SAE International

SURFACE VEHICLE STANDARD

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(R) Connections for Fluid Power and High Pressure Use - Ports, Stud Ends, and Plugs with ISO 261 Threads and O-Ring Sealing - Part 3: Port Plug Requirements, Dimensions, Design, and Test Methods

RATIONALE

Corrosion Protection clause has been updated.

FOREWORD

This part defines requirements, dimensions, design and test methods for eight metric plugs for the port connection system for hydraulic applications.

In fluid power systems, power is transmitted and controlled through a fluid (liquid or gas) under pressure within an enclosed circuit. In general applications, a fluid can be conveyed under pressure. Components are connected through their threaded ports by stud ends on fluid connectors to tubes or to hose fittings and hoses. Test procedures for metric ports, stud ends (connectors), and plugs are in accordance with SAE J1644 and can be used at working pressures shown in Table 1.

1. SCOPE

1.1 Purpose

This part of SAE J2337 specifies dimensions, design, and performance requirements for eight plugs using a conical seal to insure leak proof performance with a design factor of 4 to 1.

1.2 Field of Application

These connectors are intended for general and hydraulic systems on industrial equipment and commercial products, where elastomeric seals are acceptable to overcome leakage and variations in assembly procedures. These connectors are capable of providing leak proof full flow connections in hydraulic systems operating from 95 kPa vacuum to the working pressures shown in Table 1. Since many factors influence the pressure at which hydraulic systems 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 the required performance levels are met.

CAUTION: For use of these connectors in conditions outside the pressure and temperature limits specified, contact the manufacturer.

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2. REFERENCES

2.1 Applicable Documents

The following standards contain information which through reference in this text, constitute provisions of this document. All standards are subject to revision, and parties to agreements based on this document shall apply the most recent of the standards. Members of IEC and ISO maintain registers of currently valid International Standards. Unless otherwise indicated, the latest version of SAE publications shall apply.

2.1.1 SAE Publications

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

SAE 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 J1644 Metallic Tube Connections for Fluid Power and General Use - Test Methods for Threaded Hydraulic Fluid Power Connectors

SAE AS568 Aerospace Size Standard for O-Rings

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 261 ISO general-purpose metric screw threads - General plan

ISO 3601 Fluid systems - O-rings - Part 1: Inside diameters, cross-sections, tolerances and designation codes

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

ISO 5598 Fluid power systems and components - Vocabulary

ISO 9927 Corrosion tests in artificial atmospheres - Salt spray

2.1.3 ASTM Publication

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

ASTM B 117 Method of Salt Spray (Fog) Test

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

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2.2.1 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 J1176 External Leakage Classifications for Hydraulic Systems

SAE J2337-1 Connections for Fluid Power and High Pressure Use - Ports, Stud Ends, and Plugs with ISO 261 Threads and O-Ring Sealing - Part 1: Ports with Recessed Conical Seat Requirements, Dimensions, Design, and Test Methods

SAE J2337-2 Connections for Fluid Power and High Pressure Use - Ports, Stud Ends, and Plugs with ISO 261 Threads and O-Ring Sealing - Part 2: Stud End Requirements, Dimensions, Design, and Test Methods

2.2.2 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 1302 Technical drawings - Method of indicating surface texture on drawings

ISO 3448 Industrial liquid lubricants - ISO viscosity classifications

2.2.3 ASME Publication

Available from American Society of Mechanical Engineers, 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900, Tel: 973-882-1170, www.asme.org.

ASME B46.1 Surface Texture (Surface Roughness, Waviness, and Lay)

2.2.4 ASTM Publication

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

ASTM B 633 Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel

3. DEFINITIONS

For the purpose of this document, the definitions given in ISO 5598 and the following shall apply:

3.1 PLUG

A stud end with no through hole for liquid passage, used to contain fluid.

3.2 FLUID POWER

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

3.3 CONNECTOR

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

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4. REQUIREMENTS

4.1 Material

4.1.1 Plugs

Plugs shall be manufactured from carbon steel and shall exceed the minimum pressure/temperature requirements specified for each component or assembly. They shall have characteristics that make them suitable for use with fluid to be conveyed and to provide an effective joint.

CAUTION: For materials other than steel, contact the manufacturer.

4.2 Performance

Plugs shall meet the pressure performance for Stud Ends (connectors) and Plugs with a design factor of 4 to 1 as shown in Table 1.

