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DETAIL SPECIFICATION

MOUNTS, RESILIENT, PORTSMOUTH BONDED SPOOL TYPE

Comments, suggestions, or questions on this document should be addressed to: Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to CommandStandards@navy mil, with the subject line "Document Comment". Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at https://assist.dla.mil.

AMSC N/A FSC 5342

This specification is approved for use by the Naval Sea Systems Command and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the Portsmouth bonded spool type series of rubber resilient mounts, together with tests for evaluating the rubber stock and the completely assembled mount. These mounts are primarily for use on surface ships and submarines, where applicable.

1.2 Classification.

1.2.1 Types. Resilient mounts are of the following types, as specified (see 6.2).

Types

15P50A	15P550A	15P1000A
15P100A	15P550B	15P1000B
15P150A	15P700A	15P1200A
15P220A	15P700B	15P1200B
15P300A	15P800A	15P2000A
15P400A	15P800B	15P2000B
15P400B		

1.2.1.1 Type nomenclature. The type designation is established based upon the upper load rating characteristics of the mount. The numbers and letters in the type designation denote the following:

a. First number – Denotes the nominal natural frequency (Hertz) in the axial direction (see 6.4.1) at the upper rated load.

b. Letter P – Denotes the mount design activity (Portsmouth Naval Shipyard [PNSY]).

c. Second number – Denotes the upper load rating (pounds).

d. Letter A or B – Denotes the mount design.

1.2.1.1.1 Non-magnetic designation. Letters “NM” following the mount design designates non-magnetic construction.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 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 of documents cited in sections 3 and 4 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 STANDARDS

MIL-STD-407 - Visual Inspection Guide for Rubber Molded Items

(Copies of this document are available online at http://quicksearch.dla.mil.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications 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.

NAVAL SEA SYSTEMS COMMAND (NAVSEA) DRAWINGS

803-1385777 - Mounts, Resilient, Portsmouth Bonded Spool Type

(Copies of this document are available from the applicable repositories listed in S0005-AE-PRO-010/EDM, which can be obtained online at https://nll.ahf nmci.navy.mil, may be requested by phone at 215-697-2626, or may be requested by email at nllhelpdesk@navy.mil. Copies of this document may also be obtained from the Naval Ships Engineering Drawing Repository (NSEDR) online at https://199.208.213.105/webjedmics/index.jsp. To request an NSEDR account for drawing access, send an email to NNSY_JEDMICS_NSEDR_HELP_DESK@navy mil.)

NAVAL SEA SYSTEMS COMMAND (NAVSEA) PUBLICATIONS

S9073-A2-HBK-010 - Resilient Mount Handbook

(Copies of this document are available online at https://nll.ahf.nmci navy mil, may be requested by phone at 215-697-2626, or may be requested by email at nllhelpdesk@navy mil.)

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.

ASTM INTERNATIONAL

ASTM D395 - Standard Test Methods for Rubber Property – Compression Set

ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension

ASTM D429 - Standard Test Methods for Rubber Property – Adhesion to Rigid Substrates

ASTM D471 - Standard Test Method for Rubber Property – Effect of Liquids

ASTM D573 - Standard Test Method for Rubber – Deterioration in an Air Oven

ASTM D1229 - Standard Test Method for Rubber Property – Compression Set at Low Temperatures

ASTM D1566 - Standard Terminology Relating to Rubber

ASTM D2240 - Standard Test Method for Rubber Property – Durometer Hardness

ASTM D5992 - Standard Guide for Dynamic Testing of Vulcanized Rubber and Rubber-Like Materials Using Vibratory Methods

(Copies of these documents are available online at www.astm.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 Qualification. Mounts furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

3.2 Mount design. Mounts shall meet the requirements of this specification and be constructed in accordance with 803-1385777. S9073-A2-HBK-010 contains comprehensive test data showing performance characteristics acquired during the development of each mount type. Included are damping values, static load-deflection, and dynamic stiffness performance data. This data may be useful to the manufacturer attempting to construct mounts in accordance with this specification. Refer to 2.4.

3.3 Materials.

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

3.3.2 Metal. Mount metal components shall be manufactured from steel or manganese bronze as specified (see 6.2). Metal shall be in accordance with the appropriate specification listed in 803-1385777; substitutions are permitted when approved by NAVSEA. Components shall be formed into shape and finished in accordance with the dimensions and allowable tolerances specified in 803-1385777. Metal components shall be protected against corrosion by seawater and other atmospheric conditions encountered in service. Unless otherwise specified (see 6.2), the minimum protective treatment shall be equivalent to that specified in 803-1385777.

3.3.3 Rubber.

3.3.3.1 Resilient element. The resilient element shall be fabricated of oil resistant compounds utilizing polymerized chloroprene as the basic material. It shall be molded to the prescribed form and completely bonded to all metal components of the mount with which it makes contact, as shown in 803-1385777. The rubber compounds for the resilient elements shall be furnished in four classes. The mount type shall be fabricated from the corresponding rubber compound shown in table I.

TABLE I. Rubber classes.

