

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

RATIONALE

This revision of the standard adds size -32, corrects Table 2, adds the metric hex as the preferred option for new design, standardizes the nomenclature used in the tables and reorganizes tables from landscape to portrait mode.

In an effort to standardize within a global market and ensuring that companies can remain competitive in an international market, it is the intent to convert to metric hex sizes which will:

- lead to one global system
- guide users to preferred system
- reduce complexity
- eliminate duplications

The optional inch hexes now contain the note "NOT TO BE USED FOR NEW DESIGN" in accordance with the Metric Hex Resolution approved during the March 2008 FCCTC meeting.

INCH HEX DIMENSIONS OF PARTS WILL BE MOVED FROM THE MAIN DOCUMENT TO AN INFORMATIVE ANNEX AFTER 2013 AND ONLY METRIC HEX DIMENSIONS OF PARTS WILL BE INCLUDED IN THE MAIN DOCUMENT

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. The February 2007 revision of SAE J1453 adopted 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, since February 2007, 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 Sleeves, 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 Sleeves, 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 the exception that, starting with the February 2007 edition, it includes the half-dovetail as the standard groove design. Parts supplied to SAE J1453 JUN2002 shall now be supplied to SAE J1453-3.

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

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

Copyright © 2012 SAE International

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

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org

SAE WEB ADDRESS: <http://www.sae.org>

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/J1453/3_201206

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

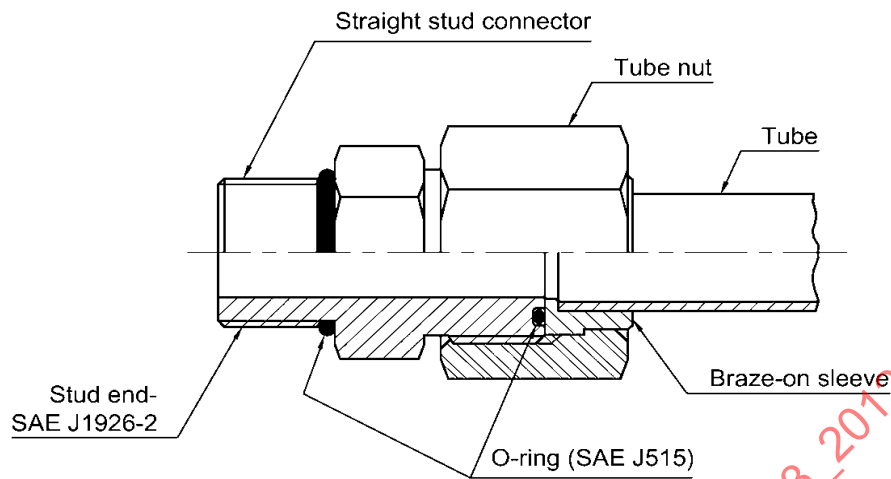


FIGURE 1 - TYPICAL REPRESENTATION OF O-RING FACE SEAL (ORFS) CONNECTION
(SEE SAE J1453-2 FOR ISO 6149-2 METRIC STUD ENDS)

SAENORM.COM : Click to view the full PDF of J1453-3_201206

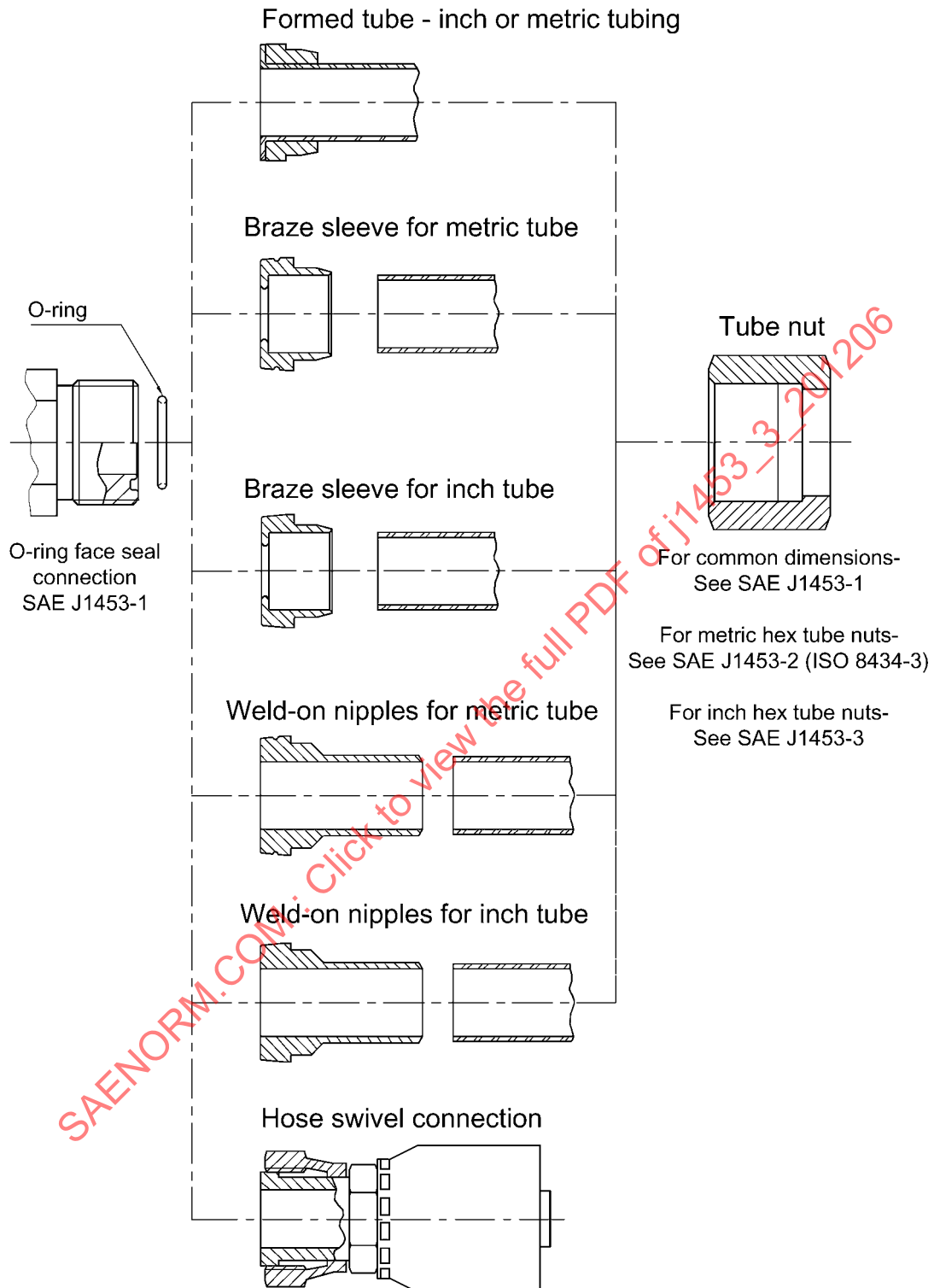


FIGURE 2 - TYPICAL O-RING FACE SEAL CONNECTION TO INCH OR METRIC TUBE OR HOSE

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)

Inch Tube OD Dash Size ⁽¹⁾	Inch Tube OD in	Inch Tube OD mm	Metric Tube OD mm	O-Ring Face Seal End Thread ⁽²⁾ in	O-Ring Face Seal and Swivel End Tube Nut Hex in	O-Ring Face Seal End Qualification ⁽³⁾ Test Torque N·m
- 4	0.250	6.35	6	9/16-18	11/16	25
- 5	0.312	7.94	8	5/8-18	3/4	30
- 6	0.375	9.52	10	11/16-16	13/16	40
- 8	0.500	12.7	12	13/16-16	15/16	55
-10	0.625	15.88	16	1-14	1-1/8	60
-12	0.750	19.05	20	1-3/16-12	1-3/8	90
-14	0.875	22.22	22	1-5/16-12	1-1/2	115
-16	1.000	25.4	25	1-7/16-12	1-5/8	125
-20	1.250	31.75	30	1-11/16-12	1-7/8	170
-24	1.500	38.1	38	2-12	2-1/4	200
-32	2.000	50.8	50	2-1/2-12	2-7/8	510

Inch Tube OD Dash Size ⁽¹⁾	Inch Tube OD in	Inch Tube OD mm	Metric Tube OD mm	Port Stud End SAE J1926-2 (ISO 11926-2) Thread ⁽³⁾ in	Port Stud End SAE J1926-2 (ISO 11926-2) Adjustable 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 Nonadjustable Stud End MPa	Connector Working Pressure, Adjustable Stud End MPa
- 4	0.250	6.35	6	7/16-20	5/8	20 ⁽⁵⁾	63	41.3
- 5	0.312	7.94	8	1/2-20	11/16	40	63	41.3
- 6	0.375	9.52	10	9/16-18	3/4	45	63	41.3
- 8	0.500	12.7	12	3/4-16	15/16	85	63	41.3
-10	0.625	15.88	16	7/8-14	1-1/16	100	41.3	41.3
-12	0.750	19.05	20	1-1/16-12	1-3/8	170	41.3	41.3
-14	0.875	22.22	22	1-3/16-12	1-1/2	235	41.3	38.0
-16	1.000	25.4	25	1-5/16-12	1-5/8	270	41.3	34.5
-20	1.250	31.75	30	1-5/8-12	1-7/8	285	27.5	27.5
-24	1.500	38.1	38	1-7/8-12	2-1/8	370	27.5	20.7
-32	2.000	50.8	50	2-1/2-12	2-3/4	500	21	17.5

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 tube.
For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size 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 standard and ISO 6149-2 take precedence)

Metric Tube OD ⁽¹⁾ mm	Inch Tube OD Dash Size ⁽¹⁾	Inch Tube OD mm	O-Ring Face Seal End Thread in	O-Ring Face Seal and Swivel End Tube Nut Hex mm	O-Ring Face Seal End Qualification Test Torque ⁽²⁾ N·m
6	– 4	6.35	9/16-18	17	25
8	– 5	7.94	5/8-18	19	30
10	– 6	9.52	11/16-16	22	40
12	– 8	12.7	13/16-16	24	55
16	–10	15.88	1-14	30	60
20	–12	19.05	1-3/16-12	36	90
22	–14	22.23	1-5/16-12	41	115
25	–16	25.4	1-7/16-12	41	125
30	–20	31.75	1-11/16-12	50	170
38	–24	38.1	2-12	60	200
50	–32	50.8	2-1/2-12	75	510

Metric Tube OD ⁽¹⁾ mm	Inch Tube OD Dash Size ⁽¹⁾	Inch Tube OD mm	Port Stud End ISO 6149-2 Thread ⁽⁴⁾ mm	Port Stud End ISO 6149-2 Nut Hex mm	Port Stud End ISO 6149-2 Qualification Test Torque ⁽²⁾ N·m	Connector Working Pressure Face Seal ⁽³⁾ and Nonadjustable Stud End MPa	Connector Working Pressure, Adjustable Stud End MPa
6	– 4	6.35	M12X1.5	17	35	63	40
8	– 5	7.94	M14X1.5	19	45	63	40
10	– 6	9.52	M16X1.5	22	55	63	40
12	– 8	12.7	M18X1.5	24	70	63	40
16	–10	15.88	M22X1.5	27	100	40	40
20	–12	19.05	M27X2	32	170	40	40
22	–14	22.23	M30X2	36	235	40	35
25	–16	25.4	M33X2	41	310	40	35
30	–20	31.75	M42X2	50	330	25	25
38	–24	38.1	M48X2	55	420	25	20
50	–32	50.8	M60X2	65	500	21	16

1. The size symbol for all tube sizes shall be the tube OD in millimeters, except dash size symbols may be used for braze sleeve and weld nipple for inch tubing.
2. Torque values listed in Table 2 are for controlled testing to establish compliance to the performance requirements as set forth in paragraph 4.2. Recommended assembly torques by manufacturers may vary from those shown.
3. This covers unions, caps, bulkheads, swivels and plugs.
4. Screw threads on the port end of the connectors shall be metric per ISO 261.

TABLE OF CONTENTS

1.	SCOPE.....	9
1.1	Purpose.....	9
1.2	Field of Application.....	9
2.	REFERENCES.....	11
2.1	Applicable Documents	11
3.	DEFINITIONS	12
4.	REQUIREMENTS	13
4.1	General	13
4.2	Dimensional Specifications	13
4.3	Stud End Dimensions	13
4.4	Across Flats	13
4.5	Hex Tolerances Across Flats	14
4.6	Hex Chamfer	14
4.7	Screw Threads.....	14
4.8	Working Pressure	14
4.9	Tube Sizes	15
4.10	Plating	16
4.11	Passage Tolerance	16
4.12	Angular Tolerance.....	16
5.	TEST REQUIREMENTS AND QUALITY PROCEDURES	16
5.1	Test Requirements.....	16
5.2	Performance Tests.....	16
5.3	Test Pressures.....	16
6.	PACKAGING AND MARKING	18
6.1	Marking	18
6.2	Protection	18
6.3	SAE J846 Ordering Designation, Part Identification Number (PIN)	18
7.	NOTES.....	20
7.1	Assembly Information.....	20
7.2	Identification Statement	20
7.3	Procurement Information	20
7.4	Marginal Indicia.....	51
APPENDIX A	INSTRUCTIONS AND EXAMPLES FOR CALCULATING THE DIMENSIONS FOR SPECIAL SIZE (JUMP) CONNECTORS	52
APPENDIX B	REDUCTION FACTOR TABLES FOR JUMP FITTINGS.....	59
APPENDIX C	ASSEMBLY INSTRUCTIONS FOR ADJUSTABLE STYLE CONNECTORS IN STRAIGHT THREAD O-RING PORT	66
APPENDIX D	DIMENSIONS FOR JUMP SIZE CONNECTORS	67
FIGURE 1	TYPICAL REPRESENTATION OF O-RING FACE SEAL (ORFS) CONNECTION (SEE SAE J1453-2 FOR ISO 6149-2 METRIC STUD ENDS)	2
FIGURE 2	TYPICAL O-RING FACE SEAL CONNECTION TO INCH OR METRIC TUBE OR HOSE	3
FIGURE 3	TYPICAL CONNECTION NONADJUSTABLE CONNECTOR TO HYDRAULIC HOSE.....	9
FIGURE 4	TYPICAL CONNECTION ADJUSTABLE STYLE CONNECTOR TO TUBE.....	10
FIGURE 5	TYPICAL CONNECTION STRAIGHT STUD WITH 90 DEGREE SWIVEL ELBOW OPTIONAL CONFIGURATION TO GAIN FULL PERFORMANCE RATING	10
FIGURE 6	ILLUSTRATION OF TEE CONNECTOR SHOWING RUN AND BRANCH	12
FIGURE 7	HEX DETAILS	14
FIGURE 8	CONNECTOR STYLE DESIGNATION	18
FIGURE 9	CONNECTOR STYLE AND MATERIAL DESIGNATION.....	19

