

SURFACE VEHICLE STANDARD

SAE J1644

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Submitted for recognition as an American National Standard

METALLIC TUBE CONNECTIONS FOR FLUID POWER AND GENERAL USE— TEST METHODS FOR THREADED HYDRAULIC FLUID POWER CONNECTORS

This document is technically equivalent to ISO 8434-5.

TABLE OF CONTENTS

1. Scope	2
2. References	2
2.1 Applicable Documents	2
2.2 Definitions	3
3. General Requirements	3
3.1 Test Samples	3
3.2 Test Temperatures	3
3.3 Test Report	3
4. Test Procedures	3
4.1 Proof Pressure Test	3
4.2 Failure Pressure Test (Burst)	4
4.3 Cyclic Endurance Test	4
4.4 Vacuum Test	5
4.5 Overtorque Test	5
5. Marking	6
6. Key Words	6
APPENDIX A Normative—Test Data Form	7
APPENDIX B Informative—Applicable Tests for Various Fitting and Stud End Standards	8

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SAE J1644 Issued MAY93

Foreword—In fluid power systems, power is transmitted and controlled through a fluid (liquid or gas) under pressure within an enclosed circuit. Components must be designed to meet these requirements under varying conditions. Testing of components to meet performance requirements provides users a basis of assurance for determining design application and for checking component compliance with their stated requirements.

ISO 8434-5 was prepared by a joint working group between Technical Committee ISO/TC 5, Ferrous metal pipes and metallic fittings and Technical Committee ISO/TC 131, Fluid Power Systems. These test methods were included with the publication of several ISO standards, but because of its generic application to ports, studs, and tube connections for both metric and inch connections, it was agreed a separate standard should be established. Additional tests are being considered for inclusion by the ISO Joint Working Group.

1. Scope—This SAE Standard specifies uniform methods for the testing and performance evaluation of threaded metallic tube connections and stud ends of ports for hydraulic fluid power.

1.1 Application—Tests outlined within this document are independent of each other and document the method to follow for each test; see the appropriate component SAE or ISO standard for the test(s) requirements and the performance criteria.

Appendix A of SAE J1644 is normative; Appendix B is informative.

2. References

2.1 Applicable Documents—The following standards contain provisions which, through reference in this text, constitute provisions of this document. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this document are encouraged to investigate the possibility of applying the most recent edition of the standards indicated as follows. Members of IEC and ISO maintain registers of currently valid International Standards.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J514—Hydraulic Tube Fittings

SAE J1453—Fitting—O-ring Face Seal

SAE J1926/2—Connections for Fluid Power and General Use—Ports and Stud Ends With ISO 725 Threads and O-ring Sealing Part 2: Heavy-Duty (S Series) Stud Ends—Dimensions, Design, Test Methods, and Requirements

SAE J1926/3—Connections for Fluid Power and General Use—Ports and Stud Ends With ISO 725 Threads and O-ring Sealing Part 3: Light-Duty (L Series) Stud Ends—Dimensions, Design, Test Methods, and Requirements

SAE J2244/2—Connections for Fluid Power and General Use—Ports and Stud Ends With ISO 261 Threads and O-ring Sealing Part 2: Heavy-Duty (S Series) Stud Ends—Dimensions, Design, Test Methods, and Requirements

SAE J1644 Issued MAY93

2.1.2 ISO PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO 48:1979—Vulcanized rubbers—Determination of hardness (Hardness between 30 and 85 IRHD)

ISO 261—ISO general purpose metric screw threads—General plan

ISO 725—ISO inch screw threads—Basic dimensions

ISO 1179—Pipe connections, threaded to ISO 228/1, for plain end steel and other metal tubes in industrial applications

ISO 3448:1975—Industrial liquid lubricants—ISO viscosity classification—first edition

ISO 3601-3:1987—Fluid systems—Sealing devices—O-rings—Part 3: Quality acceptance criteria

