2] in ref.	O-Ring Face Seal and Swivel 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) Thread[3] in ref.	Port Stud End SAE J1926-2 (ISO 11926-2) Adjustable Inch Nut Hex in	Port Stud End SAE J1926-2 (ISO 11926-2) Qualification[3] Test Torque N·m	Connector Working Pressure[4], Face Seal and Nonadjust-able Stud End MPa	Connector Working Pressure, Adjustable Stud End MPa
– 4	0.250	6.35	6	9/16-18	11/16	25	7/16-20	5/8	20[5]	63	41.3
– 5	0.312	7.94	8	5/8-18	3/4	30	1/2-20	11/16	40	63	41.3
– 6	0.375	9.52	10	11/16-16	13/16	40	9/16-18	3/4	45	63	41.3
– 8	0.500	12.70	12	13/16-16	15/16	55	3/4-16	15/16	85	63	41.3
–10	0.625	15.88	16	1-14	1-1/8	60	7/8-14	1-1/16	100	41.3	41.3
–12	0.750	19.05	20	1-3/16-12	1-3/8	90	1-1/16-12	1-3/8	170	41.3	41.3
–14	0.875	22.22	22	1-5/16-12	1-1/2	115	1-3/16-12	1-1/2	235	41.3	38.0
–16	1.000	25.40	25	1-7/16-12	1-5/8	125	1-5/16-12	1-5/8	270	41.3	34.5
–20	1.250	31.75	30	1-11/16-12	1-7/8	170	1-5/8-12	1-7/8	285	27.5	27.5
–24	1.500	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 for Screw Thread information.
3. Torque values listed in Table 2 are for controlled testing to establish compliance to the performance requirements set forth in Part 3. Recommended assembly torques by manufacturers can 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.

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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 J1453-2 covers the requirements for “metric based” O-ring face seal connectors to metric stud ends along with the associated adapters, bulkhead and union connectors. Metric hex wrenching flats are used throughout this standard.

1.2 Field of Application

These connectors are intended for general application 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 the working pressures shown in Table 3. Since many factors influence the pressure at which a hydraulic system does or does 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.

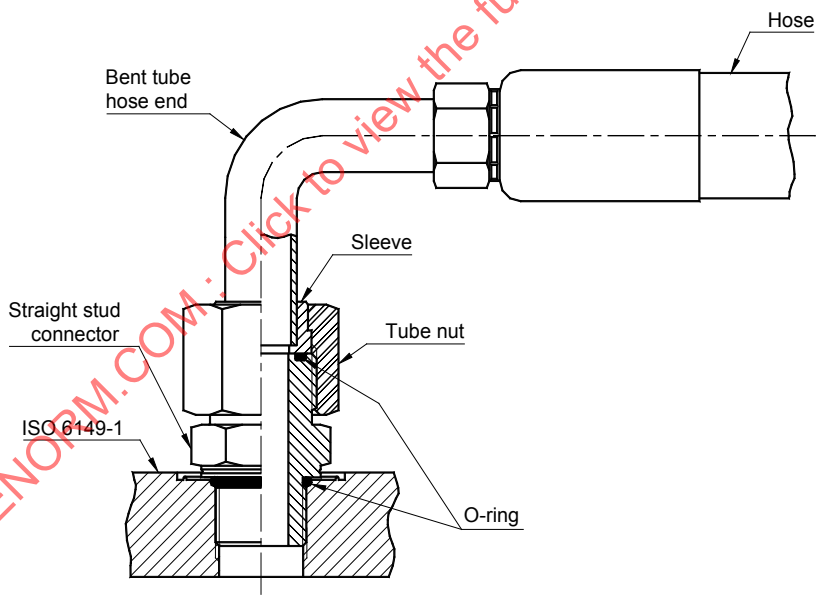


Figure 3 - Typical connection – Non-adjustable connector to hydraulic hose

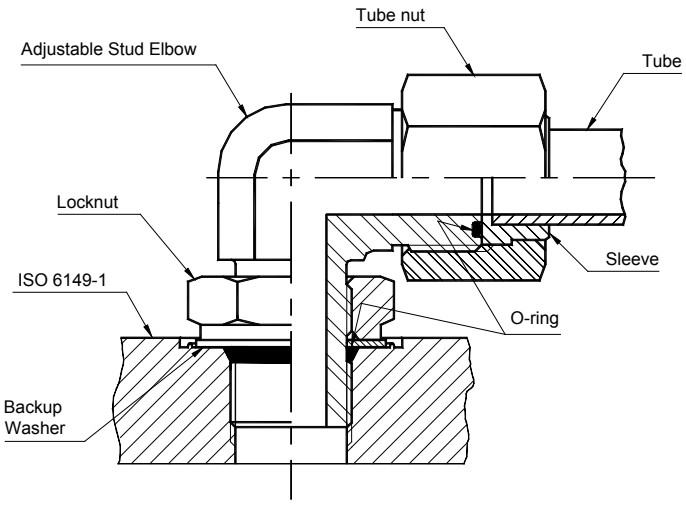


Figure 4 - Typical connection - adjustable style connector to tube

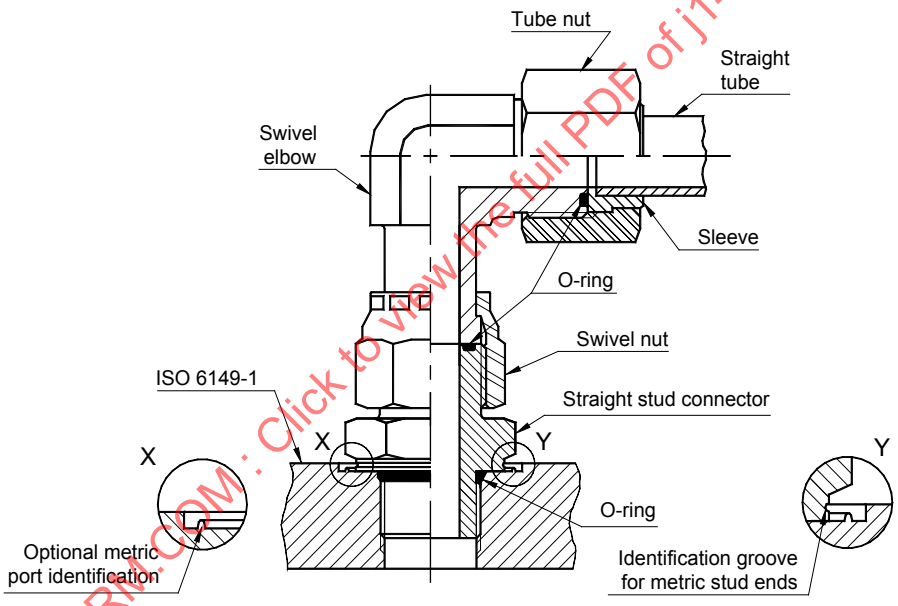


Figure 5 - Typical connection - Straight stud with 90 degree swivel elbow optional configuration to gain full performance rating for 25 mm (–16) at 40 MPa for 38 mm (–24) at 25 MPa

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. For a complete list of all references, see SAE J1453-1.

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 J356 Welded Flash-Controlled Low-Carbon Steel Tubing Normalized for Bending, Double Flaring and Beading

SAE J515 Specification for O-ring Materials Used with Hydraulic Connectors

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 Faring

SAE J846 Coding Systems for Identification of Fluid Conductors and Connectors

SAE J1273 Recommended Practices for Hydraulic Hose Assemblies

SAE J1453-1 Specification for O-Ring Face Seal Connectors: Part 1 - Tube Connection Details and Common Requirements for Performance and Tests

SAE J2593 Information Report for the Installation of Fluid Conductors and Connectors

2.1.2 ISO Publications

Available from American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, Tel: 212-642-4900, www.ansi.org.ISO 68-2ISO general purpose screw threads - Basic profile - Part 2: Inch screw thread

ISO 261 ISO general purpose metric screw threads - General Plan

ISO 19879 Metallic Tube Connections for Fluid Power and General Use - Test Methods for Hydraulic Fluid Power Connectors

ISO 2768-1 General tolerances - Part 1: Tolerances for linear and angular dimensions without individual tolerances indicated

ISO 4759-1 Tolerances for fasteners - Part 1: Bolts, screws and nuts with threaded diameters between 1.6 (inclusive) and 150 mm (inclusive) and product grades A, B. and C

ISO 6149-1 Connections for fluid power and general use - Ports and stud ends with ISO 261 threads and O-ring sealing - Part 1: Port with O-ring seal in truncated housing

ISO 6149-2 Connections for fluid power and general use - Ports and stud ends with ISO 261 threads and O-ring sealing - Part 2: Heavy Duty (S series) stud ends - Dimensions, design, test methods, and requirements

ISO 3304 Plain end seamless precision steel tubes - Technical conditions of delivery

ISO 3305 Plain end welded precision steel tubes

ISO 5598 Fluid power systems and components - Vocabulary

ISO 5864 ISO inch screw thread - Allowances and tolerances

ISO 8434-3 Metallic tube connections for fluid power and general use - Part 3: O-ring face seal connectors

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) Leak proof 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 axially aligned outlets of a tee or cross. See Figure 6.

3.5 BRANCH

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

Figure 6 - Illustration of tee connector showing run and branch

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 Overtorque

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. (From ISO 5598)

3.9 ADJUSTABLE STUD END

A stud end connector that allows for 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 non-preferred parts are given to provide standardization within the industry.

3.13 JUMP SIZE CONNECTOR

Connectors with unpaired end connections, for example, M 14 stud end with 12 mm tube end.

3.14 SIZE DESIGNATION

Connector sizes are designated by the nominal outside diameter of the tubing or nominal inside diameter of hose. See SAE J846 for specific size details.

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 the 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 jump size connectors shall be ±1.5 mm. See SAE J1453-2 Appendix A for procedure to calculate jump size connector dimensions.

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

a. The appropriate end may be countersunk to the larger diameter, or

b. The appropriate end may be drilled to the larger diameter up to the middle of the hex

4.3 Stud End Dimensions

Dimensions for the stud ends shall be in accordance with ISO 6149-2.

4.4 Working Pressure

The connectors, except the 4-bolt flange connectors, shall meet or exceed the working pressures shown in Table 3.

The rated working pressure of the 4-bolt flange connector shall not exceed the lower of the flange and face seal connection working pressure rated values.

The rated working of a hose assembly comprising of SAE J1453-2 connectors and SAE J517 hose shall not exceed the lower of the two working pressure rated values. For additional information, see SAE J1273.

Table 3 - Working pressures for O-Ring face seal connectors

Nominal Metric Tube OD mm	Inch Tube OD Dash Size	Nominal Inch Tube[1] OD mm	Connector Working Pressure[2] Face Seal[3] and Nonadjustable Stud End MPa[4]	Connector Working Pressure[2] Adjustable Stud End MPa[4]
6	– 4	6.35	63	40
8	– 5	7.94	63	40
10	– 6	9.52	63	40
12	– 8	12.70	63	40
16	–10	15.88	40	40
20	–12	19.05	40	40
22	–14	22.23	40	35
25	–16	25.40	40	35
30	–20	31.75	25	25
38	–24	38.10	25	20

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, swivels, bulkheads, plugs, and caps.
4. 1 bar = 10^5 N/m^2 = 10^5 Pa = 0.1 MPa = 14.5 psi. (To convert from MPa to psi multiply by 145, for example, 63 MPa equals 9135 psi.)

4.5 Tube Sizes

Hydraulic tubes used with O-ring face seal connectors shall meet the size requirements shown in Table 4. Carbon steel inch tubes shall comply with SAE J356, SAE J524 or SAE J525. Metric tubes shall comply with ISO 3304 or ISO 3305.

Table 4 - Inch and metric tube size limits

Units in millimeters

Nominal Metric[2] Tube OD	Metric Tube OD min	Metric Tube OD max	Inch Tube OD[1] [2] Dash Size	Nominal Inch Tube OD[3]	Inch Tube OD[4] min	Inch Tube OD[4] max
6	5.9	6.1	– 4	6.35	6.25	6.45
8	7.9	8.1	– 5	7.94	7.84	8.04
10	9.9	10.1	– 6	9.52	9.42	9.62
12	11.9	12.1	– 8	12.70	12.60	12.80
16	15.9	16.1	–10	15.88	15.78	15.98
20	19.9	20.1	–12	19.05	18.95	19.15
22	21.9	22.1	–14	22.23	22.13	22.33
25	24.9	25.1	–16	25.40	25.30	25.50
30	29.85	30.15	–20	31.75	31.60	31.90
38	37.85	38.15	–24	38.10	37.95	38.25

1. Metric tubing shall be considered. See SAE J1453-1 for sleeve dimensions.
2. The size symbol for all tube sizes shall be the tube OD or nominal hose ID in millimeters, except dash size symbols may be used for inch tube and braze sleeve and weld nipple for inch tubing.
3. Equivalent dimension in millimeters.
4. SAE J524 may require sizing to meet these limits for brazing.

4.6 Screw Threads

The screw threads on the stud ends of connectors shall be metric per ISO 261. Face seal end and tube nut shall be manufactured with inch threads (UN/UNF/UNS) per ASME B1.1. See 4.3.8 of SAE J1453-1 for more information.

4.7 Across Flats

The across flat dimensions of elbows, tees, bulkhead, and swivel connectors given in this standard are intended to be for nominal metric 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 24 mm, and +0/–1 for sizes larger than 24 mm. The basic forging size may be increased up to the maximum size shown for barstock, but the size selected shall be a nominal metric wrench size across flats with minus tolerance only.

4.8 Hex Tolerances Across Flats

Hex tolerances across flats shall be according to ISO 4759-1 product grade C. 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.

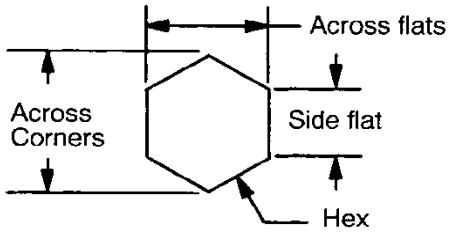


Figure 7 - Hex details

4.9 Hex Chamfer

See SAE J1453-1.

4.10 Plating

See SAE J1453-1.

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 5 when tested at the torques shown in Table 6. Connectors shall pass the burst, cyclic endurance (impulse), vacuum and overtorque tests when tested per ISO 19879.

Torque values listed in Table 6 are for controlled testing to establish compliance to the performance requirements for face seal connectors. Recommended assembly torques by manufacturers can vary from the torques in Table 6.

NOTE: The previous tests shall be conducted on each of the following types and sizes of connectors to ensure overall performance of all configurations: Figure 11A (5201M15A), Figure 13A (52M0110A), Figure 13B (52M0110B), Figure 15 (52M0287), Figure 21 (52M0187), Figure 33 (52M0221), and Figure 40 (52M0112).