Mount type	Rubber compound
15P50A, 15P150A, 15P400A, 15P400B	Class A
15P100A, 15P220A, 15P550A, 15P550B, 15P800A, 15P800B	Class B
15P300A, 15P700A, 15P700B, 15P1000A, 15P1000B	Class C
15P1200A, 15P1200B, 15P2000A, 15P2000B	Class D

3.3.3.2 Physical requirements. Physical properties of the cured rubber compound used in the resilient element shall conform to the physical requirements specified in table II.

TABLE II. Physical requirements of rubber compounds.

Property	Class A	Class B	Class C	Class D	Verification method
1. Tensile strength (minimum), psi					
-Before aging	2200	2500	2800	2900	4.4.1.1
-After aging at 194 °F for 46 hours	2100	2400	2700	2800	4.4.1.1 and 4.4.1.3

TABLE II. Physical requirements of rubber compounds – Continued.

Property	Class A	Class B	Class C	Class D	Verification method
2. Elongation at break (minimum), percent					
-Before aging	650	600	575	550	4.4.1.1
-After aging at 194 °F for 46 hours	600	550	525	500	4.4.1.1 and 4.4.1.3
3. Compression set (maximum), percent	40	37	34	30	4.4.1.2
4. Adhesion of resilient element to metal (minimum), psi	450	500	550	600	4.4.1.6
5. Hardness, Shore A after 3 seconds	38±5	43±5	48±5	57±5	4.4.1.4
6. Resistance to oil swelling (maximum), percent	15	15	15	15	4.4.1.5

3.3.4 Hazardous materials. Materials and products utilized in this specification should avoid chemicals listed on the NAVSEA List of Targeted Chemicals (N-LTC). Refer to NAVSEA for the most recent list. These chemicals pose significant risk to the user, the environment, or both, and are deemed both undesirable and unsustainable by NAVSEA Technical Authority (TA). NAVSEA is minimizing the use of hazardous materials in the design and development of its assets. It is recommended that alternative materials be considered for associated applications, so as to minimize the integration of targeted chemicals in assets called out in this specification.

3.4 Requirements for finished mounts.

3.4.1 Construction requirements. Mounts shall be constructed in accordance with 803-1385777. In addition, there shall be no backrinding, blisters, tears, cracks, or other defects on the outer surface of the resilient element. MIL-STD-407, in conjunction with ASTM D1566, may be used to assist in identifying defects in the resilient element. Refer to 4.3.3.1 for the compliance verification examination.

3.4.2 Dynamic stiffness. The dynamic stiffness (see 6.4.2) of the bonded spool type mounts at upper rated load shall be within the limits specified in table III when tested in accordance with 4.4.2.1.

TABLE III. Axial dynamic stiffness requirements.

Mount type	Axial load (lb)	Dynamic stiffness (lb/in)
15P50A	50	830 to 1520
15P100A	100	1661 to 3040
15P150A	150	2491 to 4560
15P220A	220	3654 to 6689
15P300A	300	4983 to 9121
15P400A and 15P400B	400	6644 to 12161
15P550A and 15P550B	550	9135 to 16721
15P700A and 15P700B	700	11627 to 21282
15P800A and 15P800B	800	13287 to 24322
15P1000A and 15P1000B	1000	16609 to 30403

TABLE III. Axial dynamic stiffness requirements – Continued.

Mount type	Axial load (lb)	Dynamic stiffness (lb/in)
15P1200A and 15P1200B	1200	19931 to 36483
15P2000A and 15P2000B	2000	33219 to 60805

3.4.3 Static strength. Mounts, when tested in accordance with 4.4.2.2, shall not show any appreciable permanent deformation of metal parts or damage such as separation, tears, cracks, or breaks in or between component parts.

3.4.4 Fatigue. Mounts, when tested in accordance with 4.4.2.3, shall not show evidence of failure of the resilient element, bond, and metal parts.

3.4.5 Drift. The mounts shall not have a loss in height greater than 0.012 inch when tested in accordance with 4.4.2.4.

3.4.6 Delamination and porosity. When tested in accordance with 4.4.2.5, the resilient element shall not show evidence of porosity or separation into distinct layers or laminations.

4. VERIFICATION

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

a. Qualification inspection (see 4.2).

b. Conformance inspection (see 4.3).

4.2 Qualification inspection. Qualification inspection shall be performed on finished mounts (see 4.2.2) and their associated rubber compounds (see 4.2.1). Refer to 3.1 and 6.3. If the manufacturer is seeking qualification for all mount types (see 1.2.1), then the four mount types specified in table VI shall be subjected to qualification inspection. If the manufacturer is seeking qualification for one mount type, then only that mount type and associated rubber compound shall be subjected to qualification inspection.

4.2.1 Qualification inspection of the rubber compounds. Specimens described in table IV shall be produced from the four classes of rubber compounds which are mixed for the manufacture of mounts subjected to qualification inspection. Refer to 4.2.2 for mount types subjected to qualification. The manufacturer shall certify that the specimens are of the same material and equivalent cure (and bond) as the mounts to be tested for qualification. These specimens shall be subjected to the tests specified in table V to determine compliance with 3.3.3.2. If all test specimens meet all requirements, then mounts shall be tested for qualification in accordance with 4.2.2.

