

INCH-POUNDS

MIL-DTL-5513D
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 SUPERSEDING
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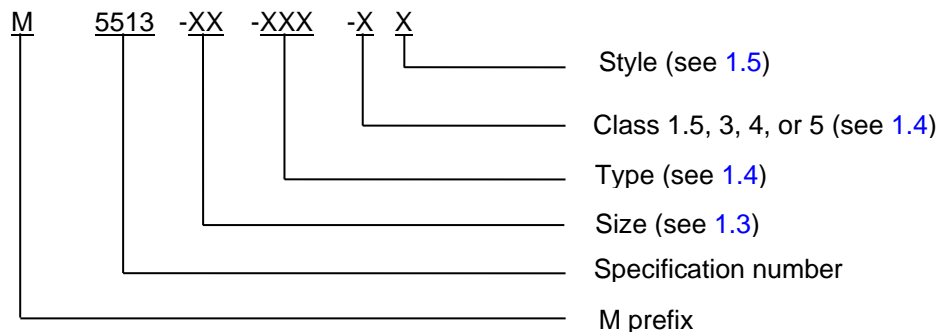
DETAIL SPECIFICATION
 SWIVEL JOINT, HYDRAULIC

This specification is approved for use by all
 Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification establishes the requirements for hydraulic swivel joints (see 6.1).

1.2 Part or Identifying Number (PIN). The PIN consists of the prefix M, the specification number, a dash, swivel dash size, type designator, a dash, class designator, and style.



M5513-20-I-1.5-1b is an aluminum swivel size -20 size, type I, class 1500, style b.

M5513-6-V-4b is a steel swivel size -6 size, type III, class 4000, style b.

M5513-20-VI-5a is a corrosion resistant (CRES) swivel sized -20, type II, class 5000, style a.

M5513-16-IX-3b is a titanium swivel size -6, type I, class 3000, style b.

Comments, suggestions, or questions on this document should be addressed to: DLA Land and Maritime, Columbus, Attn: VAI, P.O. Box 3990, Columbus, OH 43218-3990, or emailed to FluidFlow@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <https://assist.daps.dla.mil>.

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1.3 Swivel dash size. Swivel size see [table I](#).

TABLE I. Swivel dash size.

Swivel dash size	Equivalent tube size		
	Fraction	decimal	mm
-4	1/4	.250	6.35
-6	3/8	.375	9.53
-8	1/2	.500	12.70
-10	5/8	.625	15.88
-12	3/4	.750	19.05
-16	1	1.000	25.40
-20	1 1/4	1.250	31.75

1.4 Classification. Hydraulic swivel joints covered by this specification are of the following types and classes, as specified in [table II](#).

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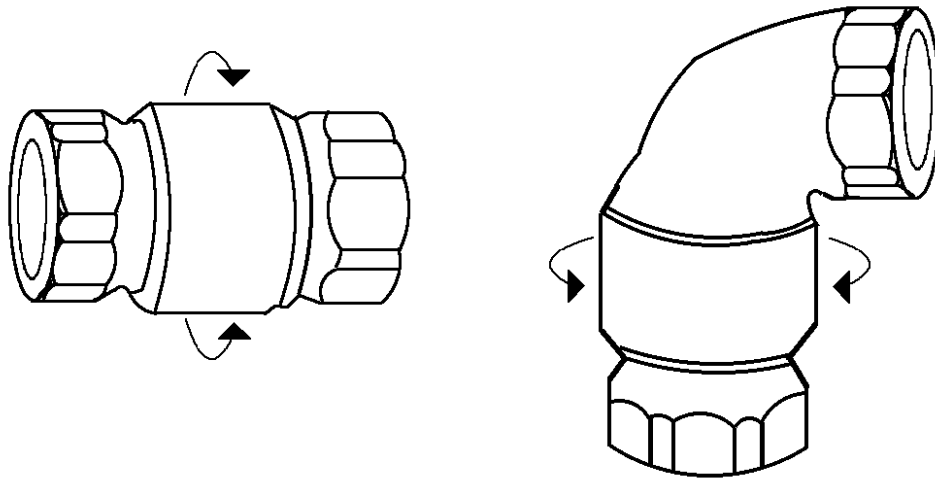
TABLE II. Type and classes designators.

Designator	Type/Class	Characteristics
Aluminum		
I	Type I	-65° to +160°F (-55° to +70°C) temperature range
II	Type II	-65° to +275°F (-55° to +135°C) temperature range
1.5	Class 1500	Where the nominal cut out pressure at the main pressure controlling device is 1500 psig
Steel		
III	Type I	-65° to +160°F (-55° to +70°C) temperature range
IV	Type II	-65° to +275°F (-55° to +135°C) temperature range
V	Type III	-65° to +450°F (-55° to +232°C) temperature range
1.5	Class 1500	Where the nominal cut out pressure at the main pressure controlling device is 1500 psig
3	Class 3000	Where the nominal cut out pressure at the main pressure controlling device is 3000 psig
4	Class 4000	Where the nominal cut out pressure at the main pressure controlling device is 4000 psig
5	Class 5000	Where the nominal cut out pressure at the main pressure controlling device is 5000 psig
Corrosion resistant steel (CRES)		
VI	Type I	-65° to +160°F (-55° to +70°C) temperature range
VI	Type II	-65° to +275°F (-55° to +135°C) temperature range
VIII	Type III	-65° to +450°F (-55° to +232°C) temperature range
1.5	Class 1500	Where the nominal cut out pressure at the main pressure controlling device is 1500 psig
3	Class 3000	Where the nominal cut out pressure at the main pressure controlling device is 3000 psig
4	Class 4000	Where the nominal cut out pressure at the main pressure controlling device is 4000 psig
5	Class 5000	Where the nominal cut out pressure at the main pressure controlling device is 5000 psig
Titanium		
IX	Type I	-65° to +160°F (-55° to +70°C) temperature range
X	Type II	-65° to +275°F (-55° to +135°C) temperature range
XI	Type III	-65° to +450°F (-55° to +232°C) temperature range
1.5	Class 1500	Where the nominal cut out pressure at the main pressure controlling device is 1500 psig
3	Class 3000	Where the nominal cut out pressure at the main pressure controlling device is 3000 psig
4	Class 4000	Where the nominal cut out pressure at the main pressure controlling device is 4000 psig

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1.5 Styles. Hydraulic swivel joints covered by this specification are of the following styles:

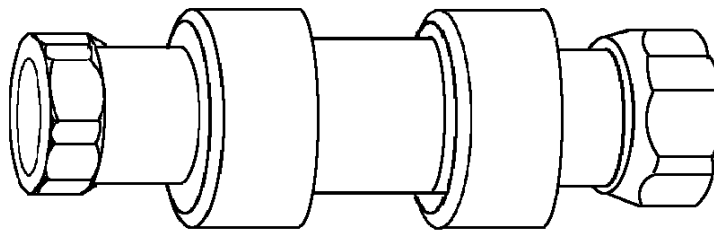
- Style a - Plane swivel: Able to swivel (rotate) in a single plane only, see [figure 1](#).
- Style b - Angular misalignment swivel: Able to swivel and compensate for a conical axial motion of 5 minimum to 7.5 maximum degrees (total axial motion of 10 to 15 degrees).
- Style c - Other styles: Other swivel requirements, or other styles of swivel joints, such as joints incorporating sliding features, are covered by this specification, see [figure 2](#).



SINGLE PLANE OF ROTATION

NOTE: Figure not meant to limit designs.

FIGURE 1. Style A plane swivel.



NOTE: Figure not meant to limit designs.

FIGURE 2. Style C slip joint.

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2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, and 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3, 4, and 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE SPECIFICATIONS

- MIL-F-8815 - Filter and Filter Elements, Fluid Pressure, Hydraulic Line, 15 Micron Absolute and 5 Micron Absolute, Type II Systems, General Specification For
- MIL-H-8890 - Hydraulic Components, Type III (-65° to 450°F), General Specification For
- MIL-DTL-25579 - Hose Assembly, Polytetrafluoroethylene, High Temperature, Medium Pressure

DEPARTMENT OF DEFENSE STANDARDS

- MIL-STD-129 - Marking For Shipment and Storage
- MIL-STD-810 - Environmental Test Methods
- MIL-STD-889 - Dissimilar Metals

(Copies of these documents are available online at <https://assist.daps.dla.mil/quicksearch/> or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

- ISO 17025 - General requirements for the competence of testing and calibration laboratories

(Copies of these documents are available online at www.ansi.org or from the ANSI Customer Service Department, 25 W. 43rd Street, 4th Floor, New York, NY 10036.)

NATIONAL CONFERENCE OF STANDARDS LABORATORIES (NCSL)

- NCSL Z540.3 - Requirements for the Calibration of Measuring and Test Equipment

(Copies of these documents are available online at <http://www.ncsli.org> or from NCSL International 2995 Wilderness Place, Suite 107 Boulder, Colorado 80301-5404.)

