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SUPERSEDING
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(See 6.11)

MILITARY SPECIFICATION

MOUNT, RESILIENT, TYPE 5M10,000-H

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 This specification covers the type 5M10,000-H resilient mount assembly consisting of three elements: a compression component, a shear component, and a snubber component. Tests are provided for evaluating the rubber compounds in the components and the components themselves. This mount assembly has an assigned load capacity of 5,000 to 10,000 pounds and shall support loads only in its axial direction.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

QQ-S-781 - Strapping, Steel and Seals.
PPP-T-97 - Tape, Packaging/Industrial, Filament Reinforced.
PPP-B-591 - Boxes, Shipping, Fiberboard, Wood-Cleated.
PPP-B-601 - Boxes, Wood, Cleated Plywood.
PPP-B-621 - Boxes, Wood, Nailed and Lock-Corner.
PPP-B-636 - Boxes, Shipping, Fiberboard.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

MILITARY

MIL-L-10547 - Liners, Case and Sheet, Overwrap; Water-Vaporproof or Waterproof, Flexible.

STANDARDS

MILITARY

MIL-STD-129 - Marking for Shipment and Storage.
MIL-STD-407 - Visual Inspection Guide for Rubber Molded Items.

2.1.2 Government drawing. The following Government drawing forms a part of this specification to the extent specified herein.

DRAWING

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

NAVSHIP 803-1385873 - Mount, Resilient; Type 5M10,000-H

(Copies of specifications, standards, and drawings, required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D 395 - Rubber Property - Compression Set, Standard Test Method for. (DoD adopted)
D 412 - Rubber Properties in Tension, Standard Test Method for. (DoD adopted)
D 429 - Rubber Property - Adhesion to Rigid Substrates, Standard Test Method for. (DoD adopted)
D 471 - Rubber Property - Effect of Liquids, Standard Test Method for. (DoD adopted)
D 573 - Rubber - Deterioration in an Air Oven, Standard Test Method for. (DoD adopted)
D 792 - Specific Gravity and Density of Plastics by Displacement, Standard Test Method for. (DoD adopted)
D 1149 - Rubber Deterioration - Surface Ozone Cracking in a Chamber (Flat Specimen), Standard Test Method for. (DoD adopted)
D 1186 - Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to a Ferrous Base, Method for. (DoD adopted)
D 1229 - Rubber Property - Compression Set at Low Temperatures, Standard Test Method for. (DoD adopted)
D 2240 - Rubber Property - Durometer Hardness, Standard Test Method for. (DoD adopted)
D 2632 - Rubber Property - Resilience (Vertical Rebound), Standard Test Method for.

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

UNIFORM CLASSIFICATION COMMITTEE AGENT
Uniform Freight Classification Ratings, Rules and Regulations

(Application for copies should be addressed to the Uniform Classification Committee Agent, Tariff Publication Officer, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Qualification. The mounts furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.3 and 6.3).

3.2 Materials.

3.2.1 Metal. The metal components of the mount shall be made of a material equivalent to that specified on the drawing for the mount. The contracting activity shall specify (see 6.2) whether the mount is to be manufactured from steel or manganese bronze, as shown on Drawing 803-1385873. The metal components for the mounts shall be formed to shape and shall be finished in accordance with the dimensions and allowable tolerances specified by the applicable drawing.

3.2.2 Rubber.

3.2.2.1 Resilient elements. The components of the 5M10,000-H mount assembly shall be molded to the specified form shown on Drawing 803-1385873. The load carrying resilient elements of the shear and compression components shall be molded from a compound using natural rubber (see 6.8 and 6.9) as the basic material. The natural rubber components shall be coated with an oil-ozone resistant compound (see 6.7 and 6.9). The rubber element of the snubber component shall be fabricated of an oil resistant compound (see 6.7 and 6.9) utilizing polymerized chloroprene or a copolymer product of butadiene and acrylonitrile as the basic material. Coating of the mounts may be accomplished by, but not limited to, dipping, painting, or spraying. BUNA-N components shall be coated with an oil-ozone resistant compound (see 6.7 and 6.9).

