INCH-POUND

MIL-M-24476B(SH)
9 September 1993
SUPERSEDING
MIL-M-24476A(SH)
10 February 1977
(See 6.10)

MILITARY SPECIFICATION

MOUNTS, RESILIENT: PIPE SUPPORT, TYPES 7M50, 6M150, 6M450, 6M900, AND 5M3500

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

1. SCOPE

1.1 Scope. This specification covers resilient mounts which are intended primarily for use in supporting pipes and isolating their vibration.

1.2 Classification. The resilient mounts shall conform to drawing number 803-5001002 and shall be furnished in the following types, as specified (see 6.2):

7M50 (load capacity of 20 to 50 pounds)
6M150 (load capacity of 50 to 150 pounds)
6M450 (load capacity of 150 to 450 pounds)
6M900 (load capacity of 450 to 900 pounds)
5M3500 (load capacity of 2000 to 3500 pounds)

1.2.1 Type designation. The numbers and letters in the type designation denote the following:

First number	- Denotes the nominal resonant frequency (hertz) in the axial direction at upper rated load.
Letter M	- Denotes the mount design activity (Mare Island Rubber Laboratory).
Second number	- Denotes the upper load rating (pounds).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, ATTN: 03Q42, Naval Sea Systems Command, 2531 Jefferson Davis Hwy, Arlington, VA 22242-5160 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 5340

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 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 listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

PPP-B-636 - Boxes, Shipping, Fiberboard.

MILITARY

MIL-P-116 - Preservation, Methods of.
MIL-L-19140 - Lumber and Plywood, Fire-Retardant Treated.

STANDARDS

MILITARY

MIL-STD-407 - Visual Inspection Guide for Rubber Molded Items.
MIL-STD-2073-1 - DOD Material Procedures for Development and Application of Packaging Requirements.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Bldg. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.1.2 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 are those cited in the solicitation.

DRAWING

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

803-5001002 - Mount, Resilient, Pipe Support Type 7M50, 6M150, 6M450, 6M900, and 5M3500.

(Copies of NAVSEA Drawings may be obtained from Portsmouth Naval Shipyard, Naval Engineering Drawing Support Activity, Code 202.2, Portsmouth, NH 03804-5000.)

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D 412 - Standard Test Methods for Rubber Properties in Tension. (DOD adopted)
D 429 - Standard Test Methods for Rubber Property - Adhesion to Rigid Substrates. (DOD adopted)
D 471 - Standard Test Method for Rubber Property - Effect of Liquids. (DOD adopted)
D 573 - Standard Test Method for Rubber - Deterioration in an Air Oven. (DOD adopted)
D 792 - Standard Test Methods for Specific Gravity (Relative Density) and Density of Plastics by Displacement. (DOD adopted)
D 1186 - Standard Test Methods for Nondestructive Measurement of Dry Film Thickness of NonMagnetic Coatings Applied to a Ferrous Base. (DOD adopted)
D 1229 - Standard Test Method for Rubber Property - Compression Set at Low Temperatures. (DOD adopted)
D 2240 - Standard Test Method for Rubber Property - Durometer Hardness. (DOD adopted)
D 2632 - Standard Test Method for Rubber Property - Resilience by Vertical Rebound. (DOD adopted)
D 3951 - Standard Practice for Commercial Packaging. (DOD adopted)
D 4727 - Standard Specifications for Corrugated and Solid Fiberboard Sheet Stock (Container Grade) and Cut Shapes. (DOD adopted)

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specifications, specification sheets or MS standards), 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), a sample shall be subjected to first article inspection (see 6.4) in accordance with 4.3.

3.2 Materials. Materials shall meet the requirements specified in 3.2.1 through 3.2.3.

3.2.1 Metal. The metal components of the mounts shall be as specified on the drawings for the mounts. The contracting activity shall specify (see 6.2) whether the mounts shall be manufactured from steel or manganese bronze as shown on NAVSEA drawing number 803-5001002. The metal components for the mounts shall be formed to shaped and finished in accordance with the dimensions and allowable tolerances specified by the applicable mount drawing.

3.2.2 Rubber. Rubber materials shall meet the requirements specified in 3.2.2.1 through 3.2.2.1.4.4.

3.2.2.1 Resilient element. The resilient elements of the mounts shall be molded from compounds using natural rubber (see 6.6) as the basic material. The natural rubber components shall be coated with an oil-ozone resistant compound (see 6.7). Coating of the mounts may be accomplished by, but is not limited to, dipping, painting, or spraying. The mounts shall be molded to the specified form as shown on NAVSEA drawing no. 803-5001002. The rubber element of the snubbers shall be fabricated of an oil resistant compound (see 6.7) utilizing polymerized chloroprene or a copolymer of butadiene and acrylonitrile as the basic material.

3.2.2.1.1 Porosity and delamination. The rubber elements of the finished mounts shall have no delamination, air pockets, or porosity in any portion when tested in accordance with 4.6.18.

3.2.2.1.2 Bond. The rubber elements shall be bonded to the metal components as specified on NAVSEA drawing no. 803-5001002.

3.2.2.1.3 Surface condition. There shall be no backrinding nor blisters on the outer surfaces of the rubber elements of the finished mounts.

3.2.2.1.4 Physical requirements. Physical requirements of rubber materials shall be as specified in 3.2.2.1.4.1 through 3.2.2.1.4.4.

3.2.2.1.4.1 Rubber compounds. The vulcanized rubber compounds used in the rubber elements of the mounts shall conform to the physical requirements specified in table I.

3.2.2.1.4.2 Hardness. The hardness of the rubber compounds used in the resilient elements and snubbers shall be determined in accordance with 4.6.10. The hardness found during first article inspection of the contractor's mount compounds shall be recorded as a requirement with a tolerance of plus or minus 5 points for subsequent quality conformance testing of this contractor's mount compounds.

3.2.2.1.4.3 Specific gravity. The specific gravity of the rubber compounds used for the resilient elements and snubbers shall be determined in accordance with 4.6.11. The specific gravity found during first article inspection of the contractor's mount compounds shall be recorded as a requirement with a tolerance of plus or minus 0.03 for subsequent quality conformance testing of the contractor's mount compounds.

3.2.2.1.4.4 Oil-ozone resistant coating. The oil-ozone resistance coating shall conform to the physical requirements specified in table II (see 6.7).

TABLE I. Physical requirements for rubber compounds in mounts and snubbers.