Table 5 - Test pressures for O-Ring face seal connectors with ISO 6149-2 stud ends

Units in mega pascals (MPa)[1]

Nominal Metric Tube OD mm	Inch Tube OD or Hose ID Dash Size	Nominal Inch Tube OD mm	Face Seal[2] and Nonadjustable Stud End Connectors Working	Face Seal[2] and Nonadjustable Stud End Connectors Burst	Face Seal[2] and Nonadjustable Stud End Connectors Impulse[3]	Adjustable Stud End Connectors Working	Adjustable Stud End Connectors Burst	Adjustable Stud End Connectors Impulse[3]
6	– 4	6.35	63	252	83.8	40	160	53.2
8	– 5	7.94	63	252	83.8	40	160	53.2
10	– 6	9.52	63	252	83.8	40	160	53.2
12	– 8	12.70	63	252	83.8	40	160	53.2
16	–10	15.88	40	160	53.2	40	160	53.2
20	–12	19.05	40	160	53.2	40	160	53.2
22	–14	22.23	40	160	53.2	35	140	46.6
25	–16	25.40	40	160	53.2	35	140	46.6
30	–20	31.75	25	100	33.2	25	100	33.2
38	–24	38.10	25	100	33.2	20	80	26.6

1. 1 bar = 10^5 N/m^2 = 10^5 Pa = 0.1 MPa = 14.5 psi. (To convert from MPa to psi multiply by 145, for example, 63 MPa equals 9135 psi.)
2. This includes unions, swivels, bulkheads, plugs, and caps.
3. Cyclic endurance test pressure.

Table 6 - Connector qualification test torques

Nominal Metric Tube OD mm	Inch Tube OD or Hose ID Dash Size	Nominal Inch Tube OD mm	Port Stud End Thread ISO 6149-2 mm	Port Stud End Torque[2] ISO 6149-2 +10% 0 N·m	Face Seal End Thread[1] UN/UNF/UNS in	Face Seal End Torque[2] +10% 0 N·m	Face Seal End Overtorque N·m
6	– 4	6.35	M12x1.5	35	9/16-18	25	32
8	– 5	7.94	M14x1.5	45	5/8-18	30	45
10	– 6	9.52	M16x1.5	55	11/16-16	40	54
12	– 8	12.70	M18x1.5	70	13/16-16	55	81
16	–10	15.88	M22x1.5	100	1-14	60	136
20	–12	19.05	M27x2	170	1-3/16-12	90	180
22	–14	22.23	M30x2	235	1-5/16-12	115	230
25	–16	25.40	M33x2	310	1-7/16-12	125	270
30	–20	31.75	M42x2	330	1-11/16-12	170	380
38	–24	38.10	M48x2	420	2-12	200	450
50	–32	50.80	M60x2	500	—	—	—

1. In accordance with ASME B1.1 (ISO 68-2 and ISO 5864).
2. Torque values listed in Table 6 are for controlled testing to established compliance to the performance requirements set forth in Table 3. Recommended assembly torques by manufacturers can vary from Table 6.

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 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:

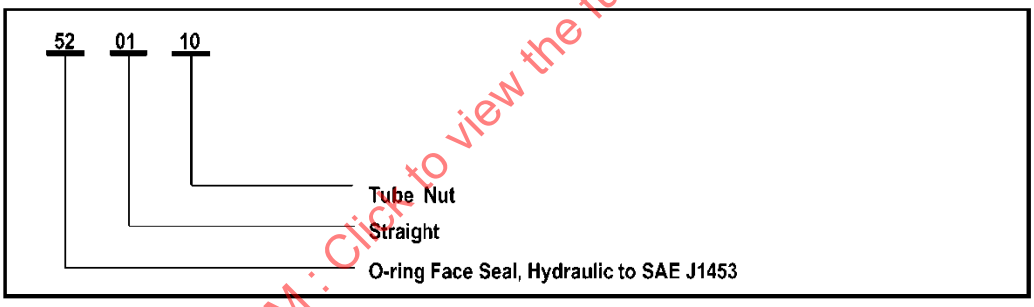


Figure 8 - Connector style designation

6.3.2 Style and Material Modifiers

Modifiers are added to the code to provide additional information. An "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.)

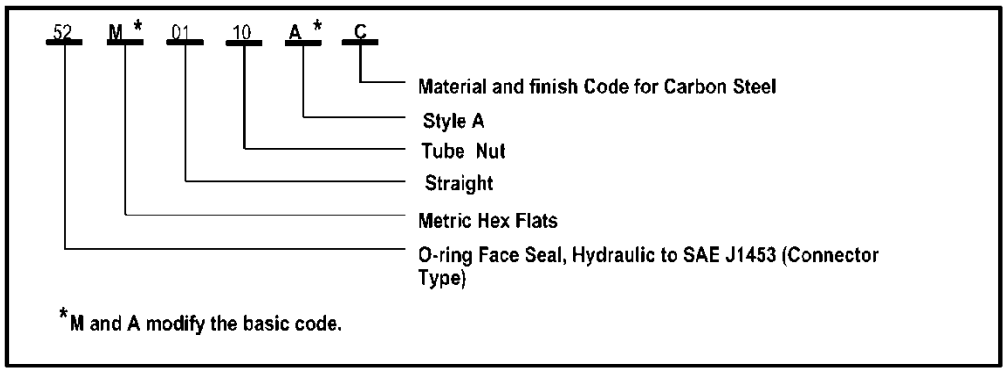


Figure 9 - Connector style and material designation

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 the ISO metric tube sizes: to order a 12 mm size SAE J1453-2 face seal end with a M18 SAE J2244-2 stud end on a straight connector in steel, use the following designation: (NOTE: Metric tubing is assumed unless inch tubing is designated. See Table 1 for the cross-reference between inch dash size designations and ISO metric tube designations.)

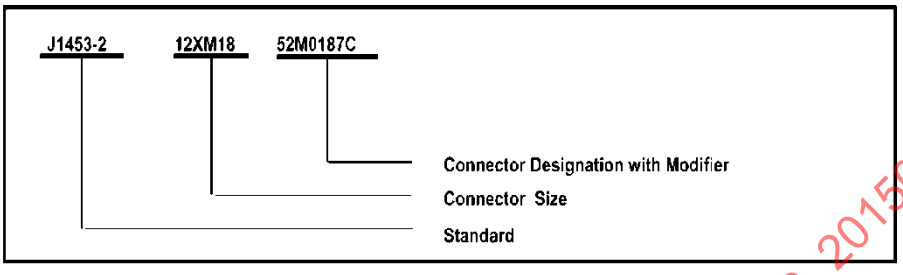


Figure 10 - Connector style, material, and size designation

Table 7 - Examples of part identification

	Connector Description	SAE Part Identification Number
a	To order a size 12 mm (–8) straight connector with a M18 stud end (Figure 21) made from carbon (C) steel:	J1453-2 12xM18 52M0187 C
b	To order a size 25 mm (–16) style A standard tube nut (Figure 13A) made from carbon (C) steel:	J1453-2 25 52M0110A C
c	To order a size 25 mm (–16) swivel elbow connector (Figure 34) made from carbon (C) steel:	J1453-2 25x25 52M0221 C
d	To order a jump bulkhead branch tee connector, size 25 mm (–16) with a size 20 (–12) branch (Figure 28) made from carbon (C) steel:	J1453-2 25x25x20 52M0959 C
e	To order a size 12 mm (–8) Style 'A' sleeve (Figure 11A) for metric tubing made from carbon steel and oil dipped (cx):	J1453-2 12x12 5201M15A CX
f	To order the connector described in 'a' with nitrile O-rings installed on both ends:	J1453-2 12xM18 52M0187 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 J1453-2:

O-ring face seal connectors conform to SAE J1453-2: Specification for O-ring Face Seal Connectors: Part 2—Requirements, Dimensions, and Tests for Steel Unions, Bulkheads, Swivels, Braze Sleeves, Caps and Connectors with ISO 6149-2 Metric Stud Ends.

7.3 Procurement Information

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

a. Description of connector

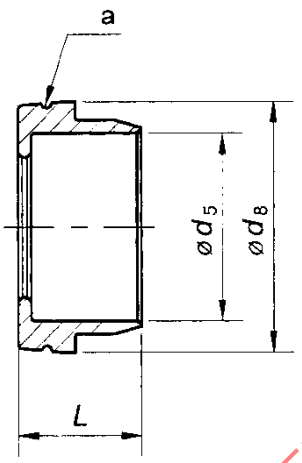
b. Material of connector

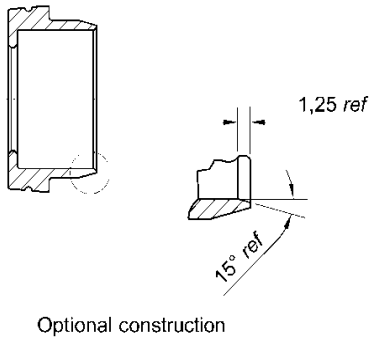
c. Material and size of tube

d. Fluid to be conveyed

e. Working pressure

f. Working temperature





NOTE 1: See SAE J1453-1 for manufacturing dimensions.

a. Identification Groove for Metric Tube Sleeve Only

Figure 11A - Braze-on sleeve, style A (5201M15A)

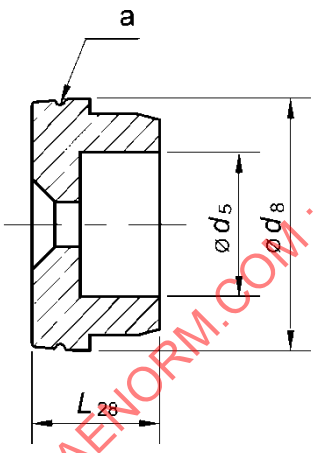
Figure 11B - Braze-on sleeve, style B (5201M15B)

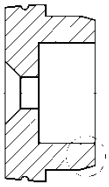
Table 8 - Dimensions of braze-on sleeve for metric and inch tube

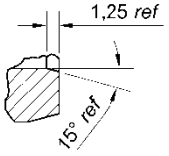
Dimensions in millimeters

Metric Tube Ordering Size Code[5] ORFS Tube Side X Side	Metric Tube OD	d_5 ref.[1] for Metric Tube	Inch Tube Ordering[2][3][5] Size Code ORFS Tube Side—Side	Inch Tube OD[3][4]	d_5 ref.[1] for Inch Tube	d_8 ref.	L ref.
6x6	6	6.15	4-4	6.35	6.5	12.75	9.5
8x8	8	8.15	5-5	7.94	8.09	14.35	9.5
10x10	10	10.15	6-6	9.52	9.68	15.75	9.5
12x12	12	12.15	8-8	12.7	12.85	18.9	9.5
16x16	16	16.15	10-10	15.88	16.03	23.45	10.5
20x20	20	20.18	12-12	19.05	19.23	27.85	14
22x22	22	22.18	14-14	22.23	22.41	31.0	14
25x25	25	25.18	16-16	25.4	25.58	34.2	15.5
30x30	30	30.2	20-20	31.75	31.95	40.55	15.5
38x38	38	38.2	24-24	38.1	38.3	48.5	15.5

1. Actual bore size and depth depends upon joining process. Dimensions given are for silver braze.
2. The ordering size code for inch tube sleeve is based on dash size system as used in SAE J1453-3.
3. Metric tube shall be preferred.
4. Equivalent dimensions in millimeters.
5. The size symbol for all tube sizes shall be the tube OD or nominal hose ID in millimeters, except dash size symbols may be used for braze sleeve and weld nipple for inch tubing.







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

a. Identification groove for metric tube sleeve only.

Figure 12A - Braze-on reducing sleeve, style A (5201M15A)

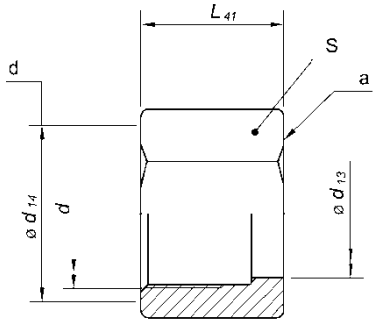
Figure 12B - Braze-on reducing sleeve, style B (5201M15B)

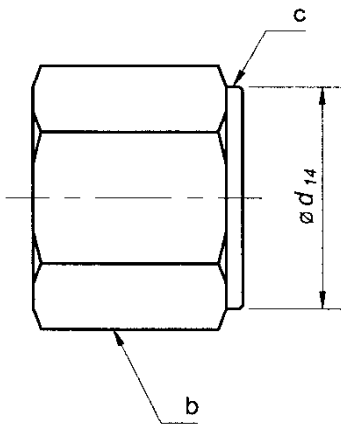
Table 9 - Dimensions of braze-on reducing and expanding sleeve

Dimensions in millimeters

Metric Tube Ordering[5] Size Code ORFS Tube Side X Side	Metric Tube OD	d_5 ref. for Metric Tube[1]	Inch Tube Ordering[2] [5] Size Code ORFS Tube Side—Side	Inch[3][4] Tube OD	d_5[1] ref. for Inch Tube	d_8 ref.	L_{28} ref.
8x6	6	6.15	5-4	6.35	6.5	14.35	10.5
10x6	6	6.15	6-4	6.35	6.5	15.75	10.5
10x8	8	8.15	6-5	7.94	8.09	15.75	10.5
12x6	6	6.15	8-4	6.35	6.5	18.90	12.0
12x8	8	8.15	8-5	7.94	8.09	18.90	12.0
12x10	10	10.15	8-6	9.52	9.68	18.90	12.0
16x6	6	6.15	10-4	6.35	6.5	23.45	13.5
16x8	8	8.15	10-5	7.94	8.09	23.45	13.5
16x10	10	10.15	10-6	9.52	9.68	23.45	13.5
16x12	12	12.15	10-8	12.70	12.85	23.45	13.5
20x6	6	6.15	12-4	6.35	6.5	27.85	14.5
20x8	8	8.15	12-5	7.94	8.09	27.85	14.5
20x10	10	10.15	12-6	9.52	9.68	27.85	14.5
20x12	12	12.15	12-8	12.70	12.85	27.85	14.5
20x16	16	16.15	12-10	15.88	16.03	27.85	15.0
22x8	8	8.15	14-5	7.94	8.09	31.00	14.5
22x10	10	10.15	14-6	9.52	9.68	31.00	14.5
22x12	12	12.15	14-8	12.70	12.85	31.00	14.5
22x16	16	16.15	14-10	15.88	16.03	31.00	15.0
22x20	20	20.18	14-12	19.05	19.23	31.00	18.5
25x12	12	12.15	16-8	12.70	12.85	34.20	15.5
25x16	16	16.15	16-10	15.88	16.03	34.20	16.0
25x20	20	20.18	16-12	19.05	19.23	34.20	17.0
25x22	22	22.18	16-14	22.23	22.4	34.20	17.0

1. Actual bore size and depth depends on joining process; dimensions shown are for silver braze.
2. Ordering size code for inch tube sleeve is based on dash size system as used in SAE J1453-3.
3. Metric tube shall be preferred.
4. Equivalent dimensions in millimeters.
5. The size symbol for all tube sizes shall be the tube OD or nominal hose ID in millimeters, except dash size symbols may be used for braze sleeve and weld nipple for inch tubing.