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SAE INTERNATIONAL

- SAE-AS604 - Hose Assembly, Polytetrafluoroethylene, Metallic Reinforced, 3000 psi, 400 °F, Heavyweight, Hydraulic
- SAE-AS1339 - Hose Assembly, Polytetrafluoroethylene, Metallic Reinforced, 3000 psi, 400 Degrees Lightweight, Hydraulic and Pneumatic
- SAE-AS4841 - Fittings, 37° Flared, Fluid Connection
- SAE-AS4395 - Fitting End, Flared, Tube Connection, Design Standard
- SAE-AS4396 - Fitting, End, Bulkhead, Flared Tube Connection, Design Standard
- SAE-AS8775 - Hydraulic System Components, Aircraft and Missiles, General Specification For
- SAE-AS18280 - Fittings, 24° Cone Flareless, Fluid Connection, 3000 psi
- SAE-AS33514 - Fitting End, Standard Dimensions for Flareless Tube Connection and Gasket Seal
- SAE-AS33515 - Fitting End, Standard Dimensions For Bulkhead Flareless Tube Connections

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

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified (see 6.2), samples shall be subjected to first article inspection in accordance with 4.5 and 6.3.

3.2 Materials. Materials used in the manufacture of swivel joints shall be of high quality, suitable for the purpose intended, and shall conform to applicable Government specifications. Materials conforming to industry or contractor specifications may be used provided the specifications are satisfactory to the Government and contain adequate provisions for testing. The use of these specifications shall not constitute waiver of Government inspection.

3.2.1 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials shall be used to the maximum extent possible provided that the material meets operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.2.2 Hazardous substances. The use of hazardous substances, toxic chemicals, or ozone depleting chemicals (ODCs) shall be avoided whenever possible.

3.2.3 Corrosion protection. All metals used on the construction of swivel joints shall be suitably protected to resist corrosion in accordance with SAE-AS8775 or MIL-H-8890, as applicable.

3.2.4 Dissimilar metals. Contact between dissimilar metals, as defined by MIL-STD-889, especially brass, copper, or steel, in contact with aluminum or magnesium alloys, shall be avoided wherever possible. Dissimilar metals shall not be used in intimate contact with each other unless protected against electrolytic corrosion.

3.2.5 Flared tube connecting end materials. Materials for flared tube connecting ends shall be in accordance with SAE-AS4841 and 3.2.5.1.

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3.2.5.1 Flared tube fitting end material. Joints shall have tube ends in accordance with the materials as specified:

- a. Joints of sizes -6 and smaller which incorporate tube ends in accordance with SAE-AS4395 or SAE-AS4396 (flared) shall have at least the tube connecting ends made of CRES or steel.
- b. Joints of sizes -8 and larger shall be made of aluminum alloy 7075-T73 or 7075-T351.
- c. Titanium joints of sizes -4 through -20, when specified (see 1.3), which incorporate tube ends in accordance with SAE-AS4395 or SAE-AS4396 (flared) shall have the tube connecting ends made of titanium.

3.2.5.2 Flareless tube materials. Materials for flareless tube connecting ends in accordance with SAE-AS33514 or SAE-AS33515 shall conform to the requirements of SAE-AS18280.

3.2.5.3 Swivel joints with tube ends. Swivel joints which incorporate tube ends in accordance with SAE-AS33514 or SAE-AS33515 (flareless) shall have the tube connecting ends made of CRES, steel, titanium or aluminum alloy 7075-T73 or 7075-T351.

3.2.5.4 Prohibited materials. Aluminum alloys 2014 and 2024 shall not be used for any components.

3.3 Design and construction.

3.3.1 Design. The hydraulic swivel joint shall be designed and tested in accordance with this specification and the requirements of SAE-AS8775 (types I, II, and IV) and MIL-H-8890 (type III). In the event of conflict, the requirements of this specification shall apply.

3.3.2 Packings and gland design. If a satisfactory installation using standard packing's or gland design is not possible due to performance requirements, non-standard packing and gland designs may be used subjected to approval by the procuring activity, and provided the units satisfactorily complete first article inspection.

3.3.3 Dimensions. Hydraulic swivel joints shall be designed and constructed within the limiting dimensions indicated on the applicable manufacturing drawings.

3.4 Performance. Hydraulic swivel joints shall satisfy the performance requirements specified in section 4 when subjected to the applicable tests.

3.4.1 Fluid immersion. All swivel joints containing nonmetallic seals or other nonmetallic parts, other than AN or MS static seals with standards glands, shall be fluid immersion tested in accordance with 4.7.2. There shall be no leakage, sticking, binding, or other malfunctioning of the joint after this immersion.

3.4.2 Proof pressure. The swivel joints when subjected to the proof pressure testing in accordance with 4.7.3 at the proof pressure specified in table III shall show no evidence of leakage or other malfunctioning during this test.

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TABLE III. Proof and burst pressure. 1/

Rated operating pressure of joint psig (MPa)	Elevated temperature		Room temperature	
	Proof pressure min psig (MPa)	Burst pressure min. psig (MPa)	Proof pressure min. psig (MPa)	Burst pressure min. psig (MPa)
1500 (10.3)	2250 (15.5)	3750 (25.9)	3000 (20.7)	6000 (41.4)
3000 (20.7)	4500 (31.0)	7500 (51.37)	6000 (41.4)	12,000 (82.7)
4000 (27.6)	6000 (41.4)	10,000 (68.9)	8000 (55.2)	16,000 (110.3)
5000 (34.5)	7500 (51.7)	12,500 (86.2)	10,000 (68.9)	20,000 (137.9)

1/ Metric equivalents are given for information only.

3.4.3 Leakage at low pressure. The fittings shall not leak, when tested in accordance with 4.7.4.

3.4.4 Reverse leakage. When swivel joints are tested in accordance with 4.7.5, there shall be no reverse leakage, as indicated by loss of vacuum during this period.

3.4.5 Endurance. When swivel joints are endurance tested in accordance with 4.7.6 there shall be no reverse leakage, as indicated by loss of vacuum during this period.

3.4.6 Swiveling torque. Swivel joints when swiveling torque tested in accordance with 4.7.7 the torque required to swivel and to compensate for angular realignment within the limits of such action of the swivel joint shall be noted and shall not exceed the value specified in table IV.

TABLE IV. Swiveling torque and flow rate. 1/

Swivel joint dash size	Torque maximum, pound-inch (Nm)								Rated flow gpm
	1500 psi (10 MPa)		3000 psi (21 MPa)		4000 psi (28 MPa)		5000 psi (34 MPa)		
	Plane swivel	Other swivels	Plane swivel	Other swivels	Plane swivel	Other swivels	Plane swivel	Other swivels	
4	8 (.9)	40 (4.5)	15 (1.7)	60	Torque values for 4000 (28 MPa) and 5000 psi (34 MPa) swivel joints shall be as specified by the procuring activity. (see 6.2)				1.2
5	10 (1.1)	60 (6.8)	20 (2.3)	85					2.3
6	15 (1.7)	70 (7.9)	30 (3.4)	90					3.5
8	25 (2.8)	80 (9.0)	45 (5.1)	130					6.0
10	30 (3.4)	100 (11.3)	60 (6.8)	170					10.5
12	50 (5.6)	200 (22.6)	90 (10.2)	350					16.0
16	100 (11.3)	400 (45.2)	135 (15.3)	600					29.0
20	125 (14.1)	200 (22.6)	200 (22.6)						45.0

1/ Metric equivalents are given for information only.

3.4.7 Swiveling torque at elevated temperature. Swivels when tested in accordance with 4.7.8 the torque shall not exceed the values specified in table IV.

3.4.8 Pressure drop. Swivels when tested in accordance with 4.7.9 the pressure drop through a swivel joint shall not exceed 5 psig.

3.4.9 Cold temperature operation. Swivels when tested in accordance with 4.7.10 shall show no evidence of leakage or other malfunctioning.

3.4.10 Operation at differential temperature. Swivels when tested in accordance with 4.7.11 shall show no leakage.

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3.4.11 Vibration. Swivels when tested in accordance with 4.7.12 shall be proof pressure tested in accordance with 4.7.3 and shall show no evidence of leakage or malfunction.

3.4.12 Functional shock. Swivels when tested in accordance with 4.7.13 shall be proof pressure tested in accordance with 4.7.3 and shall show no evidence of leakage or malfunction.

3.4.13 Burst pressure. Swivels when tested in accordance with 4.7.14 rupture of the assembly at any pressure below the specified burst pressure specified in table III shall be cause for rejection.

3.5 Weight. The weight of the hydraulic swivel joints shall be as low as possible, consistent with the requirements of this specification.

3.6 Identification of product. All fitting connections and swivel joints shall be marked with the manufacturer's part number, serial number, and name, CAGE, or trademark.

3.7 Workmanship. All details of workmanship shall be of a sufficiently high grade to insure proper operation and service life.

4. VERIFICATION

4.1 Classification of inspection. The inspection requirements specified herein are classified as follows:

- a. First article inspection (see 4.5)
- b. Conformance inspection (see 4.6).