	Type 7M50, 6M150 and 6M450 mounts	Type 6M900 mounts	Type 5M3500 mounts	Snubbers	Test method
Tensile strength (minimum) Before aging, lb/in^2 After aging at 194°F for 46 hours, lb/in^2	2700 2300	3000 2500	3000 2700	2300 2300	4.6.2 4.6.4
Elongation at break (minimum) Before aging, percent After aging at 194°F for 46 hours, percent	450 400	500 450	400 350	250 180	4.6.2 4.6.4
Compression set (maximum) After aging 94 hours at 30°F, percent	12	20	20	No requirement	4.6.3
Volume change in oil (maximum), percent	No requirement	No requirement	No requirement	5	4.6.5.1
Adhesion of rubber to metal (minimum), lb/in^2	600	600	600	450	4.6.6.1
Resilience (maximum), percent	No requirement	No requirement	No requirement	40	4.6.12

TABLE II. Physical requirements for oil-resistant coating.

Property	Requirement	Test
Properties of dried film		
Tensile strength (minimum), lb/in^2	2000	4.6.2
Elongation at break (minimum), percent	400	4.6.2
Properties of coated test specimens		
Volume change (maximum) after immersion in oil at 158°F for 70 hours, percent	5	4.6.5.2
Adhesion of coating		
Before immersion in oil	No failures	4.6.6.2
After immersion in oil at 158°F	No failures	4.6.6.2
Ozone resistance after 1 week at 104°F in air containing 100 parts per hundred million (pphm) ozone	No cracks	4.6.7
Flexibility of coating after flexing for 6 cycles to 100 percent elongation	No cracks	4.6.8
Properties of coated mount		
Appearance	Shall be dry and tack free and free from blisters or other imperfections	4.4.3.2
Film thickness (minimum) on rubber element as measured on coated metal, inch	0.003	4.6.9

3.2.3 Protective treatment. The metal components and elastomers used in the manufacture of the mounts shall be resistant to or protected against, corrosion by seawater, oil, ozone, or other atmospheric conditions encountered in service. Unless otherwise specified (see 6.2) the coating on the metal shall be equivalent to that specified on drawing 803-5001002 and shall have a minimum dry film thickness of 0.006 inch.

3.3 Finished mounts. Finished mounts shall meet the requirements specified in 3.3.1 through 3.3.6.

3.3.1 Dynamic stiffness. The dynamic stiffness and resonance frequency of the mounts, when tested in the axial direction (see 6.5.1) in accordance with 4.6.13, shall be within the limits specified in table III.

TABLE III. Axial dynamic stiffness and resonance frequency requirements at various loads.

		Requirement - limits	
Mount	Test load, lb	Resonance frequency, Hz	Dynamic stiffness, lb/in
7M50	20	9.3 - 11.3	176 - 260
	30	7.9 - 9.7	190 - 288
	40	7.0 - 8.6	199 - 302
	50	6.3 - 7.8	202 - 310
6M150	50	8.8 - 10.8	394 - 595
	80	7.2 - 8.8	423 - 632
	110	6.2 - 7.6	431 - 648
	150	5.5 - 6.8	462 - 707
6M450	150	8.9 - 10.9	1211 - 1818
	250	6.8 - 8.4	1179 - 1799
	350	5.7 - 7.0	1159 - 1749
	450	5.0 - 6.2	1147 - 1764
6M900	450	7.4 - 9.1	2513 - 3801
	600	6.3 - 7.8	2429 - 3723
	750	5.5 - 6.8	2314 - 3537
	900	4.9 - 6.1	2204 - 3416
5M3500	2000	6.1 - 7.5	7590 - 11475
	2500	5.4 - 6.7	7435 - 11447
	3000	4.9 - 6.1	7347 - 11386
	3500	4.5 - 5.6	7229 - 11196

3.3.2 Deflection at rated load. The deflections of the mounts, when tested in the axial direction at their respective rated loads in accordance with 4.6.14, shall be within the limits specified in table IV and shall not show any break or separation between component parts.

TABLE IV. Deflection at rated load.

Mount	Load Pounds	Deflection, inch	
		Minimum	Maximum
7M50	50	0.27	0.37
6M150	150	0.33	0.45
7M450	450	0.30	0.40
6M900	900	0.32	0.42
5M3500	3500	0.47	0.57

3.3.3 Quality of the rubber-to-metal bond. Mounts shall not show breaks, cracks, or tears in the rubber elements or evidence of delamination at rubber-to-metal bond interfaces when tested as specified in 4.6.15.

3.3.4 Strength. Mounts, when tested in the axial direction in accordance with 4.6.16 shall not show any separation or break between the parts nor any permanent deformation of the metal parts in excess of 1/32 inch.

3.3.5 Drift. Mounts, when tested in accordance with 4.6.17, shall not drift more than the requirements specified in table V. There shall be no failure of the resilient element, rubber-to-metal bond, or metal parts during the tests. At the end of the tests, the dynamic stiffness and resonance frequency of the mounts shall be no more than the amounts specified in table III.

TABLE V. Drift requirements.

Mount	Drift (maximum), inches
7M50	0.020
6M150	0.025
7M450	0.025
6M900	0.032
6M3500	0.045

3.3.6 Porosity and delamination. The resilient elements of the mounts shall not show evidence of porosity in the rubber nor separation of the rubber into distinct layers or laminations, when tested and examined as specified in 4.6.18.

3.4 Identification. Each mount shall be identified with the applicable markings specified on Drawing no. 803-5001002.

3.5 Mount design. Each mount shall conform to all applicable details shown on Drawing no. 803-5001002.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 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 the 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.

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

(a) First article inspection (see 4.3).
(b) Quality conformance inspection (see 4.4).

4.3 First article inspection. First article inspection shall consist of the examinations specified in 4.4.3.1 and the tests specified in 4.6. The material tested shall be identical in composition and equivalent in manufacture to the material to be supplied for quality conformance inspection.

4.3.1 Samples. Samples for first article tests shall consist of rubber samples and mount samples.

4.3.2 Rubber samples. For the tests specified in 4.3.3, the contractor shall provide the samples listed in table VI.

TABLE VI. Rubber samples for first article tests.

Quantity	Type of rubber compound	Sample description	Size of sample	Property to be measured
3	Resilient element	Sheet	0.08±0.01x6x6 inches	Tensile strength and ultimate elongation (initial and aged). Specific gravity (initial)
3	Snubber	Sheet	0.08±0.01x6x6 inches	Tensile strength and ultimate elongation, (initial and aged). Specific gravity (initial)
3	Resilient element	Specimen covered with oil-resistant coating	0.08±0.01x1x2 inches	Resistance to oil, volume change
3	Snubber	Uncoated specimen	0.08±0.01x1x2 inches	Resistance to oil, volume change
3	Resilient element	Specimen covered with oil-resistant coating	0.08±0.01x1x6 inches	Ozone resistance adhesion, and flexibility of coating
3	Resilient element	ASTM D 429 method A specimen	See ASTM D 429	Rubber-metal adhesion
3	Snubber	ASTM D 429 method A specimen	See ASTM D 429	Rubber-metal adhesion
4	Resilient element	Cylinder	0.50±0.02 inch high x 1.14±0.02 inches diameter	Compression set and hardness
3	Snubber	Cylinder	0.50±0.02 inch high x 1.14±0.02 inches diameter	Hardness and resilience
1	Oil-resistant coating	Sheet	0.006±0.003x6x6 inches	Tensile strength and ultimate elongation

4.3.2.1 Mount samples. If the rubber samples listed in table VI meet the requirements herein, the prospective contractor shall then conduct the tests specified in 4.3.4 using four mounts of each type manufactured from the compounds represented by the rubber samples.