ISO 5598:1985—Fluid power systems and components—Vocabulary

ISO 6149—Fluid power systems and components—Metric ports—Dimensions and design

ISO 6508:1986—Metallic materials—Hardness test—Rockwell test (scales A-B-C-D-E-F-G-H-K)

ISO 6605:1986—Hydraulic fluid power—Hose assemblies—Methods of test

ISO 8434-5—Metallic tube connections for fluid power and general use—Part 5: Test methods for threaded hydraulic fluid power connectors

ISO 9974—Connections for general use and fluid power—Port and stud ends with ISO 261 threads with elastomeric or metal-to-metal sealing

2.2 Definitions—For the purpose of this document, the definitions given in ISO 5598 shall apply.

3. General Requirements

3.1 Test Samples—All components tested shall be tested in the final form (as the customer receives the part) including annealing as required for brazing.

3.2 Test Temperatures—Test temperature (ambient and fluid) shall be 15 to 35 °C unless otherwise specified in the controlling ISO standard.

3.3 Test Report—Test results and test conditions shall be reported on the test data form in Appendix A.



Warning

FIGURE 1—WARNING SYMBOL

WARNING—Some of the tests described in this document are considered hazardous; it is therefore essential that, in conducting these tests, all appropriate safety precautions are strictly adhered to. Attention is drawn to the danger of burst, fine jets (which can penetrate the skin), and energy release of expanding gases. To reduce the hazard to energy release, bleed air out of test specimens prior to pressure testing. Tests shall be set-up and performed by properly trained personnel.

4. Test Procedures

4.1 Proof Pressure Test

4.1.1 PRINCIPLE—Three samples shall be tested to confirm that the specified connection(s) meet(s) or exceed(s) a ratio of 2:1 between the proof and working pressure for 60 s minimum at proof pressure without any visual sign of leakage.

SAE J1644 Issued MAY93

4.1.2 MATERIALS

4.1.2.1 *Test Block*—Test blocks shall be unplated and hardened to 45 to 55 HRC per ISO 6508. The distance between the centerlines of test ports shall be a minimum of 1.5 x the port diameter. The distance between the port centerline and the edge of the test block shall be a minimum of 1 x the port diameter.

4.1.2.2 *Test Seals (If Applicable)*—Unless otherwise specified, seals shall be nitrile (NBR) rubber with a hardness of 85, +10/-0 IHRD when measured per ISO 48. Seals shall conform to their respective dimensional requirements, and O-rings shall meet or exceed the quality requirement grade N in ISO 3601-3, if applicable.

4.1.3 PROCEDURES

4.1.3.1 *Thread Lubrication*—For testing only, threads and contact surfaces shall be lubricated with hydraulic oil with a viscosity of VG 32 per ISO 3448 prior to application of torque.

4.1.3.2 *Torque*—Tube connections and stud ends shall be tested at the required minimum torques of the respective connector standard, if specified. Otherwise test at the minimum torque values supplied by the manufacturer. Adjustable stud torques shall be applied after being backed out one full turn from finger-tight position to correctly test the worst possible actual assembly conditions.

4.1.3.3 *Pressure Rise Rate*—The rate of pressure rise shall be constant and chosen to reach the final pressure between 30 and 60 s.

4.1.4 REUSE OF COMPONENTS—Parts which pass this test may be used for other tests or in production.

4.2 Failure Pressure Test (Burst)

4.2.1 PRINCIPLE—Three samples shall be tested to confirm that the specified connection(s) shall be capable of withstanding the minimum of four times the working pressure, without failure.

4.2.2 MATERIALS—Use the same materials as in 4.1.2.

4.2.3 PROCEDURES—Use the same procedures as in 4.1.3.

4.2.4 REUSE OF COMPONENTS—Parts which pass this test **shall not** be tested further, used, or returned to stock.

4.3 Cyclic Endurance Test

4.3.1 PRINCIPLE—Six samples, when tested at their respective impulse pressure, shall pass a cyclic endurance test for 1 000 000 cycles without leakage or component failure.