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

a. Style “A” nut not suitable for copper braze assemblies.
b. Style “B” nut is 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 (52M0110A)

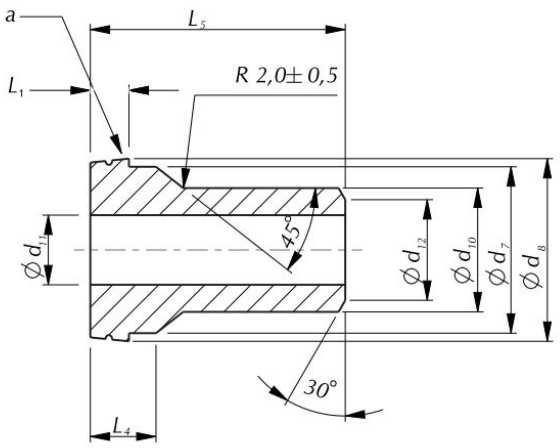
Figure 13B - High strength tube nut, style B (52M0110B)

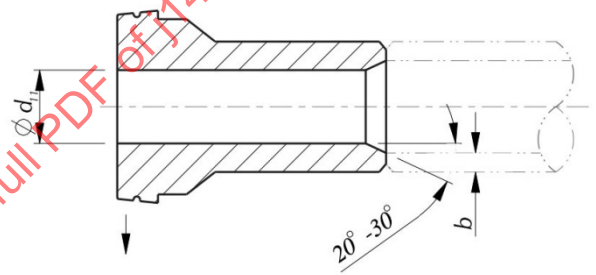
Table 10 - Dimensions of metric hex tube nut

Dimensions in millimeters

Ordering Size Code	Metric(2) Tube OD	Inch Tube OD(2) Dash Size	Nominal Inch Tube OD	d(1) Thread in	d_{13} ref.	d_{14} ±0.3	L_{41} ref.	S(3) Hex
6	6	– 4	6.35	9/16 - 18	10.5	16	15	17
8	8	– 5	7.94	5/8 - 18	12	18	16	19
10	10	– 6	9.52	11/16 - 16	13.55	21	17	22
12	12	– 8	12.70	13/16 - 16	16.6	23	20	24
16	16	–10	15.88	1 - 14	21.1	29	24	30
20	20	–12	19.05	1-3/16 - 12	24.15	34.5	26.5	36
22	22	–14	22.23	1-5/16 - 12	27.3	39.5	26.5	41
25	25	–16	25.40	1-7/16 - 12	29.1	39.5	27.5	41
30	30	–20	31.75	1-11/16-12	36	48.5	27.5	50
38	38	–24	38.10	2 - 12	44	58	27.5	60

1. See 4.6.
2. The size symbol for all tube sizes shall be the tube OD or nominal hose ID in millimeters, except dash size symbols may be used for braze sleeve and weld nipple for inch tubing.
3. Per ISO 4759-1, tolerance class C.





For dimensions not shown, see Braze-on sleeve in SAE J1453-1.

a. Identification Groove for Metric Tube Weld-On Nipple, Centrally located on “L1” Surface, 1.5 Wide x 0.5 Deep Max. Shape Optional.
b. Tube wall transition.

Figure 14A - Weld-on nipple, style A

Figure 14B - Weld-on nipple, style B

Table 11 - Dimensions of weld-on nipples for metric and inch tubing

Ordering[3] Size Code ORFS Tube Side X Side	Nominal Metric Tube OD	Metric Tube Wall Thick-ness[1]	Metric Tube d_{10} ±0.1	Metric Tube d_{11} nom.	Metric Tube d_{11} tol.	Metric Tube d_{12} ±0.3	Ordering[3] Size Code ORFS Tube Side X Side	Inch Tube OD[2] [4]	Inch Tube Wall Thick-ness[1]	Inch Tube d_{10} ±0.1	Inch Tube d_{11} nom.	Inch Tube d_{11} tol.	Inch Tube d_{12} ±0.3	d_7 ±0.1	d_8 ref.	L_1 ±0.15	L_4 ±0.5	L_5 ±0.3
6x6	6	2	6	2	±0.1	4	4-4	6.35	2.11	6.4	2	±0.1	4	10.2	12.75	4	6.5	25
8x8	8	2.5	8	3	±0.1	5	5-5	7.94	2.41	7.9	3	±0.1	5	11.7	14.35	4	6.5	25
10x10	10	3	10	4	±0.1	6	6-6	9.52	2.77	9.5	4	±0.1	6	13.25	15.75	4.5	7.5	26
12x12	12	3.5	12	5	±0.1	7	8-8	12.7	3.76	12.7	5	±0.1	7	16.3	18.9	5	9.5	26
16x16	16	3	16	10	±0.2	12	10-10	15.88	3.05	15.9	10	±0.2	12	20.75	23.45	6	10	32
20x20	20	3.5	20	13	±0.2	15	12-12	19.05	3.76	19	11.5	±0.2	13.5	23.75	27.85	6.5	11.5	37
22x22	22	3	22	16	±0.2	18	14-14	22.23	3.05	22.2	16.1	±0.2	18	26.9	31	6.5	11.5	37
25x25	25	4.5	25	16	±0.2	18	16-16	25.4	4.76	25.4	16	±0.2	18	28.7	34.2	7	13	42
30x30	30	4	30	22	±0.2	24	20-20	31.75	4.76	31.8	22.2	±0.2	24	35.6	40.55	7	13	44
38x38	38	5	38	28	±0.3	30	24-24	38.1	5.59	38.1	27	±0.3	29	43.55	48.5	7	13	49

1. For other wall thicknesses, contact the manufacturer.
2. Equivalent dimensions in millimeters.
3. The size symbol for all tube sizes shall be the tube OD or nominal hose ID in millimeters, except dash size symbols may be used for braze sleeve and weld nipple for inch tubing.
4. Metric tubing is preferred.

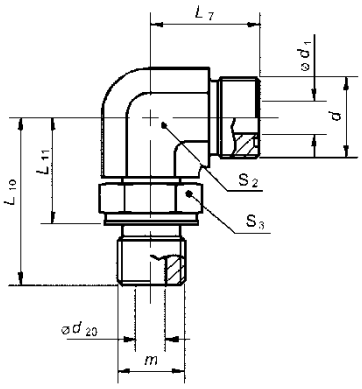


Figure 15 - 90 Degree adjustable stud elbow (52M0287)

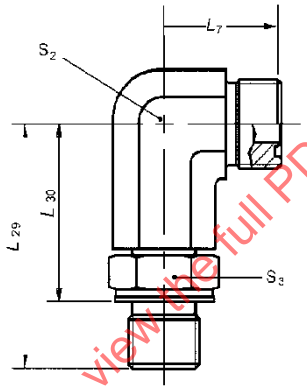


Figure 16 - 90 Degree adjustable stud elbow, long (52M1587)

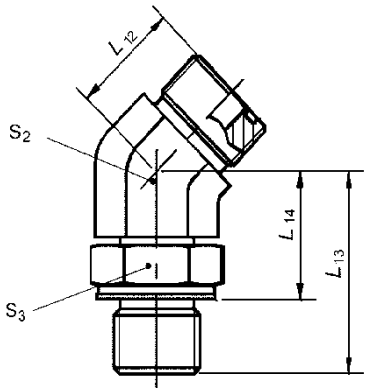


Figure 17 - 45 Degree adjustable stud elbow (52M0387)

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

Table 12 - Dimensions for adjustable stud elbow connectors with ISO 6149-2 stud ends

Dimensions in millimeters

Ordering Size Code	Metric Tube OD	Inch Tube Dash Size	d Thread	m Thread	d_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_{29} ±1	L_{30} ref.	S_2 Forging min	S_2 Barstock max	S_3 Hex
6xM12	6	– 4	9/16-18	M12x1.5	4.5	4	21.5	33	22	16	30	19	56.5	45.5	14	17	17
8xM14	8	– 5	5/8-18	M14x1.5	5.5	6	23.5	35.5	24.5	17.5	31.5	20.5	56.5	45.5	17	22	19
10xM16	10	– 6	11/16-16	M16x1.5	6.5	7	25	37.5	25	19	33.5	21	66.5	54	17	27	22
12xM18	12	– 8	13/16-16	M18x1.5	9.5	9	28	41	27	20.5	37	23	75	61	19	30	24
16xM22	16	–10	1-14	M22x1.5	12.5	12	33.5	49	34	23.5	44	29	88	73	24	36	27
20xM27	20	–12	1-3/16-12	M27x2	15.5	15	37.5	55.5	37	26	50.5	32	100.5	82.5	27	41	32
22xM30	22	–14	1-5/16-12	M30x2	18	17	41.5	59.5	41	30	52.5	34	108	89.5	36	46	36
25xM33	25	–16	1-7/16-12	M33x2	20.5	20	41.5	59.5	41	30	52.5	34	114.5	96	36	46	41
30xM42	30	–20	1-11/16-12	M42x2	26	26	44.5	63	44	32	54	35	126.5	107.5	41	55	50
38xM48	38	–24	2-12	M48x2	32	32	49	71.5	50	37	56.5	35	142	120.5	50	60	55

1. For tolerances, see ISO 6149-2 d_3 dimensions.

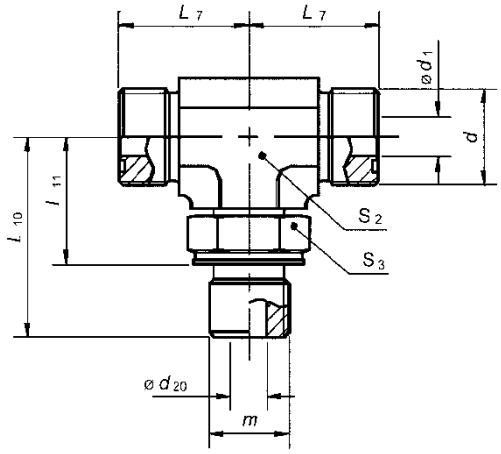


Figure 18 - Adjustable stud branch tee (52M0489)

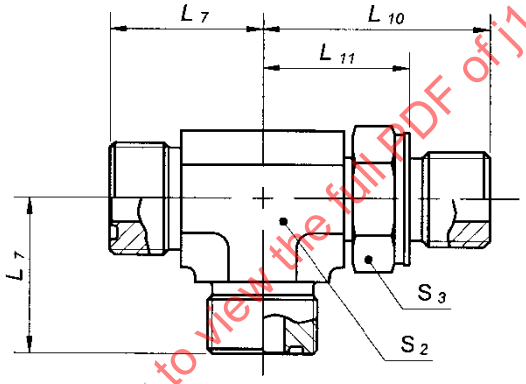


Figure 19 - Adjustable stud run tee (52M0488)

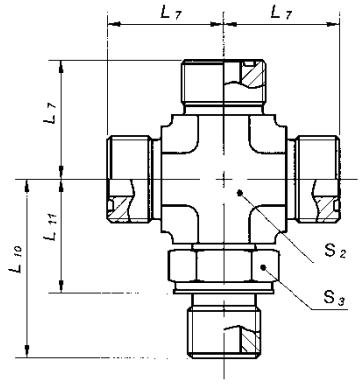


Figure 20 - Adjustable stud cross (52M0587)

Table 13 - Dimensions for adjustable stud branch tee, run tee and cross with ISO 6149-2 stud ends

Dimensions in millimeters

Ordering Size Code[1]	Metric Tube OD	Inch Tube OD Dash Size	d Thread	m ISO 6149-2 Stud End Thread	d_1 ref.	d_{20}[2] ref.	L_7 ref.	L_{10} ref.	L_{11} ref.	S_2 Forging min	S_2 Barstock max	S_3
6x6xM12	6	– 4	9/16-18	M12x1.5	4.5	4	21.5	33	22	14	17	17
8x8xM14	8	– 5	5/8-18	M14x1.5	5.5	6	23.5	35.5	24.5	17	22	19
10x10xM16	10	– 6	11/16-16	M16x1.5	6.5	7	25	37.5	25	17	27	22
12x12xM18	12	– 8	13/16-16	M18x1.5	9.5	9	28	41	27	19	30	24
16x16xM22	16	–10	1-14	M22x1.5	12.5	12	33.5	49	34	24	36	27
20x20xM27	20	–12	1-3/16-12	M27x2	15.5	15	37.5	55.5	37	27	41	32
22x22xM30	22	–14	1-5/16-12	M30x2	18	17	41.5	59.5	41	36	46	36
25x25xM33	25	–16	1-7/16-12	M33x2	20.5	20	41.5	59.5	41	36	46	41
30x30xM42	30	–20	1-11/16-12	M42x2	26	26	44.5	63	44	41	55	50
38x38xM48	38	–24	2-12	M48x2	32	32	49	71.5	50	50	60	55

1. Code given is for branch tee. For run tees and cross, show size using left, right, up, down sequence.
   Examples: Size 6 run tee - 6xM12x6
   Size 6 cross - 6x6x6xM12
2. For tolerances see ISO 6149-2 d_3 dimensions.