4.3.3 First article inspection on rubber samples. First article inspection rubber samples shall consist of the tests specified in 4.3.3.1 and 4.3.3.2.

4.3.3.1 Uncoated rubber samples. The uncoated rubber samples specified in 4.3.2.1 shall be subjected to the following tests:

	Inspection paragraph
Initial tensile strength	4.6.2
Initial ultimate elongation	4.6.2
Tensile strength after oven aging	4.6.2 and 4.6.4
Ultimate elongation after oven aging	4.6.2 and 4.6.4
Cold compression set	4.6.3
Hardness	4.6.10
Specific gravity	4.6.11
Resistance to oil (snubber stock only)	4.6.5.1
Adhesion to metal	4.6.6.1
Resilience (snubber stock only)	4.6.12

4.3.3.2 Oil-ozone resistant coating. The oil-ozone resistant coating samples specified in 4.3.2 shall be subjected to the following tests:

	Inspection paragraph
Tensile strength of dried film	4.6.2
Ultimate elongation of dried film	4.6.2
Swelling of coated rubber sample	4.6.5.2
Adhesion of coating	4.6.6.2
Ozone resistance	4.6.7
Flexibility of coating	4.6.8

4.3.4 First article inspection of the finished mounts. First article inspection of the finished mounts shall be as follows:

(a) Two mounts of each type specified in 4.3.2.1 shall be subjected to the following examinations and tests:

	Inspection paragraph
Examinations	4.4.3.2
Dynamic stiffness and resonance frequency	4.6.13
Deflection at rated load	4.6.14
Quality of rubber-to-metal bond	4.6.15
Strength, axial	4.6.16
Film thickness of oil-ozone resistant coating	4.6.9

(b) The remaining two mounts of each type specified in 4.3.2.1 shall be subjected to the following examinations and tests:

	Inspection paragraph
Examination	4.4.3.1
Dynamic stiffness and resonance frequency	4.6.13
Deflection at rated load	4.6.14
Quality of rubber-to-metal bond	4.6.15
Drift	4.6.17
Porosity and delamination	4.6.18

4.4 Quality conformance inspection. Quality conformance inspection shall consist of the examination and the tests of sample units as specified herein.

4.4.1 Lot. For the purpose of quality conformance inspection and sampling, a lot shall consist of all the mounts of one type, design, and load rating offered for delivery at the same time. A lot serial number shall be assigned to each mount. The lot serial number shall not be repeated in any one quarter. The serial number shall be traceable to the mount and snubber rubber batch numbers, the manufacturing and process records against which the mounts and snubbers were manufactured, and all quality conformance requirements as required by this specification. The lot serial number shall be specified on all shipping documents sent to the receiving facility, as well as on all package and shipping containers (see 5.4).

4.4.2 Samples and tests for quality conformance inspection. Samples and tests for quality conformance inspection shall be as specified in 4.4.2.1 through 4.4.2.3.

4.4.2.1 Rubber compound samples. Samples, as specified in table VII, shall be provided from each batch of resilient element and snubber rubber stock which is mixed for manufacture of the mounts in the lot. The samples shall be certified to be of the same material and equivalent cure as the corresponding components in the lot of finished mounts offered for delivery.

TABLE VII. Rubber samples for quality conformance.

Quantity	Type of rubber compound	Description of sample	Size of sample	Property to be measured
2	Resilient element	Sheet	0.08±0.01x6x6 inches	Tensile strength and ultimate elongation. Specific gravity
2	Snubber	Sheet	0.08±0.01x6x6 inches	Tensile strength, and ultimate elongation. Specific gravity
1	Resilient element	Slab or disc	0.05 inch thick	Hardness
1	Snubber	Slab or disc	0.5 inch thick	Hardness

4.4.2.2 Quality conformance tests on rubber samples. Samples as specified in 4.4.2.1 shall be subjected to the tests of 4.6.2, 4.6.10 and 4.6.11.

4.4.2.3 Rejection. If any samples tested in accordance with 4.4.2.2 fail to meet the test requirements of table VII all mounts in the lot represented by the samples shall be rejected.

4.4.3 Quality conformance inspection on mounts. Quality conformance inspection on mounts shall be as specified in 4.4.3.1 and 4.4.3.2.

4.4.3.1 Sampling for visual and dimensional examination. A random sample of mounts shall be taken from each lot for visual and dimensional examination.

TABLE VIII. Sampling for visual and dimensional examination.

Number of mounts in lot	Number of mounts in sample
90 and under	8
91 to 200	20
201 to 300	30

4.4.3.2 Procedure for visual and dimensional examination. Each of the mounts selected shall be visually and dimensionally examined to verify compliance with this specification. MIL-STD-407 shall be used to determine and evaluate defects through visual examination. The classification of defects are shown in table IX.

TABLE IX. Classification of defects.

Category	Defects
Critical: 1	None defined in this table.
Major: 101 102 103 104 105 106 107 108 109	 Evidence of use of unauthorized materials. Resilient elements not molded to specified form on drawing. Evidence of delamination or air pockets in rubber elements of finished product. Rubber elements not bonded to metal components in conformance with drawing. Evidence of backrinding and blisters on outer surface of rubber elements. Evidence of tackiness or nondrying of the oil resistant coating. Metal components not protected from corrosion by seawater or spray or other atmospheric conditions encountered in service. Dimension, length, width and height and configuration not in conformance with drawing. Any other defect which would affect the serviceability of the mount.
Minor: 201 202 203	 Identification marking not in conformance with drawing. Burrs, rough edges, and sharp corners not removed. Any other defect which would not affect the serviceability of the mount.

4.4.3.3 Rejection. Any mount in the sample containing one or more major visual or dimensional defect shall be rejected and counted against major defects. Any mount containing more than one minor defect shall be rejected and counted against total defects. Any mount containing only one minor defect (no major defects) shall be counted against total defect but shall not be rejected. If, in any sample, the number of defective mounts as defined above exceeds the acceptance number for that sample the lot represented by the sample shall be rejected.

4.4.3.4 Quality conformance tests on mounts. Quality conformance tests on mounts shall be as specified in 4.4.3.4.1 through 4.4.3.4.4, and tables X and XI.