FIGURE 10	CONNECTOR STYLE, MATERIAL, AND SIZE DESIGNATION.....	19
FIGURE 11A	DIMENSIONS OF BRAZE-ON BRAZE-ON SLEEVE – STYLE A.....	21
FIGURE 11B	DIMENSIONS OF BRAZE-ON BRAZE-ON SLEEVE – STYLE B.....	21
FIGURE 12A	DIMENSIONS OF BRAZE-ON REDUCING AND EXPANDING SLEEVE	22
FIGURE 13A	DIMENSIONS OF BRAZE-ON REDUCING AND EXPANDING SLEEVE	24
FIGURE 14	90 DEGREE ADJUSTABLE STUD ELBOW (52M0220 AND 520220) REFER TO TABLE 12	25
FIGURE 15	90 DEGREE ADJUSTABLE STUD ELBOW, LONG (52M1520 AND 521520) REFER TO TABLE 12	25
FIGURE 16	45 DEGREE ADJUSTABLE STUD ELBOW (52M0320 AND 520320) REFER TO TABLE 12	25
FIGURE 17	ADJUSTABLE STUD BRANCH TEE (52M0429 AND 520429) REFER TO TABLE 13	27
FIGURE 18	ADJUSTABLE STUD CROSS (52M0520 AND 520520) REFER TO TABLE 13.....	27
FIGURE 19	ADJUSTABLE STUD RUN TEE (52M0428 AND 520428) REFER TO TABLE 13.....	28
FIGURE 20	STUD STRAIGHT (52M0120 AND 520120) REFER TO TABLE 14.....	30
FIGURE 21	STUD STRAIGHT LONG - LONG HEX (52M1820 AND 521820)-REFER TO TABLE 14.....	30
FIGURE 22	STUD STRAIGHT LONG (52M1720 AND 521720)-REFER TO TABLE 14.....	30
FIGURE 23	BULKHEAD STRAIGHT (520601) REFER TO TABLE 15	32
FIGURE 24	90 DEGREE BULKHEAD ELBOW (520701) REFER TO TABLE 15.....	32
FIGURE 25	BULKHEAD RUN TEE (520958) REFER TO TABLE 15	33
FIGURE 26	45 DEGREE BULKHEAD ELBOW (520801) REFER TO TABLE 15.....	33
FIGURE 27	BULKHEAD BRANCH TEE (520959) REFER TO TABLE 15.....	34
FIGURE 28	BULKHEAD LOCKNUT (520118) REFER TO TABLE 15.....	34
FIGURE 29	UNION STRAIGHT (520101) REFER TO TABLE 16.....	36
FIGURE 30	90 DEGREE UNION ELBOW (520201) REFER TO TABLE 16.....	36
FIGURE 31	UNION TEE (520401) REFER TO TABLE 16.....	36
FIGURE 32	UNION CROSS (520501) REFER TO TABLE 16	37
FIGURE 33	SWIVEL 90 DEGREE ELBOW (520221) REFER TO TABLE 17.....	38
FIGURE 34	SWIVEL BRANCH TEE (520433) REFER TO TABLE 17.....	38
FIGURE 35	SWIVEL RUN TEE (520432) REFER TO TABLE 17	39
FIGURE 36	SWIVEL 45 DEGREE ELBOW (520321) REFER TO TABLE 17.....	39
FIGURE 37	SWIVEL 90 DEGREE ADJUSTABLE STUD ELBOW (52M0281 AND 520281) REFER TO TABLE 18... 41	41
FIGURE 38	STUD STRAIGHT SWIVEL (52M0181 AND 520181) REFER TO TABLE 18	41
FIGURE 39	BRAZE-ON STRAIGHT (INCH TUBE 520104) (METRIC TUBE 5201M04) REFER TO TABLE 19	43
FIGURE 40	PLUG (520109) REFER TO TABLE 20	45
FIGURE 41	CAP ASSEMBLY (520112) REFER TO TABLE 21	46
FIGURE 42	REDUCER WITH NUT STYLE A (520123) AND STYLE B (520123B).....	47
FIGURE 43	REDUCER WITHOUT NUT (520123) REFER TO TABLE 23.....	49
FIGURE A1	STUD END REDUCTION	53
FIGURE A2	TUBE END REDUCTION	54
FIGURE A3	STUD STRAIGHT CONNECTOR WITH REDUCED O-RING STUD END (520120) REFER TO TABLE B2	55
FIGURE A4	STUD STRAIGHT CONNECTOR WITH REDUCED FACE SEAL END (520120)	56
FIGURE A5	SHAPED FACE SEAL CONNECTOR WITH REDUCED O-RING STUD END (520220).....	57
FIGURE A6	SHAPED FACE SEAL CONNECTOR WITH REDUCED FACE SEAL END (520220).....	58
FIGURE B1	STUD STRAIGHT CONNECTOR WITH REDUCED O-RING FACE SEAL END (520120) REFER TO TABLE B1	59
FIGURE B2	REDUCER UNION (520101) REFER TO TABLE B1.....	59
FIGURE B3	STUD STRAIGHT CONNECTOR WITH REDUCED O-RING STUD END (520120)	61
FIGURE B4	SHAPED STUD END CONNECTORS WITH SMALLER FACE SEAL END (520220) REFER TO TABLE B3	62
FIGURE B5	SHAPED FACE SEAL CONNECTORS WITH SMALLER FACE SEAL END (520201) REFER TO TABLE B3	62
FIGURE B6	90 DEGREE ADJUSTABLE STRAIGHT THREAD ELBOW WITH REDUCED O-RING STUD END (520220) REFER TO TABLE B4.....	63
FIGURE B7	90 DEGREE SWIVEL ELBOW WITH REDUCED SWIVEL END (520221) REFER TO TABLE B5.....	64
FIGURE B8	SWIVEL STUD CONNECTOR (520181) REFER TO TABLE B5.....	64
FIGURE D1A	90 DEGREE ADJUSTABLE JUMP STUD ELBOW WITH REDUCED ORFS END.....	67
FIGURE D1B	90 DEGREE ADJUSTABLE JUMP STUD ELBOW WITH REDUCED STUD END.....	67
FIGURE D2A	45 DEGREE ADJUSTABLE JUMP STUD ELBOW WITH REDUCED ORFS END.....	69
FIGURE D2B	45 DEGREE ADJUSTABLE JUMP STUD ELBOW WITH REDUCED STUD END.....	69
FIGURE D3A	STRAIGHT-STUD CONNECTOR WITH REDUCED ORFS END	71

FIGURE D3B	STRAIGHT-STUD CONNECTOR WITH REDUCED STUD END.....	71
FIGURE D4A	LONG STRAIGHT STUD CONNECTOR WITH REDUCED ORFS END	73
FIGURE D4B	LONG STRAIGHT STUD CONNECTOR WITH REDUCED STUD END.....	73
FIGURE D5	STRAIGHT UNION CONNECTOR WITH ONE END REDUCED	75
FIGURE D6	SWIVEL ELBOW CONNECTOR WITH REDUCED SWIVEL END.....	76
FIGURE D7A	STRAIGHT STUD SWIVEL WITH REDUCED SWIVEL END.....	77
FIGURE D7B	STRAIGHT STUD SWIVEL WITH REDUCED STUD END.....	77
TABLE 1	QUICK REFERENCE CHART: TUBE OD TO INCH PORT STUD END SIZES, HEX NUT SIZES, QUALIFICATION TEST TORQUES AND WORKING PRESSURES.....	4
TABLE 2	QUICK REFERENCE CHART: TUBE OD TO METRIC PORT STUD END SIZES, HEX NUT SIZES, QUALIFICATION TEST TORQUES AND CONNECTOR WORKING PRESSURES	5
TABLE 3	DIMENSIONS FOR HEX TOLERANCES.....	14
TABLE 4	WORKING PRESSURES FOR O-RING FACE SEAL CONNECTORS.....	15
TABLE 5	INCH AND METRIC TUBE SIZE LIMITS.....	15
TABLE 6	TEST PRESSURES FOR O-RING FACE SEAL CONNECTORS WITH SAE J1926-2 STUD ENDS.....	17
TABLE 7	CONNECTOR QUALIFICATION TEST TORQUES	17
TABLE 8	ORDERING CODE EXAMPLES	19
TABLE 9	DIMENSIONS OF BRAZE-ON SLEEVE FOR INCH AND METRIC TUBES	21
TABLE 10	DIMENSIONS OF BRAZE-ON REDUCING AND EXPANDING SLEEVES FOR INCH AND METRIC TUBES.....	23
TABLE 11	DIMENSIONS OF INCH HEX TUBE NUT	24
TABLE 12	DIMENSIONS OF ADJUSTABLE STUD ELBOW CONNECTORS WITH SAE J1926-2 STUD ENDS	26
TABLE 13	DIMENSIONS OF ADJUSTABLE STUD TEE AND CROSS CONNECTORS WITH SAE J1926-2 STUD ENDS	29
TABLE 14	DIMENSIONS OF STRAIGHT STUD CONNECTORS WITH SAE J1926-2 STUD ENDS.....	31
TABLE 15	DIMENSIONS OF INCH HEX BULKHEAD CONNECTORS.....	35
TABLE 16	DIMENSIONS OF INCH HEX UNION STRAIGHT, 90 DEGREE UNION ELBOW, UNION TEE AND UNION CROSS	37
TABLE 17	DIMENSIONS OF INCH HEX SWIVEL CONNECTORS	40
TABLE 18	DIMENSIONS OF SWIVEL STUD CONNECTORS	42
TABLE 19	DIMENSIONS OF INCH BRAZE-ON STRAIGHT CONNECTORS.....	43
TABLE 20	DIMENSIONS OF INCH HEX PLUGS.....	45
TABLE 21	DIMENSIONS OF INCH HEX CAP ASSEMBLY	46
TABLE 22	DIMENSIONS OF INCH HEX FACE SEAL REDUCER WITH NUT	48
TABLE 23	DIMENSIONS OF FACE SEAL REDUCER WITHOUT NUT	50
TABLE A1	STANDARD PART SIZE FOR TUBE AND STUD SIZE CONNECTIONS.....	52
TABLE B1	REDUCTION FACTORS FOR STRAIGHT CONNECTORS WITH SMALLER O-RING FACE SEAL END ⁽¹⁾	60
TABLE B2	L ₉ , FOR STRAIGHT STUD CONNECTORS WITH LARGER FACE SEAL END ⁽¹⁾⁽³⁾	61
TABLE B3	REDUCTION FACTORS FOR FACE SEAL END ON SHAPED CONNECTORS WITH SMALLER FACE SEAL END ⁽¹⁾	62
TABLE B4	REDUCTION FACTORS FOR L ₁₀ LENGTH ADJUSTABLE O-RING BOSS END ON SHAPED CONNECTORS ⁽¹⁾	63
TABLE B5	REDUCTION FACTORS L ₂₁ , L ₃₄ , AND L ₃₅ FOR SWIVEL END ON SHAPED AND STRAIGHT CONNECTORS ⁽¹⁾⁽²⁾	65
TABLE D1	DIMENSIONS OF 90 DEGREE ADJUSTABLE ELBOW, TEE, AND CROSS JUMP CONNECTORS	68
TABLE D2	DIMENSIONS OF 45 DEGREE ADJUSTABLE ELBOW JUMP CONNECTORS.....	70
TABLE D3	DIMENSIONS OF STRAIGHT STUD JUMP CONNECTORS	72
TABLE D4	DIMENSIONS OF LONG, STRAIGHT STUD JUMP CONNECTORS	74
TABLE D5	DIMENSIONS OF STRAIGHT UNION JUMP CONNECTORS.....	75
TABLE D6	DIMENSIONS OF 90 DEGREE SWIVEL JUMP CONNECTORS ⁽¹⁾	76
TABLE D7	DIMENSIONS OF STRAIGHT SWIVEL JUMP CONNECTORS ⁽¹⁾	78

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 50 mm. SAE J1453-3 covers the requirements for O-ring face seal connectors to inch stud ends along with the associated adapters, bulkhead and union connectors. Inch hex dimensions of parts will be moved from the main document to an informative annex after 2013.

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.

The rated working pressure of a fluid conductor assembly using SAE J1453 hose stem connections or formed tube or braze-on tube connections shall not exceed rated working pressure of the lowest rated component thereof.

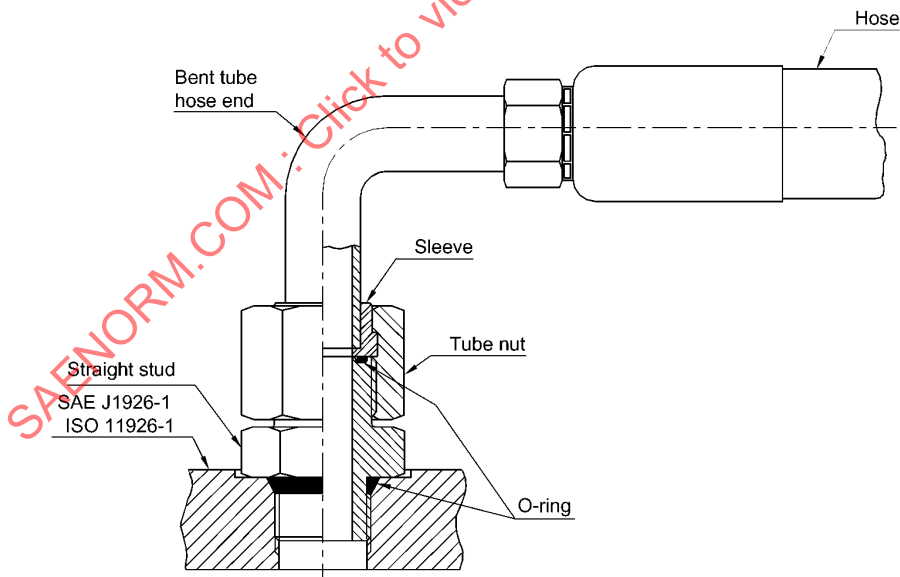


FIGURE 3 - TYPICAL CONNECTION NONADJUSTABLE CONNECTOR TO HYDRAULIC HOSE

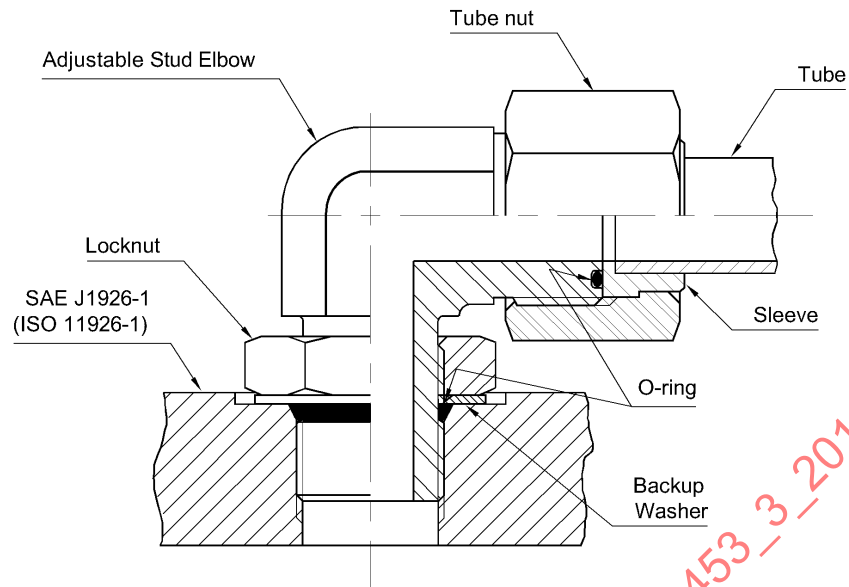


FIGURE 4 - TYPICAL CONNECTION ADJUSTABLE STYLE CONNECTOR TO TUBE

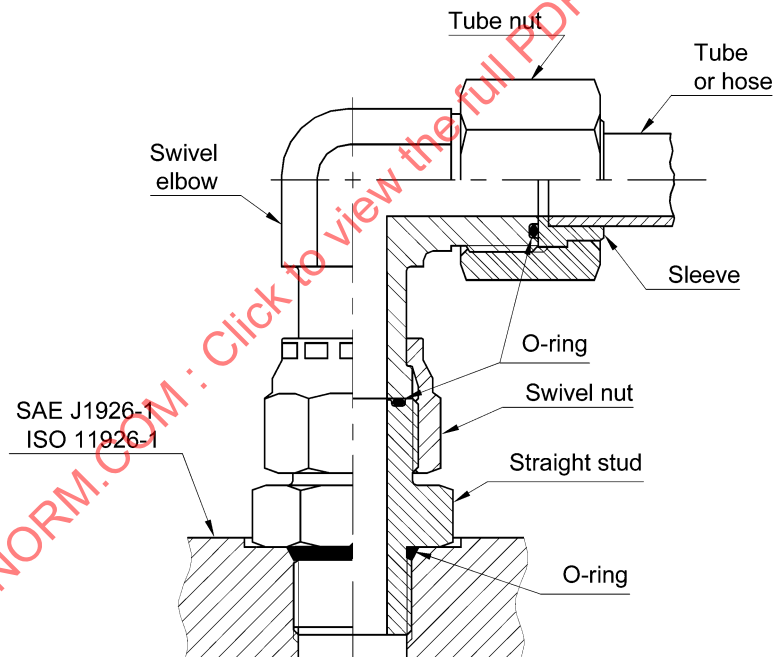


FIGURE 5 - TYPICAL CONNECTION STRAIGHT STUD WITH 90 DEGREE SWIVEL ELBOW
OPTIONAL CONFIGURATION TO GAIN FULL PERFORMANCE RATING

2. REFERENCES

2.1 Applicable Documents

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 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 Hydraulic O-Ring Materials, Properties, and Sizes for Metric and Inch Stud Ends, Face Seal Fitting 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, Caps, and Connectors with ISO 6149-2 Metric Stud Ends
SAE J1926-2	Connections for General Use and Fluid Power - Ports and Stud Ends with ASME B1.1 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 American National Standards Institute, 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
ISO 19879	Metallic tube connections for fluid power and general use - Test methods for hydraulic fluid power connections

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.