TABLE IV. Rubber specimens for qualification.

Quantity	Specimen description	Property to be measured
6	ASTM D412, Die C: from sheets 0.08±0.01 by 6 by 6 inches	Tensile strength and ultimate elongation (initial and aged)
3	Rectangular: 0.08±0.01 by 1 by 2 inches	Resistance to oil
3	Cylinder: 0.125±0.005-inch thickness by 1.597±0.005-inch diameter bonded to metal plates	Adhesion to metal
4	Cylinder: 0.49±0.02-inch thickness by 1.14±0.02-inch diameter	Hardness and compression set

TABLE V. Qualification tests on rubber specimens.

Property	Verification method	Requirement
1. Initial tensile strength	4.4.1.1	3.3.3.2 (table II, no. 1)
2. Initial ultimate elongation	4.4.1.1	3.3.3.2 (table II, no. 2)
3. Tensile strength after oven aging	4.4.1.1 and 4.4.1.3	3.3.3.2 (table II, no. 1)
4. Ultimate elongation after oven aging	4.4.1.1 and 4.4.1.3	3.3.3.2 (table II, no. 2)
5. Compression set after oven aging	4.4.1.2.1 and 4.4.1.3	3.3.3.2 (table II, no. 3)
6. Cold compression set	4.4.1.2.2	3.3.3.2 (table II, no. 3)
7. Adhesion to metal	4.4.1.6	3.3.3.2 (table II, no. 4)
8. Hardness	4.4.1.4	3.3.3.2 (table II, no. 5)
9. Volume change in oil	4.4.1.5	3.3.3.2 (table II, no. 6)

4.2.2 Qualification inspection of finished mounts. If rubber specimens meet all requirements associated with qualification inspection (see 4.2.1), then four of each of the finished mount types specified in table VI shall be manufactured and subjected to testing (sixteen mounts total). If the manufacturer is seeking qualification for only one mount type, then only four finished mounts of that type shall be subjected to qualification inspection. The manufacturer shall certify that the finished mounts are molded from the same batch of rubber compound as the specimens that have successfully passed qualification. Four mounts of each type specified shall undergo qualification testing in accordance with tables VII and VIII. Two mounts shall be tested in accordance with table VII. The remaining two mounts shall be tested in accordance with table VIII. Mounts shall be tested in the sequence shown in each of the two tables.

TABLE VI. Mount samples for qualification.

Mount type	Rubber compound (4.2.1)
15P150A or 15P400A	Class A
15P220A or 15P550A	Class B
15P300A or 15P700A	Class C
15P1200A or 15P2000A	Class D

TABLE VII. Qualification tests on finished mounts, group one.

Property	Verification method	Requirement
1. Physical appearance, dimensions, and materials	803-1385777 and table XII	3.4.1
2. Dynamic stiffness	4.4.2.1	3.4.2
3. Static strength	4.4.2.2	3.4.3

TABLE VIII. Qualification tests on finished mounts, group two.

Property	Verification method	Requirement
1. Physical appearance, dimensions, and materials	803-1385777 and table XII	3.4.1
2. Drift	4.4.2.4	3.4.5
3. Dynamic stiffness	4.4.2.1	3.4.2
4. Fatigue	4.4.2.3	3.4.4
5. Delamination and porosity	4.4.2.5	3.4.6

4.3 Conformance inspection. Conformance inspection shall be performed on each production lot.

4.3.1 Lots. For the purpose of sampling for conformance inspection, a lot shall contain all mounts of one type produced at the same time in the same facility under the same conditions with the same batch of rubber compound. A lot number shall be assigned to the mounts and shall not be repeated in any one quarter. The lot number with elastomer cure date (quarter, year) shall be traceable to the rubber batch number, manufacturing/process control records, and conformance documentation. The lot number along with cure date shall be permanently marked on each mount (refer to 803-1385777) and be included on all shipping documents, packages, and shipping containers.

4.3.2 Conformance inspection of the rubber compound. The specimens identified in table IX shall be prepared for each mount lot produced and at least one set of specimens from each 450 pounds of rubber mixed. The specimens shall be made from the same batch of rubber compound mixed for the manufacture of mounts in the lot. The specimens shall be certified to be of the same material and equivalent cure as the corresponding lot of finished mounts. These specimens shall be subjected to verification tests specified in table X to determine compliance with 3.3.3.2. If any specimens tested fail to meet any requirement, all mounts in the lot represented by that specimen shall be rejected.

TABLE IX. Rubber specimens for conformance inspection.

Quantity	Specimen description	Property to be measured
3	ASTM D412, Die C: from sheets 0.08±0.01 by 6 by 6 inches	Tensile strength and ultimate elongation
1	Cylinder: 0.50±0.02-inch height by 1.14±0.02-inch diameter	Hardness

TABLE X. Conformance tests on rubber specimens.