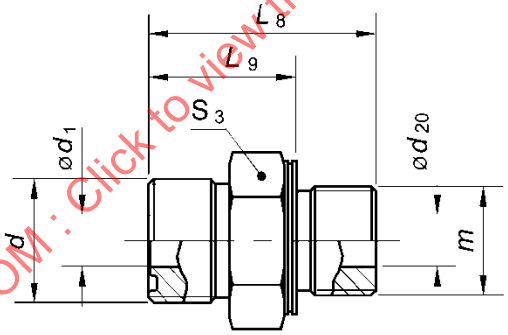


Figure 21 - Stud straight (52M0187)

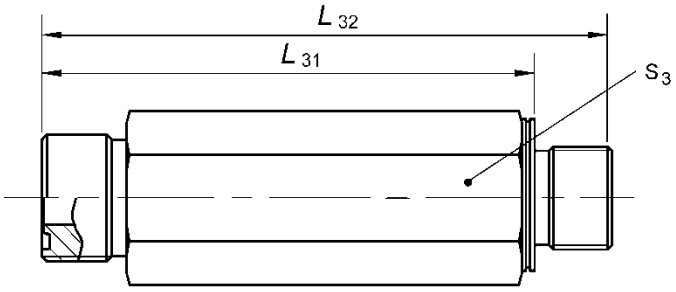


Figure 22 - Stud long - long hex (52M1887)

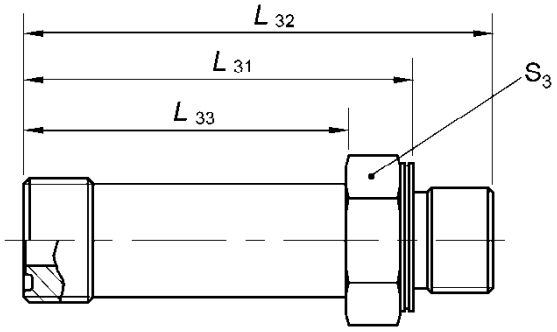


Figure 23 - Stud straight long
(52M1787)

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

Table 14 - Dimensions of straight stud connectors with ISO 6149-2 stud ends

Dimensions in millimeters

Ordering Size Code	Metric Tube OD	Inch Tube OD Dash Size	d Thread	m Thread	d_1(1) ref.	d_{20}(1)(2) ref.	L_8 ±0.8	L_9 ref.	L_{31} ref.	L_{32} ±0.8	L_{33} ±0.8	S_3 Hex
6xM12	6	– 4	9/16-18	M12x1.5	4.5	4	28.5	17.5	41.5	52.5	34	17
8xM14	8	– 5	5/8-18	M14x1.5	5.5	6	29.5	18.5	41.5	52.5	33	19
10xM16	10	– 6	11/16-16	M16x1.5	6.5	7	33.5	21	45.5	58	35.5	22
12xM18	12	– 8	13/16-16	M18x1.5	9.5	9	38	24	54	68	43	24
16xM22	16	–10	1-14	M22x1.5	12.5	12	42	27	63.5	78.5	52	27
20xM27	20	–12	1-3/16-12	M27x2	15.5	15	48.5	30	77	95.5	64	32
22xM30	22	–14	1-5/16-12	M30x2	18	17	50	31.5	81.5	100	67.5	36
25xM33	25	–16	1-7/16-12	M33x2	20.5	20	52	33.5	86.5	105	70.5	41
30xM42	30	–20	1-11/16-12	M42x2	26	26	54.5	35.5	102.5	121.5	84.5	50
38xM48	38	–24	2-12	M48x2	32	32	57	35.5	115	136.5	97	55

1. The smaller of d_1 and d_{20} may go all the way through or with a transition area approximately halfway within the hex.
2. For tolerances see ISO 6149-2 d_3 dimensions.

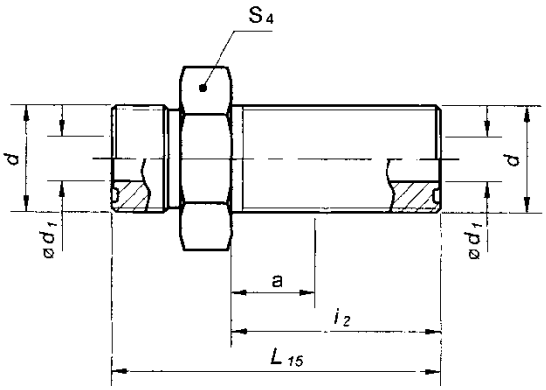


Figure 24 - Bulkhead straight
(52M0601)

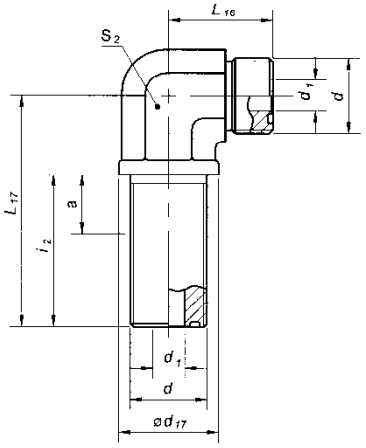


Figure 25 - 90 Degree bulkhead elbow (52M0701)

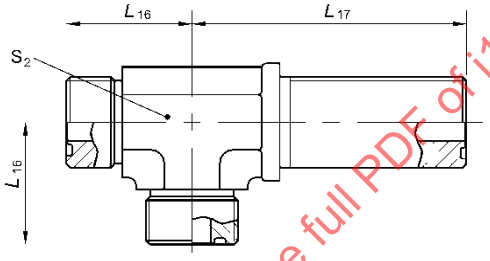


Figure 26 - Bulkhead run tee (52M0958)

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

a. Maximum bulkhead thickness is 14 mm. For minimum thickness, see i_3 and i_4 in SAE J1453-1 Figure 10.

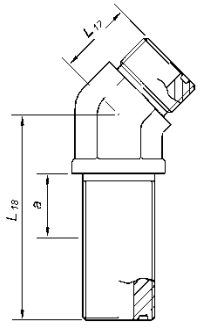


Figure 27 - 45 Degree bulkhead elbow (52M0801)

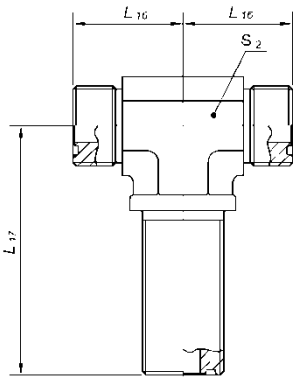


Figure 28 - Bulkhead branch tee (52M0959)

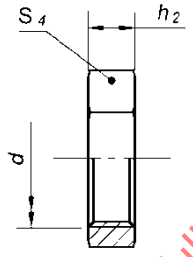


Figure 29 - Bulkhead locknut (52M0118)

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

a. Maximum bulkhead thickness is 14 mm. For minimum bulkhead thickness see i_3 and i_4 in SAE J1453-1 Figure 10.

Table 15 - Dimensions of bulkhead connectors

Dimensions in millimeters

Ordering[1] Size Code	Metric Tube OD	Inch Tube OD Dash Size	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 Barstock max	S_4 Nut Hex
6X6	6	– 4	9/16-18	4.5	16.5	7	31.5	16	48	22.5	47	44	14	17	22
8X8	8	– 5	5/8-18	5.5	19	7	31.5	18	49.5	25	49.5	46	17	22	22
10X10	10	– 6	11/16-16	6.5	21	8	34	19	53	26	52	48.5	17	27	27
12X12	12	– 8	13/16-16	9.5	24.5	9	36.5	20.5	58.5	29	55.5	51	19	30	30
16X16	16	–10	1-14	12.5	29	10.5	40.5	23.5	66.5	34.5	63	56.5	24	36	36
20X20	20	–12	1-3/16-12	15.5	34	10.5	41.5	26	69	38.5	67	60.5	27	41	41
22X22	22	–14	1-5/16-12	18	38	10.5	42	30	70	42.5	71	65	36	46	46
25X25	25	–16	1-7/16-12	20.5	40.5	10.5	42	30	70	42.5	71	65	36	46	46
30X30	30	–20	1-11/16-12	26	46.5	10.5	42	32	70	45.5	75.5	67	41	55	50
38X38	38	–24	2-12	32	54.5	10.5	42	37	70	49.5	79.5	67	50	60	60

1. Add third end size for tees; the ordering sequence is: Left - Right - Up - Down.

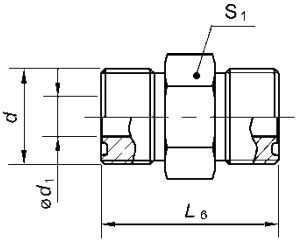


Figure 30 - Union straight
(52M0101)

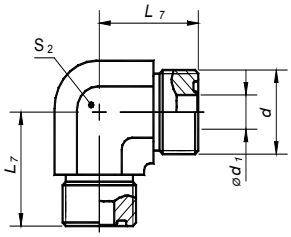


Figure 31 - 90º Union elbow
(52M0201)

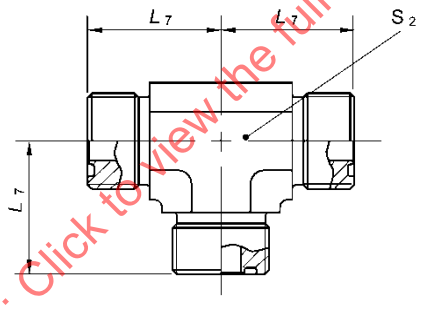


Figure 32 - Union tee
(52M0401)

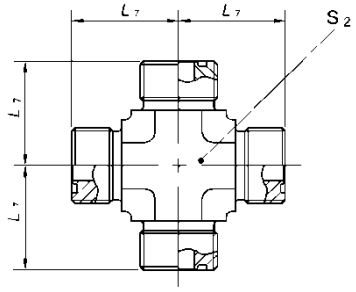


Figure 33 - Union cross
(52M0501)

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

Table 16 - Dimensions for unions

Dimensions in millimeters

Ordering[1] Size Code	Metric Tube OD	Inch Tube OD Dash Size	d Thread	d_1 ref.	L_6 ±0.8	L_7 ref.	S_1 Hex	S_2 Forging min	S_2 Barstock max
6x6	6	– 4	9/16-18	4.5	27.5	21.5	17	14	17
8x8	8	– 5	5/8-18	5.5	29	23.5	19	17	22
10x10	10	– 6	11/16-16	6.5	31	25	19	17	27
12x12	12	– 8	13/16-16	9.5	35.5	28	22	19	30
16x16	16	–10	1-14	12.5	42.5	33.5	27	24	36
20x20	20	–12	1-3/16-12	15.5	47	37.5	32	27	41
22x22	22	–14	1-5/16-12	18	47.5	41.5	36	36	46
25x25	25	–16	1-7/16-12	20.5	49.5	41.5	41	36	46
30x30	30	–20	1-11/16-12	26	51.5	44.5	46	41	55
38x38	38	–24	2-12	32	53	49	55	50	60

1. This code is for straights and elbows. Add additional tube end sizes for the tee and cross, using the sequence Left - Right - Up - Down, for example for a size 10 tee: 10x10x10 and for a size 10 cross 10x10x10x10.

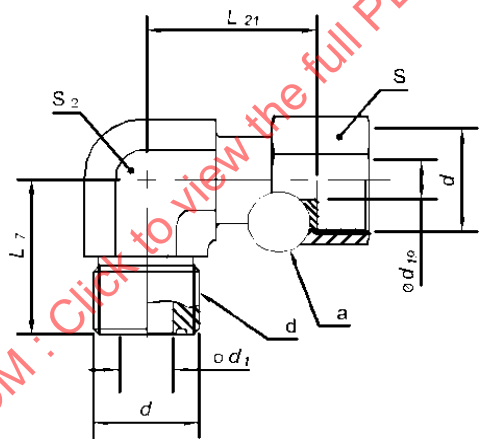


Figure 34 - Swivel 90 degree elbow (52M0221)

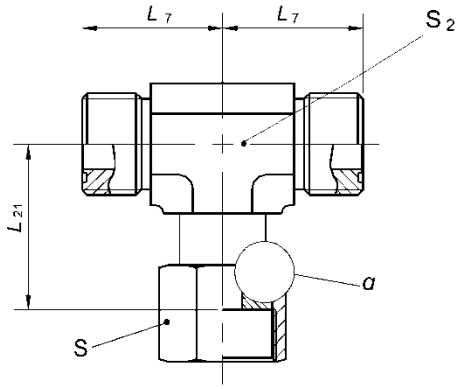


Figure 35 – Swivel branch tee (52M0433)

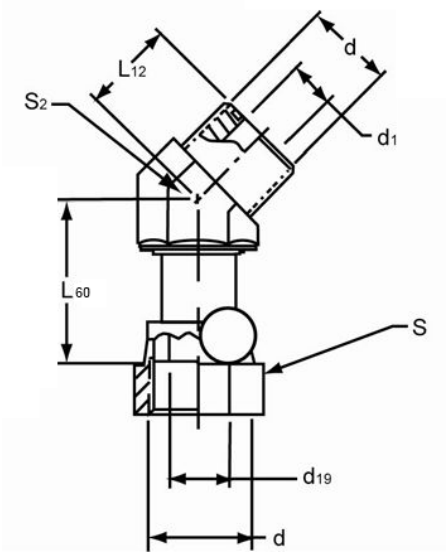


Figure 36 - Swivel 45 degree elbow (52M0321)

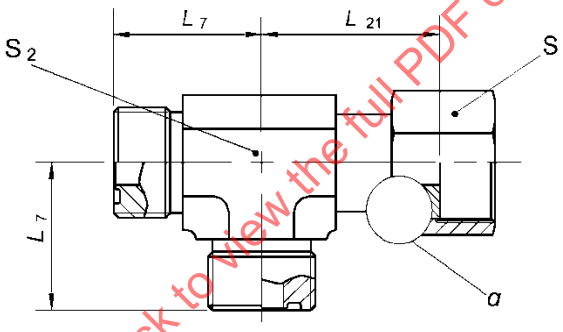


Figure 37 - Swivel run tee (52M0432)

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

a. Method of attachment of swivel nut is optional with the manufacturer.

Table 17 - Dimensions of swivel connectors

Dimensions in millimeters

Ordering Size Code [1]	Metric Tube OD mm	Inch Tube OD Dash Size	d Thread	d_1 ref.	d_{19} ref.	L_7 ref.	L_{12} ref.	L_{21} ±1.5	L_{60} ±1.5	S Hex	S_2 Forging min	S_2 Barstock max
6x6	6	– 4	9/16-18	4.5	4	21.5	16	26.5	25	17	14	19
8x8	8	– 5	5/8-18	5.5	5.5	23.5	18	28	26	19	17	22
10x10	10	– 6	11/16-16	6.5	6.5	25	19	29	28.5	22	17	27
12x12	12	– 8	13/16-16	9.5	9	28	20.5	38	38	24	19	30
16x16	16	–10	1-14	12.5	11.5	33.5	23.5	41	39	30	24	36
20x20	20	–12	1-3/16-12	15.5	14	37.5	26	46.5	44	36	27	41
22x22	22	–14	1-5/16-12	18	18	41.5	30	52.5	46.5	41	36	46
25x25	25	–16	1-7/16-12	20.5	20	41.5	30	53.5	47.5	41	36	50
30x30	30	–20	1-11/16-12	26	26	44.5	32	58	50.5	50	41	60
38x38	38	–24	2-12	32	32	49	37	61	52.5	60	50	65

1. Code given is for elbow. Add additional ends for the tees using the sequence Left - Right - Up - Down: for example for size 10 tee, 52M0432, the ordering code is 10x10x10.