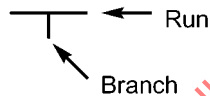


FIGURE 6 - ILLUSTRATION OF TEE CONNECTOR
SHOWING RUN AND BRANCH

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 NON-PREFERRED

Parts which are low volume, considered specials and their use require 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 wrench size across flats with minus tolerance only. For metric stock sizes for parts other than stud connectors, see SAE J1453-2.

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.

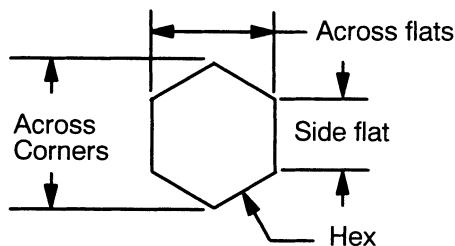


FIGURE 7 - HEX DETAILS

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	25.4	0.4
25.4	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 for 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 Dash Size ⁽¹⁾	Inch Tube OD mm	Metric Tube 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	12.7	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	25.4	25	41.3	34.5
-20	31.75	30	27.5	27.5
-24	38.1	38	27.5	20.7
-32	50.8	50	21	17.5

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 N/m² = 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.)

4.9 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 OD Dash Size ⁽¹⁾⁽²⁾	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	12.7	12.6	12.8	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	25.4	25.3	25.5	25	24.9	25.1
-20	31.75	31.6	31.9	30	29.85	30.15
-24	38.1	37.95	38.25	38	37.85	38.15
-32	50.8	50.65	50.95	50	49.85	50.15

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 tube.
For example: -4 = $4/16 = 0.25 = 6.35$ mm inch tube size 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 over-torque tests when tested per ISO 19879. 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 (5201M15 or 520115), Figure 13 (520110), Figure 14 (52M0220 or 520220), Figure 20 (52M0120 or 520120), Figure 33 (520221) and Figure 39 (520104 or 5201M04).

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

Units in Megapascals (MPa)⁽¹⁾

Inch Tube OD Dash Size ⁽²⁾	Inch Tube OD mm	Metric Tube OD mm	Face Seal ⁽³⁾ and Nonadjustable Stud End Connectors Test Proof	Face Seal ⁽³⁾ and Nonadjustable Stud End Connectors Test Burst	Face Seal and Nonadjustable Stud End Connectors Test ⁽³⁾⁽⁴⁾ Impulse	Connectors With Adjustable Stud End Test Proof	Connectors With Adjustable Stud End Test Burst	Connectors With Adjustable Stud End Test Impulse ⁽⁴⁾
- 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	12.7	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	25.4	25	82.5	165	55	69	138	46
-20	31.75	30	55	110	36.6	55	110	36.6
-24	38.1	38	55	110	36.6	41.3	82.5	27.5
-32	50.8	50	42	84	28	35	70	23.5

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

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 tube.

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

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

4. Cyclic endurance test pressure.

TABLE 7 - CONNECTOR QUALIFICATION TEST TORQUES

Inch Tube OD Dash Size ⁽²⁾	Inch Tube OD mm	Metric 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
- 4	6.35	6	7/16-20	25 ⁽³⁾	9/16-18	25	32
- 5	7.94	8	1/2-20	40	5/8-18	30	45
- 6	9.52	10	9/16-18	45	11/16-16	35	54
- 8	12.7	12	3/4-16	85	13/16-16	55	81
-10	15.88	16	7/8-14	100	1-14	60	136
-12	19.05	20	1-1/16-12	170	1-3/16-12	90	180
-14	22.22	22	1-3/16-12	235	1-5/16-12	115	230
-16	25.4	25	1-5/16-12	270	1-7/16-12	125	270
-20	31.75	30	1-5/8-12	285	1-11/16-12	170	380
-24	38.1	38	1-7/8-12	370	2-12	200	450
-32	50.8	50	2-1/2-12	540	2-1/2-12	510	640

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 tube.

For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size 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.

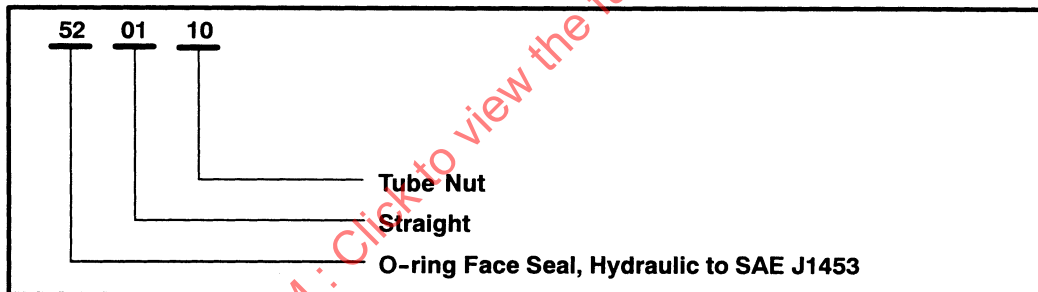
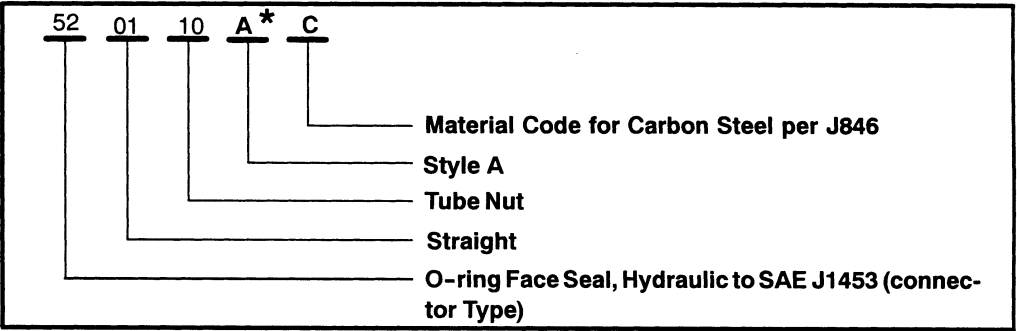


FIGURE 8 - CONNECTOR STYLE DESIGNATION

6.3.2 Style and Material Modifiers

Modifiers are added to the code to provide additional information. 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.) 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 and the port end size for stud connectors. These are added to the connector designation and modifiers. Example using a dash 12 ORES to a dash 12 inch O-ring stud end on a straight connector in steel with metric hex, 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:

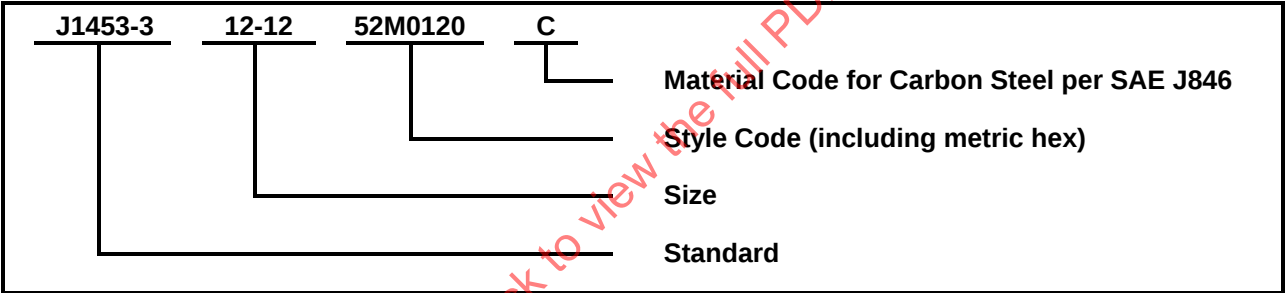


FIGURE 10 - CONNECTOR STYLE, MATERIAL, AND SIZE DESIGNATION

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

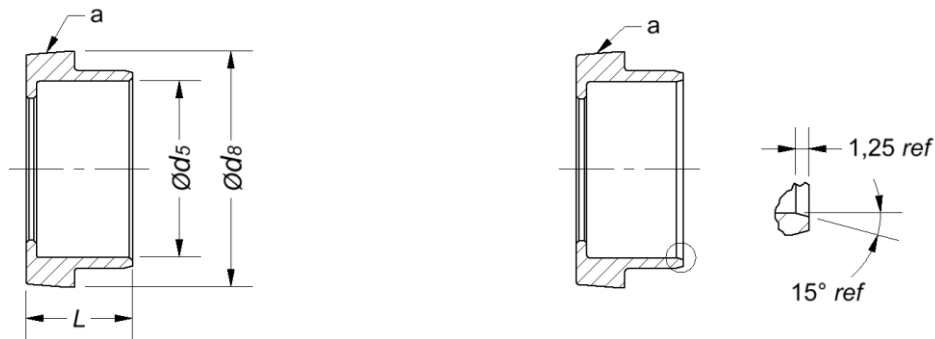
Use the following statement in test reports, catalogues and sales literature when electing to comply with this part of SAE J1453-3:

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



a. Location of identification groove for sleeve used with metric tube.

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

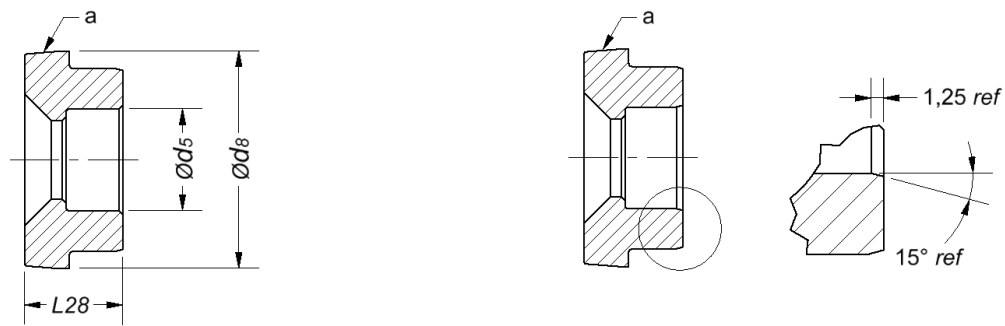
FIGURE 11A - DIMENSIONS OF BRAZE-ON SLEEVE – STYLE A
(5201M15A AND 520115A)

FIGURE 11B - DIMENSIONS OF BRAZE-ON SLEEVE – STYLE B
(5201M15B AND 520115B)

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

Inch Tube ⁽¹⁾ Ordering Size Code ⁽²⁾ Face Tube Seal – Side	Inch Tube OD mm ⁽³⁾	Inch Tube d ₅ ⁽⁴⁾	Metric Tube Ordering Size Code ⁽⁵⁾ Face Tube Seal x Side	Metric Tube OD	Metric Tube 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
32-32	50.8	51	50x50	50	50.2	61.1	16.5

1. Metric tubes 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 tube.
For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size 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.



a. Location of identification groove for sleeve used with metric tube.

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

FIGURE 12A - BRAZE-ON REDUCING AND EXPANDING SLEEVE (5201M15A AND 520115A)

FIGURE 12B - BRAZE-ON REDUCING AND EXPANDING SLEEVE (5201M15B AND 520115B)

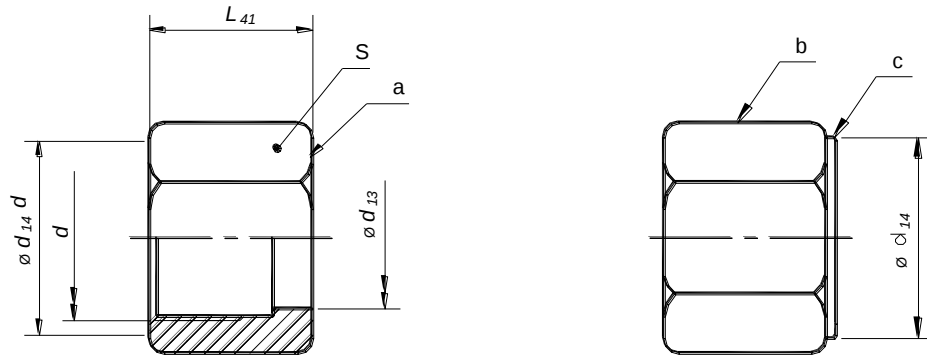
SAENORM.COM : Click to view the full PDF of J1453-3-201206

TABLE 10 - DIMENSIONS OF BRAZE-ON REDUCING AND EXPANDING SLEEVES FOR INCH AND METRIC TUBES

Dimensions in millimeters (mm)

Inch			Metric			Metric		
Tube Ordering Size Code ⁽³⁾			Tube Ordering Size Code ⁽²⁾			Tube d ₅ ⁽¹⁾		
Face Seal	Tube — Side	Inch Tube OD	Inch Tube d ₅ ⁽¹⁾ ref.	Face Seal	Tube x Side	Metric Tube OD	d ₈ ref.	L ₂₈ ref.
5-4		6.35	6.5	8 x 6		6	6.15	10.5
6-4		6.35	6.5	10 x 6		6	6.15	10.5
6-5		7.94	8.09	10 x 8		8	8.15	10.5
8-4		6.35	6.5	12 x 6		6	6.15	12
8-5		7.94	8.09	12 x 8		8	8.15	12
8-6		9.52	9.68	12 x 10		10	10.15	12
10-4		6.35	6.5	16 x 6		6	6.15	13.5
10-5		7.94	8.09	16 x 8		8	8.15	13.5
10-6		9.52	9.68	16 x 10		10	10.15	13.5
10-8		12.7	12.85	16 x 12		12	12.15	13.5
12-4		6.35	6.5	20 x 6		6	6.15	14.5
12-5		7.94	8.09	20 x 8		8	8.15	14.5
12-6		9.52	9.68	20 x 10		10	10.15	14.5
12-8		12.7	12.85	20 x 12		12	12.15	14.5
12-10		15.88	16.03	20 x 16		16	16.13	14.5
14-5		7.94	8.09	22 x 8		8	8.15	14.5
14-6		9.52	9.68	22 x 10		10	10.15	14.5
14-8		12.7	12.85	22 x 12		12	12.15	14.5
14-10		15.88	16.03	22 x 16		16	16.15	14.5
14-12		19.05	19.23	22 x 20		20	20.18	15.5
16-8		12.7	12.85	25 x 12		12	12.15	15.5
16-10		15.88	16.03	25 x 16		16	16.15	15.5
16-12		19.05	19.23	25 x 20		20	20.18	17
16-14		22.23	22.4	25 x 22		22	22.18	17
EXPANDING SLEEVE								
12-14 ⁽⁵⁾		22.23	22.4	20 x 22		22	22.18	16.5

1. Actual bore size and depth depends on joining process. Dimensions given 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 tube.
For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size 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	d ₁₄ Tol.	L ₄₁ ⁽¹⁾ ref.	S Inch Hex ^{(4) (5)}
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	12.7	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	25.4	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	38.1	38	2 - 12	44	56.6	+0 / –2	27.5	57.15
32	–32	50.8	50	2-1/2-12	56.35	72.5	+0 / –2	33	73.03
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 tube.