Verification test	Test method	Requirement
1. Tensile strength (unaged)	4.4.1.1	3.3.3.2 (table II, no. 1)
2. Ultimate elongation (unaged)	4.4.1.1	3.3.3.2 (table II, no. 2)
3. Hardness	4.4.1.4	3.3.3.2 (table II, no. 5)

4.3.3 Conformance inspection of finished mounts. Mounts shall be sampled and subjected to verification tests and examination in accordance with 4.3.3.1 and 4.3.3.2.

4.3.3.1 Sampling for examination. For each lot, a quantity of mounts randomly sampled in accordance with table XI shall be subjected to a visual examination to determine compliance with 3.4.1. Classifications of defects are shown in table XII. If one or more major defect is found in any sample, the manufacturer may screen the entire lot for compliance prior to proceeding with conformance testing; otherwise, the entire lot shall be rejected. MIL-STD-407, in conjunction with ASTM D1566, may be used to assist in identifying defects in the resilient element. Corrective action shall be taken to prevent the systematic occurrence of any defects.

TABLE XI. Sampling for visual examination.

Number of mounts in a lot	Number of mounts in a sample
40 or under	10
41 to 110	15
111 to 300	25
301 to 500	35

TABLE XI. Sampling for visual examination – Continued.

Number of mounts in a lot	Number of mounts in a sample
501 to 800	50
801 to 1300	75
1301 to 3200	110

TABLE XII. Classification of defects.

Category	Defects
Major:	
101	Evidence of unauthorized materials, including lack of documentation demonstrating components were produced in accordance with material specifications listed in 803-1385777 and acquisition requirements.
102	Mount dimensions, materials, and construction not in accordance with 803-1385777 and acquisition requirements.
103	Evidence of delamination or air pockets in resilient element.
104	Evidence of backrinding, blisters, cracks, debonding, breaks, deep gouges, tears, voids, blisters, or other imperfections on the surface of resilient element that can affect mount performance and service life.
105	Mounts with cure dates more than 2 years old shall not be offered.
106	Any other defect that could affect mount performance or service life.
Minor:	
201	Identification marking not distinct or in accordance with 803-1385777.
202	Burrs, rough edges, and sharp corners not removed.
203	Minor surface imperfections on the rubber that will not affect mount performance or service life.
204	Any other negligible defect which would not affect the performance or serviceability of the mount.

4.3.3.2 Sampling for conformance testing. For each lot, a quantity of mounts sampled in accordance with table XIII shall be subjected to verification tests in table XIV to determine compliance with 3.4.2 and 3.4.3. Tests shall be conducted in the sequence shown in table XIV. If one or more defects are found in any sample, the entire lot shall be rejected. The manufacturer has the option of screening the entire lot for compliance with the dynamic stiffness requirement only if the axial strength requirement has been met for the sampled quantity.

TABLE XIII. Sampling for conformance tests.

Number of mounts in a lot	Sample quantity
65 and under	4
66 to 110	5
111 to 180	6

TABLE XIII. Sampling for conformance tests – Continued.

Number of mounts in a lot	Sample quantity
181 to 300	8
301 to 500	10
501 to 800	12
801 to 1300	15
1301 to 3200	20

TABLE XIV. Conformance verification tests.

Verification test	Test method	Requirement
1. Dynamic stiffness	4.4.2.1	3.4.2
2. Static strength test in axial direction	Axial strength test shall be in accordance with 4.4.2.2.2 except the peak load obtained shall be from Curve 2 for all four loading-unloading cycles.	3.4.3

4.4 Verification tests. Unless otherwise specified in a particular test procedure, all tests shall be conducted at an ambient temperature of 80±10 °F. Within this range, the temperature from the beginning to the end of any one test shall not vary more than ±5 °F.

4.4.1 Test methods for rubber specimens.

4.4.1.1 Tensile and elongation tests. For tensile strength and elongation, the method of tests shall be in accordance with ASTM D412, Method A, using three Die C test specimens.

4.4.1.2 Compression set. For compression set tests, rubber specimens with a hardness less than or equal to 44 durometer shall be compressed 40 percent. Rubber specimens with a hardness greater than or equal to 45 durometer shall be compressed 30 percent.

4.4.1.2.1 Compression set after aging. Compression set shall be determined on two test specimens in accordance with ASTM D395, Method B, except aging shall be as specified in 4.4.1.3.

4.4.1.2.2 Cold compression set. Cold compression set shall be determined in accordance with ASTM D1229 on two rubber specimens, except exposure shall be 30±2 °F for 94±½ hours. The compression set shall be determined 30 minutes after the compressive load is released.

4.4.1.3 Oven aging test. The specimens for tensile, ultimate elongation, and compression set tests shall be given an accelerated aging test by subjecting them to dry circulating air at a temperature of 194±2 °F for 46±¼ hours. Final determination of aged tensile and elongation specimens shall be made not less than 10 hours or more than 48 hours after removal from the oven. Tensile and elongation tests on unaged specimens shall be made immediately prior to, and on the same machine as, the tensile tests on the aged specimens. Refer to ASTM D573 for guidance.

4.4.1.4 Hardness test. Hardness (Shore A) of the 0.49±0.02-inch thick specimens shall be determined in accordance with ASTM D2240. A 3-second reading shall be taken to determine conformance.