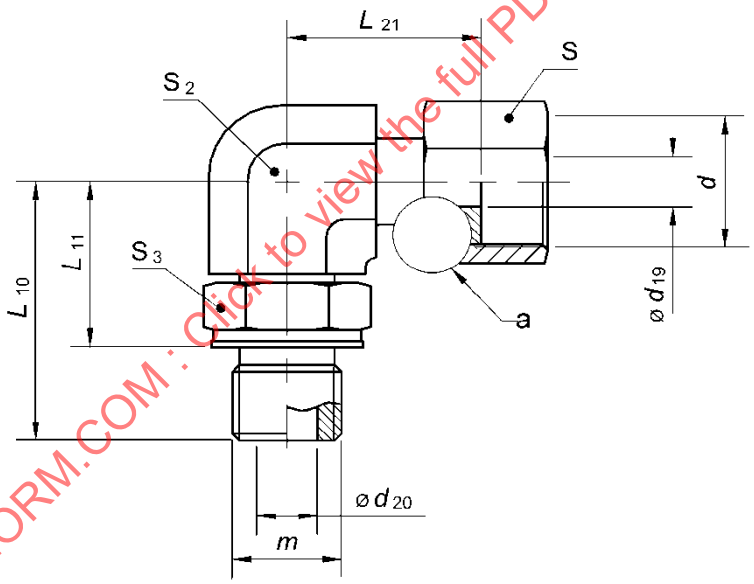


Figure 38 - Swivel 90 degree adjustable stud elbow (52M0296)

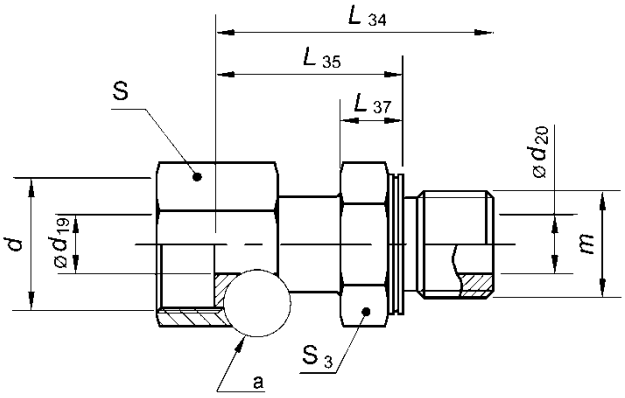


Figure 39 - Stud straight swivel (52M0196)

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

a. Method of attachment of swivel nut is optional with the manufacturer.

Table 18 - Dimensions of swivel stud connectors with ISO 6149-2 stud end

Dimensions in millimeters

Ordering Size Code	Metric Tube OD	Tube OD Dash Size	d Thread	m Thread	d_{19}[1] ref.	d_{20}[2] ref.	L_{10} ref.	L_{11} ref.	L_{21} ref.	L_{34} ±0.8	L_{35} ref.	L_{37} min	S Hex	S_2 Forging min	S_2 Barstock max	S_3 Hex
6xM12	6	– 4	9/16-18	M12x1.5	4	4	33	22	26.5	37	26	7.5	17	14	17	17
8xM14	8	– 5	5/8-18	M14x1.5	5.5	6	35.5	24.5	28	38	27	8.5	19	17	22	19
10xM16	10	– 6	11/16-16	M16x1.5	6.5	7	37.5	25	29	40.5	28	9	22	17	27	22
12xM18	12	– 8	13/16-16	M18x1.5	9	9	41	27	38	49.5	35.5	11	24	19	30	24
16xM22	16	–10	1-14	M22x1.5	11.5	12	49	34	41	53	38	11.5	30	24	36	27
20xM27	20	–12	1-3/16-12	M27x1.5	14	15	55.5	37	46.5	59.5	41	12	36	27	41	32
22xM30	22	–14	1-5/16-12	M30x2	18	17	59.5	41	53.5	63	44.5	14	41	36	41	36
25xM33	25	–16	1-7/16-12	M33x2	20	20	59.5	41	53.5	67.5	49	16	41	36	46	41
30xM42	30	–20	1-11/16-12	M42x2	26	26	63	44	58	68	49	16	50	41	55	50
38xM48	38	–24	2-12	M48x2	32	32	71.5	50	61	70.5	49	16	60	50	60	55

1. For stud straight swivels the smaller of d_{19} and d_{20} may go all the way through with a transition area approximately halfway within the hex.
2. For tolerances see ISO 6149-2 d_3 dimensions.

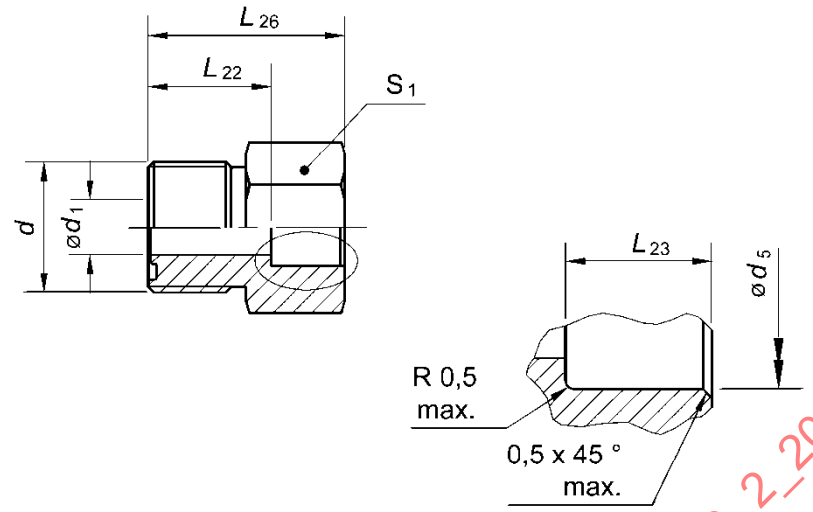


Figure 40 - Braze-on straight (52M0172), (52M01M72, metric tubing)

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

Table 19 - Dimensions of braze-on straight connector

Dimensions in millimeters

Metric Tube Ordering[2] Size Code ORFS Tube Side X Side 52M01M04	Metric Tube OD	d_5[1] ref. for Metric Tube	Inch Tube Ordering[2] Size Code 52M0104	Inch Tube Dash Size	d_5[1] ref. for Inch Tube	d Thread	d_1 ref.	L_{22} ±0.8	L_{23}[1] ±0.5	L_{26} ref.	S_1 Hex
6x6	6	6.15	4-4[3]	– 4	6.5	9/16-18	4.5	13.5	8.5	22	17
6x8	8	8.15	4-5	– 5	8.09	9/16-18	4.5	13.5	8.5	22	17
6x10	10	10.15	4-6	– 6	9.68	9/16-18	4.5	13.5	8.5	22	17
8x6	6	6.15	5-4	– 4	6.5	5/8-18	4.5[4]	13.5	8.5	22	17
8x8	8	8.15	5-5	– 5	8.09	5/8-18	5.5	13.5	8.5	22	17
8x10	10	10.15	5-6	– 6	9.68	5/8-18	5.5	13.5	8.5	22	17
8x12	12	12.15	5-8	– 8	12.85	5/8-18	5.5	13.5	8.5	22	19
10x6	6	6.15	6-4	– 4	6.5	11/16-16	4.5[4]	14.5	8.5	23	19
10x8	8	8.15	6-5	– 5	8.09	11/16-16	5.5[4]	14.5	8.5	23	19
10x10	10	10.15	6-6	– 6	9.68	11/16-16	6.5	14.5	8.5	23	19
10x12	12	12.15	6-8	– 8	12.85	11/16-16	6.5	14.5	8.5	23	19
10x16	16	16.15	6-10	–10	16.03	11/16-16	6.5	14.5	9	23.5	22
12x8	8	8.15	8-5	– 5	8.09	13/16-16	5.5[4]	16	8.5	24.5	22
12x10	10	10.15	8-6	– 6	9.68	13/16-16	6.5[4]	16	8.5	24.5	22
12x12	12	12.15	8-8	– 8	12.85	13/16-16	9.5	16	8.5	24.5	22
12x16	16	16.15	8-10	–10	16.03	13/16-16	9.5	16	9	25	22
16x10	10	10.15	10-6	– 6	9.68	1-14	6.5[4]	19	8.5	27.5	27
16x12	12	12.15	10-8	– 8	12.85	1-14	9.5[4]	19	8.5	27.5	27
16x16	16	16.15	10-10	–10	16.03	1-14	12.5	19	9	28	27
16x20	20	20.18	10-12	–12	19.23	1-14	12.5	19	12.5	31.5	27
20x12	12	12.15	12-8	– 8	12.85	1-3/16-12	9.5[4]	21	8.5	29.5	32
20x16	16	16.15	12-10	–10	16.03	1-3/16-12	12.5[4]	21	9	30	32
20x20	20	20.18	12-12	–12	19.23	1-3/16-12	15.5	21	12.5	33.5	32
20x25	25	25.18	12-16	–16	25.58	1-3/16-12	15.5	21	14	35	32
22x16	16	16.15	14-10	–10	16.03	1-5/16-12	12.5[4]	23	9	32	36
22x20	20	20.18	14-12	–12	19.23	1-5/16-12	15.5[4]	23	12.5	35.5	36
22x22	22	22.18	14-14	–14	22.41	1-5/16-12	18	23	12.5	35.5	36
22x25	25	25.18	14-16	–16	25.58	1-5/16-12	18	23	14	37	36
25x16	16	16.15	16-10	–10	16.03	1-7/16-12	12.5[4]	24.5	9	33.5	41
25x20	20	20.18	16-12	–12	19.23	1-7/16-12	15.5[4]	24.5	12.5	37.0	41
25x25	25	25.18	16-16	–16	25.58	1 -7/16-12	20.5	24.5	14	38.5	41
25x30	30	30.2	16-20	–20	31.95	1-7/16-12	20.5	24.5	14	38.5	41

Table 19 - Dimensions of braze-on straight connector (continued)

Dimensions in millimeters

Metric Tube Ordering[2] Size Code ORFS Tube Side X Side 52M01M04	Metric Tube OD	d_5[1] ref. for Metric Tube	Inch Tube Ordering[2] Size Code 52M0104	Inch Tube Dash Size	d_5[1] ref. for Inch Tube	d Thread	d_1 ref.	L_{22} ±0.8	L_{23}[1] ±0.5	L_{26} ref.	S_1 Hex
30x20	20	20.18	20-12	–12	19.23	1-11/16-12	15.5[4]	24.5	12.5	37	46
30x25	25	25.18	20-16	–16	25.58	1-11/16-12	20.5[4]	24.5	14	38.5	46
30x30	30	30.2	20-20	–20	31.95	1-11/16-12	26	24.5	14	38.5	46
30x38	38	38.2	20-24	–24	38.3	1-11/16-12	26	24.5	14	38.5	50
38x25	25	25.18	24-16	–16	25.58	2-12	20.5[4]	24.5	14	38.5	55
38x30	30	30.2	24-20	–20	31.95	2-12	26[4]	24.5	14	38.5	55
38x38	38	38.2	24-24	–24	38.3	2-12	32	24.5	14	38.5	55

1. Dimensions given are for silver brazing. Other dimensions may apply for other joining methods.
2. The size symbol for all tube sizes shall be the tube OD or nominal hose ID in millimeters, except dash size symbols may be used for braze sleeve and weld nipple for inch tubing.
3. 4-4 means a –4 O-ring face end to a –4 inch tube with a metric hex since the code 52M0104 is for a metric hex part with inch tube.
4. d_1 diameter is smaller than the standard through hole passage for this size ORFS end. Accordingly, d_1 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

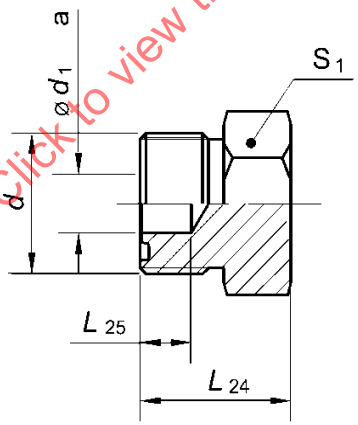


Figure 41 - Plug (52M0109)

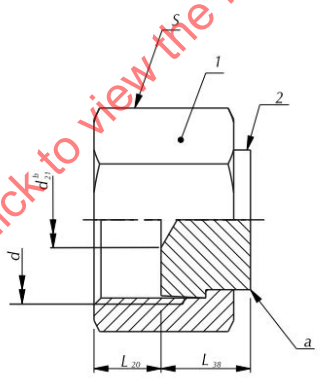
NOTE 1: For manufacturing dimensions or options not shown see SAE J1453-1.

a. Optional

Table 20 - Dimensions of plug

Dimensions in millimeters

Ordering Size Code	Inch Tube OD Dash Size	Metric Tube OD	d Thread	d_1 ref.	L_{24} ±0.8	L_{25} max	S_1 Hex
6	– 4	6	9/16-18	4.5	16.5	7.1	17
8	– 5	8	5/8-18	5.5	16.5	7.1	17
10	– 6	10	11/16-16	6.5	19	8.2	19
12	– 8	12	13/16-16	9.5	22	9.8	22
16	–10	16	1-14	12.5	26	12.2	27
20	–12	20	1-3/16 -12	15.5	27.5	13.2	32
22	–14	22	1-5/16 -12	18	28	13.2	36
25	–16	25	1-7/16 -12	20.5	28	13.7	41
30	–20	30	1-11/16 -12	26	28	13.7	46
38	–24	38	2-12	32	28	13.7	55



Legend

1. 52M0110A Nut
2. Cap Insert
   a. Stake insert must be free to turn.
   b. Optional drill point permitted.

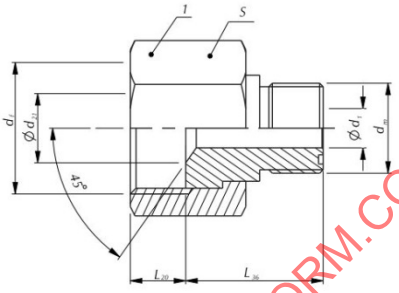
NOTE 1: For manufacturing dimensions or options not shown see SAE J1453-1.

Figure 42 - Cap assembly (52M0112)

Table 21 - Dimensions of cap assembly

dimensions in millimeters

Size Code	Metric Tube OD	Inch Tube OD Dash Size	d Thread	d_{21} max.	L_{20} ref.	L_{38} ref.	S Hex
6	6	– 4	9/16-18	4.5	7.8	9	17
8	8	– 5	5/8-18	5.5	7.8	10	19
10	10	– 6	11/16-16	6.5	8.3	10.5	22
12	12	– 8	13/16-16	9.5	10	12	24
16	16	–10	1-14	12.5	12.5	13.5	30
20	20	–12	1-3/16-12	15.5	13.6	15	36
22	22	–14	1-5/16-12	18	13.5	15	41
25	25	–16	1-7/16-12	20.5	13.5	16	41
30	30	–20	1-11/16-12	26	13.5	16	50
38	38	–24	2-12	32	13.5	16	60



1. Tube Nut
2. Crimped Nut

Figure 43A - Reducer with tube nut (Style A) (52M0123A)

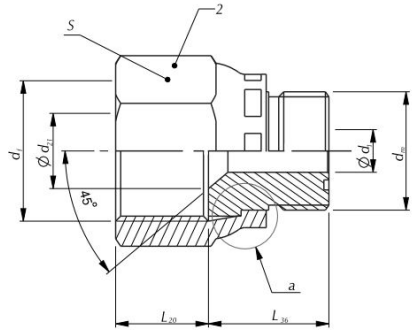


Figure 43B - Reducer with crimped nut (Style B) (52M0123B)

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

a. Method of nut attachment optional.