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

4. For metric hex tube nut see SAE J1453-2.

5. INCH HEX TUBE NUTS ARE NOT TO BE USED FOR NEW DESIGN.

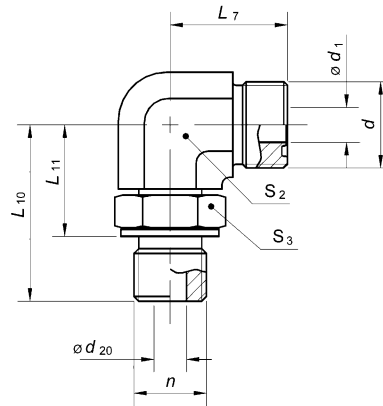


FIGURE 14 - 90 DEGREE ADJUSTABLE STUD ELBOW
(52M0220 AND 520220)
REFER TO TABLE 12

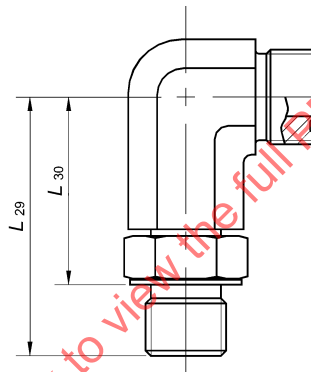


FIGURE 15 - 90 DEGREE ADJUSTABLE STUD ELBOW, LONG
(52M1520 AND 521520)
REFER TO TABLE 12

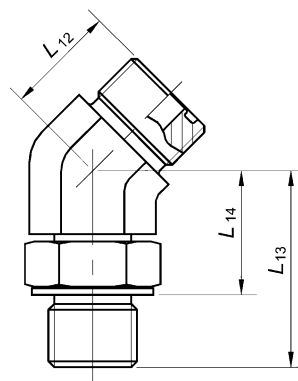


FIGURE 16 - 45 DEGREE ADJUSTABLE STUD ELBOW
(52M0320 AND 520320)
REFER TO TABLE 12

TABLE 12 - DIMENSIONS OF ADJUSTABLE STUD ELBOW CONNECTORS WITH SAE J1926-2 STUD ENDS

Dimensions in millimeters

Ordering Size Code ⁽³⁾	Inch Tube OD Dash Size ⁽³⁾	Inch Tube OD	Metric Tube OD	d ⁽²⁾ Thread	n 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
4 - 4	- 4	6.35	6	9/16-18	7/16-20	4.5	4.5	21.5	33	22	16	30
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
6 - 6	- 6	9.52	10	11/16-16	9/16-18	6.5	7.5	25	37	25	19	33
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
10 - 10	-10	15.88	16	1-14	7/8-14	12.5	12.5	33.5	50	34	23.5	44.5
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
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
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
20 - 20	-20	31.75	30	1-11/16-12	1-5/8-12	26	27.5	44.5	62	44	32	53.5
24 - 24	-24	38.1	38	2-12	1-7/8-12	32	33.5	49	66	47.5	37	53.5
32 - 32	-32	50.8	50	2-1/2-12	2-1/2-12	45	40	70	78	59.5	44.5	54

Ordering Size Code ⁽³⁾	Inch Tube OD Dash Size ⁽³⁾	Inch Tube OD	Metric Tube OD	L ₁₄ ref.	L ₂₉ ±1	L ₃₀ ref.	S ₂ Metric Forging min	S ₂ Metric Barstock max	S ₃ Metric Hex	S ₂ Inch Forging min ⁽⁷⁾	S ₂ Inch Barstock max ⁽⁷⁾	S ₃ Inch Hex ⁽⁷⁾
4 - 4	- 4	6.35	6	19	56.5	45.5	14	17	17	14.29	19.05	15.88
5 - 5	- 5	7.94	8	20.5	56.5	45.5	17	22	17	17	25.4	17.46
6 - 6	- 6	9.52	10	21	66.5	54	17	27	19	17	25.4	19.05
8 - 8	- 8	12.7	12	23	75	61	19	30	24	19.05	30.16	23.81
10 - 10	-10	15.88	16	28.5	89	73	24	36	27	26.99	33.34	26.99
12 - 12	-12	19.05	20	31.5	101	82.5	27	41	36 ⁽⁴⁾	30.16	38.1	34.93
14 - 14	-14	22.2	22	34	108	89.5	36	46	41 ⁽⁵⁾	36.51	47.62	38.1
16 - 16	-16	25.4	25	34	114.5	96	36	46	41	36.51	47.62	41.28
20 - 20	-20	31.75	30	35	126.5	107.5	41	55	50 ⁽⁶⁾	41.28	57.15	47.63
24 - 24	-24	38.1	38	35	139	120.5	50	60	55	47.62	63.50	53.98
32 - 32	-32	50.8	50	35.5	165	146.5	65	85	70	63.5	82.55	69.85

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

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

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 tube.

4. Hex corners shall be turned to a diameter of 40 ± 0.2 mm to prevent possible interference with the port spotface diameter.

5. Hex corners shall be turned to a diameter of 44 ± 0.2 mm to prevent possible interference with the port spotface diameter.

6. Hex corners shall be turned to a diameter of 57 ± 0.2 mm to prevent possible interference with the port spotface diameter.

7. INCH HEX PARTS ARE NOT TO BE USED FOR NEW DESIGN.

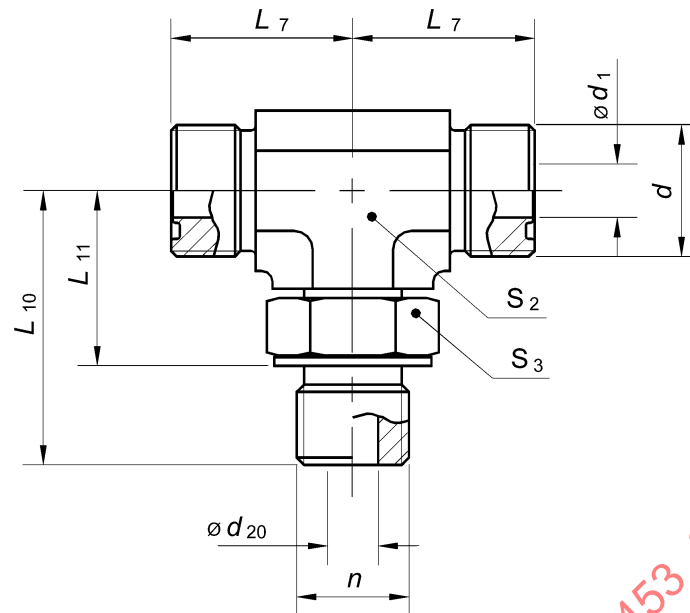


FIGURE 17 - ADJUSTABLE STUD BRANCH TEE
(52M0429 AND 520429)
REFER TO TABLE 13

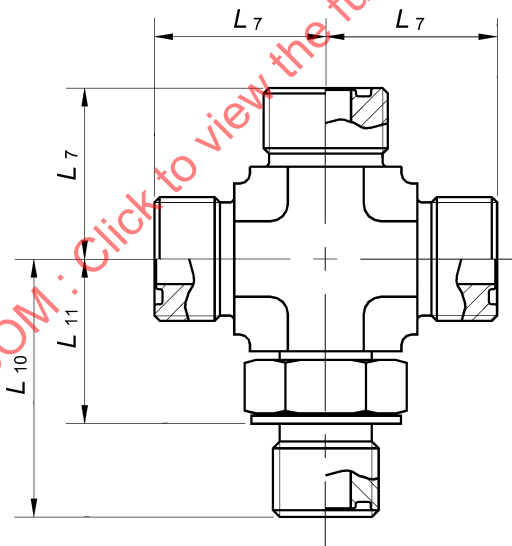


FIGURE 18 - ADJUSTABLE STUD CROSS
(52M0520 AND 520520)
REFER TO TABLE 13

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

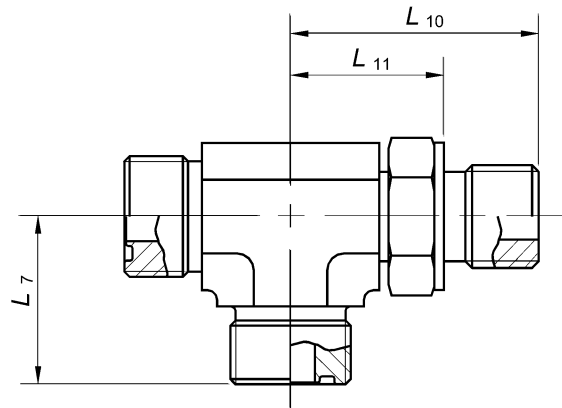


FIGURE 19 - ADJUSTABLE STUD RUN TEE
(52M0428 AND 520428)
REFER TO TABLE 13

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

SAENORM.COM : Click to view the full PDF of J1453_3_201206

TABLE 13 - DIMENSIONS OF ADJUSTABLE STUD TEE AND CROSS CONNECTORS
WITH SAE J1926-2 STUD ENDS

Dimensions in millimeters (mm)

Ordering Size Code ⁽¹⁾⁽⁴⁾	Inch Tube OD Dash Size ⁽⁴⁾	Inch Tube OD	Metric Tube OD	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.
4 - 4 - 4	- 4	6.35	6	9/16-18	7/16-20	4.5	4.5	21.5	33	22
5 - 5 - 5	- 5	7.94	8	5/8-18	1/2-20	5.5	6	23.5	35.5	24.5
6 - 6 - 6	- 6	9.52	10	11/16-16	9/16-18	6.5	7.5	25	37	25
8 - 8 - 8	- 8	12.7	12	13/16-16	3/4-16	9.5	10	28	40.5	26.5
10 - 10 - 10	-10	15.88	16	1-14	7/8-14	12.5	12.5	33.5	50	34
12 - 12 - 12	-12	19.05	20	1-3/16-12	1-1/16-12	15.5	15.5	37.5	55	36.5
14 - 14 - 14	-14	22.22	22	1-5/16-12	1-3/16-12	18	18	41.5	59.5	41.5
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
20 - 20 - 20	-20	31.75	30	1-11/16-12	1-5/8-12	26	27.5	44.5	62	44
24 - 24 - 24	-24	38.1	38	2-12	1-7/8-12	32	33.5	49	66	47.5
32 - 32 - 32	-32	50.8	50	2-1/2-12	2-1/2-12	45	40	70	78	59.5

Ordering Size Code ⁽¹⁾⁽⁴⁾	Inch Tube OD Dash Size ⁽⁴⁾	Inch Tube OD	Metric Tube OD	S ₂ Metric Forging min	S ₂ Metric Barstock max	S ₃ Metric Hex	S ₂ Inch Forging min ⁽⁸⁾	S ₂ Inch Barstock max ⁽⁸⁾	S ₃ Inch Hex ⁽⁸⁾
4 - 4 - 4	- 4	6.35	6	14	17	17	14.29	19.05	15.88
5 - 5 - 5	- 5	7.94	8	17	22	17	17	25.4	17.46
6 - 6 - 6	- 6	9.52	10	17	27	19	17	25.4	19.05
8 - 8 - 8	- 8	12.7	12	19	30	24	19.05	30.16	23.81
10 - 10 - 10	-10	15.88	16	24	36	27	26.99	33.34	26.99
12 - 12 - 12	-12	19.05	20	27	41	36 ⁽⁵⁾	30.16	38.1	34.93
14 - 14 - 14	-14	22.22	22	36	46	41 ⁽⁶⁾	36.51	47.62	38.1
16 - 16 - 16	-16	25.4	25	36	46	41	36.51	47.62	41.28
20 - 20 - 20	-20	31.75	30	41	55	50 ⁽⁷⁾	41.28	57.15	47.63
24 - 24 - 24	-24	38.1	38	50	60	55	47.62	63.5	53.98
32 - 32 - 32	-32	50.8	50	65	85	70	63.5	82.55	69.85

- 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 tube.
For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size or corresponding port.
- Hex corners shall be turned to a diameter of 40 ± 0.2 mm to prevent possible interference with the port spotface diameter.
- Hex corners shall be turned to a diameter of 44 ± 0.2 mm to prevent possible interference with the port spotface diameter.
- Hex corners shall be turned to a diameter of 57 ± 0.2 mm to prevent possible interference with the port spotface diameter.
- INCH HEX PARTS ARE NOT TO BE USED FOR NEW DESIGN.