4.4.1.5 Swelling in oil. Volume change in oil shall be determined in accordance with ASTM D471, except the three specimens shall be immersed for a period of 46±¼ hours at 73±4 °F. The specimen shall be immersed in reference oil IRM 903 of ASTM D471.

4.4.1.6 Adhesion to metal test. The adhesion tests shall be in accordance with Method A of ASTM D429. Three specimens of the rubber compound bonded to metal shall be tested and results averaged to determine compliance. Specimens shall have the same surface preparation, adhesive system, metal type, and bonding method as used in the finished mount. Refer to table IV for specimen description.

4.4.2 Test methods for finished mounts.

4.4.2.1 Dynamic stiffness measurement.

4.4.2.1.1 Test system for measuring dynamic stiffness. The test system shall be capable of superimposing cyclical vibration while statically loading the mount. Refer to the forced non-resonant section of ASTM D5992 for discussion and a schematic of test systems capable of conducting low-frequency dynamic stiffness measurements. A commonly used type of equipment for non-resonant testing is a closed-loop servo-hydraulic machine or a vibration shaker with load frame (see figure 1). Transducers shall be arranged to measure force at the blocked output or foundation side of the mount and displacement at the equipment or input side of the mount. The stiffness of the test apparatus (machine, load-frame, force transducer, etc.) in series with the mount under test shall be determined experimentally or via calculation. A test apparatus which is at least 100 times stiffer than the dynamic stiffness of the mount being tested shall not require measurement adjustment to account for the flexibility of the test apparatus. If the test apparatus fails to meet this relative stiffness requirement, the test apparatus compliance shall be subtracted from the measurement to obtain the dynamic stiffness of the mount (K_{mount}). The dynamic stiffness of the mount can be calculated using the classic equation governing the summation of springs in series:

$$(1/K_{measured}) = (1/K_{mount}) + (1/K_{apparatus}) \qquad \text{yielding} \qquad K_{mount} = \frac{(K_{apparatus})(K_{measured})}{(K_{apparatus}) - (K_{measured})}$$

To avoid over-correction, the stiffness of the test apparatus shall be greater than 30 times the stiffness of the mount. Refer to ASTM D5992 for guidelines and requirements of the mechanical apparatus and instrumentation used in the test system.

Dynamic calibration of the complete system shall be confirmed using steel springs of known spring constants, having negligible damping, prior to the start of testing. Refer to the “mechanical and instrumentation factors influencing dynamic measurement” section of ASTM D5992 for measurement discussion and selection of springs. In addition, springs shall be selected on the basis of their linear force-deflection properties and ability to produce a spring constant comparable to the stiffness of the mount to be tested. System confirmation shall be performed using springs of known spring constants at the excitation amplitudes and frequencies at which the mount is to be tested. System confirmation shall be performed at loads which produce spring constant measurements that bracket the expected dynamic stiffness range of the mount to be tested. This shall be accomplished by adding or removing springs within the stiffness range of intended mount measurements. Care shall be taken to assure measurements are conducted within the linear load range of the springs. All spring dynamic stiffness measurements (corrected for test apparatus stiffness) should be within 2 percent of the known spring constants. If this is not the case, the error shall be investigated and corrected. This procedure is not intended to replace the periodic calibration of transducers, signal conditioners, and other measuring instruments as required by ASTM D5992.