3.2.2.1.1 Porosity and delamination. The rubber elements in the components of the finished mount shall have no porosity or air pockets, nor delamination in any portion. The cut specimens obtained in 4.6.13 and 4.6.19 shall be examined for these defects.

3.2.2.1.2 Bond. The rubber elements shall be bonded to the metal components, as specified on Drawing 803-1385873.

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

3.2.2.1.4 Physical requirements.

3.2.2.1.4.1 Rubber compounds. The vulcanized rubber compounds used for the resilient elements of the shear, compression, and snubber components shall conform to the physical requirements specified in table I.

TABLE I. Physical requirements for rubber compounds in mount components.

	Rubber elements of shear and compression components	Rubber element of snubber	Test methods
Tensile strength (min), lb/in^2			
Before aging	2700	2400	4.6.2
After aging at 194°F for 46 hours	2300	2300	4.6.4
Elongation at break (min) percent			
Before aging	400	300	4.6.2
After aging at 194°F for 46 hours	400	250	4.6.4
Compression set (max) after aging at 194°F for 46 hours, percent	35	----	4.6.3.1
Cold compression set (max), percent	12	----	4.6.3.2
Volume change in oil (max), percent	----	5	4.6.5.1
Adhesion of rubber to metal (min) lb/in^2	600	450	4.6.6.1
Resilience (max), percent	----	40	4.6.12
Cut growth	No increase in length	----	4.6.13

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 qualification inspection of the contractor's mount and snubber compounds shall be recorded as a requirement with a tolerance of plus or minus 5 points for subsequent quality conformance testing of the contractor's mount and snubber 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 qualification inspection of the contractor's mount and snubber compounds shall be recorded as a requirement with a tolerance of plus or minus 0.01 for subsequent quality conformance testing of the contractor's mount compounds.

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

TABLE II. Physical requirements for oil-resistant coating.

Property	Requirement	Test
Properties of dried film		
Tensile strength, lb/in^2 (min)	2000	4.6.2
Elongation at break, percent (min)	400	4.6.2
Properties of coated test specimens		
Volume change percent (max), after immersion in oil at 158°F for 70 hours	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 p/m 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 free from blisters or other imperfections	4.4.3.1.2
Film thickness (min) 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, spray or other atmospheric conditions encountered in service. Unless otherwise specified (see 6.2), the minimum protective treatment shall be equivalent to that specified on Drawing 803-1385873.

3.3 Recovered materials. Unless otherwise specified herein, all equipment, material, and articles incorporated in the products covered by this specification shall be new and shall be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification unless otherwise specifically specified.

3.4 Requirements for finished mount.

3.4.1 Dynamic stiffness. The dynamic stiffness of individual compression and shear mounts when tested in the axial direction, in accordance with 4.6.14, shall be within the specified limits of table III.

TABLE III. Axial dynamic stiffness requirements for shear and compression mounts.

Mount	Test load, pounds	Dynamic stiffness requirement, lb/in
Shear	1600	2300 - 3500
Compression	8400	18000 - 26000

3.4.2 Deflection at rated load. Each shear and compression mount, when tested in accordance with 4.6.15, shall not deflect less than 0.55 inch or more than 0.78 inch, and shall not show any break or separation between component parts.

3.4.3 Quality of rubber to metal bond. Individual compression and shear mounts, when tested in accordance with 4.6.16, shall show no breaks, cracks, or tears in the rubber elements or evidence of delamination at rubber to metal to bond interfaces.

3.4.4 Strength. Individual compression and shear components when tested in the axial direction in accordance with 4.6.17.1, and shear components when tested in the radial direction in accordance with 4.6.17.2, shall not show any separation or break between the parts or any permanent deformation in excess of 1/32-inch. The snubber components, when tested in accordance with 4.6.17.3, shall have axial deflections within the range of 0.39 to 0.50 inch under 50,000 pounds load and axial deflections within the range of 0.50 to 0.63 inch under 150,000 pounds load.