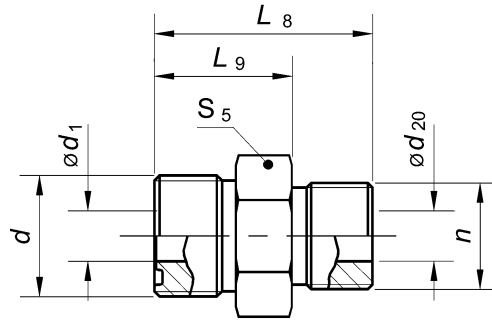


FIGURE 20 - STUD STRAIGHT
(52M0120 AND 520120)
REFER TO TABLE 14

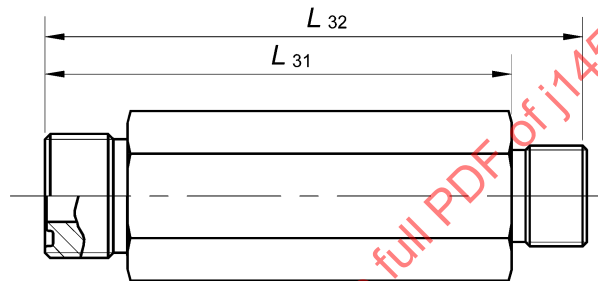


FIGURE 21 - STUD STRAIGHT LONG - LONG HEX
(52M1820 AND 521820)
REFER TO TABLE 14

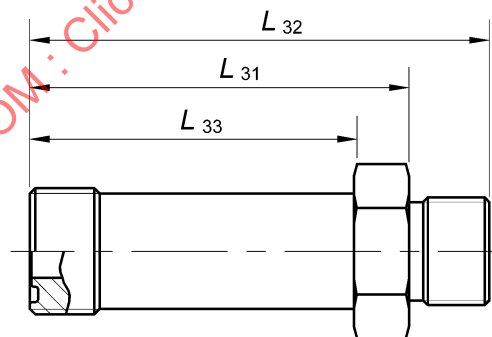


FIGURE 22 - STUD STRAIGHT LONG
(52M1720 AND 521720)
REFER TO TABLE 14

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 ENDS

Dimensions in millimeters (mm)

					n					
Ordering Size Code ⁽²⁾		Inch Tube OD			Thread SAE					
Face Seal	Stud — End	Tube OD Dash Size ⁽²⁾	Inch Tube OD	Metric Tube OD	d ⁽³⁾ Thread	J1926-2 Stud End	d ₁ ⁽¹⁾ ref.	d ₂₀ ⁽¹⁾ ref.	L ₈ ±0.8	
4 - 4		– 4	6.35	6	9/16-18	7/16-20	4.5	4.5	29	
5 - 5		– 5	7.94	8	5/8-18	1/2-20	5.5	6	29.5	
6 - 6		– 6	9.52	10	11/16-16	9/16-18	6.5	7.5	32	
8 - 8		– 8	12.7	12	13/16-16	3/4-16	9.5	10	36.5	
10 - 10		– 10	15.88	16	1-14	7/8-14	12.5	12.5	43	
12 - 12		– 12	19.05	20	1-3/16-12	1-1/16-12	15.5	15.5	48.5	
14 - 14		– 14	22.22	22	1-5/16-12	1-3/16-12	18	18	50	
16 - 16		– 16	25.4	25	1-7/16-12	1-5/16-12	20.5	21.5	50	
20 - 20		– 20	31.75	30	1-11/16-12	1-5/8-12	26	27.5	52.5	
24 - 24		– 24	38.1	38	2-12	1-7/8-12	32	33.5	54	
32 - 32		– 32	50.8	50	2-1/2-12	2-1/2-12	45	40	59	
Ordering Size Code ⁽²⁾		Inch Tube OD							S ₅	S ₅
Face Seal	Stud — End	Tube OD Dash Size ⁽²⁾	Inch Tube OD	Metric Tube OD	L ₉ ref.	L ₃₁ ref.	L ₃₂ ±0.8	L ₃₃ ±0.8	Metric Hex	Inch Hex ⁽⁵⁾
4 - 4		– 4	6.35	6	18	41.5	52.5	34	17	15.88
5 - 5		– 5	7.94	8	18.5	41.5	52.5	34	17	17.46
6 - 6		– 6	9.52	10	20	45.5	57.5	37	19	19.05
8 - 8		– 8	12.7	12	22.5	54	68	44.5	24	22.23
10 - 10		– 10	15.88	16	27	63.5	79.5	52.5	27	26.99
12 - 12		– 12	19.05	20	30	77	95.5	64	32	31.75
14 - 14		– 14	22.22	22	32	81.5	100	67.5	36	34.93
16 - 16		– 16	25.4	25	32	86.5	105	73	41	38.1
20 - 20		– 20	31.75	30	34	102.5	121	86.5	50 ⁽⁴⁾	47.63
24 - 24		– 24	38.1	38	35.5	115	133.5	97	55	53.98
32 - 32		– 32	50.8	50	40.5	146.5	165	126.5	70	69.85

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 tube.
For example: –4 = 4/16 = 0.25 = 6.35 mm inch tube size or corresponding port.
3. See SAE J1453-1 Screw Thread Specifications.
4. Hex corners shall be turned to a diameter of 57 ± 0.2 mm to prevent possible interference with the port spotface diameter.
5. INCH HEX PARTS ARE NOT TO BE USED FOR NEW DESIGN.

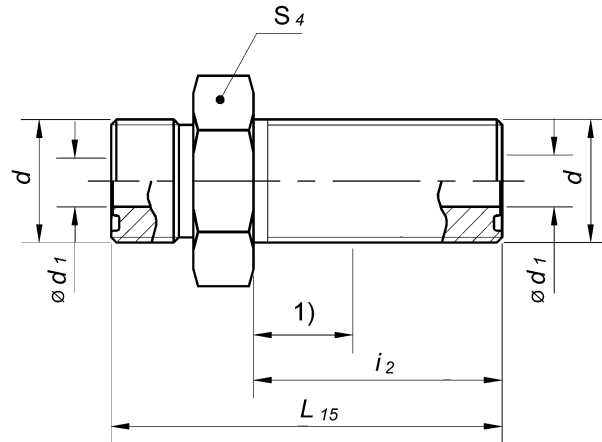


FIGURE 23 - BULKHEAD STRAIGHT
(520601)
REFER TO TABLE 15

NOTE: For dimensions not shown, see SAE J1453-1.
See SAE J1453-2 for parts made from metric hex (52M0601).

- 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.

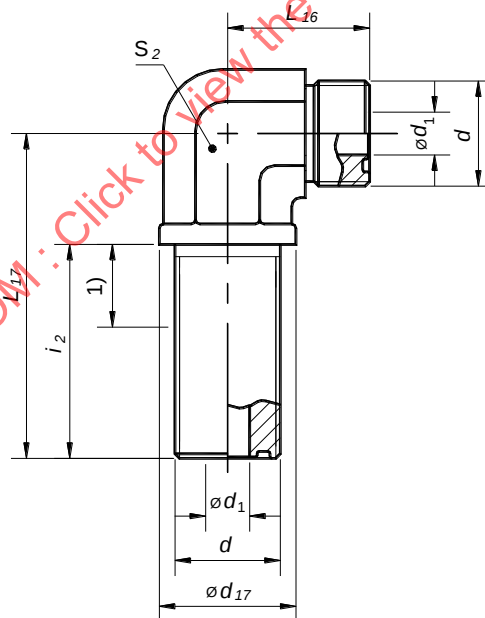


FIGURE 24 - 90 DEGREE BULKHEAD ELBOW
(520701)
REFER TO TABLE 15

NOTE: For dimensions not shown, see SAE J1453-1.
See SAE J1453-2 for parts made from metric flats forgings (52M0701).

- 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.

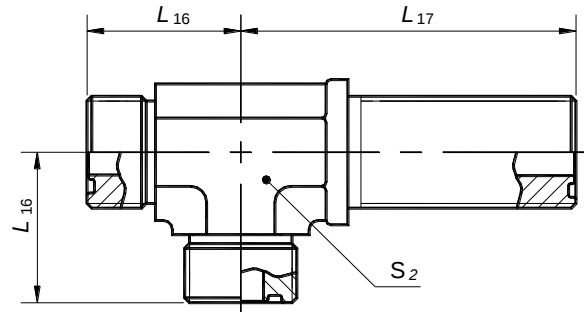


FIGURE 25 - BULKHEAD RUN TEE
(520958)
REFER TO TABLE 15

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

See SAE J1453-2 for parts made from metric flats forgings (52M0958).

- 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.

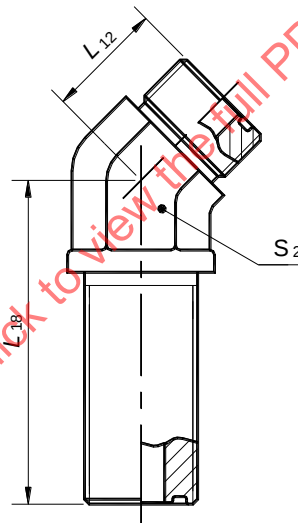


FIGURE 26 - 45 DEGREE BULKHEAD ELBOW
(520801)
REFER TO TABLE 15

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

See SAE J1453-2 for parts made from metric flats forgings (52M0801).

- 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.

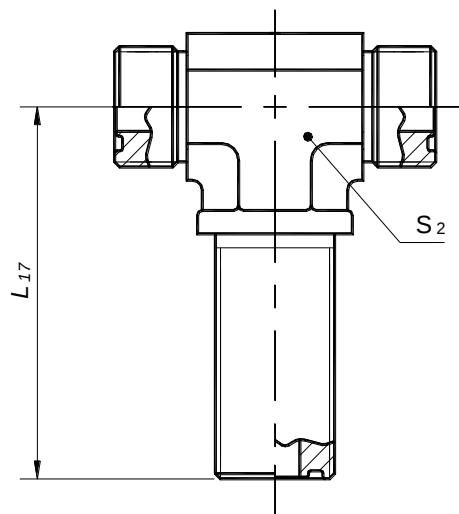


FIGURE 27 - BULKHEAD BRANCH TEE
(520959)
REFER TO TABLE 15

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

See SAE J1453-2 for parts made from metric flats forgings (52M0959).

- 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.

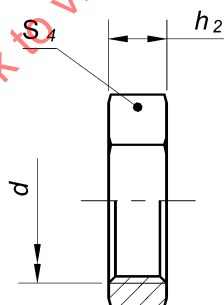


FIGURE 28 - BULKHEAD LOCKNUT
(520118)
REFER TO TABLE 15

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

See SAE J1453-2 for metric hex bulkhead locknuts (52M0118).

TABLE 15 - DIMENSIONS OF INCH HEX BULKHEAD CONNECTORS

Dimensions in millimeters (mm)

Ordering Size Code ⁽¹⁾⁽²⁾	Inch Tube OD Dash Size ⁽²⁾	Inch Tube OD	Metric Tube OD	d Thread	d ₁ ref.	d ₁₇ min	h ₂ ref.	i ₂ ref.	L ₁₂ ±1
4 - 4	- 4	6.35	6	9/16-18	4.5	16.5	7	31.5	16
5 - 5	- 5	7.94	8	5/8-18	5.5	19	7	31.5	18
6 - 6	- 6	9.52	10	11/16-16	6.5	21	8	34	19
8 - 8	- 8	12.7	12	13/16-16	9.5	24.5	9	36.5	20.5
10 - 10	- 10	15.88	16	1-14	12.5	29	10.5	40.5	23.5
12 - 12	- 12	19.05	20	1-3/16-12	15.5	34	10.5	41.5	26
14 - 14	- 14	22.23	22	1-5/16-18	18	38	10.5	42	30
16 - 16	- 16	25.4	25	1-7/16-12	20.5	40.5	10.5	42	30
20 - 20	- 20	31.75	30	1-11/16-12	26	46.5	10.5	42	32
24 - 24	- 24	38.1	38	2-12	32	54.5	10.5	42	37
32 - 32	- 32	50.8	50	2-1/2-12	45	68	14	46.5	44.5

Ordering Size Code ⁽¹⁾⁽²⁾	Inch Tube OD Dash Size ⁽²⁾	Inch Tube OD	Metric Tube OD	L ₁₅ ±0.8	L ₁₆ ±1	L ₁₇ ±1	L ₁₈ ±1	S ₂ Inch Forging min ⁽³⁾⁽⁴⁾	S ₂ Inch Bar-stock max ⁽³⁾⁽⁴⁾	S ₄ Inch Hex ⁽³⁾⁽⁴⁾
4 - 4	- 4	6.35	6	48	22.5	47	44	14.29	19.05	20.64
5 - 5	- 5	7.94	8	49.5	25	49.5	46	17	25.4	22.23
6 - 6	- 6	9.52	10	53	26	52	48.5	17	25.4	25.4
8 - 8	- 8	12.7	12	58.5	29	55.5	51	19.05	30.16	28.58
10 - 10	- 10	15.88	16	66.5	34.5	63	56.5	26.99	33.34	33.34
12 - 12	- 12	19.05	20	69	38.5	67	60.5	30.16	38.1	38.1
14 - 14	- 14	22.23	22	70	42.5	71	65	36.51	47.62	41.28
16 - 16	- 16	25.4	25	70	42.5	71	65	36.51	47.62	44.45
20 - 20	- 20	31.75	30	70	45.5	75.5	67	41.28	57.15	50.8
24 - 24	- 24	38.1	38	70	49.5	79.5	67	47.62	63.5	60.33
32 - 32	- 32	50.8	50	81.5	70	99	90	63.5	82.55	69.85

- 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 tube.
For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size or corresponding port.
- See SAE J1453-2 for parts made from metric hex or metric forgings.
- INCH HEX PARTS ARE NOT TO BE USED FOR NEW DESIGN.

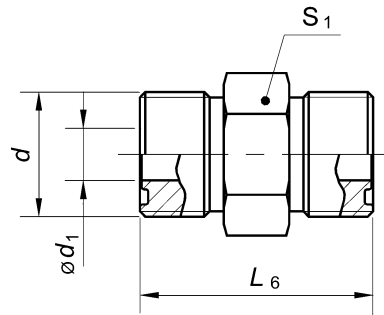


FIGURE 29 - UNION STRAIGHT
(520101)
REFER TO TABLE 16

NOTE: For dimensions not shown, see SAE J1453-1.
See SAE J1453-2 for parts made from metric hex (52M0101).

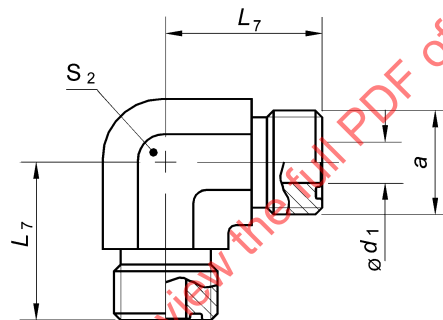


FIGURE 30 - 90 DEGREE UNION ELBOW
(520201)
REFER TO TABLE 16

NOTE: For dimensions not shown, see SAE J1453-1.
See SAE J1453-2 for parts made from metric flats forgings (52M0201).

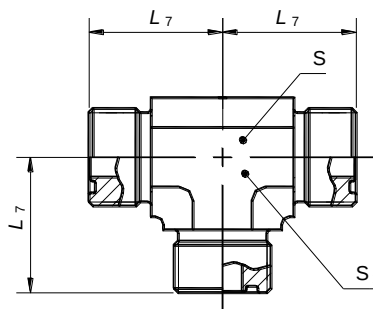


FIGURE 31 - UNION TEE
(520401)
REFER TO TABLE 16

NOTE: For dimensions not shown, see SAE J1453-1.
See SAE J1453-2 for parts made from metric flats forgings (52M0401).

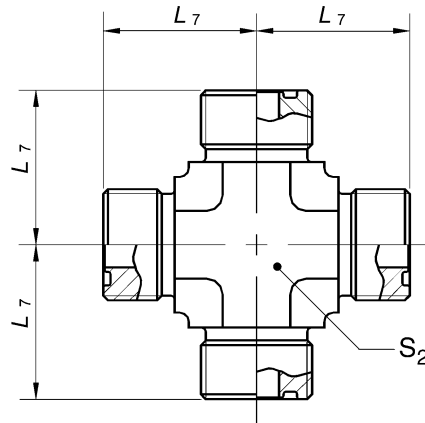


FIGURE 32 - UNION CROSS
(520501)
REFER TO TABLE 16

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

See SAE J1453-2 for parts made from metric flats forgings (52M0501).