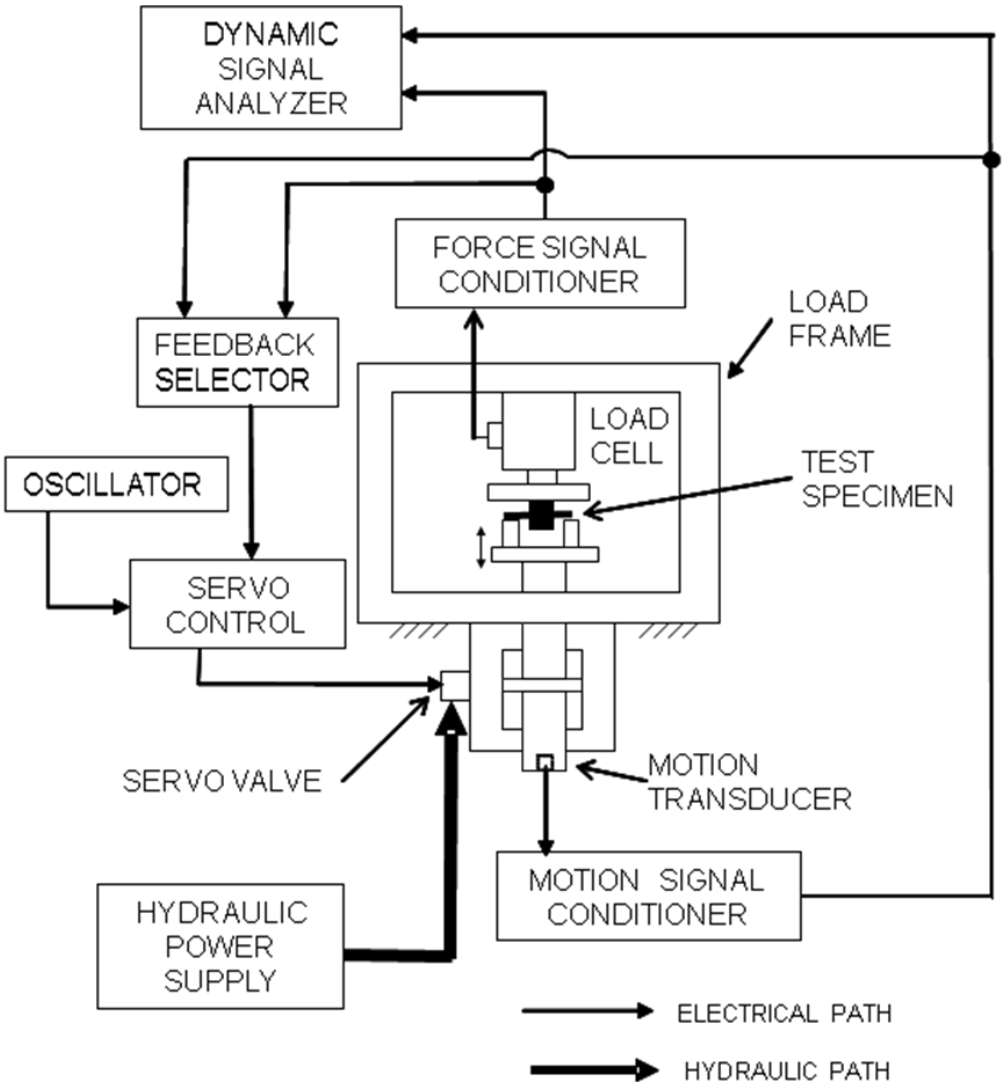

FIGURE 1. Diagram of major components of servo-hydraulic universal test machine.

4.4.2.1.2 Method for measuring dynamic stiffness. Dynamic stiffness shall be measured in the axial direction while loaded at the mount upper load rating. The mount shall be "conditioned" by cycling it three times from "0" to its upper rated load prior to the start of measuring dynamic stiffness. Then, the mount shall be vibrated and allowed to settle before readjusting (if necessary) to the required load and acquiring dynamic stiffness data. Excitation shall be at 15 Hertz with displacement amplitude of approximately 0.020 inch peak-to-peak. The measurement method is based on the transmitted force principle and is used to define the properties of a dynamic model consisting of a parallel combination of an ideal spring and damper to represent the mount. Although a more exact model includes a mass term, it may be omitted with negligible error at low excitation frequencies. Dynamic stiffness measurements, as defined in this specification, shall be acquired by following the guidelines given in ASTM D5992 for forced non-resonant measurements using the Fast Fourier Transform (FFT) method. This requires measurement of the sinusoidal displacement amplitude (X) at the input of the mount and transmitted dynamic force amplitude (F) at the blocked output of the mount, as well as the phase relationship (θ) between them. It should be noted that damping loss factor is the tangent of the phase between the displacement and force. The dynamic stiffness is calculated from the measurements as follows:

$K_{measured} = C(F/X)(\cos(\theta + \delta))$

Where "C" and "δ" are minor adjustment factors, if necessary, to account for system calibration (see 4.4.2.1.1).

In order to obtain mount stiffness (K_{mount}) to determine compliance with 3.4.2, the measured stiffness ($K_{measured}$) may likely require adjustment to account for test apparatus flexibility (see 4.4.2.1.1).

$$K_{mount} = \frac{(K_{apparatus})(K_{measured})}{(K_{apparatus}) - (K_{measured})}$$

4.4.2.2 Static strength test.

4.4.2.2.1 Test system. A suitable test system capable of loading the mounts at a constant rate of deflection while measuring load and deflection shall be used. A commonly used type of equipment for measuring load-deflection is a Universal Testing Machine. The sampling rate of measured load and deflection shall provide a sufficient number of samples to furnish smooth load-deflection plots without discontinuities. Deflection shall be measured to the nearest 0.001 inch. Flexibility of the test apparatus (load frame, force gauge, fixtures, etc.) shall be accounted for via correction of measured mount data. All sensors used for measurement (force and displacement transducer) shall be calibrated at regular intervals.

4.4.2.2.2 Test in the axial direction (parallel to center bolt axis). A single mount shall be secured in a fixture and subjected to four loading and unloading cycles at a constant deflection rate not exceeding 0.3 inch per minute. For the first three loading cycles, loads shall be applied up to the peak static test load specified in Curve 2 on figure 2 for the upper load rating of the mount. For the fourth loading cycle, the mount shall be loaded up to the peak load specified in Curve 1 on figure 2 for the upper load rating of the mount. Load-deflection data shall be recorded during the fourth loading cycle and shall be reported as the static load-deflection curve for the mount. The mount shall be inspected during and after testing to determine compliance with 3.4.3.