4.2 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, quality, and quantity to permit performance of the required inspection shall be established and maintained or identified by the contractor. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with ISO 17025 and NCSL Z540.3 as applicable.

4.2.1 Test conditions.

4.2.1.1 Test fluid. The hydraulic fluid used for all tests shall be the specified service fluid (see 3.3.1), which shall be filtered through a MIL-F-8815 (15 micron) filter, or equivalent.

4.2.1.2 Temperature. Except where otherwise specified, the tests shall be conducted at a room temperature of approximately 21° to 32°C (70° to 90°F) and a fluid temperature of approximately 21° to 43°C (70° to 110°F). The actual fluid temperature during testing shall be recorded.

4.2.1.3 Tolerance. Unless otherwise specified, the allowable tolerance for pressure during testing shall be plus or minus 2 percent.

4.3 First article inspection. When specified in the contract or purchase order (see 6.2), samples that are representative of the production item shall be subjected to first article inspection after the Government has awarded the contract. First article inspection shall be performed in accordance with table V to determine whether the production items meet the requirements of this specification.

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4.4 Responsibility for compliance. All items shall meet all requirements of sections 3, 4, and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material. The supplier's inspection and test records shall clearly demonstrate the products conformance to technical specifications.

4.4.1 Lot records. Manufacturers shall keep lot records for 3 years minimum. Manufacturers shall monitor for compliance to the prescribed procedures, and observe that satisfactory manufacturing conditions and records on lots are maintained for these hose assemblies. The records, including as a minimum, an attributes summary of all quality conformance inspections conducted on each lot, shall be available to review by customers at all times

4.5 First article inspection. The first article inspection of swivel joints shall consist of tests specified in table V. When specified, the first article inspection shall be supplemented by tests approximating service conditions (see 6.2 and 6.3).

TABLE V. First article tests.

Test	Requirement paragraph	Test paragraph
Examination of product	3.3.1, 3.6, and 3.7	4.7.1
Fluid immersion	3.4.1	4.7.2
Proof pressure and leakage	3.4.2	4.7.3
Leakage at low pressure	3.4.3	4.7.4
Reverse leakage	3.4.4	4.7.5
Endurance	3.4.5	4.7.6
Swiveling torque	3.4.6	4.7.7
Swiveling torque at elevated temperature	3.4.7	4.7.8
Pressure drop	3.4.8	4.7.9
Cold temperature operation	3.4.9	4.7.10
Operation at differential temperature	3.4.10	4.7.11
Vibration	3.4.11	4.7.12
Functional shock	3.4.12	4.7.13
Burst	3.4.13	4.7.14

4.5.1 Similarity. Swivel joints passing the first article inspection tests to specific type, class and style shall be considered as acceptable to those types and classes of the same style with lower requirements.

4.5.2 Inspection lot. All Swivels of the same type and size offered to the Government at one time shall be considered as a lot for the purpose of inspection.

4.5.3 Test report. The contractor shall prepare test reports showing quantitative results of all tests required. Tests shall be validated by authorized representatives of the contractor or laboratory, as applicable.

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4.5.4 Disposition of samples. Samples subjected to destructive testing shall not be part of the contract or order.

4.5.5 Inspection lot. All swivels of the same type and size offered to the Government at one time shall be considered as a lot for the purpose of inspection.

4.5.6 Disposition of first article samples. Unless otherwise specified, after award of the contract or order, the manufacturer shall forward (1 swivel assembly), fabricated from random samples. The sample shall be representative of the construction, workmanship, components, and materials used during production. When a manufacturer is in continuous production of the swivel assemblies from one contract to another, submission of additional first article samples for a new contract may be waived at the discretion of the acquiring activity (see 6.2).

4.5.7 Waivers or deviations to specification requirements. All waivers or deviations to specification requirements shall be coordinated through the preparing activity; DLA Land and Maritime, Attn: VAI, P.O. Box 3990, Columbus, OH 43218-3990, or emailed to Fluidflow@dla.mil.

4.5.8 First article information. Upon completion of first article inspection, the Government activity responsible for conducting the inspection program (see 6.2), shall report the results of the inspection, with appropriate recommendation, to the contracting officer. Approval of the first article samples or the waiving of first article inspection does not preclude the requirements for performing conformance inspection.

4.5.9 Disposition of samples. First article samples shall be furnished to the Government as directed by the contracting officer (see 6.2).

4.6 Conformance inspection. Conformance inspection shall consist of the following:

- a. Individual inspection tests.
- b. Sampling tests.

4.6.1 Individual inspection tests. Testing shall be performed on each lot and shall include all the tests specified in [table VI](#).

TABLE VI. Individual inspection.

Test	Requirement paragraph	Test paragraph
Examination of product	3.3.1 , 3.6 , and 3.7	4.7.1
Proof pressure	3.4.2	4.7.3
Leakage at low pressure	3.4.3	4.7.4

4.6.2 Sampling tests. Test swivel joints shall be selected at random in accordance with [table VII](#) and subjected to the tests as described under [4.6.2.1](#). Any failure resulting from these tests shall be thoroughly documented, analyzed, and corrected according to the procedures described in [4.6.2.3](#).

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TABLE VII. Inspection sample.

Production lot size	Sample size
1 to 8	All
9 to 90	8
91 to 150	12
151 to 280	19
281 to 500	21
501 to 1,200	27
1,201 to 3,200	35
3,201 to 10,000	38
10,001 to 35,000	46

4.6.2.1 Sampling test procedure. The swivel joints shall be subjected to the endurance test in accordance with 4.7.6, 4.7.6.1, 4.7.6.1.1, and 4.7.6.1.2. The sand and dust (see 4.7.2 g (2) portion of this test should only be accomplished twice, after the first 10,000 swivel cycles and after 50,000 swivel cycles.

4.6.2.2 Nonconformance of sampling tests. If one or more defects are identified, then the entire production lot shall be screened for that defect and all defects shall be removed. A second inspection sample shall then be selected from the different lot and the sampling tests shall be performed again. If one or more defects are identified from the second inspection lot then the lot shall be considered as failed.

4.6.2.3 Rejection and retest. When a swivel joint selected from a production run fails to meet the specification, no swivel joints still on hand or later produced shall be accepted until the extent and cause of failure have been determined and appropriately corrected. The contractor shall explain fully in writing to the procuring activity the cause of failure and the action taken to preclude recurrence. After correction, all of the tests shall be repeated using new samples.

4.6.2.4 Individual tests. For production reasons, individual tests or other sampling plans may be continued pending the investigation of a sampling test failure. But final acceptance of the swivel joints on hand or swivel joints produced later shall not be made until it is determined that all swivel joints meet all the requirements of the specification.

4.6.2.5 Defects in swivel joints already accepted. The investigation of a test failure could indicate that defects may exist in swivel joints already accepted. If so, the contractor shall fully advise the procuring activity of all the defects likely to be found and the method of correcting them.

4.7 Test methods

4.7.1 Examination of product. Each swivel joint shall be examined for conformance to applicable detail and assembly drawings, marking, and workmanship see 3.3.1, 3.6, and 3.7.

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4.7.2 Fluid immersion (see 3.4.1). All swivel joints containing nonmetallic seals or other nonmetallic parts, other than AN or MS static seals with standard glands, when subjected to fluid immersion shall meet the requirements of 3.4.1. The following details shall apply:

- a. Swivels shall be immersed in the appropriate hydraulic fluid at the applicable temperature required by table VIII for a period of 72 hours before being subjected to the first article inspection.
- b. There shall be no leakage, sticking, binding, or other malfunctioning of the joint after this immersion.

TABLE VIII. Elevated temperature test requirements.

Swivel joint type	Test temperature
I	158° to 162°F (70° to 72°C)
II	270° to 280°F (132° to 138°C)
III	440° to 460°F (227° to 238°C)
IV	270° to 280°F (132° to 138°C)

4.7.3 Proof pressure (see 3.4.2). Each swivel joint shall be subjected to the proof pressures as specified in table III and shall meet the requirements of 3.4.2. The following details shall apply:

- a. For first article inspection test items (see 4.5), the test shall be conducted with the fluid at the maximum rated temperature (table VIII).
- b. The testing of conformance inspection items shall be conducted with fluid at room temperature.
- c. The pressure shall be applied for not less than two minutes.
- d. During this time, the joint shall be swiveled to four approximately equidistant positions through its swiveling circle and the pressure shall be held for a minimum of 30 seconds at each position.
- e. There shall be no evidence of leakage or other malfunctioning during this test.

4.7.4 Leakage at low pressure (see 3.4.3). Swivel joints shall be subjected to the leakage at low pressures and shall meet the requirements of 3.4.3. The following details shall apply:

- a. For first article inspection items, the test specified for proof pressure and leakage (see 4.7.3) shall be used except that the pressure applied at maximum rated fluid temperature, for the two minute period shall be 5 to 10 psi (34.5 to 69 KPa).
- b. The tests for conformance inspection items shall also use the proof pressure and leakage test (see 4.7.3) at room temperature, except air-under water shall be used in place of hydraulic fluid and the pressure for the two minute period shall be 5 to 10 psi (35 to 69 KPa).