4.4.3.4.1 Sampling. A random sample of mounts, shall be taken from each lot in accordance with table X for the tests specified in table XI.

TABLE X. Sampling for tests.

Number of mounts in a lot	Number of mounts in a sample
3 to 15	3
16 to 20	4
21 to 25	5
26 to 90 First	8
Second	8
91 to 150 First	13
Second	13
151 to 280 First	20
Second	20
281 to 300 First	32
Second	32

4.4.3.4.2 Tests to be performed. Each of the samples selected in accordance with 4.4.3.4.1 shall be subjected to the tests specified in table XI.

TABLE XI. Tests to be performed on mounts in quality conformance sampling.

Test (Listed in sequence of performance)	Paragraph
Thickness of oil-resistant film	4.6.9
Dynamic stiffness	4.6.13
Deflection at rated load	4.6.14
Quality of rubber-to-metal bond	4.6.15

4.4.3.4.3 Action in case of conformance. Every mount that passes the quality conformance tests shall be returned to the lot.

4.4.3.4.4 Action in case of nonconformance. If any of the samples subjected to the quality conformance tests do not conform with the requirements of this specification, the lot represented by the samples shall be rejected. Each lot shall be considered acceptable only after satisfactory results are obtained on the test or tests by all the samples taken or provided to represent the lot. This additional testing shall be discontinued after four successive lots have passed the test or tests.

4.6 Tests. Test methods shall be as specified in 4.6.1 through 4.6.18.

4.6.1 Standard test conditions. All tests shall be made within an ambient temperature range of 65 to 89 degrees Fahrenheit (°F) unless otherwise specified.

4.6.2 Tensile and ultimate elongation tests. Tensile strength and ultimate elongation tests shall be conducted on the resilient element and snubber compounds and the 0.006 inch thick coating film in accordance with ASTM D 412. Die C test specimens shall be used.

4.6.3 Cold compression set. Cold compression set shall be determined in accordance with ASTM D 1229, except the exposure shall be at 30 ± 2°F for 94 ± 1/2-hours. Compression set shall be determined 30 minutes after release from compression.

4.6.4 Oven aging test. Specimens for tensile, ultimate elongation and compression set tests shall be oven aged in accordance with ASTM D 573 at a temperature of 194 ± 2°F for 46 ± 1/4-hours. Final determination of aged tensile and ultimate elongation specimens shall be made not less than 16 hours nor more than 48 hours after removal from the oven. Tensile and ultimate elongation tests on unaged specimens shall be made immediately prior to, and on the same machine as, the tensile tests on the oven aged specimens (see 4.6.2).

4.6.5 Swelling in oil. Test methods for swelling in oil shall be as specified in 4.6.5.1 and 4.6.5.2.

4.6.5.1 Volume change in oil (uncoated rubber compounds). Volume change shall be determined in accordance with ASTM D 471 on uncoated 0.08 by 1 x 2 inch specimens as specified in table VI. The specimen shall be immersed in reference oil no. 3 of ASTM D 471. The immersion period shall be 46 ± 1/4-hours at 73°F.

4.6.5.2 Volume change in oil (coated samples). Volume change in oil shall be determined in accordance with ASTM D 471 on the three coated 0.08 by 1 by 2 inch specimens as specified in table VI and the immersion period shall be 70 ± 1/4-hours at 168 ± 2°F. The specimen shall be immersed in reference oil no. 3 of ASTM D 471.

4.6.6 Adhesion tests. Adhesion tests shall be performed as specified in 4.6.6.1 and 4.6.6.2.

4.6.6.1 Adhesion-to-metal tests. The adhesion tests shall be in accordance with method A of ASTM D 429. Three specimens of each rubber compound, as specified in table VI, shall be tested and the results averaged.

4.6.6.2 Adhesion of coating (coated sample). The adhesion of the oil resistant coating to three 0.08 by 1 by 2 inch samples of the coated rubber specimens (see table VI) shall be determined before and after immersion in oil in accordance with 4.6.5.2. Each coated specimen shall be flexed, elongated by hand, and then visually examined for adhesion failures. The coated specimens shall not exhibit cracks, breaks, tears, or blisters conducive to peeling of the coating by hand either before or after immersion in oil.

4.6.7 Ozone resistance. The ozone resistance of the coated resilient components of the mounts shall be determined on two coated 1 by 6 by 0.080 inch thick specimens (see table VI). The specimens shall be elongated to a 20 percent extension. A thin layer of melted paraffin wax shall be applied to each of the four surfaces of the stretched specimens in an area not exceeding a 1/4 inch width from the clamps. The stretched specimens shall be conditioned for 16 ± 2 hours at 104 ± 2°F before being exposed, in accordance with ASTM D 1149. The concentration of ozone shall be 100 ± 10 parts per hundred million (pphm) by volume, the temperature shall be 104 ± 2°F, and the period of exposure shall be 168 hours. Observation magnification shall be 7X.

4.6.8 Flexibility of the coating. The flexibility of the coated 1 by 6 by 0.08 inch coated rubber specimens specified in table VI shall be determined. Each specimen shall be clamped in a universal test machine and a tensile force applied to elongate the specimen 100 percent at a loading rate of 20 inches per minute. The force shall then be released so that the specimen is no longer elongated. The cycle shall be repeated six times. The coated specimens shall be visually examined and shall exhibit no cracks, breaks, tears, or blisters.

4.6.9 Film thickness of the oil resistant coating. The film thickness of the oil resistant coating shall be measured on the coated steel plates of the mount using a micrometer for conformance with the requirement in table II. The thickness of the steel plate shall be determined before coating and after 0.003 inch of multiple coatings have been applied to the mount. The difference in the two thickness measurements divided by two shall be the film thickness of the oil resistant coating. In lieu of the above procedure, the film thickness may also be measured by using a magnetic type thickness gauge in accordance with ASTM D 1186.

4.6.10 Hardness. The hardness of the 0.5 inch thick specimens representing the rubber components of the mount shall be determined in accordance with ASTM D 2240. A 3 second reading shall be taken to determine conformance with 3.2.2.1.4.2.

4.6.11 Specific gravity. The specific gravity of the rubber compounds used for the mounts shall be determined on specimens cut from 0.08 by 6 by 6 inch sheets using ASTM D 792. The average of three determinations shall be reported to determine conformance with 3.2.2.1.4.3.

4.6.12 Resilience. The resilience of the 0.5-inch thick specimens (see table VI) representing the rubber component of the snubber shall be determined in accordance with ASTM D 2632. Three specimens shall be tested and the results averaged.