Table 22 - Dimensions of face seal reducer with nut

dimensions in millimeters

Ordering Size Code Female ORFS X Male ORFS	d_f Female Thread in	d_m Male Thread in	d_1 ref.	d_{21} ref.	L_{20} ref.	L_{36} ±0.8	S Hex
8x6	5/8-18	9/16-18	4.5	5.5	7.8	17	19
10x6(1)	11/16-16	9/16-18	4.5	6.5	8.3	19.5	22
10x8(1)	11/16-16	5/8-18	5.5	6.5	8.3	19.5	22
12x6	13/16-16	9/16-18	4.5	9.5	10	22	24
12x8	13/16-16	5/8-18	5.5	9.5	10	22	24
12x10(1)	13/16-16	11/16-16	6.5	9.5	10	22.5	24
16x6	1-14	9/16-18	4.5	12.5	12.5	23	30
16x8	1-14	5/8-18	5.5	12.5	12.5	23	30
16x10	1-14	11/16-16	6.5	12.5	12.5	24	30
16x12	1-14	13/16-16	9.5	12.5	12.5	25.5	30
20x6	1-3/16-12	9/16-18	4.5	15.5	13.6	25	36
20x8	1-3/16-12	5/8-18	5.5	15.5	13.6	25	36
20x10	1-3/16-12	11/16-16	6.5	15.5	13.6	26	36
20x12	1-3/16-12	13/16-16	9.5	15.5	13.6	27.5	36
20x16(1)	1-3/16-12	1-14	12.5	15.5	13.6	29.5	36
22x8	1-5/16-12	5/8-18	5.5	18	13.5	25	41
22x10	1-5/16-12	11/16-16	6.5	18	13.5	26	41
22x12	1-5/16-12	13/16-16	9.5	18	13.5	27.5	41
22x16	1-5/16-12	1-14	12.5	18	13.5	29.5	41
22x20(1)	1-5/16-12	1-3/16-12	15.5	18	13.5	32	41
25x12	1-7/16-12	13/16-16	9.5	20,5	13.5	29	41
25x16	1-7/16-12	1-14	12.5	20,5	13.5	32	41
25x20(1)	1-7/16-12	1-3/16-12	15.5	20,5	13.5	33	41
25x22(1)	1-7/16-12	1-5/16-12	18	20,5	13.5	33.5	41
30x20	1-11/16-12	1-3/16-12	15.5	26	13.5	33.5	50
30x22	1-11/16-12	1-5/16-12	18	26	13.5	34	50
30x25(1)	1-11/16-12	1-7/16-12	20.5	26	13.5	38.5	50
38x22	2-12	1-5/16-12	18	32	13.5	34	60
38x25	2-12	1-7/16-12	20.5	32	13.5	34	60
38x30	2-12	1-11/16-12	26	32	13.5	34	60

1. Permanently attached nut design.

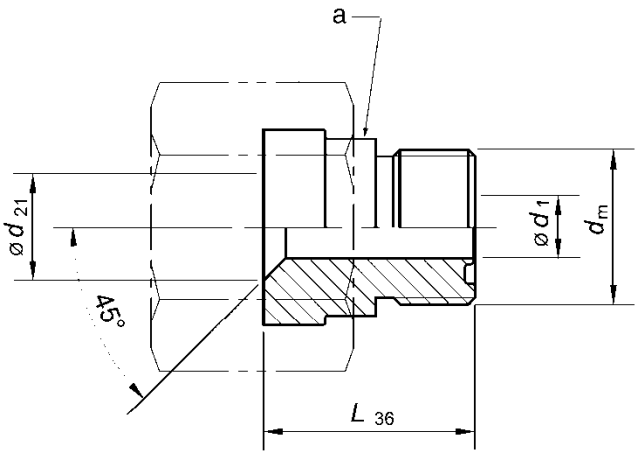


Figure 44 - Reducer without nut (Style B) (520123B)

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

a. For use with tube nut 52M0110A.

Table 23 - Dimensions of face seal reducer without nut

dimensions in millimeters

Ordering Size Female X Male ORFS ORFS	d_m Male Thread	d_1 ref.	d_{21} ref.	L_{36} ±0.8
8x6	9/16-18	4.5	5.5	17
12x6	9/16-18	4.5	9.5	22
12x8	5/8-18	5.5	9.5	22
16x6	9/16-18	4.5	12.5	23
16x8	5/8-18	5.5	12.5	23
16x10	11/16-16	6.5	12.5	24
16x12	13/16-16	9.5	12.5	25.5
20x6	9/16-18	4.5	15.5	25
20x8	5/8-18	5.5	15.5	25
20x10	11/16-18	6.5	15.5	26
20x12	13/16-16	9.5	15.5	27.5
22x8	5/8-18	5.5	18	25
22x10	11/16-16	6.5	18	26
22x12	13/16-16	9.5	18	27.5
22x16	1-14	12.5	18	29.5
25x12	13/16-16	9.5	20.5	29
25x16	1-14	12.5	20.5	32
30x20	1-3/16-12	15.5	26	33.5
30x22	1-5/16-12	18	26	34
38x22	1-5/16-12	18	32	34
38x25	1-7/16-12	20.5	32	34
38x30	1-11/16-12	26.0	32	34

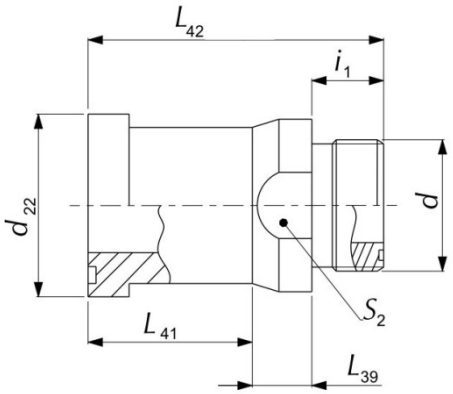


Figure 44A
(Compact – 52M2961 OR 52M2962)

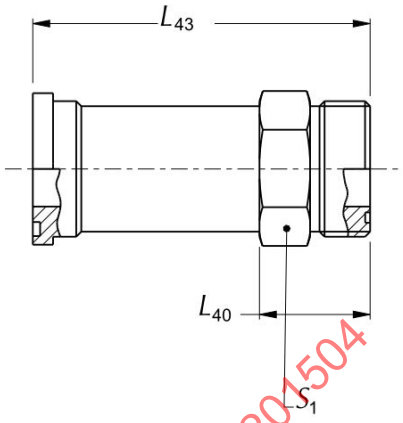


Figure 44B
(Short – 52M3061 OR 52M3062)
(Medium – 52M3161 OR 52M3162)
(Long – 52M3261 OR 52M3262)

Figures 45A and 45B – Compact, short, medium and long straight 4-bolt flange connectors

NOTE: For dimensions not shown, see SAE J1453-1, ISO 6162-1 (SAE J518-1) and ISO 6162-2 (SAE J518-2).

Table 24A - Dimensions for straight ISO 6162-1 4-bolt flange connectors

dimensions in millimeters

Ordering Size Code	Flange Dash Size	**d_{22}** Code 61 Flange Head Ref	ORFS SAE Dash Size	**d** ORFS Thread (inch)	**i_1** ±0.4	**L_{39}** Ref	**L_{40}** ±0.8	**L_{41}** Compact Code 61 52M2961 ±0.8	**L_{42}** Compact Code 61 52M2961 ±0.8	**L_{43}** Short Code 61 52M3061 ±0.8	**L_{43}** Medium Code 61 52M3161 ±0.8	**L_{43}** Long Code 61 52M3261 ±0.8
12-12	-12	38.1	-12	1-3/16-12	17.0	13	33	35	65	105	155	215
12-16	-12	38.1	-16	1-7/16/-12	17.5	13	38	35	66	106	156	216
16-16	-16	44.45	-16	1-7/16/-12	17.5	14	38	40	72	132	192	252
16-20	-16	44.45	-20	1-11/16-12	17.5	14	38	40	72	132	192	252
20-20	-20	50.8	-20	1-11/16-12	17.5	16	38	43	77	137	207	287
20-24	-20	50.8	-24	2-12	17.5	16	38	43	77	137	207	287
24-24	-24	60.35	-24	2-12	17.5	18	38	50	86	156	226	216
24-32	-24	60.35	-32	2-1/2-12	22.0	18	45	50	90	170	250	350

Table 24B - Dimensions for straight ISO 6162-2 4-bolt flange connectors

dimensions in millimeters

Ordering Size Code	Flange Dash Size	**d_{22}** Code 62 Flange Head Ref	ORFS SAE Dash Size	**d** ORFS Thread (inch)	**L_{41}** Compact Code 62 52M2962 ±0.8	**L_{42}** Compact Code 62 52M2962 ±0.8	**L_{43}** Short Code 62 52M3062 ±0.8	**L_{43}** Medium Code 62 52M3162 ±0.8	**L_{43}** Long Code 62 52M3262 ±0.8	**S_1** Hex	**S_2** Forging Wrench Flat Min	**S_2** Forging Wrench Flat Max
12-12	-12	41.3	-12	1-3/16-12	43	73	105	155	215	32	27	41
12-16	-12	41.3	-16	1-7/16/-12	43	74	106	156	216	41	36	46
16-16	-16	47.6	-16	1-7/16/-12	53	85	132	192	252	41	36	46
16-20	-16	47.6	-20	1-11/16-12	53	85	132	192	252	46	41	55
20-20	-20	54	-20	1-11/16-12	57	91	137	207	287	46	41	55
20-24	-20	54	-24	2-12	57	91	137	207	287	55	50	60
24-24	-24	63.5	-24	2-12	71	107	156	226	216	55	50	60
24-32	-24	63.5	-32	2-1/2-12	71	111	170	250	350	70	65	85

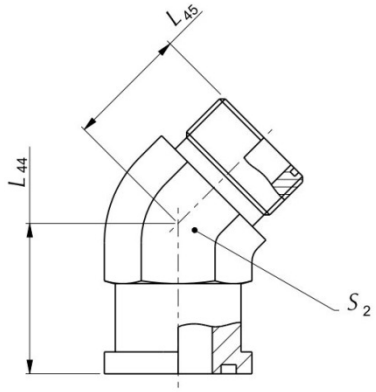


Figure 46A
(Compact – 52M3361 OR 52M3362)

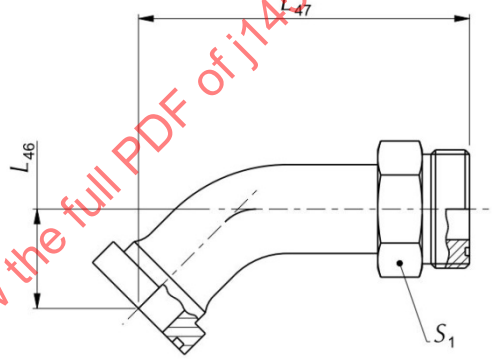


Figure 46B
(Short – 52M2261 OR 52M2262)
(Medium – 52M2361 OR 52M2362)

Figures 46A and 46B – Compact, short and medium 45º elbow 4-bolt flange connectors

NOTE: For dimensions not shown, see SAE J1453-1, ISO 6162-1 (SAE J518-1) and ISO 6162-2 (SAE J518-2).

Table 25A - Dimensions for 45º elbow ISO 6162-1 4-bolt flange connectors

dimensions in millimeters

Ordering Size Code mm	Flange Dash Size	**d_{22}** Code 61 Flange Head Ref	ORFS Dash Size	**d** ORFS Thread (inch)	**L_{44}** Compact Code 61 52M3361 ±0.8	**L_{45}** Compact Code 61 52M3361 ±1.5	**L_{46}** Short Code 61 52M2261 ± 1.5	**L_{46}** Medium Code 61 52M2361 ±1.5	**L_{47}** Code 61 ± 1.5
12-12	-12	38.1	-12	1-3/16-12	40	32	22	26	80
12-16	-12	38.1	-16	1-7/16/-12	40	33	28	32	110
16-16	-16	44.45	-16	1-7/16/-12	45	34	28	32	110
16-20	-16	44.45	-20	1-11/16-12	45	34	32	38	125
20-20	-20	50.8	-20	1-11/16-12	56	36	32	38	125
20-24	-20	50.8	-24	2-12	56	36	38	44	145
24-24	-24	60.35	-24	2-12	68	41	38	44	145
24-32	-24	60.35	-32	2-1/2-12	68	48	48	56	155

Table 25B - Dimensions for 45º elbow ISO 6162-2 4-bolt flange connectors

dimensions in millimeters

Ordering Size Code mm	Flange Dash Size	**d_{22}** Code 62 Flange Head Ref	ORFS Dash Size	**d** ORFS Thread (inch)	**L_{44}** Compact Code 62 52M3362 ±0.8	**L_{45}** Compact Code 62 52M3362 ±1.5	**L_{46}** Short Code 62 52M2262 ± 1.5	**L_{46}** Medium Code 62 52M2362 ±1.5	**L_{47}** Code 62 ± 1.5	**S_1** Hex	**S_2** Forging Wrench Flat Min	**S_2** Forging Wrench Flat Max
12-12	-12	41.3	-12	1-3/16-12	48	32	22	26	80	32	27	41
12-16	-12	41.3	-16	1-7/16/-12	48	33	28	32	110	41	36	46
16-16	-16	47.6	-16	1-7/16/-12	58	34	28	32	110	41	36	46
16-20	-16	47.6	-20	1-11/16-12	58	34	32	38	125	46	41	55
20-20	-20	54	-20	1-11/16-12	70	36	32	38	125	46	41	55
20-24	-20	54	-24	2-12	70	36	38	44	145	55	50	60
24-24	-24	63.5	-24	2-12	89	41	38	44	145	55	50	60
24-32	-24	63.5	-32	2-1/2-12	89	48	48	56	155	70	65	85

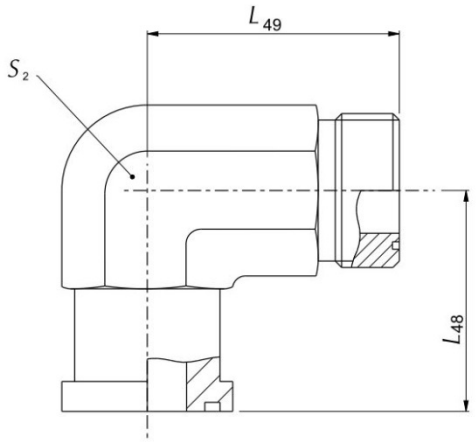


Figure 47A
(Compact – 52M3461 OR 52M3462)

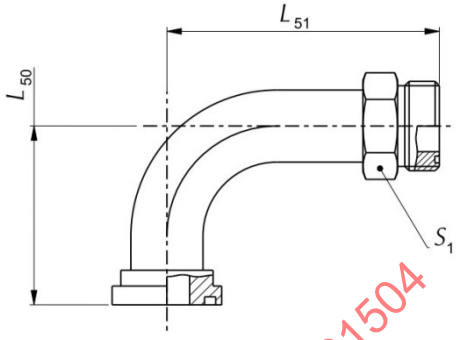


Figure 47B
(Short – 52M1461 OR 52M1462)
(Medium – 52M2061 OR 52M2062)
(Long – 52M1561 OR 52M1562)

Figures 47A and 47B – Compact, short, medium and long 90º elbow 4-bolt flange head to ORFS connector

NOTE: For dimensions not shown, see SAE J1453-1, ISO 6162-1 (SAE J518-1) and ISO 6162-2 (SAE J518-2).