3.4.5 Drift. The individual compression and shear mounts, when tested in accordance with 4.6.18, shall not drift more than 50 mils under their respective loads. When tested after the drift test, the dynamic stiffness of the mounts shall be within the specified limits of table III.

3.4.6 Porosity and delamination. The resilient elements of the mounts, when tested and examined in accordance with 4.6.19, shall not show evidence of porosity in the rubber elements nor separation of the rubber elements into distinct layers or laminations.

3.5 Identification. Each mount component shall be identified with the markings, specified on Drawing 803-1385873.

3.6 Mount design. The mount shall conform to all applicable details shown on Drawing 803-1385873.

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 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 assure supplies and services conform to prescribed requirements.

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

(a) Qualification inspection (see 4.3).
(b) Quality conformance inspection (see 4.4).

4.3 Qualification inspection. Qualification inspection shall be conducted at a laboratory satisfactory to NAVSEA (see 6.3) on sample units as specified herein.

4.3.1 Samples for qualification inspection.

4.3.1.1 Rubber samples. For the tests specified in 4.3.2, the prospective contractor shall provide the samples listed in table IV.

TABLE IV. Sampling for qualification.

Quantity	Type of rubber compound	Description of sample	Size of sample	Property to be measured
3	Shear and compression	Sheet	0.08 ± 0.010 x 6 x 6 inches	Tensile strength and ultimate elongation, (initial and aged). Specific gravity (initial)
3	Snubber	Sheet	0.08 ± 0.010 x 6 x 6 inches	Tensile strength and ultimate elongation, (initial and aged). Specific gravity (initial)
3	Shear and compression	Specimen covered with oil-resistant coating	0.08 ± 0.010 x 1 x 2 inches	Resistance to oil, volume change
3	Shear and compression	Specimen covered with oil-resistant coating	0.08 ± 0.010 x 1 x 6 inches	Ozone resistance adhesion and flexibility of coating
3	Shear and compression	ASTM D 429 Method A specimen	-----	Rubber-metal adhesion
3	Snubber	ASTM D 429 Method A specimen	-----	Rubber-metal adhesion
6	Shear and compression	Cylinder	0.5 ± .02 inch high x 1.14 ± 0.02 inches diameter	Compression set and hardness
3	Snubber	Cylinder	0.5 ± .02 inch high x 1.14 ± 0.02 inches diameter	Hardness and resilience
1	Oil-resistant coating	Sheet	0.006 ± 003 x 6 x 6 inches	Tensile strength and ultimate elongation
1	Shear and compression	Compression 1/ component cylinder sandwich 1/	1-3/8 high x 6-1/2 inches diameter	Cut growth

1/ The cut growth sample is made from compression component cylinders referred to in 4.3.3.4.

4.3.1.2 Mount samples. If the rubber samples listed in table IV meet the requirements herein, the prospective contractor shall then conduct the tests specified in 4.3.3 using four compression components and four shear components, including two snubbers and one additional compression component manufactured from the compounds represented by the rubber samples.

4.3.2 Qualification inspection on rubber samples.

4.3.2.1 Uncoated rubber samples. The uncoated rubber samples specified in 4.3.1.1 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
Compression set after oven aging (shear/compression stock only)	4.6.3.1
Cold compression set (shear/compression stock only)	4.6.3.2
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
Cut growth (shear/compression stock only)	4.6.13

4.3.2.2 Oil-ozone resistant coating. The oil-ozone resistant coating samples specified in 4.3.1.1 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

4.3.3 Qualification inspection on the finished mounts.

4.3.3.1 Two compression components and two shear components specified in 4.3.1.2 shall be subjected to the following examination and tests:

	Inspection paragraph
Examination	4.4.3.1
Dynamic stiffness	4.6.14
Deflection at rated load	4.6.15
Quality of rubber to metal bond	4.6.16
Strength, axial (compression/shear mounts)	4.6.17.1
Strength, radial (shear mounts only)	4.6.17.2
Film thickness of oil-ozone resistant coating	4.6.9

4.3.3.2 The remaining two compression components and two shear components specified in 4.3.1.2 shall be subjected to the following examination and tests:

	Inspection paragraph
Examination	4.4.3.1
Dynamic stiffness	4.6.14
Deflection at rated load	4.6.15
Quality of rubber to metal bond	4.6.16
Drift (of individual shear and compression components)	4.6.18
Porosity and delamination	4.6.19

4.3.3.3 The two snubber samples specified in 4.3.1.2 shall be subjected to the strength test in accordance with 4.6.17.3.