4.6.13 Dynamic stiffness test. Dynamic stiffness shall be measured for each mount in the axial direction at loads specified in table III to determine conformance with 3.3.1. The methods for determining dynamic stiffness of the mounts are classified into two groups, resonant and nonresonant methods. The double amplitude of vibration for each method shall be 0.020 inch peak-to-peak. An example of each type is given, but is not limited to, the methods of 4.6.13.1 and 4.6.13.2.

4.6.13.1 Resonant methods. A suitable arrangement for performing this test and the associated electronic circuitry is shown on figure 1. The mount shall be supported by a test stand of high stiffness (low compliance) and loaded to the desired value by means of weights suspended from a steel rod. The system is excited by an electromagnetic shaker attached to the bottom of the rod through an impedance head. The impedance head senses both the dynamic force applied to the system as well as its motion. The instrumentation of figure 1 amplifies and ratios the two signals to provide a single voltage proportional to the ratio of input velocity to force, that is, the drive point mobility of the system. The procedure is to apply sinusoidal vibration to the system, slowly sweeping upward in frequency, while not exceeding a vibration amplitude (peak-to-peak) of 0.020 inch. At the resonance frequency of the system the mobility ratio will be a maximum. In lieu of using a impedance head and ratio instrumentation, separate force and motion transducers and readout instruments could be used instead. The procedure would again be to sweep

upward in frequency with sinusoidal vibration, this time maintaining constant input force amplitude and determining the frequency at which the signal from the motion transducer is a maximum. Whichever method is used, it is essential that the input force to the system be accounted for so that the measured resonance frequency will be independent of the properties of the vibration exciter; this effect may be particularly pronounced for small mounts having low values of stiffness. For resonant methods, the dynamic stiffness is calculated as follows:

$$K_d = 4\ ^2f_n^2W/g$$

Where: K_d = dynamic stiffness, lb/in.
f = resonance frequency, Hz.
W = supported weight, pounds.
g = acceleration of gravity, 386 in/sec^2

4.6.13.2 Nonresonant methods. These methods are based on the transmitted force principle. One such system is the servo-controlled electrohydraulic test machine which can impress a static load on the mount and then superimpose a sinusodial compressive force as shown on figure 2. Electronic circuitry, which controls the servo valve, allows the driving frequency, the displacement, and the static force to be varied. The dynamic stiffness is determined by measuring the force transmitted through the mount, the vibration amplitude across the mount, and the phase angle between these quantities. The electrohydraulic method measures the dynamic stiffness based on the following equation:

$$F = K_dx + Cx'$$

Where: F = F(t) sinusodial transmitted force, lbf.
K_d = dynamic stiffness, lb/in.
C = damping coefficent, lb-sec/in.
x = x(t), displacement, in.
x' = dx/dt, in/sec.

4.6.13.3 Calibration of dynamic stiffness test systems. All systems used in the resonant and nonresonant methods for testing dynamic stiffness of mounts shall be calibrated before use. Steel coil springs of known spring rate may be used for calibration purposes to ensure that the equipment behaves correctly with changes in stiffness, and in a linear manner with variations of excitation amplitude and frequency. Care shall be taken to ascertain that the compliance of the test equipment does not result in erroneously low values for dynamic stiffness.

4.6.14 Test for deflection at rated load. A universal type testing machine shall be used. Each mount without snubbers shall be subjected to a single loading cycle in the axial direction. The loading shall be accomplished at a constant rate such that the maximum load is attained in not less than 1 minute. The deflection at rated load shall be measured to the closest 0.001 inch. The upper rated load for each mount is specified in table IV. The deflection at the upper rated load shall be recorded to determine conformance with 3.3.2.

4.6.15 Quality of the rubber-to-metal bond. The load on the mounts, tested as specified in 4.6.14, shall be increased to two times the upper rated load after recording the deflection at the upper rated load. The rate of loading should be

such that the maximum load is attained in not less than 2 minutes. The mount shall be held at two times its upper rated load while the appearance of the resilient element and of the rubber-to-metal bond is examined to determine conformance to 3.3.3.

4.6.16 Compressive strength. The mounts with snubbers shall be subjected to four loading-unloading cycles in the axial direction in a universal test machine capable of measuring loads in units not larger than 5 pounds and deflection in units not larger than 0.005 inches under the conditions of the test. The rate of deflection shall not exceed 0.3 inch per minute. On each of the first three cycles, the mounts shall be loaded to the load specified on curve 2 of figure 3 for the upper load rating of the mount. On the fourth cycle, the mount shall be loaded to the load specified on curve 1 of figure 3 for the upper load rating of the mounts. The specimen shall be examined after the fourth cycle to determine conformance with 3.3.4.

4.6.17 Drift test. Each mount shall be loaded to its upper rated load (see table IV) in the axial direction after being previously tested for dynamic stiffness (see table III and 4.6.13). The height of the mount shall be measured to the nearest 0.001 inch one hour after loading and again after 14 days. The difference in the two readings shall be taken as the drift of the mount. Within 16 minutes after the final reading has been obtained, the mount shall be tested again for dynamic stiffness at its upper rated load. The drift test shall be conducted at an ambient temperature of 80 $\pm$ 5°F.

4.6.18 Porosity and delamination. One of the mounts used for the drift test shall be cut into two parts along a vertical plane through the center of the mount. The cut surfaces of these components shall be carefully examined for porosity. The parts shall be immersed in toluol (technical grade) for 24 hours. After removal from the toluol, the rubber elements shall be examined for evidence of separation into distinct layers or laminations.

4.7 Inspection of packaging. Sample packs, and the inspection of preservation, packing and marking for shipment, stowage, and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition.)

5.1 General.

5.1.1 Navy shipboard stowage fire-retardant requirements.

(a) Treated lumber and plywood. Unless otherwise specified (see 6.2), all lumber and plywood including laminated veneer material used in shipping container and pallet construction, members, blocking, bracing, and reinforcing shall be fire-retardant treated material conforming to MIL-L-19140 as follows:

Levels A and B - Type II - weather resistant.
Category 1 - general use.
Level C - Type I - nonweather resistant.
Category 1 - general use.

(b) Fiberboard. Unless otherwise specified (see 6.2), fiberboard used in the construction of class-domestic, nonweather resistant fiberboard and cleated fiberboard boxes including interior packing forms shall meet the flamespread index and the specific optic density requirements of ASTM D 4727.

5.2 Preservation. Preservation shall be level A, C or commercial as specified (see 6.2).

5.2.1 Level A. Mounts shall be cleaned by process C-1, dried by procedure D-1, and unit protected in accordance with method III of MIL-P-116, as follows:

(a) Each mount, after cleaning and drying, shall be wrapped with a neutral (noncorrosive) opaque or transparent plastic paper or film which shall be secured by means of pressure-sensitive tape.
(b) Each wrapped mount shall then be placed in a fiberboard, type CF or SF, class weather-resistant, grade optional box conforming to PPP-B-636. Box closure shall be in accordance with method V as specified in the appendix to the box specification.