4.3.2 MATERIALS—Use the same materials as in 4.1.2.

4.3.3 PROCEDURES

4.3.3.1 *Thread Lubrication*—Apply lubricant per 4.1.3.1.

4.3.3.2 *Torques*—Apply torque per 4.1.3.2.

SAE J1644 Issued MAY93

4.3.3.3 *Cycle and Pressure Rise Rate*—Cycle rate shall be uniform at $1 \text{ Hz} \pm 0.25 \text{ Hz}$ and shall conform to the wave pattern shown in ISO 6605, except the pressure rise rate nominal slope shall be calculated using Equation 1:

$$R = 10 P - k \quad (\text{Eq.1})$$

where:

R = Rate of rise (MPa/s)
 P = Nominal square wave test pressure in megapascals
 k = 5 MPa

4.3.4 REUSE OF COMPONENTS—Parts which pass this test **shall not** be tested further, used, or returned to stock.

4.4 Vacuum Test

4.4.1 PRINCIPLE—Two samples shall be capable of withstanding a vacuum of 6.5 kPa (0.065 bar) absolute pressure for 5 min without leakage.

4.4.2 MATERIALS—Use the same materials as per 4.1.2.

4.4.3 PROCEDURES

4.4.3.1 *Thread Lubrication*—Apply lubricant per 4.1.3.1.

4.4.3.2 *Torques*—Apply torque as per 4.1.3.2.

4.4.4 REUSE OF COMPONENTS—Parts which pass this test may be used for other tests or in production.

4.5 Overtorque Test

4.5.1 PRINCIPLE—Six samples shall be capable of withstanding the overtorque qualification test when tested to the overtorque values shown in their respective standards.

4.5.2 MATERIALS—An unplated thread steel mandrel hardened to 40 to 45 HRC per ISO 6508 shall be used.

4.5.3 PROCEDURES

4.5.3.1 *Thread Lubrication*—Apply lubricant per 4.1.3.1.

4.5.3.2 *Wrenching Requirements*—Connections shall be restrained during the test and the wrench shall be located at the threaded end of the nut hex.

4.5.4 REUSE OF COMPONENTS—Parts which pass this test **shall not** be tested further, used, or returned to stock.

SAE J1644 Issued MAY93

5. Marking

Identification statement—(Reference to this document)

Use the following statement in test reports, catalogues, and sales literature when electing to comply with this standard. "Test methods for metallic tube connectors conform to SAE J1644, Metallic Tube Connections for Fluid Power and General Use—Test Methods for Threaded Hydraulic Fluid Power Connectors."

- 6. Key Words**—Fluid power, pipe fittings, ports, stud ends, specifications, design, operating requirements, dimensions, designation, test methods, metric, straight thread, O-ring seal, high pressure, proof, burst, test, fittings, vacuum, overtorque, procedures, rise rate.

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SAE J1644 Issued MAY93

APPENDIX A NORMATIVE—TEST DATA FORM

A.1 See Figure A1.