4.3.3.4 The additional compression component specified in 4.3.1.2 shall be used in preparing specimens for conducting the cut growth test specified in 4.6.13.

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. 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 packages and shipping containers (see 5.2.1.3).

4.4.2 Samples and tests for quality conformance inspection.

4.4.2.1 Rubber compound samples. Samples, as specified in table V, shall be provided from each batch of shear and compression component stock and snubber stock which is mixed for manufacture of the mount components 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 V. Rubber samples for quality conformance.

Quantity	Type of rubber compound	Description of sample	Size of sample	Property to be measured
2	Shear and compression	Sheet	0.08 ± 0.010 x 6 x 6 inches	Tensile strength, and ultimate elongation, and specific gravity
2	Snubber	Sheet	0.08 ± 0.010 x 6 x 6 inches	Tensile strength, ultimate elongation, and specific gravity
1	Shear and compression	Slab or disc	0.5 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, 4.6.3.1, 4.6.10 and 4.6.11.

4.4.2.3 Rejection. If any samples tested in accordance with 4.4.3.2 fail to meet the test requirements of table I, all mounts in the lot represented by the samples shall be rejected.

4.4.3 Quality conformance inspection on mounts.

4.4.3.1 Visual and dimensional examination.

4.4.3.1.1 Sampling for visual and dimensional examination. A random sample of mounts, consisting of an individual compression, shear or snubber component, shall be taken in accordance with table VI from each lot for visual and dimensional examination.

TABLE VI. Sampling for visual and dimensional examination.

Number of mounts in lot	Number of mounts in sample	Major defects		Major plus minor defects	
		Acceptance number	Rejection number	Acceptance number	Rejection number
90 and under	8	0	1	1	2
91 to 200	20	1	2	3	4
201 to 300	30	2	3	5	6

4.4.3.1.2 Procedure for visual and dimensional examination. Each of the mounts selected in accordance with table VI 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 VII.)

TABLE VII. Classification of defects.

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

4.4.3.1.3 Rejection. Any mount in the sample containing one or more major visual or dimensional defects 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 defects but shall not be rejected. If, in any sample, the number of defective mounts as defined above exceeds the acceptance number for that sample as specified in table VI, the lot represented by the sample shall be rejected.

4.4.3.2 Quality conformance tests on mounts.

4.4.3.2.1 Test to be performed on all mounts. Prior to sampling for quality conformance tests, all mounts in the lot shall be tested for deflection at rated load in accordance with 4.6.15. All mounts not meeting the requirements of 3.4.2 shall be removed from the lot and shall not be used for quality conformance testing.

4.4.3.2.2 Tests to be performed on sampling of mounts.

4.4.3.2.2.1 Sampling. A random sample of mounts consisting of an individual compression, shear, or snubber component, shall be taken from each lot in accordance with table VIII for the tests specified in table IX.

TABLE VIII. Sampling for tests.

Number of mounts in a lot		Number of mounts in a sample	Maximum number of failures for all tests combined	
			Acceptance number	Rejection number
3 to 15		3	0	1
16 to 20		4	0	1
21 to 25		5	0	1
26 to 90	First	8	0	2
	Second	8	1	2
91 to 150	First	13	0	3
	Second	13	2	3
151 to 280	First	20	1	5
	Second	20	4	5
281 to 300	First	32	2	7
	Second	32	6	7

4.4.3.2.2.1.1 Number of samples and failures permitted. For lots consisting of more than 25 mounts, a double sampling plan shall be used. If the number of failures found on the first sample does not exceed the acceptance number listed in table VIII, sampling shall be stopped and the lot shall be considered acceptable. If the number of failures found on the first sample is equal to or exceeds the reject number listed in table VIII, the lot shall be rejected and sampling shall be stopped. If the number of failures found on the first sample falls between the acceptance and rejection number, a second sample shall be selected. If the combined number of failures found in the first and second sample do not exceed the second acceptance number, the lot shall be considered acceptable. If the combined number of failures equals or exceeds the second rejection number, the lot shall be rejected.