5.2.2 Level C. Mounts shall be preserved (unit protected) as specified under level A, except the fiberboard box shall conform to class-domestic or class-domestic/fire-retardant (see 5.1.1.(b)), as specified (see 6.2). Box closure shall be in accordance with method I, using pressure sensitive tape.

5.2.3 Commercial. Commercial packaging (cleaning, preservation, cushioning, and the unit pack) shall be in accordance with ASTM D 3951.

5.3 Packing. Packing shall be level A, B, C, or commercial as specified (see 6.2).

5.3.1 General requirements for levels A, B, and C. Containers selected (see 5.3.2) shall be of minimum weight and cube consistant with the protection required, and of uniform size.

5.3.2 Levels A, B, and C containers. Mounts preserved as specified (see 5.2), shall be individually packed in exterior shipping containers for the level of packing specified (see 5.3), in accordance with table VII, exterior shipping container requirements, of MIL-STD-2073-1, Appendix C, and herein. Unless otherwise specified (see 6.2), container selection and options shall be at the contractor's option.

5.3.2.1 Caseliners, closure and gross weight.

5.3.2.1.1 Caseliners. Unless otherwise sepcified (see 6.2), level A shipping containers containing mounts preserved level C or commercial (see 5.2.2) shall be provided with waterproof caseliners in acordance with MIL-STD-2073-1.

5.3.2.1.2 Closure. Container closure, reinforcing, or banding shall be in accordance with the applicable container specification or appendix thereto except that weather-resistant fiberboard boxes shall be closed in accordance with method V and reinforced with nonmetallic or tape banding and domestic or fire retardant fiberboard boxes shall be closed in accordance with method I using pressure sensitive tape.

5.3.2.1.3 Weight. Wood, plywood, and cleated type containers exceeding 200 pounds gross weight shall be modified by the addition of skids in accordance with MIL-STD-2073-1 and the applicable container specification or appendix thereto.

5.3.3 Commercial. Mounts preserved as specified (see 5.2) shall be packed for shipment in accordance with ASTM D 3951 and herein.

5.3.3.1 Container modification. Shipping containers exceeding 200 pounds gross weight shall be provided with a minimum of two, 3- by 4-inch nominal wood skids laid flat, or a skid- or sill-type base which will support the material and facilitate handling by mechanical handling equipment during shipment and storage.

5.4 Marking, levels A, B, C, and commercial. In addition to any special marking required (see 6.2) and herein, interior (unit) packs and shipping containers shall be marked including bar coding for shipment, stowage, and storage in accordance with MIL-STD-2073-1, Appendix F.

5.4.1 Interior packs. Each pack shall be marked with the following information completed:

Mount identification _____
Specification number _____
Date cured _____
Lot number _____

5.4.2 Shipping containers. Each shipping container shall be marked on two adjacent sides with the following information completed:

Mount identification _____
Specification number _____
Date cured _____
Lot number _____

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 assemblies covered in this specification are intended for noise and vibration attenuation. The mounts are primarily for use in submarines, and where applicable in surface ships.

6.2 Acquisition requirements. Acquisition documents must specify the following:

(a) Title, number, and date of this specification.
(b) Type and number of mounts to be supplied (see 1.2).
(c) Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2).
(d) When a first article inspection is required (see 3.1).
(e) Type of material to be used in the manufacture of metal parts (see 3.2.1).
(f) Protective treatment, if different from that specified on NAVSEA drawing no. 803-5001002 (see 3.2.3).
(g) When fire-retardant requirements are not required (see 5.1.1(a) and (b)).
(h) Fiber box required (see 5.2.2).
(i) Levels of preservation and packing required (see 5.2 and 5.3).
(j) Container selection if other than contractors option (see 5.3.2).
(k) When caseliners are not required (see 5.3.2.1.1).
(l) Special marking required (see 5.4).

6.3 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Descriptions (DIDs) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DIDs are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DOD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

Reference Paragraph	DID Number	DID Title	Suggested Tailoring
4.3.1, 4.4.4	DI-NDTI-80809	Test, Inspection Reports	-------

The above DIDs were those cleared as of the date of this specification. The current issue of DOD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DIDs are cited on the DD Form 1423.

6.4 First article. When first article inspection is required, the contracting officer should provide specific guidance to offerors whether the item(s) should be a preproduction sample, a first article sample, a first production item, a sample selected from the first lot production items, a standard production item from the contractor's current inventory (see 3.1), and the number of items to be tested as specified in 4.3. The contracting officer should also include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results, and disposition of first articles. 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. Bidders should not submit alternate bids unless specifically requested to do so in the solicitation.

6.5 Definitions.

6.5.1 Axial direction. Tests specified in the axial direction shall be interpreted to mean in a direction which is parallel to the center bolt axis of the mount. When the mount is in service, the axial direction is normally the vertical direction.

6.6 Information on the techniques for manufacturing mounts. Information on the techniques for manufacturing the type 7M50, 6M150, 6M450, 6M900, and 5M3500 mounts (see 6.8) and recipes for rubber stock formulations is available (see 4.3) in the Department of the Navy and will be furnished upon request from prospective bidders.

6.7 Suggested formulations and application procedure for oil-resistant coating. Suggested formulations and application procedure for oil-resistant coating (see 6.8) shall be as specified in 6.7.1 and 6.7.2.

6.7.1 Suggested formulations. The formulations shown below should be blended together just prior to use. The viscosity of the blend should be adjusted to about 650 centipoises by using more or less methyl ethyl ketone in the formulations.

	A	B
Prefluxed blend of 70 percent nitrile rubber with 30 percent polyvinyl chloride	100	100
N330 carbon black	30	30
Stearic acid		
Zinc oxide	5	5
CPB (dibutyl xanthogen disulfide)	8	
DBA (dibenzyl amine)		8
Sulfur		4
Methyl ethyl ketone	656	674

6.7.2 Suggested procedure for application of coating to mounts. The sequence of operations shown below should be followed in order to obtain satisfactory performance from the coating:

(a) Remove rubber flash from component by trimming or buffing.
(b) Sandblast the component, brush off dust.
(c) Apply one brush coat of Thixon P-5 metal primer, or equivalent, to all metal surfaces, and allow to dry for at least 1 hour.
(d) Wash the rubber portion of the component with an aqueous solution of Vel detergent, or equivalent, and rinse with tap water.
(e) Chlorinate the rubber surfaces by immersing each component for 3 minutes in water saturated with chlorine.
(f) Rinse mount components with tap water and dry until all traces of water have evaporated.
(g) Blend the A solution with the B solution and let stand 1 hour to permit entrapped air to escape.