4.7.5 Reverse leakage (see 3.4.4). Swivel joints shall be subjected to reverse leakage and shall meet the requirements of 3.4.4. The following details shall apply:

- a. After plugging one of the ports of the swivel joint, a vacuum equivalent to 25 inches Hg (12.3 psi (86 KPa)) pressure differential shall be applied at the other port and held for a period of five minutes.
- b. During this five minute period, the plane joint shall be operated through 25 cycles with each half cycle consisting of not less than 120° of rotation.
- c. Variable axis swivels shall be rotated through a minimum 90 percent of their rated swivel excursion through each half cycle.

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4.7.6 Endurance (see 3.4.5). Swivel joints shall be subjected to endurance testing and shall meet the requirements of 3.4.5. The swivel joint shall be subject to 100,000 swivel cycles at a rate of 25 ± 4 cycles per minute (see figure 1 for a typical endurance test set-up). The following details shall apply:

- a. Each half cycle for plane swivels shall consist of a minimum of 120° rotation. For angular misalignment swivel joints, each half cycle shall consist of a minimum of 120° rotation and at the same time shall transcribe a conical motion of 120° (see figure 2).
- b. The conical motion is the result of a swivel joint being constantly misaligned 90 percent of its rated misalignment feature.
- c. During swivel cycling, the swivel joint shall be impulse at a rate of 35 ± 5 cycles per minute (see figure 3).
- d. During the first sequence of 10,000 swivel cycles, the swivel joint shall be serviced with test fluid maintained at elevated temperatures as specified in table VIII for the respective swivel joint types.
- e. During swivel cycling, the joints shall also be subjected to the eccentric loading conditions in accordance with 4.7.6.1.1 for plane swivels and 4.7.6.1.2 for angular misalignment swivels.
- f. After each 10,000 swivel cycles, reverse the direction of the load.
- g. The swivel shall be serviced with test fluid at 5 to 10 psig (35 to 69 KPa) and the fluid temperature shall be maintained at the elevated temperature specified in table VIII for the respective joint type. The following schedule of tests shall be repeated five times:
 1. 10,000 swivel/impulse cycles with eccentric loading.
 2. Blowing dust test in accordance with MIL-STD-810, method 510.1, procedure I, the following details shall apply:
 - (a) The first two schedule runs shall use MIL-STD-810, method 510.1, procedure I, steps 1 through 5 and 8 through 11 the following details shall apply:
 - (1) Temperature. 23°C (73°F).
 - (2) Humidity less than 22 percent.
 - (3) Dust composition shall be silica flour.
 - (b) The third schedule run shall use the entire MIL-STD-810, method 510.1, procedure I, dust composition shall be silica flour.
 - (c) The fourth and fifth schedule runs shall use MIL-STD-810, method 510.1, procedure I, steps 1 through 5 and 8 through 11 the following details shall apply:
 - (1) Temperature. 71°C (160°F).
 - (2) Humidity less than 22 percent.
 - (3) Dust composition shall be silica flour.
 3. 10,000 swivel/impulse cycles with eccentric loading.
 4. Icing see 4.7.6.2.

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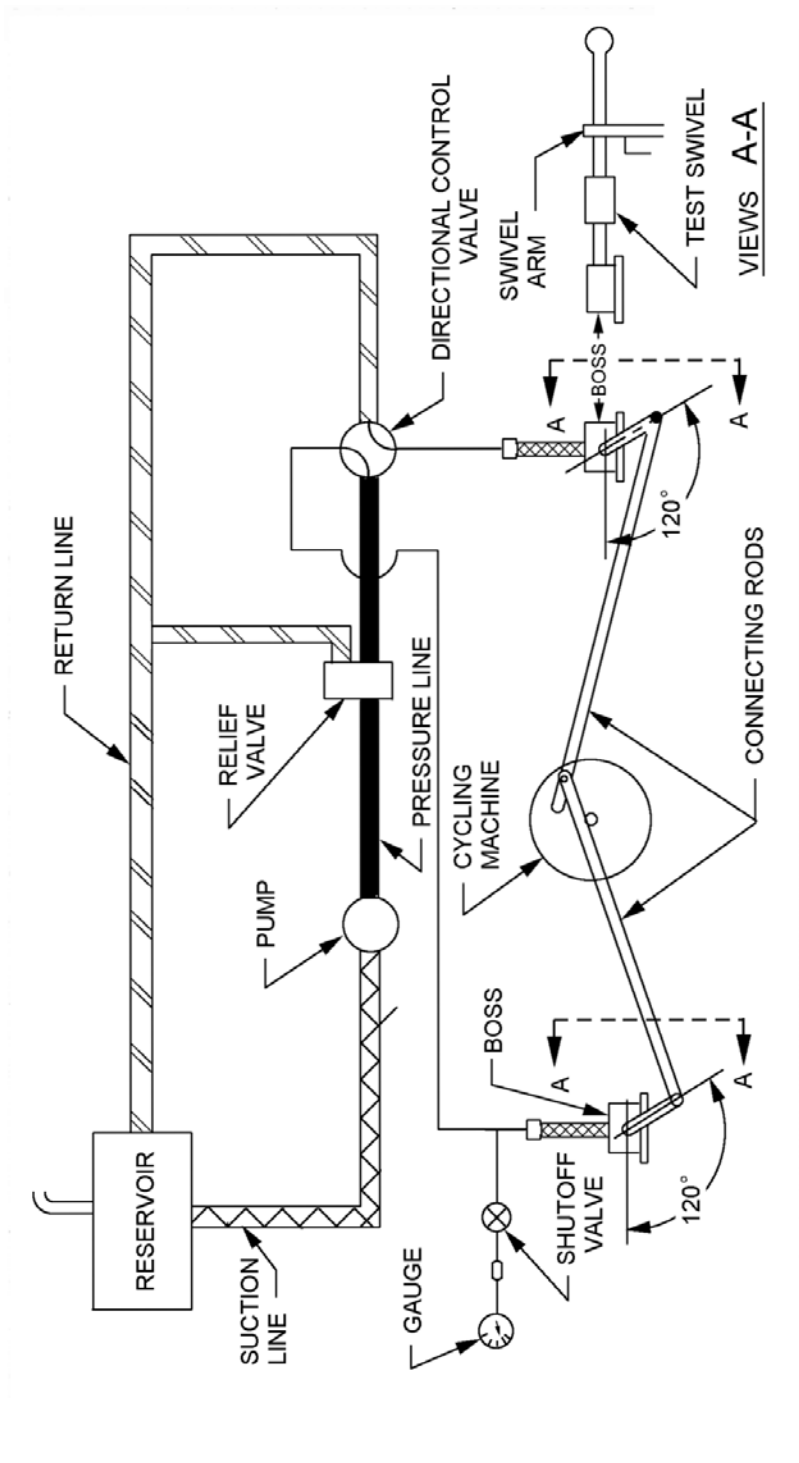


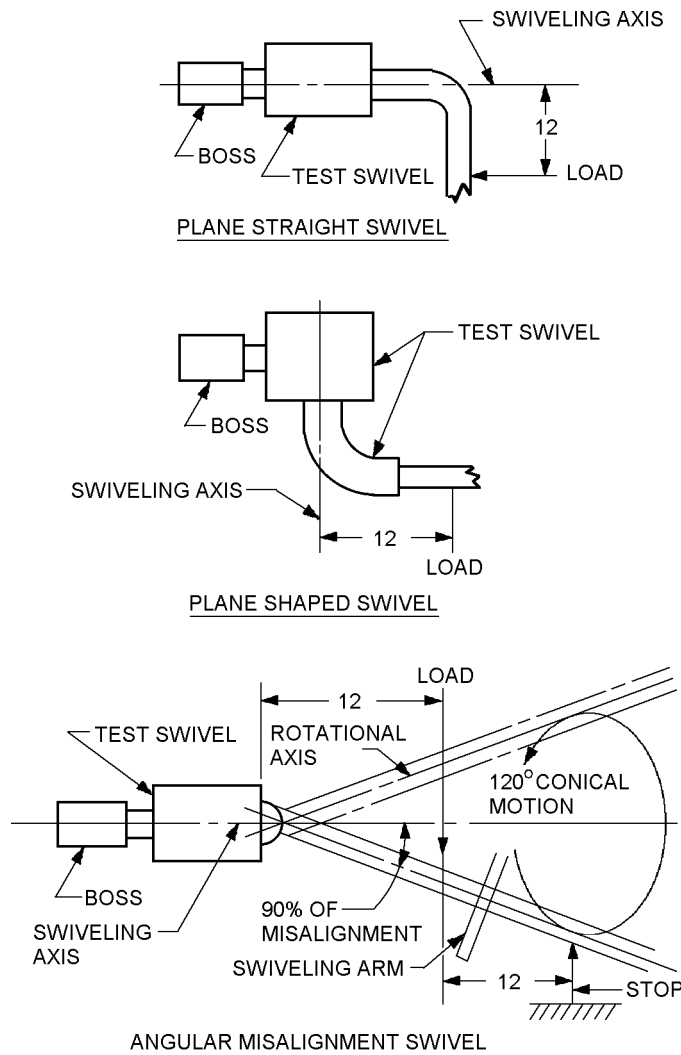
FIGURE 3. Endurance test set-up.