4.4.3.2.2.2 Tests to be performed. Each of the samples selected in accordance with 4.4.3.2.2.1 shall be subjected to the tests specified in table IX.

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

Test (Listed in sequence of performance)	Mount component(s)	Paragraph
Thickness of oil-resistant film	Compression	4.6.9
Dynamic stiffness	Shear and compression	4.6.14
Quality of rubber to metal bond	Shear and compression	4.6.16

4.4.3.2.2.3 Action in case of conformance. Every mount that passes the requirements for quality conformance tests shall be returned to the lot. The lot shall be considered acceptable if the number of failures does not exceed the applicable acceptance number for all tests combined (see table VIII).

4.4.3.2.2.4 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. Subsequent lots shall be judged acceptable or unacceptable only on the basis of both first and second samples of the double sampling plan shown in table VIII. 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.

4.5 Confirmation of quality. When deemed necessary by NAVSEA or the inspector, samples of the mounts shall be taken from the contractor and forwarded to a laboratory satisfactory to NAVSEA. These samples shall be subjected to any test considered necessary by NAVSEA to determine that the samples are equal to the samples upon which qualification was based. If an unsatisfactory test result is obtained, the laboratory shall immediately notify NAVSEA.

4.6 Method of tests.

4.6.1 Standard test conditions. All tests shall be made within an ambient temperature range of 65 to 80 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 compression, shear, 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 Compression set.

4.6.3.1 Compression set after aging. Compression set shall be determined in accordance with ASTM D 395 method B, except oven aging conditions shall be 194 ± 2°F for 46 ± 1/4-hours.

4.6.3.2 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-hour. 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.

4.6.5.1 Volume change in oil (snubber compound). Volume change shall be determined in accordance with ASTM D 471. 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 sample). Volume change in oil shall be determined in accordance with ASTM D 471 except the three coated 0.08 by 1 by 2 inch specimens shall be as described in table IV and the immersion period shall be 70 ± 1/4-hours at 158 ± 2°F. The specimen shall be immersed in reference oil no. 3 of ASTM D 471.

4.6.6 Adhesion tests.

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 (compression and shear and snubber) shall be tested and the results averaged for each compound.

4.6.6.2 Adhesion of coating (coated sample). The adhesion of the oil resistant coating to three .08 by 1 by 2 inch samples of the compression and shear rubber stock (see table IV) 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 IV). The specimens shall be elongated to 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 ± 4°F before being exposed, in accordance with ASTM D 1149. The concentration of ozone shall be 100 ± 10 p/m by volume, the temperature shall be 104 ± 4°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 0.080 inch resilient element rubber specimens specified in table IV 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 compression component using a micrometer for conformance with the requirement in table II. The thickness of the steel plate shall be determined before and after coating. 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 gage in accordance with ASTM D 1186.

4.6.10 Hardness. The hardness of the 0.50 inch thick specimens representing the rubber components of the mounts and snubber 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 compression, shear, and snubber components 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 test. The resilience of the 0.50 inch thick specimens 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 Cut-growth test.

4.6.13.1 Test specimen. The test specimen shall be one of the three rubber steel sandwiches of the compression component consisting of the rubber element and the two steel plates to which it is bonded.

4.6.13.2 Apparatus. The test apparatus shall consist of two 10 by 10 by 1 inch steel plates, bolted together through steel tube spacers as shown on figure 1. The length of the spacers shall be equal to 80 percent of the thickness of the rubber element of the specimen plus the thickness of the two mount plates.