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

Dimensions in millimeters (mm)

Ordering Size Code ⁽¹⁾ (2)	Inch Tube OD Dash Size ⁽²⁾	Inch Tube OD	Metric Tube OD	d Thread	d ₁ ref.	L ₆ ±0.8	L ₇ ref.	S ₁ Inch Hex ⁽³⁾⁽⁴⁾	S ₂ Inch Forging min ⁽³⁾⁽⁴⁾	S ₂ Inch Barstock max ⁽³⁾⁽⁴⁾
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	25.4
6 - 6	- 6	9.52	10	11/16-16	6.5	31	25	19.05	17	25.4
8 - 8	- 8	12.7	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	38.1
14 - 14	- 14	22.23	22	1-5/16-12	18	47.5	41.5	34.93	36.51	47.62
16 - 16	- 16	25.4	25	1-7/16-12	20.5	49.5	41.5	38.1	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	38.1	38	2-12	32	53	49	53.98	47.62	63.5
32 - 32	- 32	50.8	50	2-1/2-12	45	63	70	63.5	63.5	82.55

- 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 tube.
For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size or corresponding port.
- See SAE J1453-2 for parts made from metric hex or metric forgings.
- INCH HEX PARTS ARE NOT TO BE USED FOR NEW DESIGN.

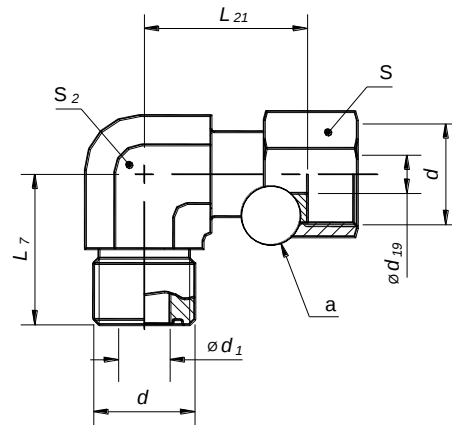


FIGURE 33 - SWIVEL 90 DEGREE ELBOW
(520221)
REFER TO TABLE 17

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

See SAE J1453-2 for parts made from metric hex or metric flats forgings (52M0221).

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

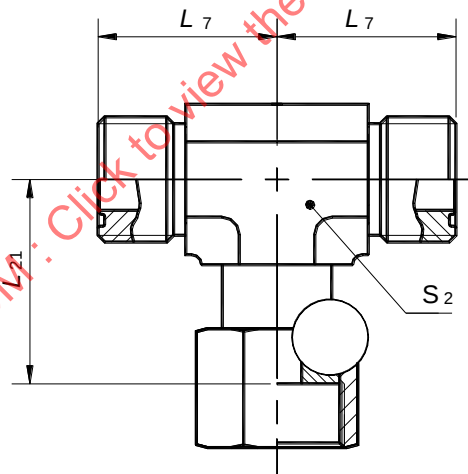


FIGURE 34 - SWIVEL BRANCH TEE
(520433)
REFER TO TABLE 17

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

See SAE J1453-2 for parts made from metric hex or metric flats forgings (52M0433).

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

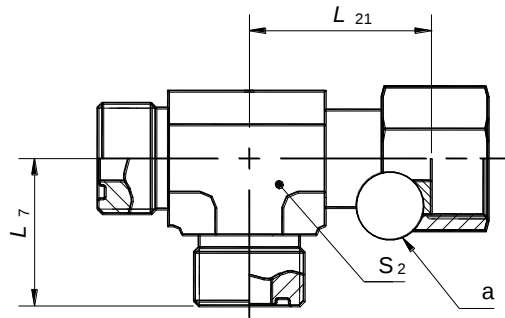


FIGURE 35 - SWIVEL RUN TEE
(520432)
REFER TO TABLE 17

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

See SAE J1453-2 for parts made from metric hex or metric flats forgings (52M0432).

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

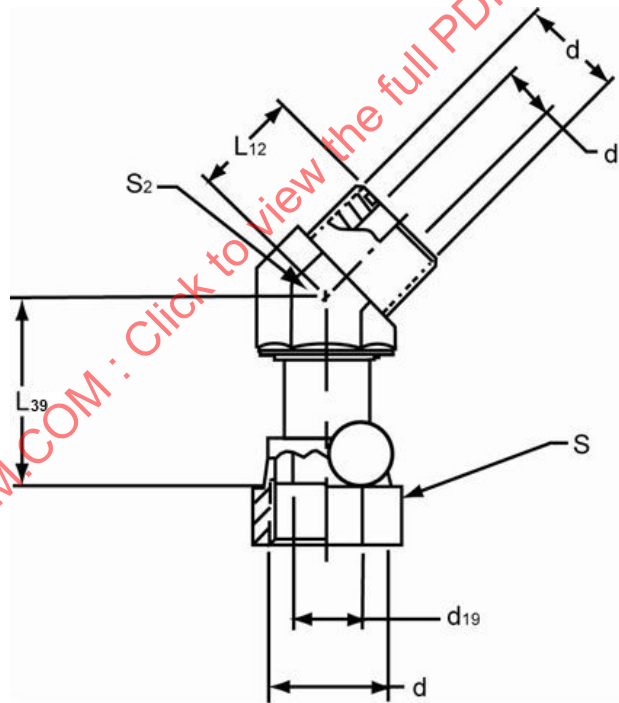


FIGURE 36 - SWIVEL 45 DEGREE ELBOW
(520321)
REFER TO TABLE 17

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

See SAE J1453-2 for parts made from metric hex or metric flats forgings (52M0321).

- 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 Size Code ⁽¹⁾⁽²⁾	Inch Tube OD Dash Size ⁽²⁾	Inch Tube OD	Metric Tube OD	d Thread	d ₁ ref.	d ₁₉ ref.	L ₇ ref.	L ₁₂ ±1	L ₂₁ ±1.5	L ₃₉ ±1.5	S Inch Hex ⁽³⁾⁽⁴⁾	S ₂ Inch Forging min ⁽³⁾⁽⁴⁾	S ₂ Inch Barstock max ⁽³⁾⁽⁴⁾
4 - 4	- 4	6.35	6	9/16-18	4.5	4	21.5	16	26.5	25	17.46	14.29	19.05
5 - 5	- 5	7.94	8	5/8-18	5.5	5.5	23.5	18	28	26	19.05	17	25.4
6 - 6	- 6	9.52	10	11/16-16	6.5	6.5	25	19	29	28.5	20.64	17	25.4
8 - 8	- 8	12.7	12	13/16-16	9.5	9	28	20.5	38	38	23.81	19.05	30.16
10 - 10	-10	15.88	16	1-14	12.5	11.5	33.5	23.5	41	39	28.58	26.99	33.34
12 - 12	-12	19.05	20	1-3/16-12	15.5	14	37.5	26	46.5	44	34.92	30.16	38.1
14 - 14	-14	22.23	22	1-5/16-12	18	18	41.5	30	52.5	46.5	38.1	36.51	47.62
16 - 16	-16	25.4	25	1-7/16-12	20.5	20	41.5	30	53.5	47.5	41.28	36.51	47.62
20 - 20	-20	31.75	30	1-11/16-12	26	26	44.5	32	58	50.5	47.63	41.28	57.15
24 - 24	-24	38.1	38	2-12	32	32	49	37	61	52.5	57.15	47.62	63.5
32 - 32	-32	50.8	50	2-1/2-12	45	44	70	44.5	82	63	73.03	63.5	82.55

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 tube.

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

3. See SAE J1453-2 for parts made from metric hex or metric forgings.

4. INCH HEX PARTS ARE NOT TO BE USED FOR NEW DESIGN.

SAENORM.COM : Click to view the full PDF of J1453-3 JUN2012

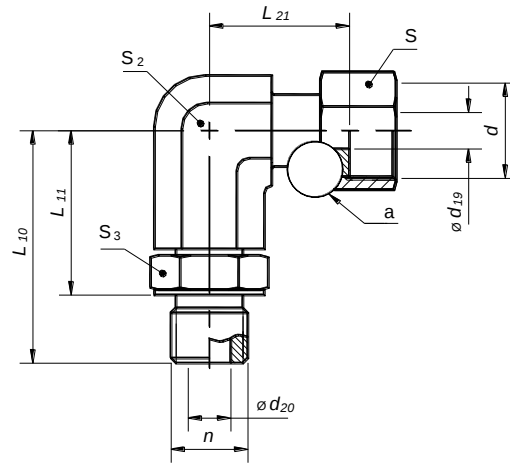


FIGURE 37 - SWIVEL 90 DEGREE ADJUSTABLE STUD ELBOW
(52M0281 AND 520281)
REFER TO TABLE 18

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.

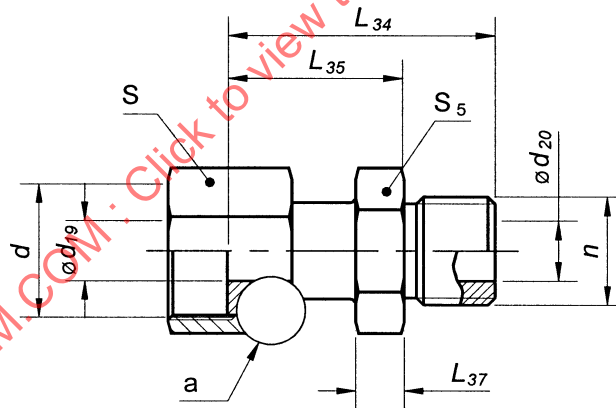


FIGURE 38 - STUD STRAIGHT SWIVEL
(52M0181 AND 520181)
REFER TO TABLE 18

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 Code ⁽²⁾	Inch Tube OD Dash Size ⁽²⁾	Inch Tube OD	Metric Tube OD	d ⁽³⁾ Thread	n SAE J1926-2		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
					Stud	End								
4 - 4	- 4	6.35	6	9/16-18	7/16-20		4	4.5	33	22	26.5	37	26	5
5 - 5	- 5	7.94	8	5/8-18	1/2-20		5.5	6	35.5	24.5	28	38	27	5.5
6 - 6	- 6	9.52	10	11/16-16	9/16-18		6.5	7.5	37	25	29	40	28	5.5
8 - 8	- 8	12.7	12	13/16-16	3/4-16		9	10	40.5	26.5	38	49.5	35.5	6.5
10 - 10	-10	15.88	16	1-14	7/8-14		11.5	12.5	50	34	41	54	38	8
12 - 12	-12	19.05	20	1-3/16-12	1-1/16-12		14	15.5	55	36.5	46.5	59.5	41	9.5
14 - 14	-14	22.23	22	1-5/16-12	1-3/16-12		18	17	59.5	41.5	52.5	63	44.5	11.5
16 - 16	-16	25.4	25	1-7/16-12	1-5/16-12		20	21.5	59.5	41.5	53.5	67.5	49	11.5
20 - 20	-20	31.75	30	1-11/16-12	1-5/8-12		26	27.5	62	44	58	67.5	49	13
24 - 24	-24	38.1	38	2-12	1-7/8-12		32	33.5	66	47.5	61	67.5	49	15
32 - 32	-32	50.8	50	2-1/2-12	2-1/2-12		44	40	78	59.5	82	79.5	61	18

Ordering Size Code ⁽²⁾	Inch Tube OD Dash Size ⁽²⁾	Nominal Inch Tube OD	Nominal Metric Tube OD	S Metric Hex	S ₂ Metric Forging min	S ₂ Metric Barstock max	S ₃ Metric Hex	S ₅ Metric Hex	S Inch Hex ⁽⁷⁾	S ₂ Inch Forging min ⁽⁷⁾	S ₂ Inch Barstock max ⁽⁷⁾	S ₃ Inch Hex ⁽⁷⁾	S ₅ Inch Hex ⁽⁷⁾
4 - 4	- 4	6.35	6	17	14	17	17	17	17.46	14.29	19.05	15.88	15.88
5 - 5	- 5	7.94	8	19	17	22	17	17	19.05	17	25.4	17.46	17.46
6 - 6	- 6	9.52	10	22	17	27	19	19	20.64	17	25.4	19.05	19.05
8 - 8	- 8	12.7	12	24	19	30	24	24	23.81	19.05	30.16	23.81	22.22
10 - 10	-10	15.88	16	30	24	36	27	27	28.58	26.99	33.34	26.99	26.99
12 - 12	-12	19.05	20	36	27	41	36 ⁽⁴⁾	32	34.92	30.16	38.1	34.93	31.75
14 - 14	-14	22.23	22	41	36	46	41 ⁽⁵⁾	36	38.1	36.51	47.62	38.1	34.93
16 - 16	-16	25.4	25	41	36	46	41	41	41.28	36.51	47.62	41.28	38.1
20 - 20	-20	31.75	30	50	41	55	50 ⁽⁶⁾	50 ⁽⁷⁾	47.63	41.28	57.15	47.63	47.63
24 - 24	-24	38.1	38	60	50	60	55	55	57.15	47.62	63.5	53.98	53.98
32 - 32	-32	50.8	50	75	65	85	70	70	73.03	63.5	82.55	69.85	69.85

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 tube.
For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size or corresponding port.
3. See SAE J1453-1 for Screw Thread Specifications.
4. Hex corners shall be turned to a diameter of 40 ± 0.2 mm to prevent possible interference with the port spotface diameter.
5. Hex corners shall be turned to a diameter of 44 ± 0.2 mm to prevent possible interference with the port spotface diameter.
6. Hex corners shall be turned to a diameter of 57 ± 0.2 mm to prevent possible interference with the port spotface diameter.
7. INCH HEX PARTS ARE NOT TO BE USED FOR NEW DESIGN.

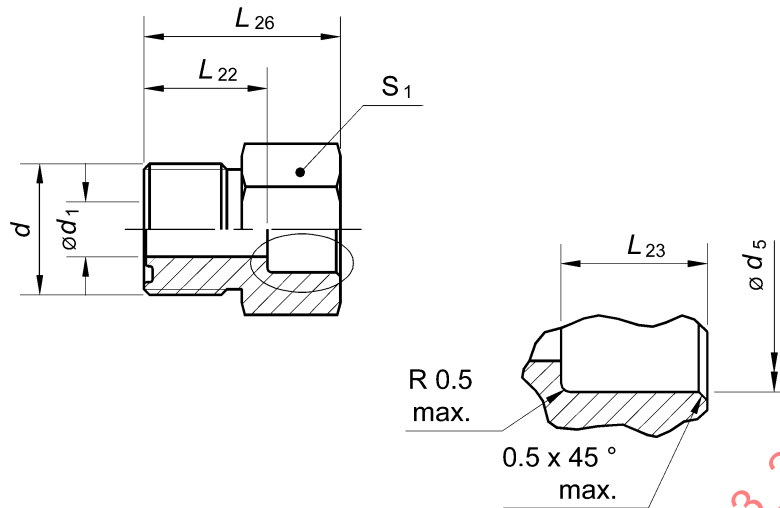


FIGURE 39 - BRAZE-ON STRAIGHT
(INCH TUBE 520104) (METRIC TUBE 5201M04)
REFER TO TABLE 19

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

See SAE J1453-2 for parts made from metric hex (52M0104 and 52M01M04).