TABLE 1 - PERFORMANCE REQUIREMENTS

Nom Tube OD mm	Inch Nom Tube Dash Size	d Thread Size	Working Pressure MPa	Proof Pressure MPa	Burst Pressure MPa	Impulse Pressure MPa	Qualification Test Torque N·m +10% –0%	Over Torque Test N·m
6	–4	M14 X 1.5	80	160	320	106	24	35
10	–6	M18 X 1.5	80	160	320	106	34	51
12	–8	M22 X 1.5	80	160	320	106	70	105
16	–10	M27 X 2	80	160	320	106	120	180
20	–12	M30 X 2	63	126	252	84	182	273
25	–16	M39 X 2	63	126	252	84	275	413
30	–20	M45 X 2	50	100	200	67	320	480
38	–24	M50 X 2	40	80	160	53	400	600

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4.3 Design

External Hex Plugs shall conform to the dimensions shown in Figure 1 and Table 2.

Internal Hex Plugs shall conform to the dimensions shown in Figure 2 and Table 3.

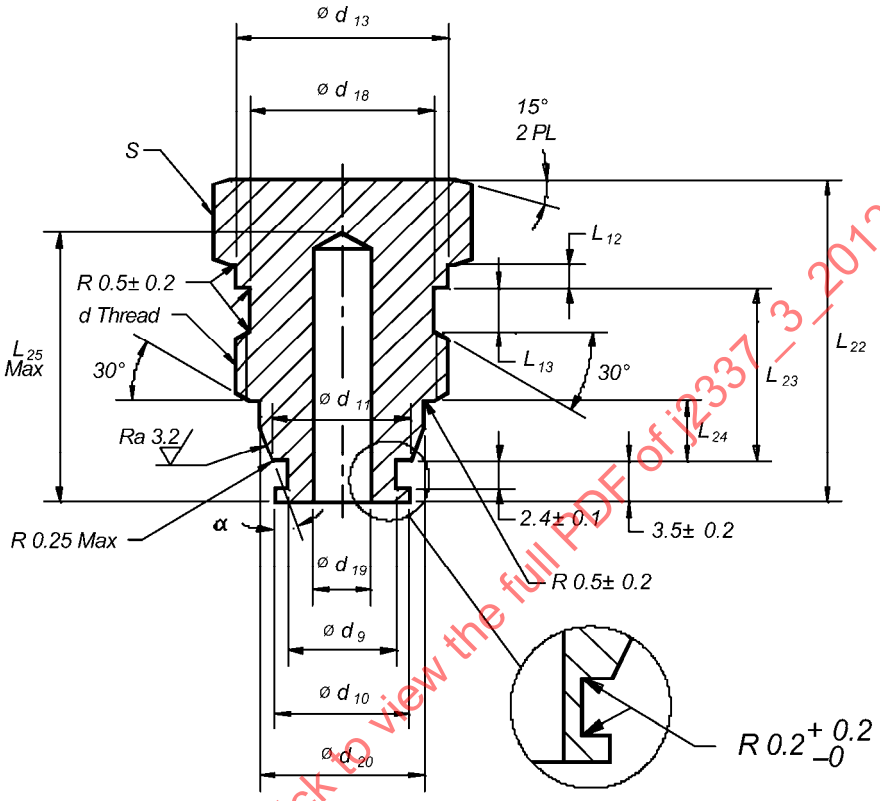

FIGURE 1 - EXTERNAL HEX PLUG

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TABLE 2 - EXTERNAL HEX PLUG
All dimensions in mm

Nom Tube OD mm	Inch Nom Tube Dash Size	d Thread Class 6g	d_9 ±0.05	d_{10} ±0.15	d_{11} ±0.05	d_{13} ±0.1	d_{18} +0 –0.1	d_{19} Optional Drill	d_{19} Drill TOL	d_{20} ±0.2	S Hex	L_{12} ±0.2	L_{13} ±0.1	L_{22} ±0.5	L_{23} ±0.1	L_{24} ±0.2	L_{25} Max	Angle α° +0 –0.5
6	–4	M14 X 1.5	5.9	8	8.5	14	11.7	3.4	±0.1	10	15	2.3	3.7	27	13.9	5.2	21	21
10	–6	M18 X 1.5	8.9	11	11.5	18	15.7	5	±0.1	14	19	2.3	3.7	27	14.8	5.2	23	21
12	–8	M22 X 1.5	12.9	15	15.5	22	19.7	8.5	±0.2	17	24	2.3	3.7	31	17.5	6.6	26	21
16	–10	M27 X 2	15.4	17.5	18	27.5	24	10	±0.2	21.5	28	3	4	38	22.8	9.5	33	21
20	–12	M30 X 2	17.9	20	20.5	30.5	27	12	±0.2	24.5	32	3	4	39	23.5	10.8	34	25
25	–16	M39 X 2	22.4	24.5	25	39.5	36	15	±0.2	32	41	3	4	39	23.7	11	34	25
30	–20	M45 X 2	28.4	30.5	31	45.5	42	20	±0.2	39	46	3	4	43	27.4	12.6	36	25
38	24	M50 X 2	35.4	37.5	38	50.5	47	26	±0.3	44	52	3	4	44	27.9	12.6	36	25