SAE J1644 TEST DATA FORM					
Specifications for connection being tested: ISO standard _____				Material type _____	
Manufacturer _____			Test Facility _____		
Stud end type _____			Size _____		
Proof test results: (Three samples minimum tested)				Test pressure _____ MPa	
Sample no.	Hardness	Torque	Pressure @ failure	Type of failure	
1. _____	_____ HRB	_____ N-m	_____ MPa	_____	
2. _____	_____ HRB	_____ N-m	_____ MPa	_____	
3. _____	_____ HRB	_____ N-m	_____ MPa	_____	
Over-pressure test results: (Three samples minimum tested)				Test pressure _____ MPa	
Sample no.	Hardness	Torque	Pressure @ failure	Type of failure	
1. _____	_____ HRB	_____ N-m	_____ MPa	_____	
2. _____	_____ HRB	_____ N-m	_____ MPa	_____	
3. _____	_____ HRB	_____ N-m	_____ MPa	_____	
Cycle endurance test results: (Six samples minimum tested)				Test pressure _____ MPa	
Sample no.	Hardness	Torque	Cycles @ failure	Type of failure	
1. _____	_____ HRB	_____ N-m	_____	_____	
2. _____	_____ HRB	_____ N-m	_____	_____	
3. _____	_____ HRB	_____ N-m	_____	_____	
4. _____	_____ HRB	_____ N-m	_____	_____	
5. _____	_____ HRB	_____ N-m	_____	_____	
6. _____	_____ HRB	_____ N-m	_____	_____	
Vacuum test results: (Two samples minimum tested)				Test pressure _____ kPa absolute	
Sample no.	Hardness	Torque	Pressure absolute	Type of failure	
1. _____	_____ HRB	_____ N-m	_____ kPa	_____	
2. _____	_____ HRB	_____ N-m	_____ kPa	_____	
Overtorque test results: (Six samples minimum tested)				Test torque _____ N-m	
Sample no.	Nut hardness	Torque at failure		Type of failure	
1. _____	_____ HRB	_____ N-m	_____	_____	
2. _____	_____ HRB	_____ N-m	_____	_____	
3. _____	_____ HRB	_____ N-m	_____	_____	
4. _____	_____ HRB	_____ N-m	_____	_____	
5. _____	_____ HRB	_____ N-m	_____	_____	
6. _____	_____ HRB	_____ N-m	_____	_____	
Conclusions: Pass/fail with reason for failure. _____					
Dimensions: List any exceptions: _____					
Name (printed/typed) and signature of person certifying this report: _____					
Date: _____					

FIGURE A1—TEST DATA FORM

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APPENDIX B
INFORMATIVE — APPLICABLE TESTS FOR VARIOUS FITTING AND STUD END STANDARDS

B.1 See Figure B1.

Fitting and stud end standards	Tests per SAE J1644 (ISO 8434-5)				
	Proof pressure	Failure pressure (Burst)	Cyclic endurance	Vacuum	Overtorque
Fittings —					
ISO 8434-1 24° compression fittings	✓	✓			
SAE J514 (ISO 8434-2) 37° flared fittings	✓	✓			
SAE J1453 (ISO 8434-3) O-ring face seal fittings	✓	✓	✓	✓	✓
ISO 8434-4 24° cone connectors with O-ring weld-on nipples	✓	✓			
Stud ends —					
SAE J2244/2 (ISO 6149-2)¹⁾ ISO 261 metric threads for heavy duty (S series) stud ends with O-ring sealing	✓	✓	✓		
ISO 6149-3¹⁾ ISO 261 metric threads for light duty (L series) stud ends with O-ring sealing	✓	✓	✓		
ISO 1179-2 ISO 228-1 Whitworth threads for heavy and light duty stud ends with elastomeric sealing	✓	✓	✓		
ISO 1179-3 ISO 228-1 Whitworth threads for light duty stud ends with sealing by O-ring with retaining ring	✓	✓	✓		
ISO 1179-4 ISO 228-1 Whitworth threads for stud ends with metal-to-metal sealing	✓	✓	✓		
SAE J1926/2 (ISO 11926-2) ISO 725 inch threads for heavy duty (S series) stud ends with O-ring sealing	✓	✓	✓		
SAE J1926/3 (ISO 11926-3) ISO 725 inch threads for light duty (L series) stud ends with O-ring sealing	✓	✓	✓		
ISO 9974-2 ISO 261 metric threads for stud ends with elastomeric sealing (type E)	✓	✓	✓		
ISO 9974-3 ISO 261 metric threads for stud ends with metal-to-metal sealing (type B)	✓	✓	✓		
¹⁾ Preferred for new design					

FIGURE B1 — APPLICABLE TESTS FOR VARIOUS FITTING AND STUD END STANDARDS