(h) Apply two coats (0.003 inch minimum dry film thickness) of the blended formulations to the entire component, including metal parts, by brushing, dipping or spraying.
(i) Determine the thickness of coating on the rubber element by measuring the thickness of the coated metal plate of the mount (see 4.6.9).
(j) Apply additional coats on the metal parts of the mount only to bring the minimum dry film thickness of the coating up to 0.006 inch (on the metal parts only).
(k) Allow all coats except the final coat to dry for at least 1 hour before subsequent coats are applied. Allow the final coat to dry for at least 4 days before handling the mount; alternatively, the final coat should be allowed to dry for at least 4 hours, and then the component placed in an oven at 130 ± 5°F for 16 hours to cure the coating.

6.8 Furnishing of information and formulations and procedures. The furnishing of information and the formulations and procedures (see 6.5 and 6.6) are solely for assistance in fabrication of the mounts for naval use. The use of this information does not constitute any agreement or obligation by the Department of the Navy to acquire mounts made of these formulas. Also, the use of this information does not guarantee compliance with this specification, nor will it relieve the contractor from having the mounts tested against the applicable test requirements of this specification. Furthermore, the Government does not guarantee that the mounts made using these formulations will conform to the requirements of this specification. Certain ingredients appear as proprietary names since these were the specific ones used in the development work. It is not intended to limit the choice of commercial sources for an ingredient, or to infer that one proprietary product is better than another.

6.9 Subject term (key word) listing.

Coating, oil ozone
Elastomers
Rubber
Snubber

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

Preparing activity:
Navy - SH
(Project 5340-N105)

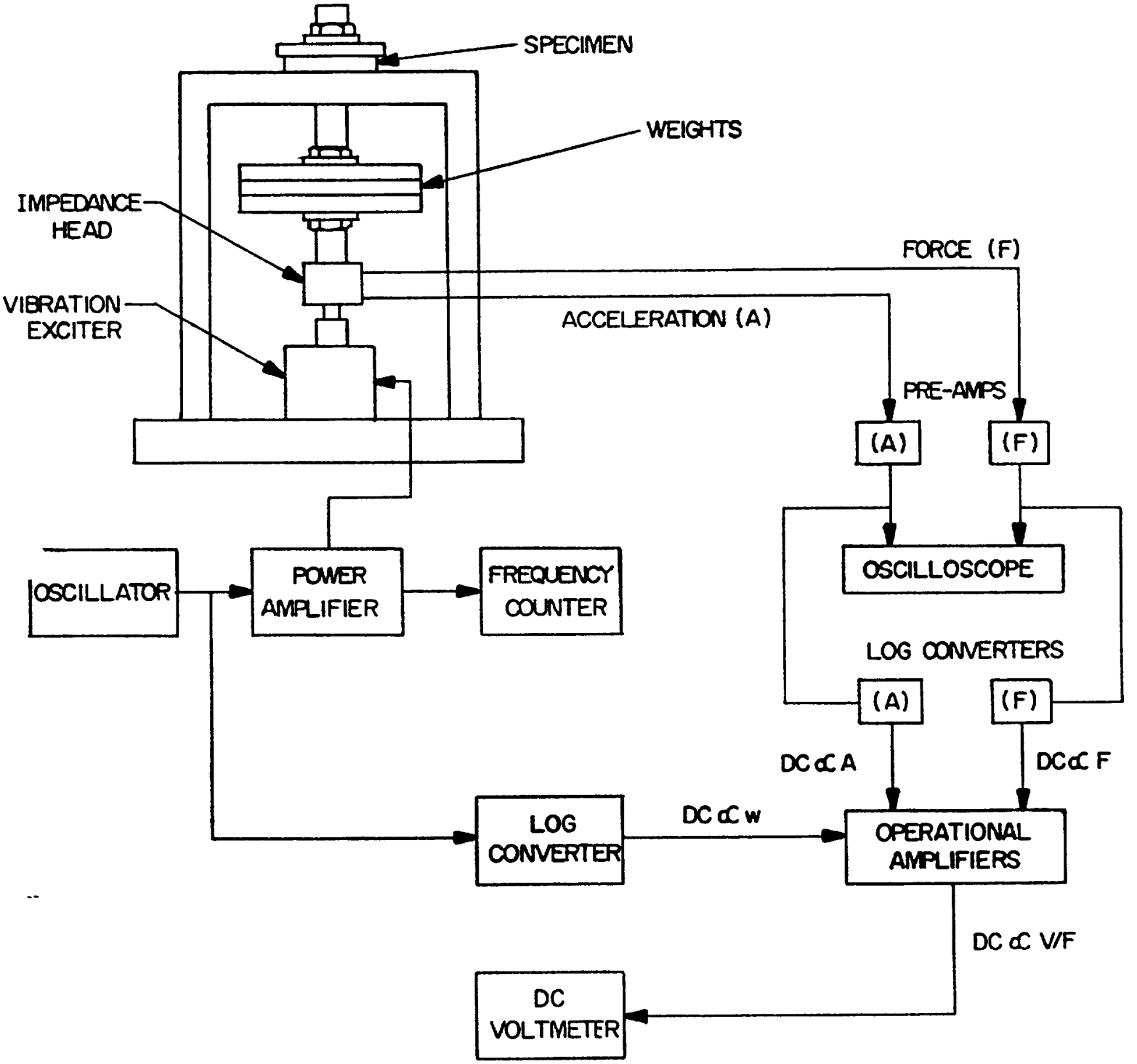

FIGURE 1. Typical system for measurement of resonant frequency by the suspended mass method.