Table 26A - Dimensions for 90º elbow ISO 6162-1 4-bolt flange connectors

dimensions in millimeters

Ordering Size Code mm	Flange Dash Size	**d_{22}** Code 61 Flange Head Ref	ORFS Dash Size	**d** ORFS Thread (inch)	**L_{48}** Compact Code 61 52M3461 ±1.5	**L_{49}** Compact Code 61 52M3461 ±1.5	**L_{50}** Short Code 61 52M1461 ±1.5	**L_{50}** Medium Code 61 52M2061 ±1.5	**L_{50}** Long Code 61 52M1561 ±1.5	**L_{51}** Code 61 ±1.5
12-12	-12	38.1	-12	1-3/16-12	54	59	56	58	133	60
12-16	-12	38.1	-16	1-7/16/-12	54	59	61	70	154	70
16-16	-16	44.45	-16	1-7/16/-12	60	61	61	70	154	70
16-20	-16	44.45	-20	1-11/16-12	60	61	68	90	189	90
20-20	-20	50.8	-20	1-11/16-12	66	65	68	90	189	90
20-24	-20	50.8	-24	2-12	66	65	81	104	220	105
24-24	-24	60.35	-24	2-12	80	75	81	104	220	105
24-32	-24	60.35	-32	2-1/2-12	80	83	120	138	275	140

Table 26B - Dimensions for 90º elbow ISO 6162-2 4-bolt flange connectors

dimensions in millimeters

Ordering Size Code mm	Flange Dash Size	**d_{22}** Code 62 Flange Head Ref	ORFS Dash Size	**d** ORFS Thread (inch)	**L_{48}** Compact Code 62 52M3462 ±1.5	**L_{49}** Compact Code 62 52M3462 ±1.5	**L_{50}** Short Code 62 52M1462 ±1.5	**L_{50}** Medium Code 62 52M2062 ±1.5	**L_{50}** Long Code 62 52M1562 ±1.5	**L_{51}** Code 62 ±1.5	**S_1** Hex	**S_2** Forging Wrench Flat Min	**S_2** Forging Wrench Flat Max
12-12	-12	41.3	-12	1-3/16-12	62	59	56	58	133	60	32	27	41
12-16	-12	41.3	-16	1-7/16/-12	62	59	61	70	154	70	41	36	46
16-16	-16	47.6	-16	1-7/16/-12	73	61	61	70	154	70	41	36	46
16-20	-16	47.6	-20	1-11/16-12	73	61	68	90	189	90	46	41	55
20-20	-20	54	-20	1-11/16-12	80	65	68	90	189	90	46	41	55
20-24	-20	54	-24	2-12	80	65	81	104	220	105	55	50	60
24-24	-24	63.5	-24	2-12	101	75	81	104	220	105	55	50	60
24-32	-24	63.5	-32	2-1/2-12	101	83	120	138	275	140	70	65	85

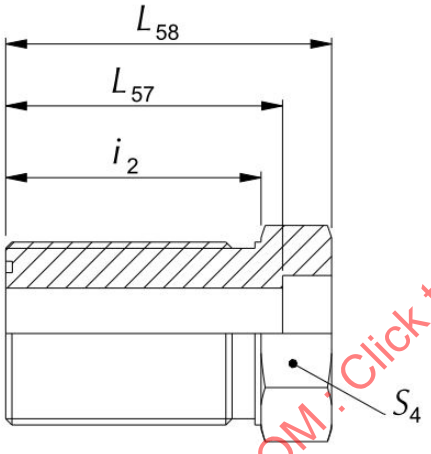


Figure 48 – Braze-on bulkhead male tube (52M0173 & 52M01M73)

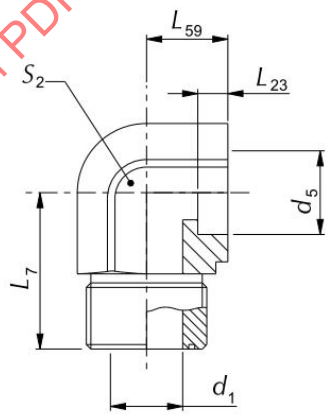


Figure 49 – Braze-on 90ºmale tube (52M0373 & 52M03M73)

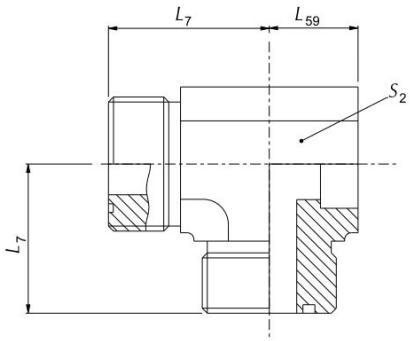


Figure 50 – Braze-on male tube run tee adapter (52M0483 & 52m04M83)

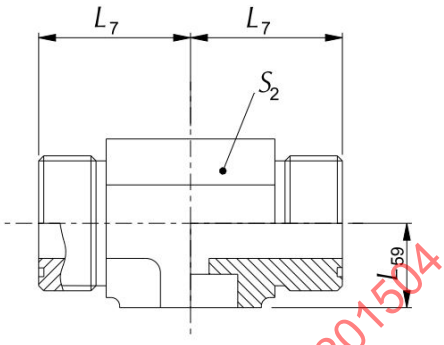


Figure 51– Braze—on male tube branch tee (52M0484 & 52M04M84)

NOTE 1: For dimensions not shown in SAE J1453-2, see Table 27.

Table 27 - Dimensions for braze-on connectors

dimensions in mm

Ordering (1) Size Code	Metric Tube OD	Inch Tube OD Dash Size	d Thread	d_1 Ref	$d_{5\ (2)}$ Ref	l_2 Ref	L_7 Ref	L_{16} Ref	$L_{23\ (2)}$ Ref
6X6	6	– 4	9/16–18UNF	4.5	6.15	31.5	21.5	22.5	8.5
8X8	8	– 5	5/8–18UNF	5.5	8.15	32	23.5	25	8.5
10X10	10	– 6	11/16–16UN	6.5	10.15	34	25	26	8.5
12X12	12	– 8	13/16–16UN	9.5	12.15	36.5	28	29	8.5
16X16	16	– 10	1–14UN	12.5	16.15	40.5	33.5	34.5	9
20X20	20	– 12	1-3/16–12UN	15.5	20.18	41.5	37.5	38.5	12.5
22X22	22	– 14	1-5/16–12UN	18	22.18	42	41.5	42.5	12.5
25X25	25	– 16	1-7/16–12UN	20.5	25.18	42	41.5	42.5	14
30X30	30	– 20	1-11/16–12UN	26	30.2	42	44.5	45.5	14
38X38	38	– 24	2–12UN	32	38.2	42	49	49.5	14

Ordering (1) Size Code	Metric Tube OD	Inch Tube OD Dash Size	d Thread	L_{57} ±0.8	L_{58} Ref.	L_{59} Min.	$S_{2`}$ Forging min	$S_{2`}$ Barstock Max	S_4
6X6	6	– 4	9/16–18UNF	35	43.5	11.5	14	17	22
8X8	8	– 5	5/8–18UNF	35.5	44	12	17	22	22
10X10	10	– 6	11/16–16UN	37.5	46	12.5	17	27	27
12X12	12	– 8	13/16–16UN	39.5	48	14	19	30	30
16X16	16	– 10	1–14UN	44	53	16	24	36	36
20X20	20	– 12	1-3/16–12UN	45.5	58	21	27	41	41
22X22	22	– 14	1-5/16–12UN	47.5	60	22	36	41	46
25X25	25	– 16	1-7/16–12UN	49	63	25	36	46	46
30X30	30	– 20	1-11/16–12UN	49	63	27.5	41	55	50
38X38	38	– 24	2–12UN	49	63	30.5	50	60	60

1. Add third end size for tees; the ordering sequence is: Left – Right – Up – Down
2. Dimensions given are for silver brazing. Other dimensions may apply for other joining methods

7.4 Marginal Indicia

A change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

PREPARED BY SAE HYDRAULIC TUBE FITTINGS COMMITTEE

APPENDIX A - DIMENSIONS FOR JUMP SIZE CONNECTORS

A.1 90 DEGREE ADJUSTABLE ELBOW JUMP CONNECTOR DIMENSIONS

NOTE: Dimensions are shown for standardization reasons; however, these are considered “specials” which might not be readily available and are nonpreferred due to poor availability and increased cost.

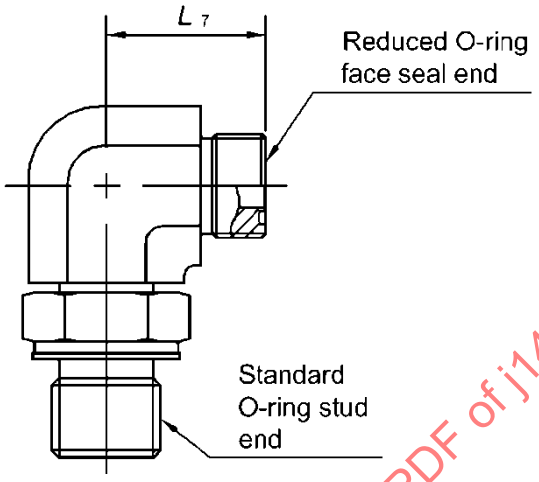


Figure A1A - 90 Degree adjustable jump stud elbow with reduced ORFS end

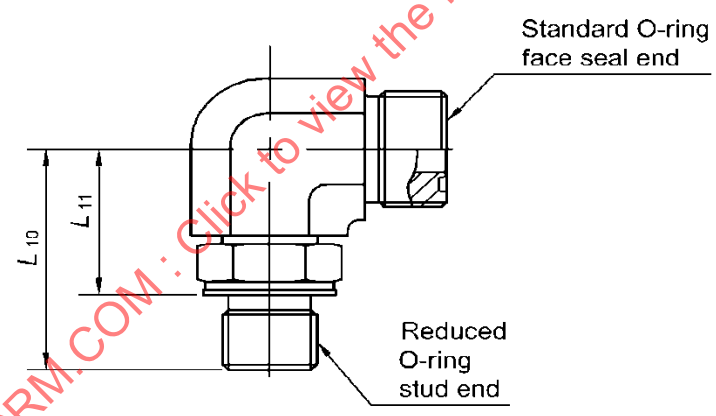


Figure A1B - 90 Degree adjustable jump stud elbow with reduced stud end

Table A1 - Dimensions of 90 degree adjustable elbow, tee, and cross jump connectors

dimensions in millimeters

Reduced O-Ring Face Seal to Standard Stud End Ordering Size Code	L_7[1][2] ±1.5	O-Ring Face Seal to Reduced Stud End Ordering Size Code	L_{10}[3][4] ±1.5	L_{11} ref.
6xM14	23.5	6xM8	29.5	20
6xM16	23.5	6xM10	29.5	20
8xM16	23.5	8xM10	32	22.5
8xM18	25	8xM12	35.5	24.5
10xM18	26.5	10xM12	35.5	24.5
10xM22	30	10xM14	35.5	24.5
12xM22	31.5	12xM14	36	25
12xM27	34	12xM16	38	25.5
16xM27	36	16xM16	44.5	32
16xM30	39.5	16xM18	47.5	33.5
20xM30	41	20xM18	47.5	33.5
20xM33	41	20xM22	49	34
22xM33	41.5	22xM22	53	38
22xM42	44.5	22xM27	59.5	41
25xM42	44.5	25xM27	59.5	41
25xM48	49	25xM30	59.5	41
30xM48	49	30xM30	62	43.5
—	—	30xM33	62	43.5
—	—	38xM33	67	48.5
—	—	38xM42	68	49

1. L_7 dimensions are applicable to the following additional connectors: Union Cross, 52M0501, 90 degree Union Elbow, 52M0201, Union Tee, 52M0401, Swivel 90 degree Elbow, 52M0281, Swivel Branch Tee, 52M0433, Swivel Run Tee, 52M0432.
2. Calculated dimensions for this feature were derived from Table C2.
3. L_{10} dimensions are applicable to the following additional connectors: Adjustable Stud Branch Tee, 52M0429, Adjustable Stud Cross, 52M0320, Adjustable Stud Run Tee, 52M0428, Swivel 90 degree Adjustable Stud Elbow, 52M0296.
4. Calculated dimensions for this feature were derived from Table C4.

A.2 45 DEGREE ADJUSTABLE ELBOW JUMP CONNECTOR DIMENSIONS

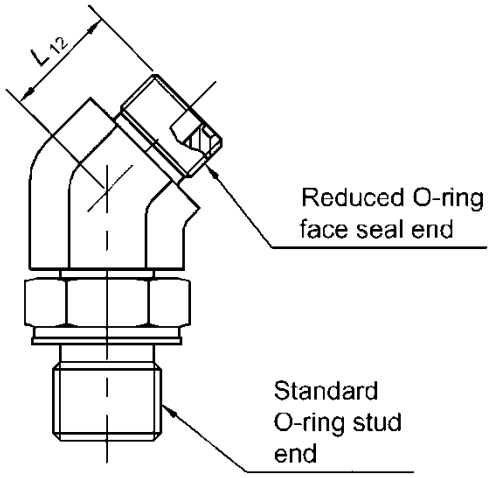


Figure A2A - 45 Degree adjustable jump stud elbow with reduced ORFS end

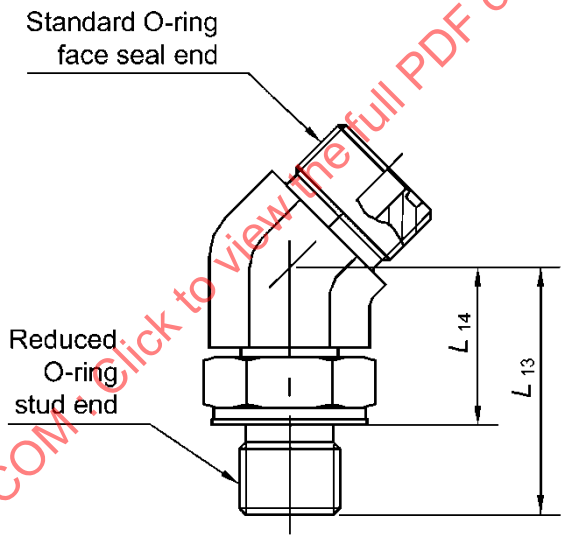


Figure A2B - 45 Degree adjustable jump stud elbow with reduced stud end

Table A2 - Dimensions of 45 degree adjustable elbow jump connectors

dimensions in millimeters

Reduced O-Ring Face Seal to Standard Stud End Ordering Size Code	L_{12}[1] ±1.5	Standard O-Ring Face Seal to Reduced Stud End Ordering Size Code	L_{13}[2] ±1.5	L_{14} ref.
6xM14	17.5	6xM8	26.5	17
6xM16	17.5	6xM10	26.5	17
8xM16	17.5	8xM10	28	18.5
8xM18	17.5	8xM12	31.5	20.5
10xM18	19	10xM12	31.5	20.5
10xM22	20	10xM14	31.5	20.5
12xM22	21.5	12xM14	32	21
12xM27	22.5	12xM16	34	21.5
16xM27	24.5	16xM16	39.5	27
16xM30	28	16xM18	42.5	28.5
20xM30	29.5	20xM18	42.5	28.5
20xM33	29.5	20xM22	44	29
22xM33	30	22xM22	46	31
22xM42	32	22xM27	52.5	34
25xM42	32	25xM27	52.5	34
25xM48	37	25xM30	52.5	34
30xM48	37	30xM27	53	34.5
—	—	30xM30	53	34.5
—	—	30xM33	53	34.5
—	—	38xM33	52	33.5
—	—	38xM42	53	34

1. Calculated dimensions for this feature were derived from Table C2.
2. Calculated dimensions for this feature were derived from Table C4.