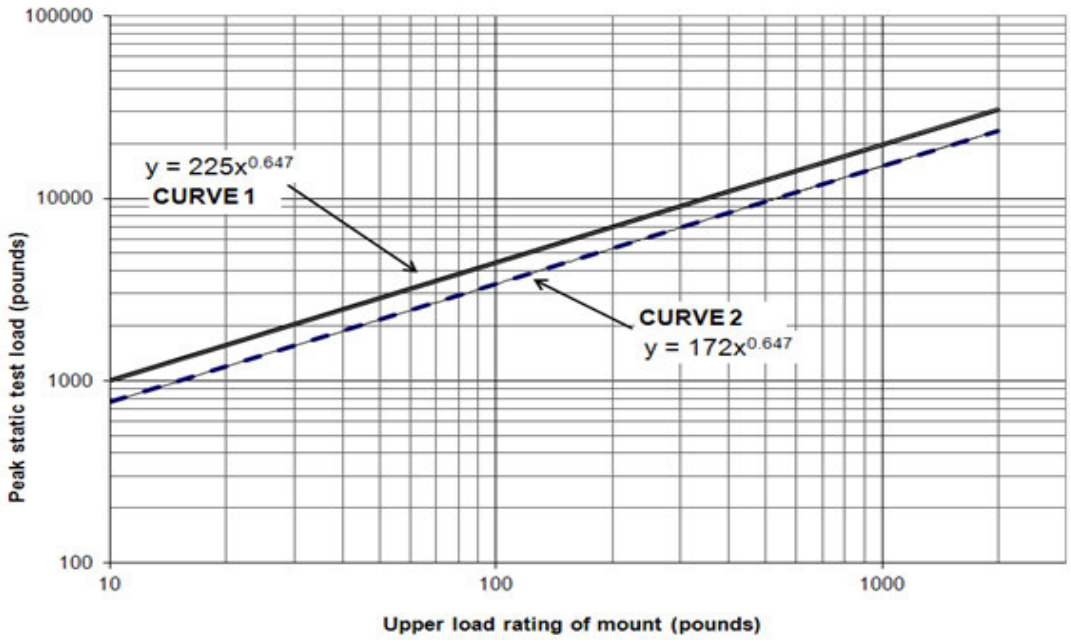

FIGURE 2. Minimum static strength loads for resilient mounts.

4.4.2.2.3 Test in the radial direction (perpendicular to the center bolt axis). Two mounts shall be tested in the radial direction (see 6.4.3) as a pair while axially compressed in a fixture similar to that shown on figure 3. Each mount shall be compressed axially to a deflection that corresponds to its upper load rating. This deflection is obtained from the static load-deflection curve acquired from axial testing (see 4.4.2.2.2). Axial compression is achieved via four threaded rods (see figure 3). After assembly in the fixture and installation in the test apparatus, the mount pair shall be subjected to four radial loading and unloading cycles at a constant deflection rate not exceeding 0.3 inch per minute. For the first three loading cycles, loads shall be applied up to the peak static test load specified in Curve 2 on figure 2 for the upper load rating of the mount. For the fourth loading cycle, the mount shall be loaded up to the peak load specified in Curve 1 on figure 2 for the upper load rating of the mount. Load-deflection data shall be recorded during the fourth loading cycle. A per-mount average load-deflection plot shall be determined by dividing the load at each displacement by 2. The mount shall be inspected during and after testing to determine compliance with 3.4.3.