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4.7.6.1 Eccentric loading. The following tests are required to simulate tube misalignment of swivel joints in aircraft by including an eccentric loading.

4.7.6.1.1 Eccentric loading for style a plane swivels. Style a plane swivels shall be loaded radially and axially during endurance cycling by imposing a force on one element of the assembly. For style a plane swivels (straight, shaped, elbow, tee, etc.) the load (see [table IX](#)) shall be applied parallel to the swiveling axis as shown on [figure 2](#).

4.7.6.1.2 Eccentric loading for style b misalignment swivel. For style b angular misalignment swivels the load (see [table IX](#)) shall be applied effective at the bearing portion of the swiveling element as shown on [figure 4](#).



Inches	mm
12	254.0

FIGURE 4. Eccentric loading for swivel joints.

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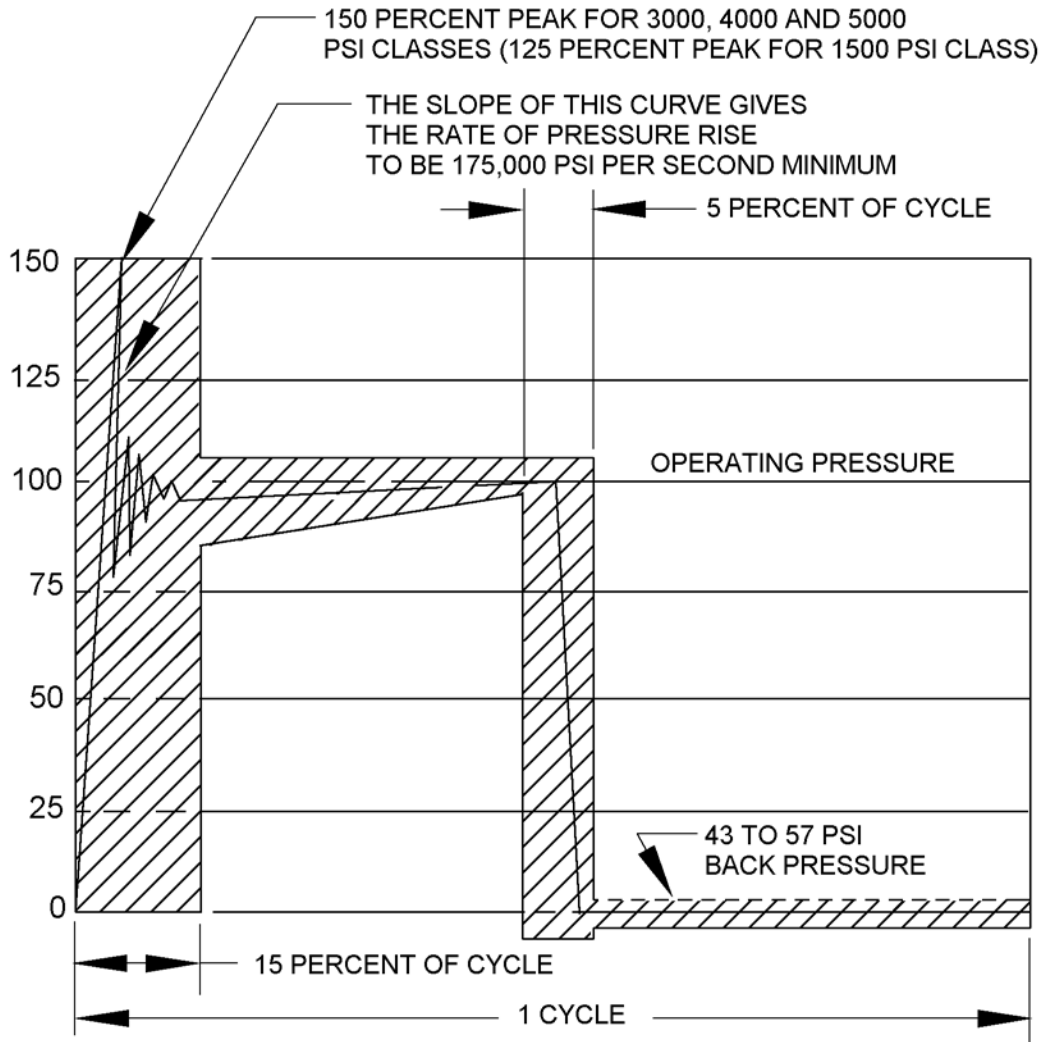


FIGURE 5. Pressure impulse graph.

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TABLE IX. Swivel loading forces. 1/ 2/

Dash size	Load	
	Pounds + 10%	Kg
4	1.5	0.68
5	2.0	0.91
6	3.0	1.36
8	4.0	1.81
10	6.0	2.72
12	8.0	3.6
16	10.0	4.54
20	12.0	5.44

1/ Metric equivalents are given for information only.

2/ Values given are for style a plane swivels. Double the lead for style b misalignment swivels.

4.7.6.2 Icing. The following details shall apply:

- With the test specimen stabilized in a test chamber at $35^{\circ} \pm 2^{\circ}\text{F}$ ($1.7^{\circ} \pm 1.1^{\circ}\text{C}$) and so oriented that the axis of rotation is horizontal, fully submerge the specimen in a mixture of water and ice at 32°F (0°C) for one minute.
- Remove the specimen from the water and decrease the chamber temperature to $15^{\circ} \pm 5^{\circ}\text{F}$ ($-9.4^{\circ} \pm 2.7^{\circ}\text{C}$) within five minutes and maintain this temperature for 30 minutes with no hydraulic pressure or motion applied to the specimen.
- Perform the cold temperature operation test see 4.7.10 except that the temperature shall remain at $15^{\circ} \pm 5^{\circ}\text{F}$ ($-9.4^{\circ} \pm 2.7^{\circ}\text{C}$) and the soak period shall be one hour in lieu of 24 hours.

4.7.6.3 Failure criteria. There shall be no evidence of malfunctioning or leakage greater than one drop in 100 cycles.

4.7.7 Swiveling torque (see 3.4.6). Swivels when subjected to swiveling torque shall meet the requirements of 3.4.6. The following details shall apply:

- After applying the rated internal operating pressure for a period of five minutes, increasing torque shall be applied gradually to obtain swiveling motion.
- The torque required to swivel and to compensate for angular realignment within the limits of such action of the swivel joint shall be noted and shall not exceed the value specified in table IV.

4.7.8 Swiveling torque at elevated temperature (see 3.4.7). Swivels when subjected to swiveling torque at elevated temperatures shall meet the requirements of 3.4.7. The following details shall apply:

- The torque test specified in 4.7.7 shall be repeated with both the joint and hydraulic fluid at the applicable temperature listed in table IV.
- The torque shall not exceed the values specified in table IV.

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4.7.9 Pressure drop (see 3.4.8). Swivels when subjected to pressure drop shall meet the requirements of 3.4.8. The following details shall apply:

- The rated flow, as specified in table IV, shall be passed through the swivel joint and the pressure drop determined by means of manometers, accurately calibrated pressure gages, or other suitable means (see figure 6).
- The pressure drop through any swivel joint shall not exceed 10 psig (69 KPa) for each 90-degree bend in the joint.