4.6.13.3 Procedure.

4.6.13.3.1 Preparation of specimen. The test specimen shall be inserted between the plates of the test apparatus, and the bolts tightened to pull the steel plates against the spacers. Six horizontal cuts, about 1/4 inch long and 1/8 inch deep, shall be made at 60 degree intervals around the rubber element, parallel to the mount plates and midway between them as shown on figure 1. A line shall be drawn at the end of each cut and perpendicular to it so that any growth of the cut during the test will be apparent.

4.6.13.3.2 Oven curing of specimen. The test assembly shall be placed in an oven maintained at 200 $\pm$ 2°F. The test assembly shall be removed from the oven after 16 hours, and the cuts examined for increase in length.

4.6.14 Dynamic stiffness test. Dynamic stiffness shall be measured individually for each compression mount and shear mount in the axial direction at loads of 8400 and 1600 pounds, respectively, to determine conformance with 3.4.1. 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 in 4.6.14.1 and 4.6.14.2.

4.6.14.1 Resonant methods. A suitable arrangement for performing this test and the associated electronic circuitry is shown on figure 2. 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 2 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 resonant frequency of the system the mobility ratio will be a maximum. In lieu of using an 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 resonant 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:

$$K_d = 0.102 f^2 W$$

Where: K_d = dynamic stiffness, lb/in
f = resonance frequency, H_z
W = supported weight, pounds

4.6.14.2 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 sinusoidal compressive force as shown on figure 3. 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:

$$F = K_d x + C\dot{x}$$

where: F = F(t) sinusoidal transmitted force, lbf
K_d = Dynamic stiffness, lb/in
C = damping coefficient, lb-sec/in
x = x(t), displacement, in
$\dot{x}$ = dx/dt, in/sec

4.6.14.3 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. When qualifying, the contractor shall include a detailed description of the test equipment and procedure used to determine the dynamic spring rates of the shear and compression mounts. The Government reserves the right to perform dynamic stiffness tests on mounts offered for qualification.

4.6.15 Test for deflection at rated load. A universal type testing machine shall be used. Each shear component and each compression component shall be tested separately. Each component shall be subjected to a single loading cycle in the axial direction. The loadings 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 rated loads are 8400 pounds for the compression component and 1600 pounds for the shear component. The deflection of the upper rated load shall be recorded to determine conformance with 3.4.2.

4.6.16 Quality of the rubber to metal bond. The load on the mounts tested, as specified in 4.6.15, 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 3.4.3.

4.6.17 Strength tests. A universal type testing machine shall be employed to conduct strength tests on mounts. The testing machine shall load the mount at a constant rate of deflection.

4.6.17.1 Tests on shear and compression components in the axial direction. Each shear and compression mount shall be individually subjected to four loading and unloading cycles in the axial direction to three times its respective rated load. The loadings shall be conducted at a rate not to exceed 0.5 inch per minute. The deflection of each respective rated load shall be noted (see 4.6.17.2) during the fourth cycle. The mount components shall be examined during and after testing for any break or separation between rubber and metal parts of deformation of the metal parts.

4.6.17.2 Test on the shear components in the radial direction. Load deflection tests in the radial direction shall be conducted only on the shear components in an assembly similar to that shown on figure 4. The shear components shall be compressed axially to that amount which the upper load rating of the mount deflected these components during the static load deflection test in the axial direction (see 4.6.17.1). This compression is obtained by adjusting the nuts on the four bolts, which changes the distance between the brackets and plane of the loading plate. After assembly, the shear components shall be

loaded radially through four loading and unloading cycles to 30,000 pounds. The four cycles shall be at a rate not exceeding 0.5 inch per minute. The mount components shall be examined during and after testing for any break, separation between component parts, or deformation of the metal parts.

4.6.17.3 Tests on the snubber component in the axial direction. The snubber component shall be arranged in a manner similar to that shown on figure 5 and subjected to four loading and unloading cycles in the axial direction, each to 150,000 pounds. The cycles shall be conducted at a rate not exceeding 0.5 inch per minute. The deflections obtained at 50,000 pound load and at 150,000 pound load on the fourth loading cycle shall meet the requirements of 3.4.4.