TABLE 19 - DIMENSIONS OF INCH BRAZE-ON STRAIGHT CONNECTORS

Dimensions in millimeters (mm)

Inch Tube Ordering Size Code ⁽³⁾			Metric Tube Ordering Size Code ⁽²⁾			Metric Tube d ₅ ⁽¹⁾		d	d ₁	L ₂₂	L ₂₃	L ₂₆	S ₁
Face Seal	Tube Side	Tube OD Dash Size ⁽³⁾	Face Seal	Tube Side	Metric Tube OD	d ₅ ⁽¹⁾ ref.	Thread	d ₁ ref.	±0.8	±0.5	ref.	Inch Hex ⁽⁵⁾	
4 - 4	—	— 4	520104	6x6	6	6.15	9/16-18	4.5	13.5	8.5	22	15.88	
4 - 5	—	— 5	520104	6x8	8	8.15	9/16-18	4.5	13.5	8.5	22	15.88	
4 - 6	—	— 6	520104	6x10	10	10.15	9/16-18	4.5	13.5	8.5	22	15.88	
5 - 4	—	— 4	520104	8x6	6	6.15	5/8-18	4.5 ⁽⁴⁾	13.5	8.5	22	17.45	
5 - 5	—	— 5	520104	8x8	8	8.15	5/8-18	5.5	13.5	8.5	22	17.45	
5 - 6	—	— 6	520104	8x10	10	10.15	5/8-18	5.5	13.5	8.5	22	17.45	
5 - 8	—	— 8	520104	8x12	12	12.15	5/8-18	5.5	13.5	8.5	22	17.45	
6 - 4	—	— 4	520104	10x6	6	6.15	11/16-16	4.5 ⁽⁴⁾	14.5	8.5	23	19.05	
6 - 5	—	— 5	520104	10x8	8	8.15	11/16-16	5.5 ⁽⁴⁾	14.5	8.5	23	19.05	
6 - 6	—	— 6	520104	10x10	10	10.15	11/16-16	6.5	14.5	8.5	23	19.05	
6 - 8	—	— 8	520104	10x12	12	12.15	11/16-16	6.5	14.5	8.5	23	19.05	
6 - 10	—	— 10	520104	10x16	16	16.15	11/16-16	6.5	14.5	9	23.5	22.23	
8 - 5	—	— 5	520104	12x8	8	8.15	13/16-16	5.5 ⁽⁴⁾	16	8.5	24.5	22.23	
8 - 6	—	— 6	520104	12x10	10	10.15	13/16-16	6.5 ⁽⁴⁾	16	8.5	24.5	22.23	
8 - 8	—	— 8	520104	12x12	12	12.15	13/16-16	9.5	16	8.5	24.5	22.23	
8 - 10	—	— 10	520104	12x16	16	16.15	13/16-16	9.5	16	9	25	22.23	

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

Dimensions in millimeters (mm)

Inch Tube Ordering Size Code ⁽³⁾			Metric Tube Ordering Size Code ⁽²⁾			Metric						
520104	Inch	Inch	5201M04	Metric	Metric	Tube	d	d ₁	L ₂₂	L ₂₃	L ₂₆	S ₁
Face Seal —	Tube Side	Tube OD Dash Size ⁽³⁾	Face Seal x Side	Tube OD	Tube ref.	d ₅ ⁽¹⁾	Thread	ref.	±0.8	±0.5	ref.	Inch Hex ⁽⁵⁾⁽⁶⁾
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	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	
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	
32 - 20	— 20	31.95	50x30	30	30.2	2-1/2-12	26 ⁽⁴⁾	30.5	15	45.5	63.5	
32 - 24	— 24	38.3	50x38	38	38.2	2-1/2-12	32 ⁽⁴⁾	30.5	15	45.5	63.5	
32 - 32	— 32	51	50x50	50	50.2	2-1/2-12	45	30.5	15	45.5	63.5	

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 tube.

For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size 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.

5. For metric hex parts see SAE J1453-2.

6. INCH HEX PARTS ARE NOT TO BE USED FOR NEW DESIGN.

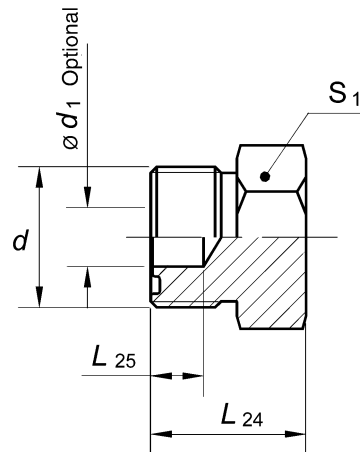


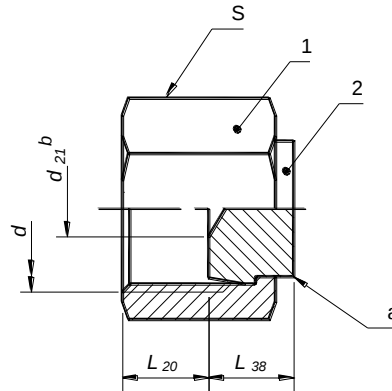
FIGURE 40 - PLUG
(520109)
REFER TO TABLE 20

NOTE: For dimensions not shown see SAE J1453-1.
See SAE J1453-2 for metric hex plugs (52M0109).

TABLE 20 - DIMENSIONS OF INCH HEX PLUGS
Dimensions in millimeters (mm)

Ordering Size Code	Inch Tube OD Dash Size ⁽¹⁾	Inch Tube OD	Metric Tube OD	Thread ⁽²⁾	d ₁ ref.	L ₂₄ ±0.8	L ₂₅ max	S ₁ Inch Hex ⁽³⁾⁽⁴⁾
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	25.4	25	1-7/16-12	20.5	28	13.7	38.1
20	-20	31.75	30	1-11/16-12	26	28	13.7	44.45
24	-24	38.1	38	2-12	32	28	13.7	53.98
32	-32	50.8	50	2-1/2-12	45	35.5	13.7	63.5

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 tube.
For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size or corresponding port.
2. See SAE J1453-1 Screw Thread Specifications.
3. For metric hex plugs see SAE J1453-2.
4. INCH HEX PARTS ARE NOT TO BE USED FOR NEW DESIGN.



1. 520110A Nut
2. Cap Insert

FIGURE 41 - CAP ASSEMBLY
(520112)
REFER TO TABLE 21

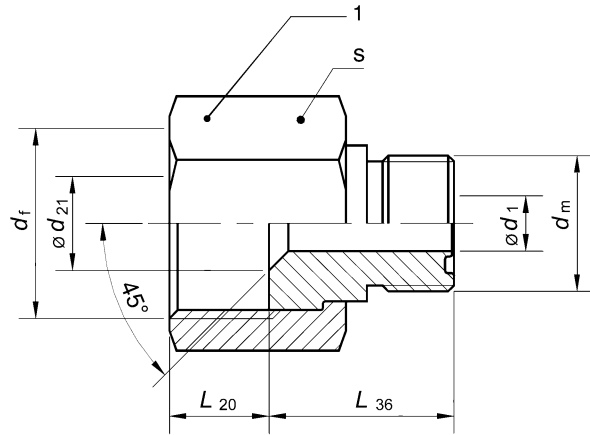
NOTE: For dimensions not shown, see SAE J1453-1.
See SAE J1453-2 for metric hex caps (52M0112).

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

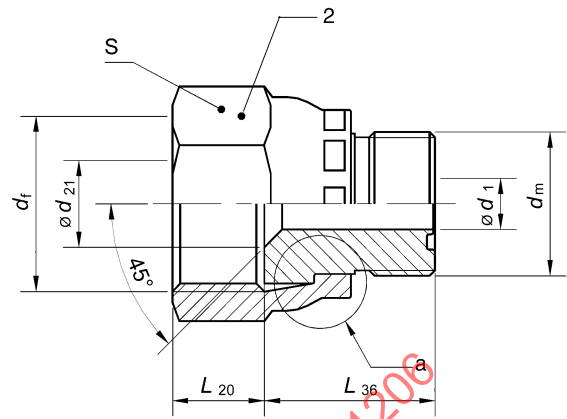
TABLE 21 - DIMENSIONS OF INCH HEX CAP ASSEMBLY
Dimensions in millimeters (mm)

Ordering Size Code	Inch Tube OD Dash Size ⁽¹⁾	Inch Tube OD	Metric Tube OD	d Thread	d ₂₁ max.	L ₂₀ ref.	L ₃₈ ±0.8	S Inch Hex ⁽²⁾⁽³⁾
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	38.1
16	-16	25.4	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	38.1	38	2-12	32	13.5	16	57.15
32	-32	50.8	50	2-1/2-12	40	17	20	73.03

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 tube.
For example: -4 = 4/16 = 0.25 = 6.35 mm inch tube size or corresponding port.
2. For metric hex caps see SAE J1453-2.
3. INCH HEX PARTS ARE NOT TO BE USED FOR NEW DESIGN.



Style 'A' (520123)



Style 'B' (520123B)

FIGURE 42 - REDUCER WITH NUT
 STYLE A (520123) AND STYLE B (520123B)
 REFER TO TABLE 22

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

See SAE J1453-2 for metric hex reducers (52M0123 and 52M0123B).

a. Crimped nut design optional

SAENORM.COM : Click to view the full PDF of J1453-3-201206

TABLE 22 - DIMENSIONS OF INCH HEX FACE SEAL REDUCER WITH NUT

Dimensions in millimeters (mm)

Ordering Size Code ⁽³⁾								
Female ORFS –	Male ORFS	d _f Thread	d _m Thread	d ₁ ref.	d ₂₁ ref.	L ₂₀ ⁽¹⁾ ref.	L ₃₆ ±0.8	S Inch Hex ⁽⁵⁾⁽⁶⁾
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	32	13.5	34	57.15
32 – 16		2-1/2-12	1-7/16-12	20.5	40	17	36	73.03
32 – 20		2-1/2-12	1-11/16-12	26	40	17	36	73.03
32 – 24		2-1/2-12	2-12	32	40	17	36	73.03

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 tube.

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

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

5. For metric hex reducers see SAE J1453-2.

6. INCH HEX PARTS ARE NOT TO BE USED FOR NEW DESIGN.

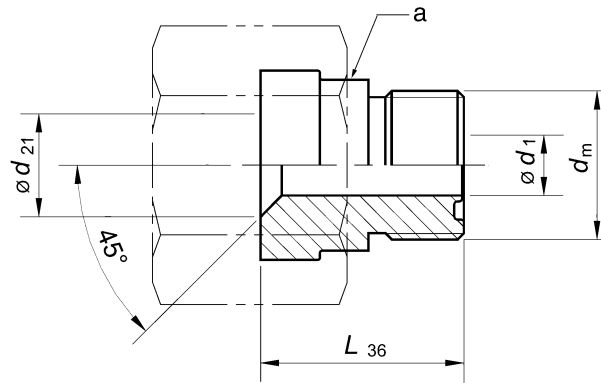


FIGURE 43 - REDUCER WITHOUT NUT
(520123)
REFER TO TABLE 23

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

a. For use with tube nut 520110A

SAENORM.COM : Click to view the full PDF of j1453_3_201206

TABLE 23 - DIMENSIONS OF FACE SEAL REDUCER WITHOUT NUT

Dimensions in millimeters (mm)

Ordering Size Code ⁽¹⁾		d ⁽²⁾			
Female	Male	m	d ₁	d ₂₁	L ₃₆
ORFS	ORFS	Thread	ref.	ref.	ref.
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	26	34
24 - 14		1-5/16-12	18	32	34
24 - 16		1-7/16-12	20.5	32	34
24 - 20		1-11/16-12	26	32	34
32 - 16		1-7/16-12	20.5	40	36
32 - 20		1-11/16-12	26	40	36
32 - 24		2-12	32	40	36

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 tube.

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

2. See SAE J1453-1 Screw Thread Specifications.

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 THE SAE FLUID CONDUCTORS AND CONNECTORS TECHNICAL STEERING COMMITTEE
C1—HYDRAULIC TUBE FITTINGS COMMITTEE

SAENORM.COM : Click to view the full PDF of J1453-3-201206

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 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 STUD SIZE CONNECTIONS

Dash Size	Tube OD			Port Stud Ends		Face Seal
	Inch		Metric	SAE J1926-2 (ISO 11926-2)	ISO 6149-2	ISO 8434-3 SAE J1453
	in	mm	mm	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	12.7	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	25.4	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	38.1	38	1-7/8-12	M48X2	2-12
-32	2.000	50.8	50	2-1/2-12	M60X2	2-1/2-12

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

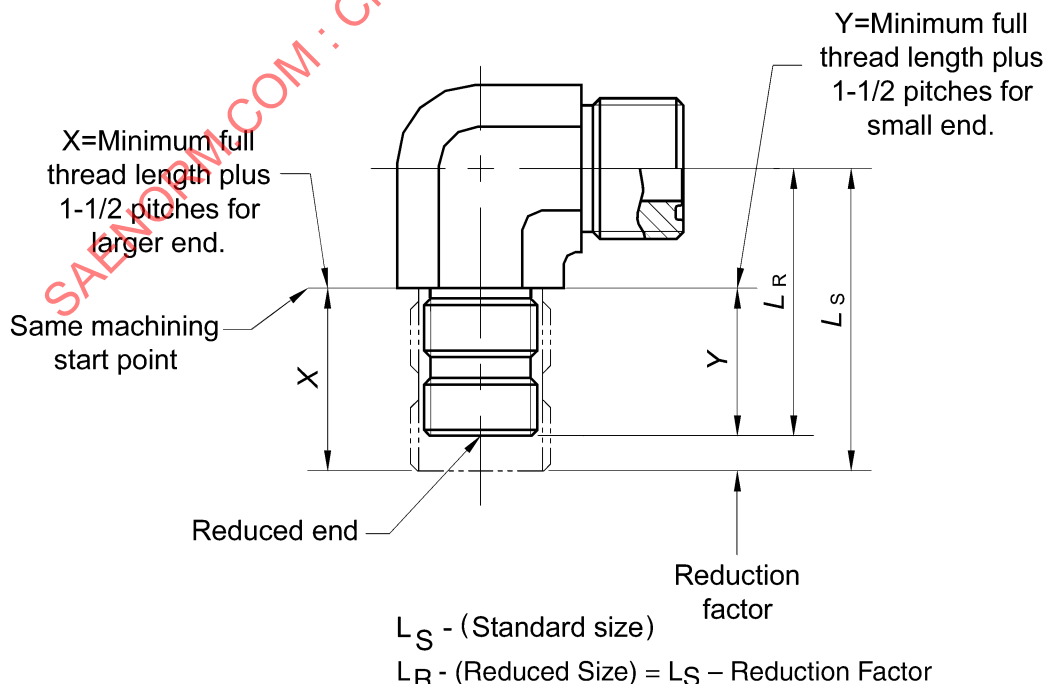


FIGURE A1 - STUD END REDUCTION

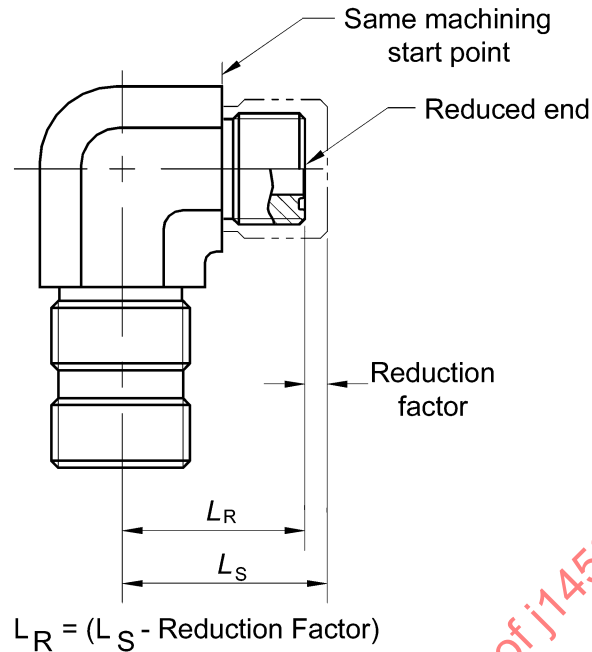


FIGURE A2 - TUBE END REDUCTION

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.