TABLE 3 - INTERNAL HEX PLUG
All dimensions in mm

Nom Tube OD mm	Inch Nom Tube Dash Size	d Thread Class 6g	d_9 ±0.05	d_{10} ±0.15	d_{11} ±0.05	d_{18} +0 –0.1	d_{20} ±0.2	d_{21} OPT +0.25 –0	d_{22} +0.2 –0	d_{23} ±0.1	d_{26} ±0.25	L_{13} ±0.1	L_{23} ±0.1	L_{24} ±0.2	L_{26} ±0.5	L_{27} Max	L_{28} Min	L_{29} OPT ±0.5	S_1 HEX	Angle α° +0 –0.5
6	–4	M14 X 1.5	5.9	8	8.5	11.7	10	7.1	6	14	7	3.7	13.9	5.2	20	12.9	8	2	6	21
10	–6	M18 X 1.5	8.9	11	11.5	15.7	14	7.1	6	18	7	3.7	14.8	5.2	21	14.7	8	2	6	21
12	–8	M22 X 1.5	12.9	15	15.5	19.7	17	9.7	8	22	9.6	3.7	17.5	6.6	23.5	17.8	11	2.4	8	21
16	–10	M27 X 2	15.4	17.5	18	24	21.5	14	12	27.5	14.4	4	22.8	9.5	29	22	15	2.8	12	21
20	–12	M30 X 2	17.9	20	20.5	27	24.5	14	12	30.5	14.4	4	23.5	10.8	29.5	22	15	2.8	12	25
25	–16	M39 X 2	22.4	24.5	25	36	32	16.4	14	39.5	16.4	4	23.7	11	30	23	17	3.2	14	25
30	–20	M45 X 2	28.4	30.5	31	42	39	16.4	14	45.5	16.4	4	27.4	12.6	33.5	26	17	3.2	14	25
38	–24	M50 X 2	35.4	37.5	38	47	44	20	17	50.5	20	4	27.9	12.6	34	28	21	3.2	17	25

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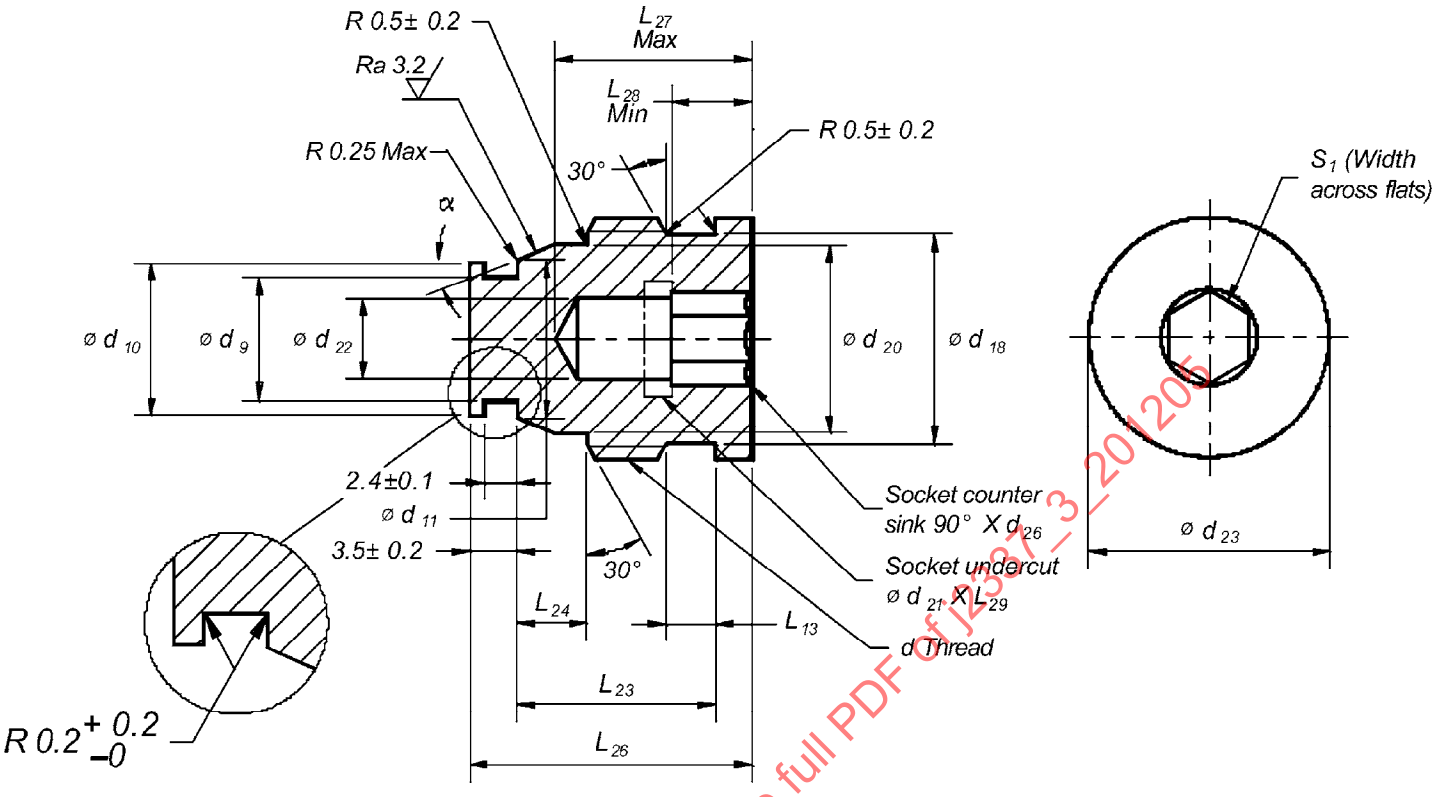