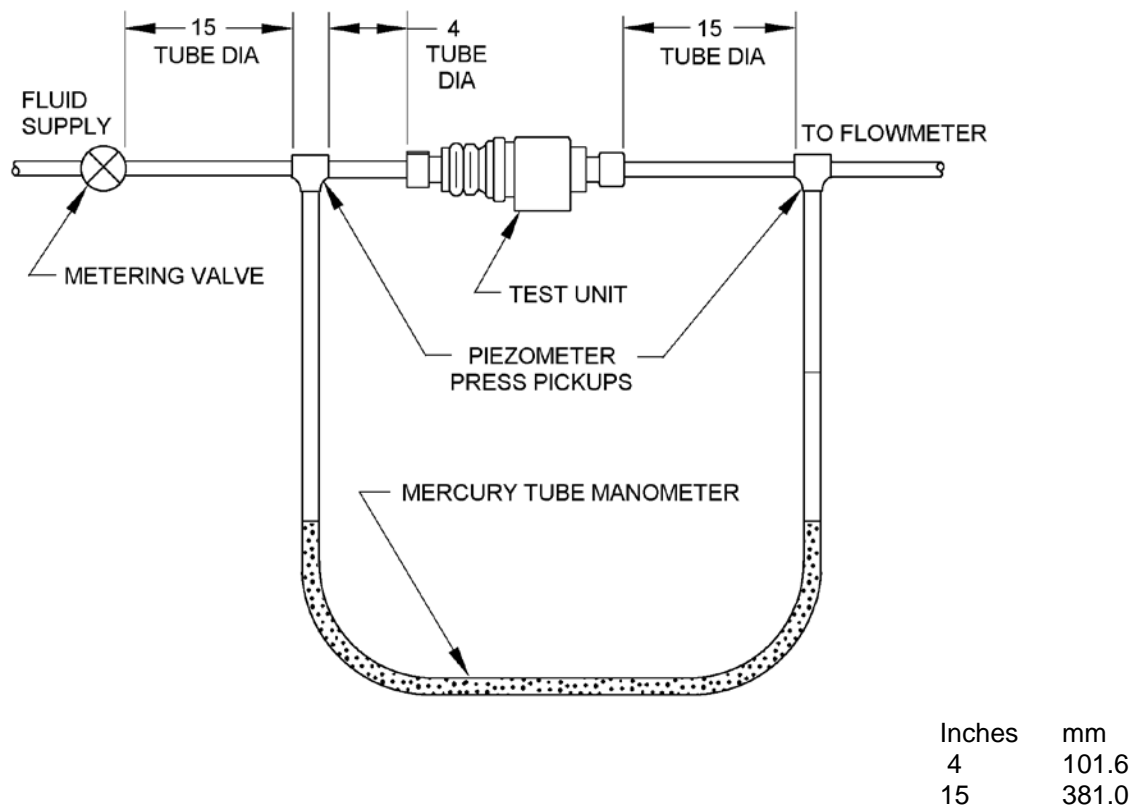


FIGURE 6. Pressure drop test set-up.

4.7.10 Cold temperature operation (see 3.4.9). Swivels when subjected to cold temperature operation shall meet the requirements of 3.4.9. The following details shall apply:

- While at room temperature, the swivel joint shall be filled with hydraulic fluid and pressurized to 5 to 10 psig.
- The swivel joint shall then be cooled to a temperature of -65° to -70°F (-54° to -57°C) and held at this temperature and pressure for a minimum of 24 hours.
- At the end of the 24-hour period, torque to obtain swiveling motion shall be determined first at 5 to 10 psig and then at operating pressure.
- The swiveling torque shall not exceed the values specified in table IV.
- The joint shall then be swiveled for 25 cycles through the range specified in 4.7.7 at both 5 to 10 psig (35 to 69 KPa) and rated operating pressure.

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4.7.11 Operation at differential temperature (see 3.4.10). Swivels when subjected to operation at differential temperature shall meet the requirements of 3.4.10. The following details shall apply:

- a. The joint shall be allowed to warm up rapidly from -65°F (-54°C) temperature to at least +40°F (+4°C).
- b. Sufficient operational check tests shall be made throughout the warm-up temperature range to prove there is no binding or other malfunctioning due to differential rates of temperature expansion or contraction of component parts.
- c. Pressure shall be varied from 5 psig (34.5 Kpa) to rated pressure during the operational checks and there shall be no leakage.

4.7.12 Vibration (see 3.4.11). Swivels when subjected to vibration shall meet the requirements of 3.4.11. The following details shall apply:

- a. Hose cut lengths and bend radii, see table X.
- b. The swivel joint shall be mounted in a fixture by the bulkhead attaching (swivel housing) end in a fixture similar to the one shown on figure 7.
- c. The opposite end of the swivel joint shall be suitably capped or plugged.
- d. The applicable operating pressure as listed in table II shall be applied and maintained.
- e. The mounted swivel joint shall then be vibration tested in accordance with appendix A.
- f. Upon completion of the vibration tests, the swivel joint shall be subjected to the proof pressure and leakage test specified in 4.7.3.

TABLE X. Hose cut lengths and bend radii. 1/

Swivel size	Equivalent size inches (mm)	MIL-DTL-25579 1500 psi (10 MPa) hose		SAE-AS604 3000 psi (21 MPa) hose	
		Hose length inches (mm)	Radius inches (mm)	Hose length inches (mm)	Radius inches (mm)
-4	.250 (6.35)	9 (228.6)	2.000 (50.80)	11 (279.4)	3.000 (76.20)
-6	.375 (9.53)	12 (304.8)	4.000 (101.60)	14 (355.6)	5.000 (127.0)
-8	.500 (12.70)	13 (330.2)	4.625 (117.48)	15 (381.0)	5.750 (146.05)
-10	.625 (15.88)	15 (381.0)	5.500 (139.70)	16 (406.4)	6.500 (165.10)
-12	.750 (19.05)	16 (406.4)	6.500 (165.10)	18 (457.2)	7.750 (196.85)
-16	1.000 (25.40)	18 (457.2)	7.375 (187.33)	21 (533.4)	9.625 (244.48)
-20	1.250 (31.75)	23 (584.2)	11.000 (279.40)	--	--

1/ Hose in accordance with MIL-DTL-25579 or SAE-AS604 as applicable to operating pressure.

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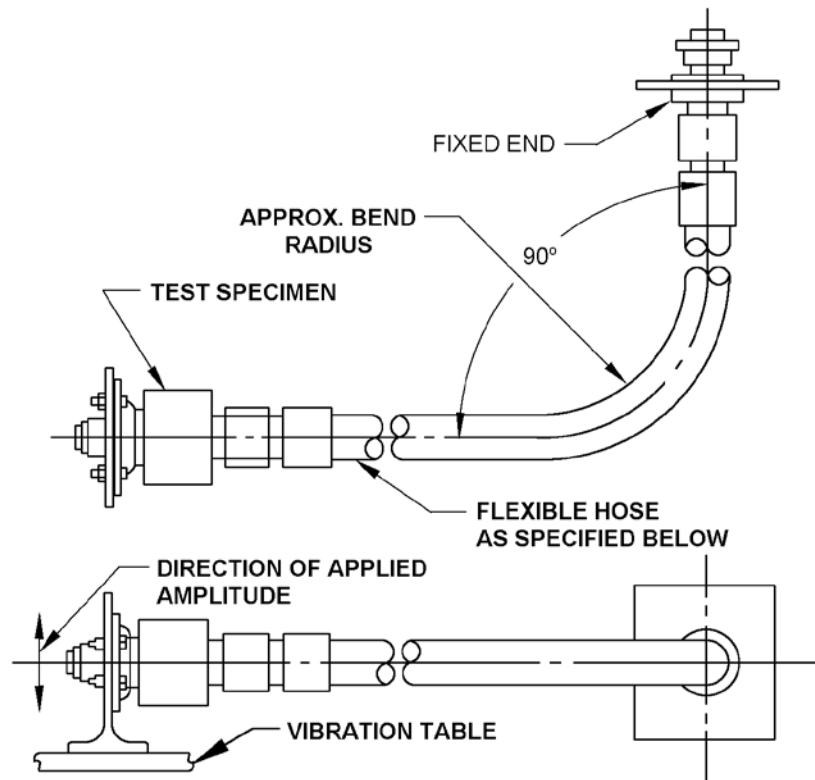


FIGURE 7. Typical set-up for vibration and shock test.

4.7.13 Functional shock (see [3.4.12](#)). Swivels when subjected to functional shock shall meet the requirements of [3.4.12](#). The following details shall apply:

- a. The swivel joint shall be mounted in a fixture by the bulkhead attaching (swivel housing) end in a fixture similar to the one shown on [figure 7](#).
- b. The opposite end of the swivel joint shall be suitably capped or plugged.
- c. The applicable operating pressure listed in [table I](#) shall be applied and maintained.
- d. The mounted swivel joint shall then be shock tested in accordance with MIL-STD-810, method 516.6, procedure I, test category, functional test for flight equipment (20g's) shock method, "Terminal peak sawtooth shock pulse configuration and its tolerance limits (for use when shock response spectrum analysis capability is not available in Procedure I - Functional Shock, and Procedure V -Crash Hazard Shock Test)".
- e. Following shock testing, the swivel joint shall be subjected to the pressure and leakage test specified in [4.7.3](#).

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4.7.14 Burst pressure (see 3.4.13). Swivels when subjected to burst pressure shall meet the requirements of 3.4.13. The following details shall apply:

- a. Hydrostatic pressure shall be applied at a rate not greater than 25,000 psi (172 MPa) per minute until the burst pressure specified in [table III](#) is reached.
- b. The swivel joint shall be serviced with test fluid maintained at elevated temperature as specified in [table VIII](#) for the respective swivel joint types.
- c. Rupture of the assembly at any pressure below the specified burst pressure, see [table III](#), shall be cause for rejection.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Service or Defense Agency, or within the Military Service's System Commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

6.1 Intended use. The swivel joints covered by this specification are intended for use in hydraulic systems conforming to SAE-AS5440 (types I II, and IV), or MIL-H-8891 (type III) to provide a connection between fluid carrying lines and a hydraulic unit where swiveling action of the lines with respect to the unit or other lines may occur. These swivels are military unique because they must be able to withstand 20 g's of shock and temperatures of -65°F to +450°F (-55°C to +232°C) commercial swivels are not designed to withstand these harsh conditions.