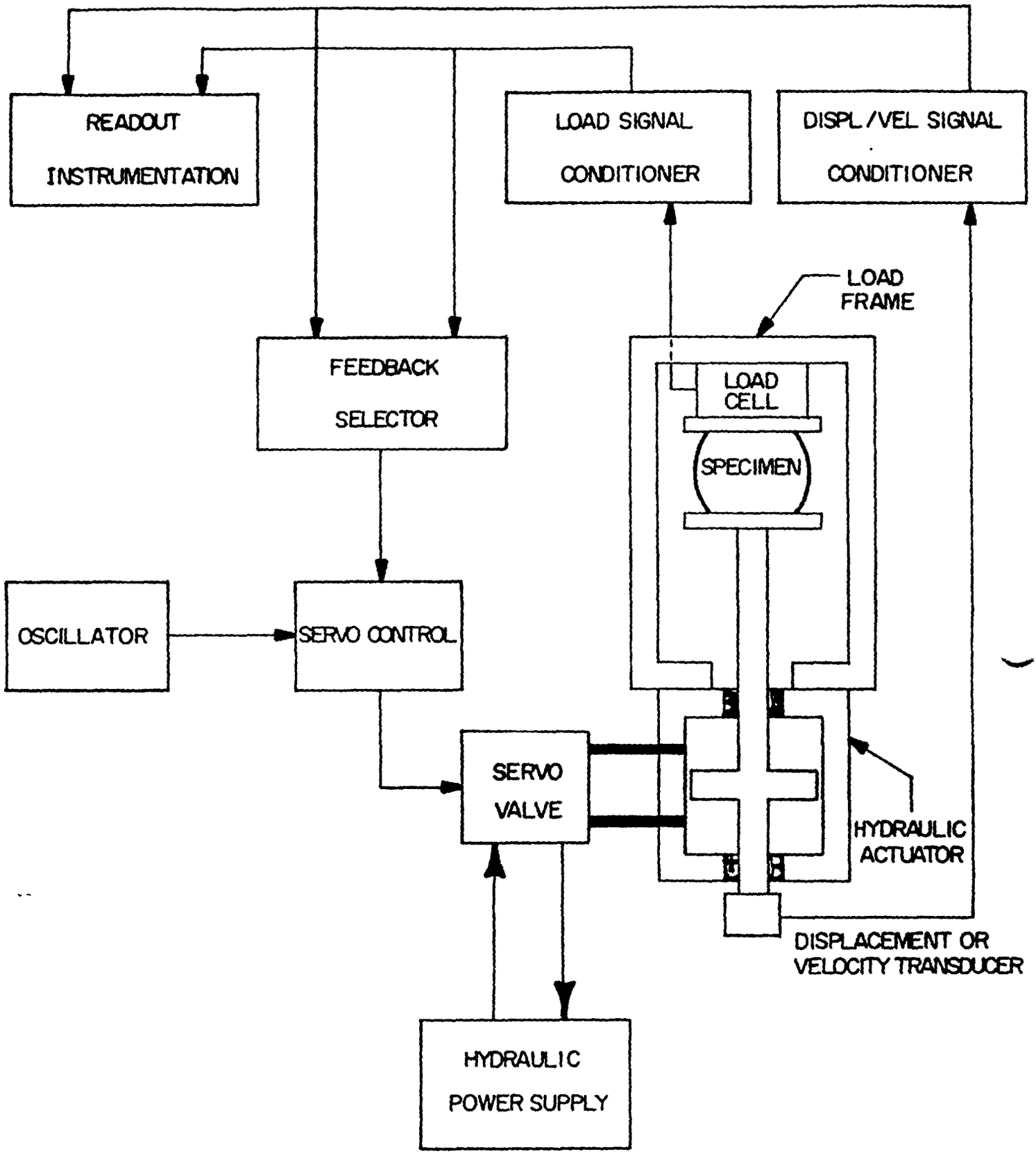

FIGURE 2. Schematic diagram of major components of electrohydraulic closed-loop test machine.

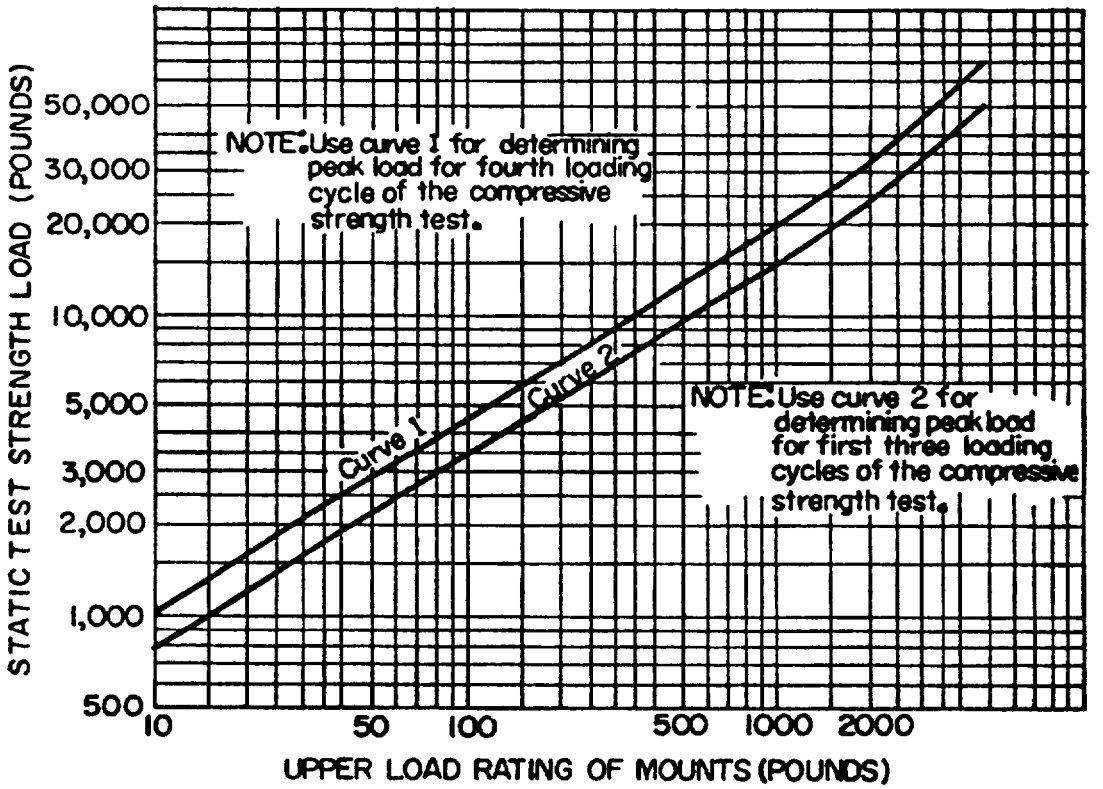

FIGURE 3. Minimum static test strength loads for resilient mountings.

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8 In block 1, both the document number and revision letter should be given
2. The submitter of this form must complete blocks 4, 5, 6, and 7
3. The preparing activity must provide a reply within 30 days from receipt of the form

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements

I RECOMMEND A CHANGE:	1 DOCUMENT NUMBER	2 DOCUMENT DATE (YYMMDD)
	MIL-M-24476B(SH)	93/09/09

3. DOCUMENT TITLE
MOUNTS, RESILIENT: PIPE SUPPORT, TYPES 7M50, 6M150, 6M450, 6M900, AND 5M3500

4 NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible Attach extra sheets as needed)

5 REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a NAME THE TECHNICAL POINT OF CONTACT (TOPC) Mr. Charles Stewart (03Y12D) PLEASE ADDRESS ALL CORRESPONDENCE TO:	b TELEPHONE (Include Area Code) (1) Commercial (703) 602-6963 (2) AUTOVON 8-332-6963
c ADDRESS (Include Zip Code) Commander, SEA 03Q42 Naval Sea Systems Command 2531 Jefferson Davis Hwy Arlington, VA 22242-5160	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340