FIGURE 2 - INTERNAL HEX PLUG

4.3.1 Hex Tolerances

Hex tolerances across flats shall be in accordance with ISO 4579-1 product grade c. Minimum across corners is 1.092 times the nominal width across flats. The minimum side flats are 0.43 times the nominal width across flats.

4.3.2 Screw Threads

The screw threads on plugs shall be metric threads to ISO 261.

4.4 Manufacturing

4.4.1 Construction

Plugs can be made from low carbon steel by forging, cold forming or machined from bar stock.

4.4.2 General Workmanship

Workmanship shall conform to the best commercial practice to produce high quality plugs. Plugs shall be free from visual contaminants, all hanging burrs, loose scale, and slivers which might be dislodged in use and any other defects that can affect the function of the plugs.

4.4.3 Surface Finish

Unless otherwise specified, surface finish on all machined surfaces shall be Ra < 6.3 µm or Ra < 3.2 µm in all seal grooves.

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4.4.4 Corrosion Protection

The external surfaces and threads of all carbon steel parts shall be plated or coated with a suitable material that passes a 72 h salt spray test in accordance with ISO 9227 or ASTM B 117. Any appearance of red rust during the 72 h salt spray test shall be considered failure, except for the following:

a. All internal fluid passages.

b. Edges such as hex points, serrations, and crests of threads where there may be mechanical deformation of the plating or coating typical of mass-produced parts or shipping effects.

c. Areas where there is mechanical deformation of the plating or coating caused by crimping, flaring, bending and other post-plate metal forming operations.

d. Areas where the parts are suspended or affixed in the test chamber where condensate can accumulate.

Parts manufactured to this standard shall not be cadmium plated. Hexavalent chromate coatings are not preferred for commercial and industrial usage due to environmental reasons. Internal fluid passages shall be protected from corrosion during storage and shipping. Changes in plating or coating may affect torque and require re-qualification, when applicable.

5. TEST METHODS AND QUALITY PROCEDURES

5.1 Test Procedures

Port plugs shall be tested in accordance with SAE J1644.

5.2 Test Frequency

Qualification testing shall be required when there is a change in design, material, or processing.

5.3 Required Tests and Sample Size

The required sample size is 2 vacuum, 3 proof, 3 burst, 6 impulse, and 3 over torque in accordance with Table 1 and reported on form from SAE J1644.

5.3.1 O-Rings

O-Rings for testing shall conform to ISO 3601, AS568 or SAE J515 (90 durometer nitrile). Barrier seals should be 70 durometer min. See Table 5 Part 2 for O-ring size codes.

6. PACKAGING AND MARKING

6.1 Marking of Plugs

Plugs shall be permanently marked with the manufacturers name or trademark. A code identifier, as agreed upon between purchaser and manufacturer, can be used instead of the manufacturers name or trademark.

6.2 Plug Protection

Plugs shall be protected by a method agreed between manufacturer and user, the plug threads shall be protected by the manufacturer from nicks and scratches, which would be detrimental to the plug function. Paper caps are not permitted.

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