6.2 Ordering data. Procurement documents should specify the following:

- a. Title, number, and date of this specification.
- b. PIN
- c. First article (see 4.5) or whether first article inspection is waived (6.3.1).
- d. Lot records if required (see 4.4.1).
- e. Name and address of the first article inspection test facility to which first article samples, if required, are to be forwarded (see 4.5.6) and the name and address of the Government activity responsible for conducting the first article inspection program (see 6.3).
- f. Special requirements or tests required (see 4.4 and 6.4).
- g. Required torque values for 4000 and 5000 psi swivel joints (see [table IV](#)).
- h. Shelf life requirements if applicable (see 6.5 and 6.6).
- i. Special cleanliness levels if required (see 6.4).
- j. Packaging requirements (see 5.1).

6.3 First article. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results, and disposition of first article samples. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

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6.3.1 Defense Logistics Agency (DLA) waiver of first article test. A waiver of a first article testing will only be considered by DLA when the contractor has delivered the same item within the last three years, has no unfavorable quality history, has not changed processes, or changed any subcontractors. DLA will not accept first article testing results outside the stated requirements.

6.4 Special requirements. When hydraulic swivel joints to be procured under this specification should be subject to requirements in excess of, or different from those herein, such as pressure ratings, flow rates, angular misalignment, environmental testing, special materials of construction, precision cleaning, etc, such requirements will be agreed upon between the contractor and the procuring activity and should be included in the contractor's control drawing (see 4.4 and 6.2).

6.5 SAE-AS28775 O-rings. Units containing SAE-AS28775 O-rings should be restricted to applications consistent with the O-ring life limitations.

6.6 Shelf life. This specification covers items where the assignment of a Federal shelf-life code is a consideration. Specific shelf-life requirements should be specified in the contract or purchase order, and should include, as a minimum, shelf-life code, shelf-life code, shelf-life package markings in accordance with MIL-STD-129 or FED-STD-123, preparation of a materiel quality storage standard for type II (extendible) shelf-life items, and a minimum of 85 percent shelf-life remaining at time of receipt by the Government. These and other requirements, if necessary, are in DoD4140.27-M, *Shelf-life Management Manual*. The shelf-life codes are in the Federal Logistics Information System Total Item Record. Additive information for shelf-life management may be obtained from DoD 4140.27-M, or the designated shelf-life Points of Contact (POC). The POC should be contacted in the following order: (1) the Inventory Control Points that manage the item and (2) the DoD Service and Agency administrators for the DoD Shelf-Life Program. Appropriate POCs for the DoD Shelf-Life Program can be contacted through the DoD Shelf-Life Management website: <http://www.shelflife.hq.dla.mil/>.

6.7 Environmentally preferable material. Environmentally preferable materials should be used to the maximum extent possible to meet the requirements of this specification. As of the dating of this document, the U.S. Environmental Protection Agency (EPA) is focusing efforts on reducing 31 priority chemicals. The list of chemicals and additional information is available on their website <http://www.epa.gov/osw/hazard/wastemin/priority.htm>. Included in the EPA list of 31 priority chemicals are cadmium, lead, and mercury. Use of these materials should be minimized or eliminated unless needed to meet the requirements specified herein (see section 3).

6.8 Subject term (key word) listing.

- Aircraft systems
- Connecting ends
- Eccentric loading
- Fittings, tubings, and hoses
- Flared tube
- Glands
- O-ring
- Ship systems
- Static seals

6.9 Changes from previous issue. Marginal notations are not used to identify changes with respect to the previous issue due to extensive changes. No changes were made to prevent the old revision from being interchangeable. Changes were to remove cancelled references, format to a "detail format" and minor improvements that came from coordination comments, plus putting back the cam-locking coupling hose fitting connector.

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APPENDIX A

VIBRATION TESTING

A.1 Scope. The vibration test specified herein requires a resonance search (part 1), a resonance dwell (part 2), and a sinusoidal vibration cycling (part 3). Test to the level of [figure A-1](#) within the time schedule specified in [table A-I](#) for parts 2 and 3. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

A.2 Part 1, resonance search. The test item shall be installed in aircraft/helicopter, air launched vehicle or ground launched vehicle equipment mounted with vibration isolator and attached by its normal mounting means directly to the vibration exciter table, or by means directly to the vibration exciter table, or by means of a rigid fixture capable of transmitting the vibration conditions specified herein. Whenever possible, the test load shall be distributed uniformly on the vibration exciter table in order to minimize effects of unbalanced loads.

A.2.1 Resonant modes of the equipment. Resonant modes of the equipment shall be determined by varying the frequency of applied vibration slowly through the specified range at reduced input amplitudes. Individual resonance searches shall be conducted with vibration applied along each of the three mutually perpendicular axis of the equipment.

A.3 Part 2, resonance dwell. Unless otherwise specified, the test item shall be operating during the test so that functional effects caused by internal resonances may be observed. The test item shall be vibrated along each axis at the most severe resonant frequencies according to [table A-I](#) and according to the applicable double amplitudes or accelerations of the specified curve from [figure A-1](#). If more than four significant resonances have been found for any one axis, the four most severe resonances shall be chosen for the test. If a change in the resonant frequency occurs during the test, immediately the frequency shall be adjusted to maintain the resonance condition. At the conclusion of the vibration test, the swivel shall be tested in accordance with [4.7.12 \(f\)](#).

TABLE A-I. Time table.

Resonance dwell		Cycling time per axis	Sweep time	
Number of resonance <u>1/</u>	Time at Resonance Per axis		5 - 500 - 5 cycles per second (cps)	5 - 500 - 5 cps
0	---	3 hours	15 minutes	20 minutes
1	¼ hours	2 ½ hours		
2	1 hours	2 hours		
3	1 ½ hours	1 ½ hours		
4	2 hours	1 hours		

1/ Dwell 30 minutes at each resonance.