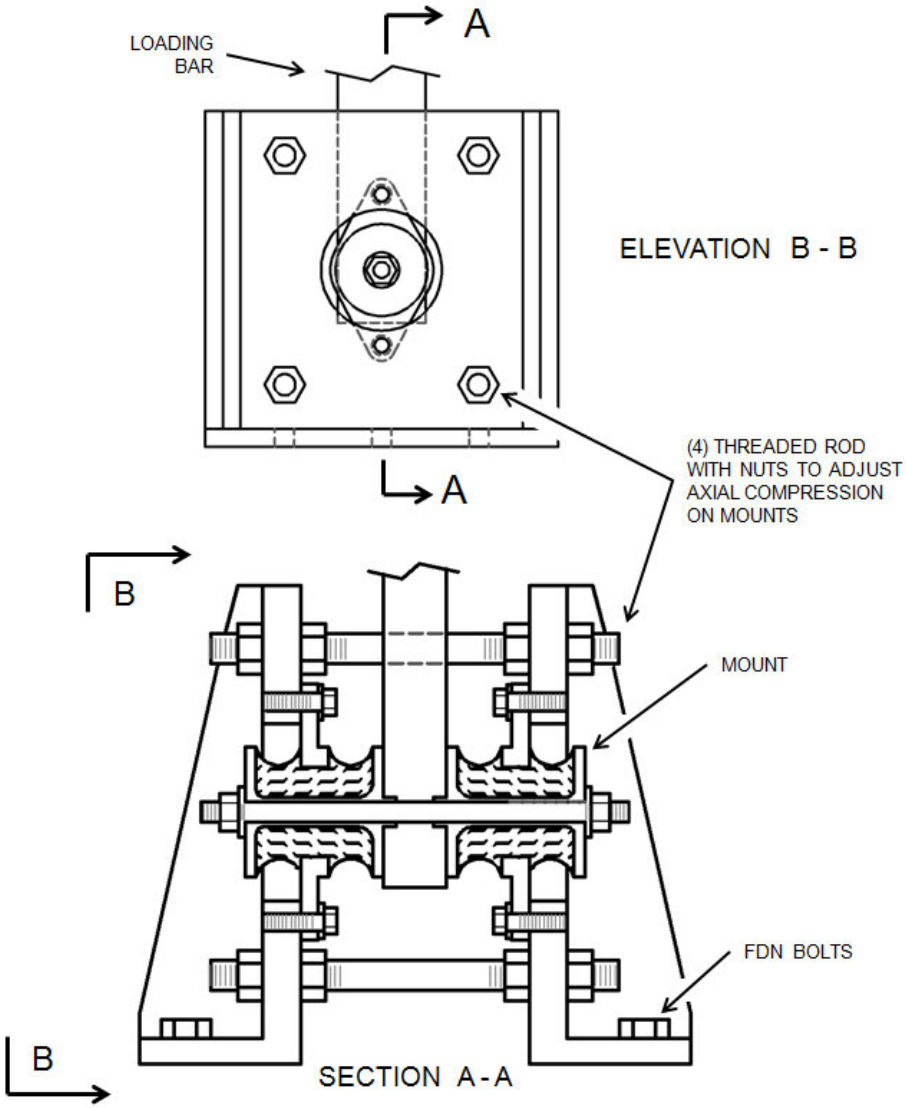

FIGURE 3. Fixture for conducting strength test in the radial direction.

4.4.2.3 Fatigue test. The test apparatus shall be capable of imparting constant sinusoidal deflection to the mount. A suitable vibration shaker with accompanying frame or Universal Testing Machine shall be used for conducting this test. The mount shall be secured to the mounting bracket of the machine and subjected to 400,000 cycles of 3/16-inch deflections measured from a neutral unloaded position. The ±3/16-inch cycling shall be in the axial direction at the rate of 175 cycles per minute.

4.4.2.4 Drift test. The mount shall be loaded for 96 hours with weight equal to the mount upper load rating. The loss of height in the resilient element measured 1 hour after application of load and again at the end of the period shall be measured with a gauge having 0.001-inch sensitivity. The difference in the two readings shall determine compliance with 3.4.5. Tests shall be conducted at room temperature of 80±5 °F. Refer to figure 4 for a diagram of a typical drift test setup.

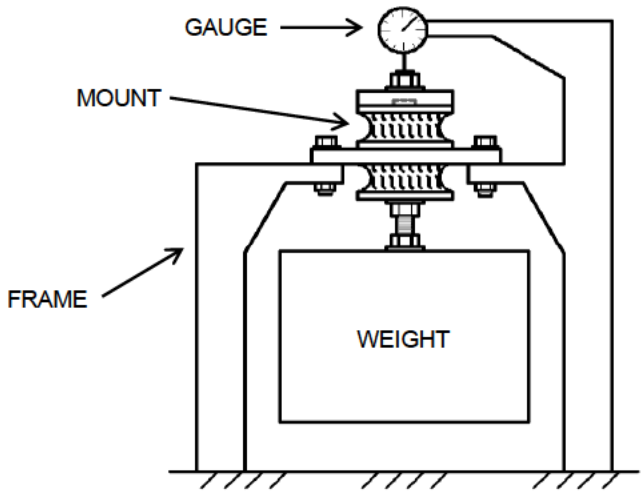

FIGURE 4. Drift test arrangement.

4.4.2.5 Delamination and porosity test. A mount shall be cut into two parts and examined for porosity. The cut parts shall be immersed in Toluene (ACS reagent grade, ≥99.5 percent) for 24±¼ hours at a temperature of 80±5 °F. After removal from Toluene, the sections of the mount shall be examined to determine evidence of separation into distinct layers or laminations.

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 activities 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

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The mount types covered in this specification are intended to isolate shock and vibration on surface ships and submarines.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Mount type (see 1.2.1).

c. Type of metal, specify steel or manganese bronze (see 3.3.2).

d. Protective treatment of metal, if other than specified (see 3.3.2).

e. Packaging requirements (see 5.1).

f. Marking (see 6.5).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL No. 17191 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard DC 20376-5160 or emailed to CommandStandards@navy.mil. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at https://assist.dla.mil.

6.4 Definitions.

6.4.1 Axial direction. The direction which is parallel to the center bolt axis of the mount as shown in 803-1385777.

6.4.2 Dynamic stiffness. The real part of the frequency-dependent complex ratio of force on the blocked output side of the mount to displacement on the input side during sinusoidal vibration. Also referred to as spring constant or elastic dynamic stiffness.

6.4.3 Radial direction. A direction which is perpendicular to the center bolt axis of the mount as shown in 803-1385777.

6.5 Marking. Waterproof marking should be provided on interior packages and exterior shipping containers with the following information (see 6.2):

MOUNT TYPE:

MILITARY SPEC NO: MIL-DTL-17191

DATE OF MFG:

LOT NO:

SHELF LIFE: 7 YEARS FROM DATE OF MFG

6.6 Subject term (key word) listing.

Isolator

Shock

Vibration

6.7 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Preparing activity:
Navy – SH
(Project 5342-2014-001)

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.dla.mil.