A.3 STRAIGHT STUD FACE SEAL JUMP CONNECTOR DIMENSIONS

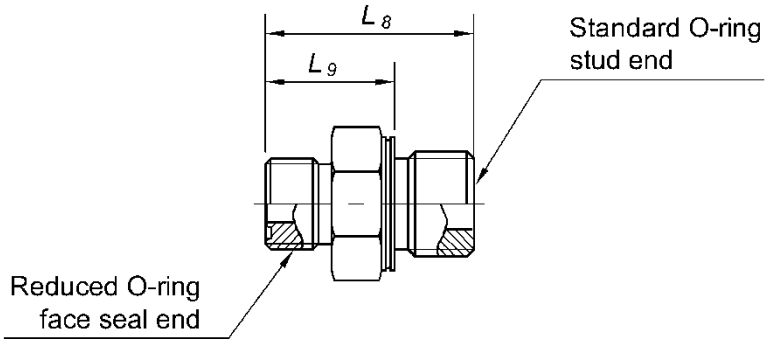


Figure A3A - Straight-stud connector with reduced ORFS end

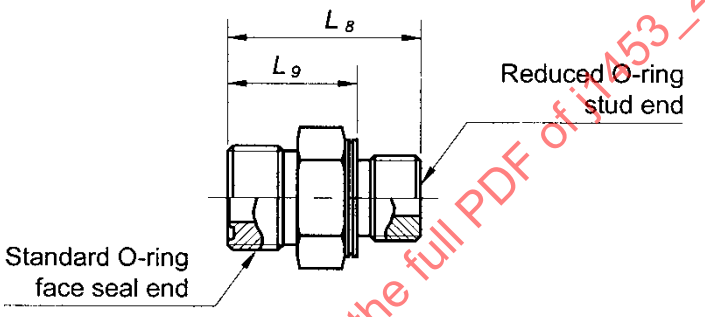


Figure A3B - Straight-stud connector with reduced stud end

Table A3 - Dimensions of straight stud jump connectors

dimensions in millimeters

Reduced O-Ring[1] Face Seal to Standard Stud End Ordering Size Code	L_8[2] ±0.8	L_9 ref.	Standard O-Ring[1] Face Seal to Reduced Stud End Ordering Size Code	L_8[3] ±0.8	L_9 ref.
6xM14	29.5	18.5	6xM8	27	17.5
6xM16	32.5	20	6xM10	27	17.5
8xM16	32.5	20	8xM10	28	18.5
8xM18	35	21	8xM12	29.5	18.5
10xM18	36	22	10xM12	32	21
10xM22	37.5	22.5	10xM14	32	21
12xM22	39.5	24.5	12xM14	35	24
12xM27	44.5	26	12xM16	36.5	24
16xM27	47	28.5	16xM16	39.5	27
16xM30	48	29.5	16xM18	41	27
16xM33	50	31.5	20xM18	44	30
20xM30	49.5	31	20xM22	45	30
20xM33	51.5	33	22xM22	46.5	31.5
22xM33	52	33.5	22xM27	50	31.5
22xM42	54.5	35.5	25xM27	52	33.5
25xM42	54.5	35.5	25xM30	52	33.5
25xM48	57	35.5	30xM27	54	35.5
30xM48	57	35.5	30xM30	54	35.5
—	—	—	30xM33	54	35.5
—	—	—	38xM33	54	35.5
—	—	—	38xM42	54.5	35.5

1. 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:
   a. The appropriate end may be countersunk to the larger diameter, or
   b. The appropriate end may be drilled to the larger diameter up to the middle of the hex.
2. Calculated dimensions for this column were derived from Table C1.
3. Calculated dimensions for this column were derived from Table C3.

A.4 LONG STRAIGHT STUD JUMP CONNECTORS DIMENSIONS

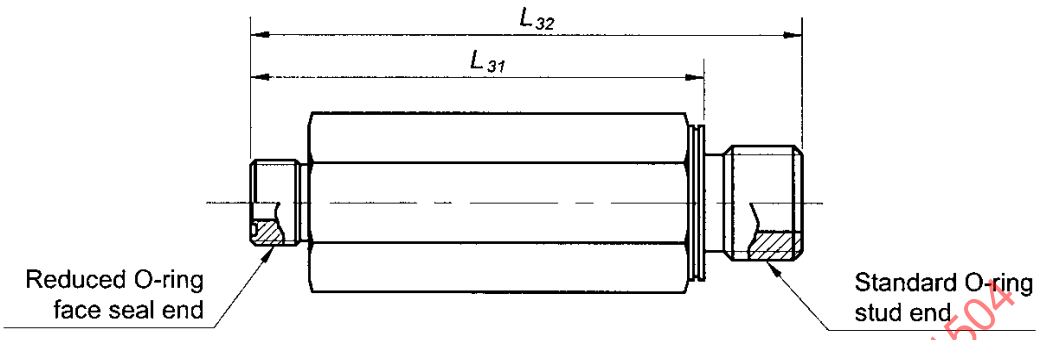


Figure A4A - Long straight stud connector with reduced ORFS end

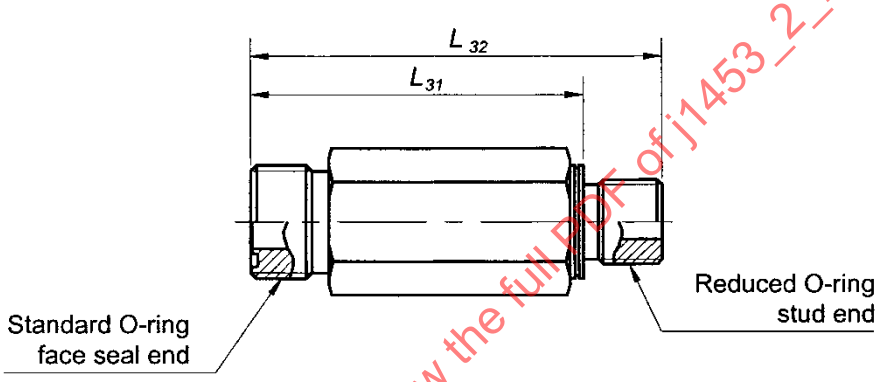


Figure A4B - Long straight stud connector with reduced stud end

Table A4 - Dimensions of long, straight stud jump connectors

dimensions in millimeters

Reduced O-Ring [1] Face Seal to Standard Stud End Ordering Size Code	L_{31} ref.	L_{32}[2] ±0.8	Standard O-Ring Face Seal to Reduced Stud End Ordering Size Code	L_{31} ref.	L_{32}[3] ±0.8
6xM14	41.5	52.5	6xM8	41.5	51
6xM16	44.5	57	6xM10	41.5	51
8xM16	44.5	57	8xM10	41.5	51
8xM18	51	65	8xM12	41.5	52.5
10xM18	52	66	10xM12	45.5	56.5
10xM22	59	74	10xM14	45.5	56.5
12xM22	61	76	12xM14	54	65
12xM27	73	91.5	12xM16	54	66.5
16xM27	75.5	94	16xM16	63.5	76
16xM30	79.5	98	16xM18	63.5	77.5
16xM33	84.5	103	20xM18	77	91
20xM30	81	99.5	20xM22	77	92
20xM33	86	104.5	22xM22	81.5	96.5
22xM33	86.5	105	22xM27	81.5	100
22xM42	102.5	121.5	25xM27	86.5	105
25xM42	102.5	121.5	25xM30	86.5	105
25xM48	115	136.5	30xM30	102.5	121
30xM48	115	136.5	30xM33	102.5	121
—	—	—	38xM33	115	133.5
—	—	—	38xM42	115	134

1. 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:
   a. The appropriate end may be countersunk to the larger diameter, or
   b. The appropriate end may be drilled to the larger diameter up to the middle of the hex.
2. Calculated dimensions for this feature were derived from Table C1.
3. Calculated dimensions for this feature were derived from Table C3.

A.5 STRAIGHT UNION JUMP CONNECTOR DIMENSIONS

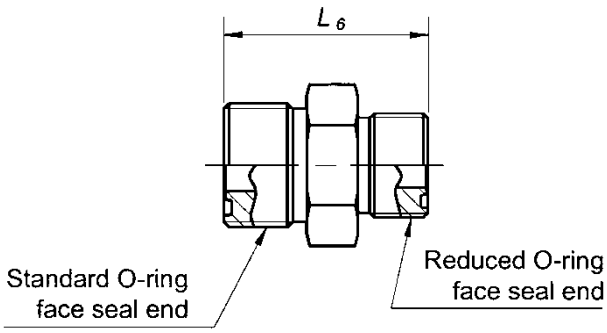


Figure A5 - Straight union connector with one end reduced

Table A5 - Dimensions of straight union jump connectors

dimensions in millimeters

Standard O-Ring Face Seal to Reduced Face Seal Ordering Size Code	L_6 (1) ±0.8
8x6	29
10x6	30
10x8	30
12x8	32.5
12x10	33.5
16x10	38
16x12	40
20x12	43
20x16	45.5
22x16	45.5
22x20	47
25x20	49
25x22	49.5
30x22	51.5
30x25	51.5
38x25	53
38x30	53

1. Calculated dimensions for this feature were derived from Table C1.

A.6 90 DEGREE SWIVEL JUMP CONNECTOR DIMENSIONS

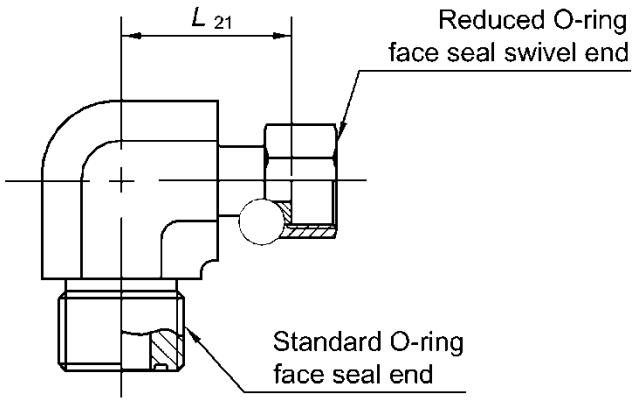


Figure A6 - Swivel elbow connector with reduced swivel end

Table A6 - Dimensions of 90 degree swivel jump connectors(1)

dimensions in millimeters

Reduced O-Ring Face Seal Swivel to Standard Face Seal Ordering Size Code	L_{21}(2) ±1.5
8x6	27
10x6	27
10x8	28
12x8	34
12x10	35
16x10	34
16x12	37
20x12	40
20x16	44
22x16	50
22x20	52.5
25x20	52.5
25x22	52.5
30x22	57
30x25	58
38x25	61
38x30	61

1. Applicable to the following connectors: Swivel Branch Tee, 52M0433, Swivel Run Tee, 52M0432, Swivel 90 Adjustable Stud Elbow, 52M0296.
2. Calculated dimensions for this table were derived from Table C5.

A.7 STRAIGHT SWIVEL JUMP CONNECTOR DIMENSIONS

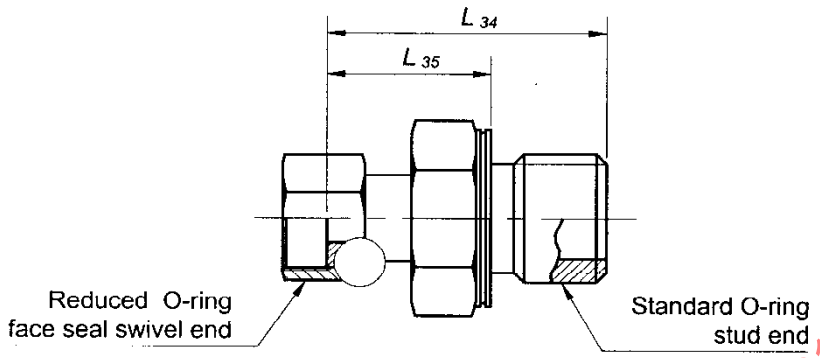


Figure A7a - Straight stud swivel with reduced swivel end

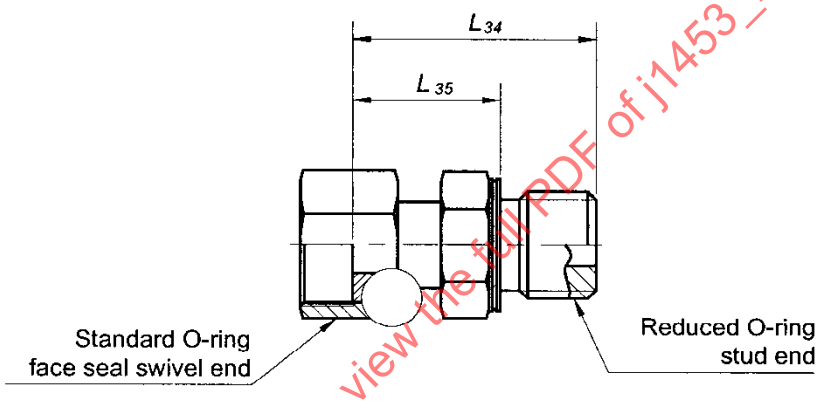


Figure A7b - Straight stud swivel with reduced stud end