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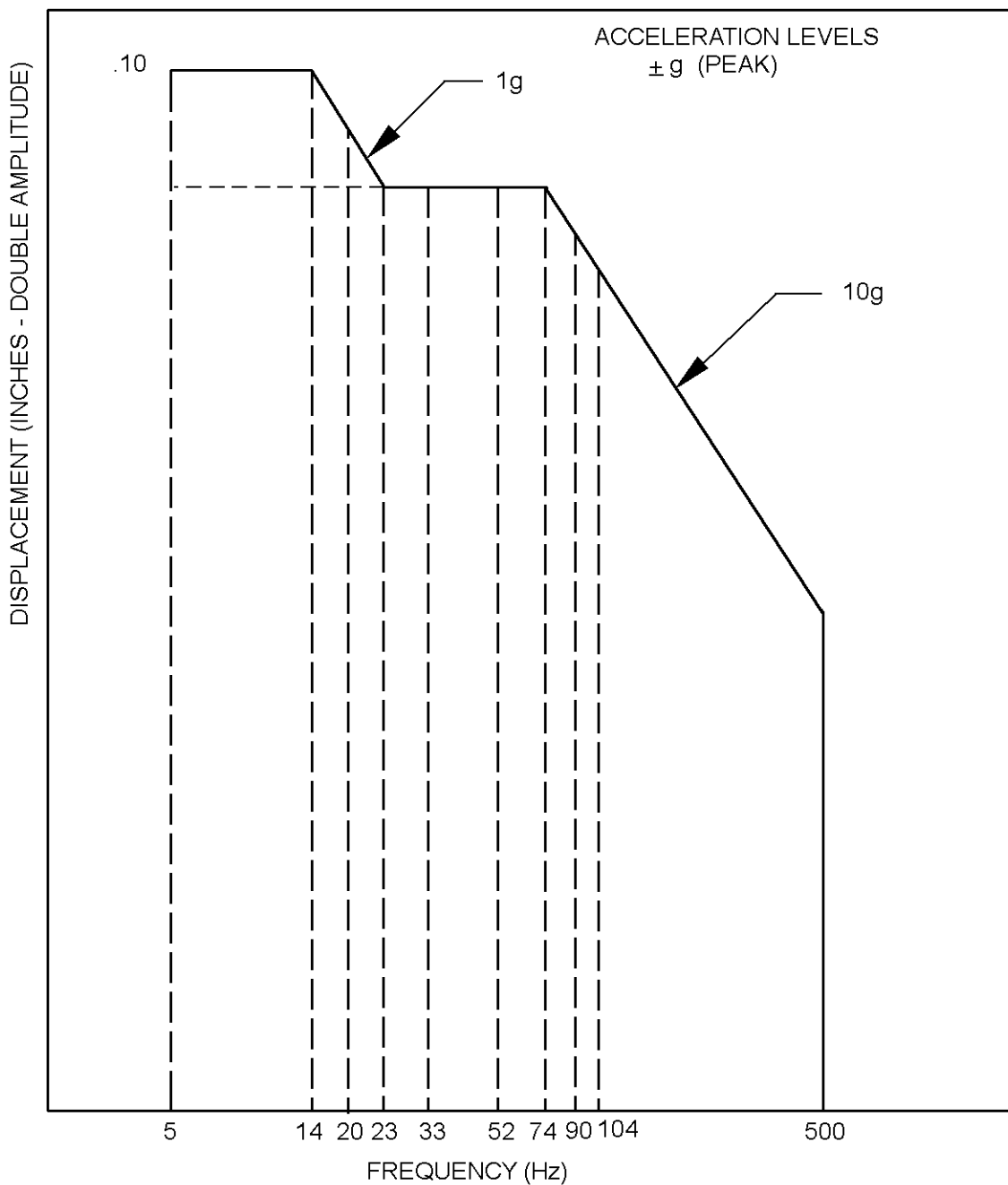
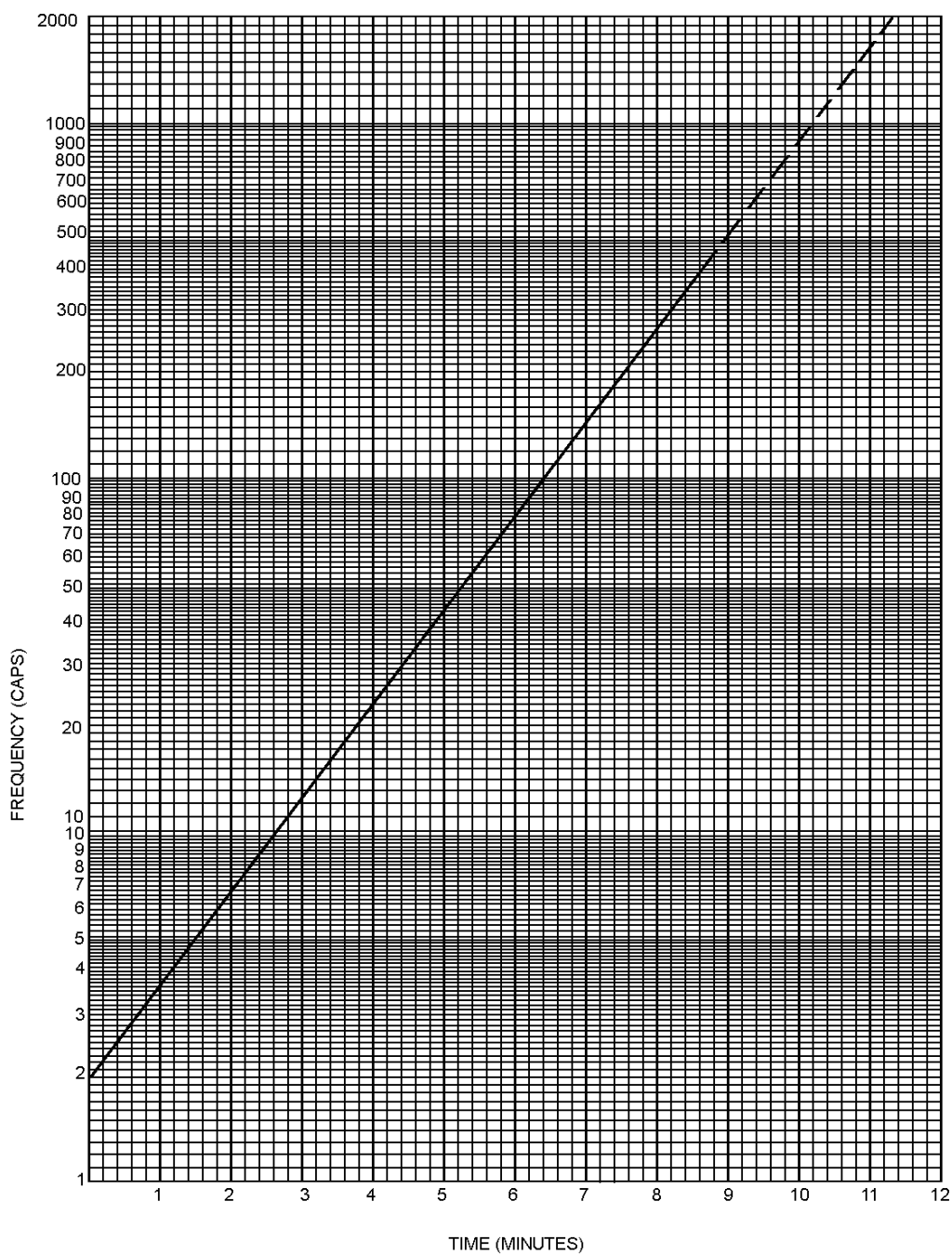


FIGURE A-1. Vibration test curve.

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A.4 Part 3, vibration cycling. The test item shall be operating throughout the vibration cycling test. The frequency of applied vibration shall be cycled at a logarithmic rate between the frequency limits and at the vibratory acceleration levels of the specified cure from [figure A-1](#). Logarithmic cycling rates shall be cycled at a logarithmic rate between the frequency limits and at the vibratory acceleration levels of the specified cure from [figure A-1](#). Logarithmic cycling rates shall be in accordance with [figure A-2](#) and the time schedule as specified in [table A-I](#). A linear cycling rate may be substituted for logarithmic cycling when performed in accordance with [A.6](#). During and at the conclusion of the test the swivel shall meet the requirements of [4.7.12](#) (f).

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NOTE: For cycling tests of less than 50 cps maximum frequency, the frequency range shall be cycled logarithmically from 5 cps to maximum in 7.5 minutes for the total cycling time specified.

FIGURE A-2. Logarithmic cycling rates.

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APPENDIX A

A.5 Combined sinusoidal cycling and random vibration test. The sinusoidal cycling random vibration test may be combined when the test apparatus permits. The sinusoidal vibration test curve acceleration level (specified in peak g) shall be converted to root mean square (rms) G. The acceleration level to be used for the combined test shall then be determined by squaring both test curve acceleration levels, adding them, and then taking the square root of the sum. The combined test level may then be achieved by obtaining the lower of the two separate levels first, then advancing the gain control for the other separate level until the overall combined test level is achieved. All other test parameters shall be the same as the separate test instructions.

A.6 Substitution of linear cycling for logarithmic cycling. When linear cycling is used, the total frequency range shall be divided into logarithmic frequency bands of equal cycling time intervals. The linear cycling rate for each band is then determined by dividing each bandwidth in cps by the time in minutes for each band. The logarithmic frequency bands may be readily determined from [figure A-2](#). The frequency bands and linear cycling rates shown in [table A-II](#) shall be used for the 2 to 500 cps frequency ranges.

TABLE A-II. Linear cycling rates.

Total frequency range	Frequency bands	Sweep time in minutes	Linear cycling rate (cps/min)
2 - 500 cps	2 to 5	1.5	2
	5 to 22.5	2.5	7
	22.5 to 100	2.5	31
	100 to 500	2.5	160

A.7 Control and analysis of random vibration. The instantaneous random vibration acceleration peaks may be limited to 3 times the rms acceleration level. Resonant modes of the moving mass (vibration exciter moving element, fixture and either the test item or substitute equivalent mass) shall be equalized or compensated for within the frequency range of the test curve. The applied vibration spectrum shall normally be within the tolerance of +40, -30 percent between the frequencies of 50 and 1,000 cps. For a power spectral density analysis of the test spectrum, these tolerances may be expressed at ± 1.5 db. Tolerance levels in terms of dv are defined as:

$$db = 10 \log \frac{(G_1)^2/cps}{(G_0)^2/cps}$$

or

$$db = 20 \log \frac{(G_1)}{(G_0)}$$

Where $(G_1)^2/cps$ = acceleration power spectral density, and $G_1 = G$ rms (measured over the analyzer effective bandwidth).

The term G_0 defines the specified level.

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APPENDIX A

A.8 Wave analyzer. A wave analyzer shall be used to assure the specified equalization tolerances. The following wave analyzer characteristics shall be required for each test:

- a. Filter bandwidths - B - 25 cps max. below 1000 cps and 1/3 octave max. above 1000 cps.
- b. Sweep rate - R - $B^2/32$ cps/sec. max.
- c. Integrator time constant = 1 second minimum.

A.9 Sinusoidal vibration input control. The vibratory acceleration levels or double amplitudes of the specified test curve shall be maintained at the test item mounting points. When the input vibration is measured at more than one control point, the minimum input vibration is measured at more than one control point; the minimum input vibration shall normally be that of the specified curve. The transverse motion at the input monitoring point(s) shall be limited to 100 percent of the input motion.

A.10 Transducer mounting. The input monitoring transducer(s) shall be rigidly attached to and locate on or near the attachment point or points of the swivel, see [figure 7](#).

A.11 Temperature. Tests shall be conducted under room ambient conditions.

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CONCLUDING MATERIAL

Custodians:

Navy - AS
Air Force - 99
DLA - CC

Preparing activity:
DLA - CC

(Project 4730-2011-106)

Review activity:

Air Force - 71

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <https://assist.daps.dla.mil>.