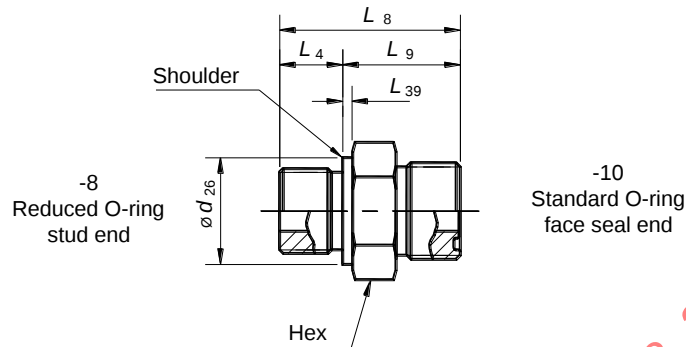


FIGURE A3 - STUD STRAIGHT CONNECTOR WITH REDUCED O-RING STUD END
(520120)
REFER TO TABLE B2

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.

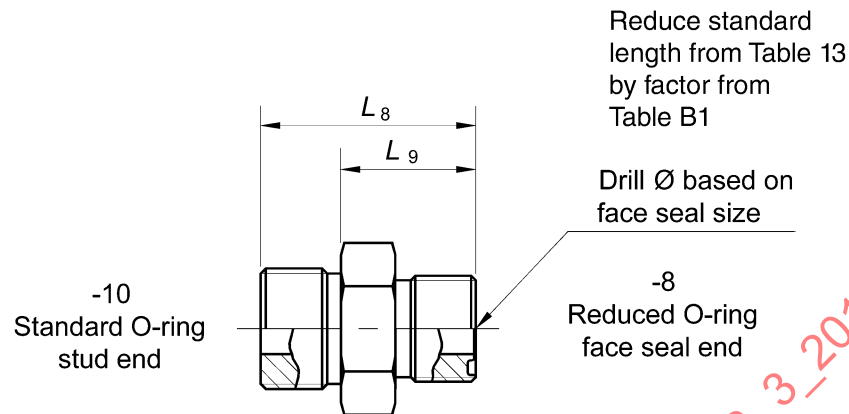


FIGURE A4 - STUD STRAIGHT CONNECTOR WITH REDUCED FACE SEAL END (520120)

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.

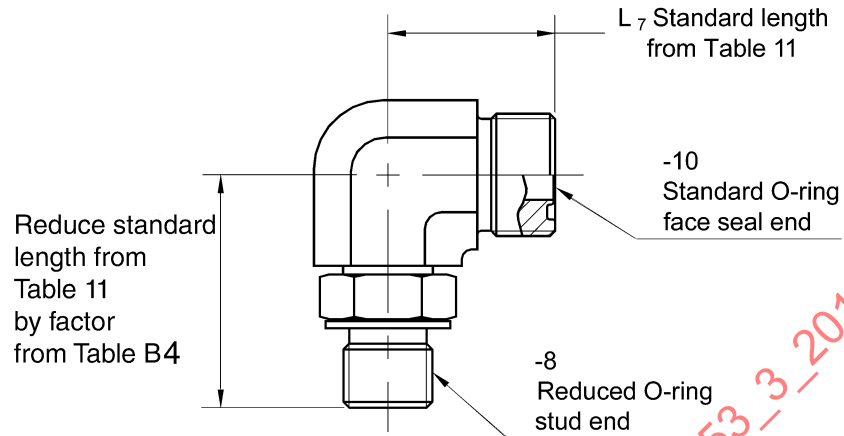


FIGURE A5 - SHAPED FACE SEAL CONNECTOR WITH REDUCED O-RING STUD END (520220)

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.

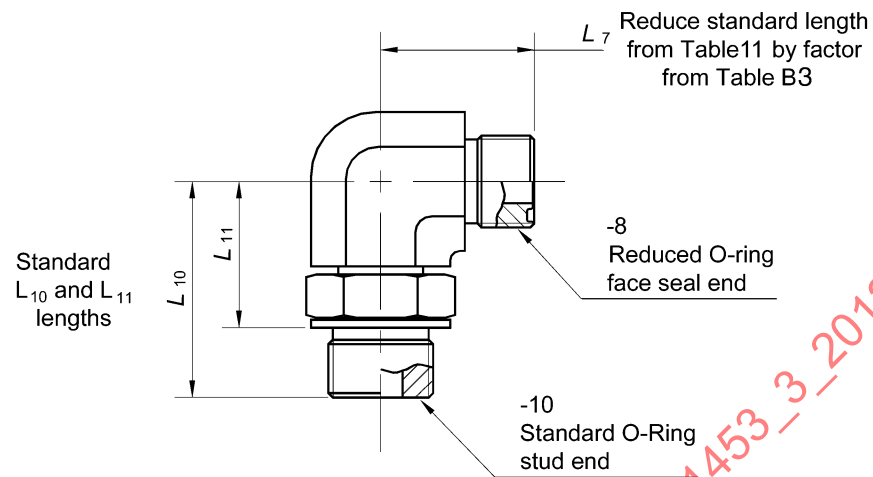


FIGURE A6 - SHAPED FACE SEAL CONNECTOR WITH REDUCED FACE SEAL END (520220)

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

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.

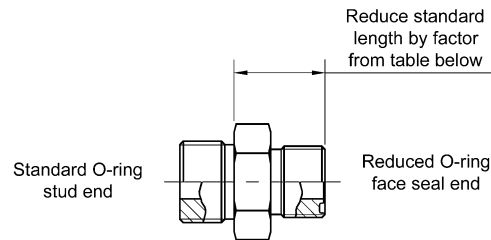


FIGURE B1 - STUD STRAIGHT CONNECTOR WITH REDUCED O-RING FACE SEAL END
(520120)

REFER TO TABLE B1

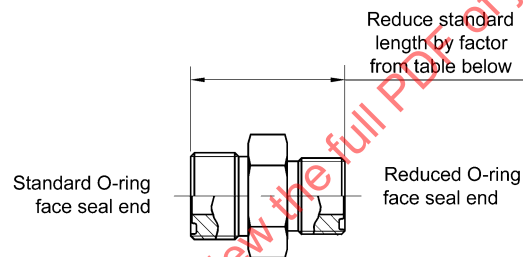


FIGURE B2 - REDUCER UNION
(520101)

REFER TO TABLE B1

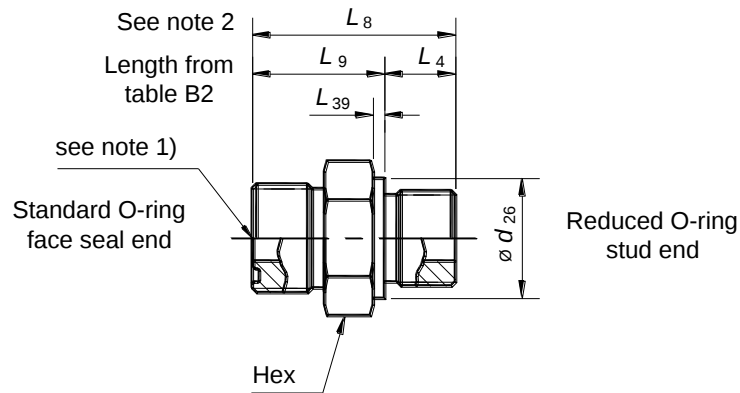
TABLE B1 - REDUCTION FACTORS FOR STRAIGHT CONNECTORS WITH SMALLER
O-RING FACE SEAL END⁽¹⁾

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

Dash Size Small ORFS End	Tube OD Small ORFS End	-5 7.92	-6 9.52	-8 12.7	-10 15.88	-12 19.05	-14 22.22	-16 25.4	-20 31.75	-24 38.1	-32 50.8
- 4	6.35	0	1	3	5.5	7	7.5	7.5 ⁽³⁾	7.5 ⁽³⁾	7.5 ⁽³⁾	12 ⁽³⁾
- 5	7.92		1	3	5.5	7	7.5	7.5 ⁽³⁾	7.5 ⁽³⁾	7.5 ⁽³⁾	12 ⁽³⁾
- 6	9.52			2	4.5	6	6.5	6.5	6.5 ⁽³⁾	6.5 ⁽³⁾	11 ⁽³⁾
- 8	12.7				2.5	4	4.5	4.5	4.5	4.5 ⁽³⁾	9 ⁽³⁾
-10	15.88					1.5	2	2	2	2	6.5 ⁽³⁾
-12	19.05		SEE NOTE ⁽²⁾				0.5	0.5	0.5	0.5	5
-14	22.22							0	0	0	4.5
-16	25.4								0	0	4.5
-20	31.75									0	4.5
-24	38.1									0	4.5
Minimum Stud Hex (mm)		17	19	24	27	32	36	41	50	55	70
Minimum Union Hex (mm)		19	19	22	27	32	36	41	46	55	65
Minimum Stud Hex (in)		15.88	17.46	22.23	25.4	31.75	34.93	38.1	47.63	53.98	69.85
Minimum Union Hex (in)		17.46	19.05	22.23	26.99	31.75	34.93	38.1	44.45	53.98	63.5

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.



NOTE 1: See Appendix A, 3.5 Drill Note.

NOTE 2: $L_8 = L_9 + L_4$ (smaller stud end).

FIGURE B3 - STUD STRAIGHT CONNECTOR WITH REDUCED O-RING STUD END
(520120)

TABLE B2 - L_9 , FOR STRAIGHT STUD CONNECTORS WITH LARGER FACE SEAL END⁽¹⁾⁽³⁾

Dimensions in millimeters (mm)

(rounded to nearest 0.5 mm)

Standard Machining Size (Larger O-Ring Face Seal End of Connector)

Dash Size	Tube OD	Stud End Length													L_{39}	d_{26}
Reduced O-Ring Boss End	Reduced O-Ring Boss End	J1926-2 ref.	-4	-5	-6	-8	-10	-12	-14	-16	-20	-24	-32		(K)	(X) Dia
			6.35	7.94	9.52	12.7	15.88	19.05	22.23	25.4	31.75	38.1	50.8	±0.5		±0.3
-2	3.18		21	21.5 ⁽²⁾	23	25.5	29.5	33	34	34.5	36.5	38	39.5	4		12.7
-3	4.76	9.5	17.5 ⁽²⁾	21.5	23	25.5	29.5	33	34	34.5	36.5	38	39.5	4		14.2
-4	6.35	11		17.5 ⁽²⁾	23	25.5	29.5	33	34	34.5	36.5	38	39.5	4		16
-5	7.94	11			20 ⁽²⁾	25.5	29.5	33	34	34.5	36.5	38	39.5	4		17.5
-6	9.52	12				25.5	29.5	33	34	34.5	36.5	38	39.5	4		19
-8	12.7	14					31	34.5	35.5	36	38	39.5	41	5.5		23.9
-10	15.88	16						34.5	35.5	36	38	39.5	41	5.5		26.9
-12	19.05	18.5				SEE NOTE ⁽²⁾				36	38	39.5	41	5.5		33.3
-14	22.23	18.5								31 ⁽²⁾	38	39.5	41	5.5		36.6
-16	25.4	18.5									39.5	41	42.5	7		39.6
-20	31.75	18.5										41	42.5	7		47.8
-24	38.1	18.5											42.5	7		53.8
Minimum Hex (mm)			17	19	19	22	27	32	36	41	46	55	65			
Minimum Hex (in)			15.88	17.46	19.05	22.22	26.99	31.75	34.93	38.10	44.45	53.98	63.5			

1. To be used when nominal tube OD of O-ring stud end is smaller than nominal tube OD of the face seal end.

2. No shoulder required for these sizes. For connectors with face seal end smaller than O-ring boss end use Table B1.

3. For long adapters (Fig 21 and 22, L_{32} and L_{31}) jump factors, use the calculated length differences shown in Table B2 and the standard size connectors.

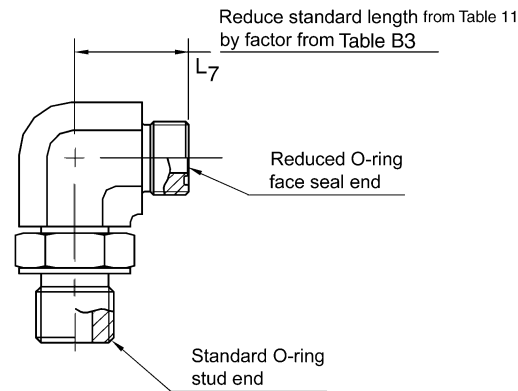


FIGURE B4 - SHAPED STUD END CONNECTORS WITH SMALLER FACE SEAL END
(520220)
REFER TO TABLE B3

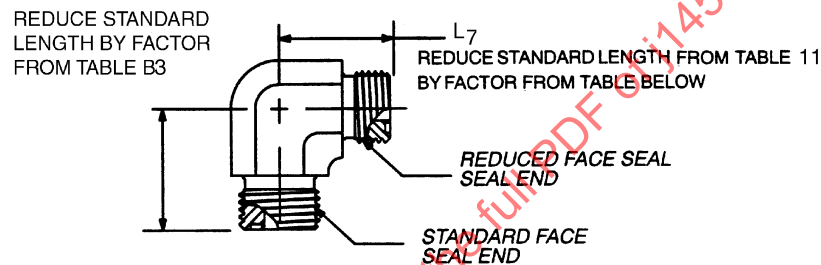


FIGURE B5 - SHAPED FACE SEAL CONNECTORS WITH SMALLER FACE SEAL END
(520201)
REFER TO TABLE B3

TABLE B3 - REDUCTION FACTORS FOR FACE SEAL END ON SHAPED CONNECTORS
WITH SMALLER FACE SEAL END⁽¹⁾

Dimensions in millimeters (mm)
Standard Machining Size (Larger O-Ring Stud End of Connector)

Dash Size Reduced ORFS End	Tube OD Reduced ORFS End	-5 7.94	-6 9.52	-8 12.7	-10 15.88	-12 19.05	-14 22.23	-16 25.4	-20 31.75	-24 38.1	-32 50.8
-4	6.35	0	1.5	3	5.5	7	7.5	See Note ⁽²⁾			
-5	7.94		1.5	3	5.5	7	7.5				
-6	9.52			1.5	3.5	5	5.5	5.5			
-8	12.7				2	3.5	4	4	4		
-10	15.88					1.5	2	2	2	2	
-12	19.05			See Note ⁽³⁾			0.5	0.5	0.5	0.5	5
-14	22.22							0	0	0	4.5
-16	25.4								0	0	4.5
-20	31.75									0	4.5
-24	38.1									0	4.5
Forging Minimum Across Flat (mm)		17	17	19	24	27	36	36	41	50	65
Forging Minimum Across Flat (in)		14.29	17	19.05	26.99	26.99	30.16	36.51	41.28	47.62	63.5

1. To be used when nominal tube OD of at least one face seal end is smaller than the nominal tube OD or adjustable O-ring boss of the other end.

2. Multiple jump connectors are not preferred.

3. No factor required for connector with same end sizes. For connectors with face seal end larger than the stud end, see Table B4.