4.6.18 Drift test of individual shear and compression mounts. The compression and the shear components previously tested for dynamic stiffness shall be tested individually for drift. Loads of 8400 and 1600 pounds shall be applied to the individual compression and shear mount, respectively, in the axial direction. The height of each component shall be measured to the nearest 0.001 inch 1 hour after application of the load and again after 14 days. The difference in the two readings in mils shall be taken as the drift of the mount. At the end of the 14 days, the dynamic stiffness in the axial direction shall be determined while each mount is supporting its rated load.

4.6.19 Porosity and delamination. The shear component used for the resonant frequency test and a snubber component shall be cut into two parts along a vertical plane through the center of the component. The cut surfaces of these components shall be carefully examined for porosity. The parts shall be immersed in toluol (technical grade toluene) 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 packages and packs, and the inspection of the preservation-packaging, packing and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PACKAGING

(The preparation for delivery requirements specified herein apply only for direct Government acquisition. For the extent of applicability of the preparation for delivery requirements of referenced documents listed in section 2, see 6.10.)

5.1 Domestic shipment and early equipment use.

5.1.1 Preservation and packaging. Preservation and packaging, which may be the contractor's commercial practice, shall be sufficient to afford adequate protection against corrosion, deterioration, and physical damage during shipment from the supply source to the using activity and until early use.

5.1.2 Packing. Packing shall be accomplished in a manner which will ensure acceptance by common carrier and will afford protection against physical or mechanical damage during direct shipment from the supply source to the using activity for early installation. The shipping containers or methods of packing shall conform to the Uniform Freight Classification Rules and Regulations or other carrier regulations, as applicable to the mode of transportation.

5.1.3 Marking. Shipment marking information shall be provided on interior packages and exterior shipping containers in accordance with the contractor's commercial practice. The information shall include nomenclature, Federal stock number or manufacturer's part number, contract or order number, contractor's name, and destination.

5.2 Domestic shipment and storage or overseas shipment. The requirements and levels of preservation, packaging, packing, and marking for shipment shall be specified by the contracting activity (see 6.2).

5.2.1 The following provides various levels of protection during domestic shipment and storage or overseas shipment, which may be required when acquisition is made.

5.2.1.2 Packing.

5.2.1.2.1 Level A. The mounts packaged in accordance with level A or C, as specified (see 6.2), shall be packed in snug fitting, wood cleated fiberboard; overseas type wood cleated-plywood; nailed wood; or fiberboard boxes conforming to PPP-B-591, PPP-B-621, or PPP-B-636 (class 3), respectively. Boxes shall be lined with a sealed, waterproof caseliner conforming to MIL-L-10547. Shipping containers shall be closed and strapped in accordance with the appendix of the applicable container specification, except fiberboard boxes shall be banded with tape conforming to type III of PPP-T-97. Flat steel strapping shall be in accordance with QQ-S-781. The gross weight of wood boxes shall not exceed 200 pounds. Caseliners will not be required when the mounts and snubbers are packaged in fiberboard boxes conforming to PPP-B-636 (class 2 or 3) and appendix A thereto.

5.2.1.2.2 Level B. The mounts packaged, in accordance with level A or C (see 6.2), shall be packed in snug fitting, wood cleated fiberboard; cleated plywood; nailed wood; corrugated or solid fiberboard boxes conforming to PPP-B-591, PPP-B-601, PPP-B-621, or PPP-B-636 (class 2), respectively. The gross weight of wood boxes shall not exceed 200 pounds.

5.2.1.2.3 Level C. The mounts packaged in accordance with level A or C, as specified (see 6.2), shall be packed in a manner to ensure acceptance and safe delivery at destination. Containers shall comply with the Uniform Freight Classification Rules or other regulations, as applicable to the mode of transportation.

5.2.1.3 Marking.

5.2.1.3.1 Packages. In addition to the marking specified in MIL-STD-129, each package shall be plainly marked in black waterproof ink with the following information completed:

MOUNT IDENTIFICATION _____
MILITARY SPEC. NO. _____
DATE OF MFG. _____
LOT NO(s). _____

5.2.1.3.2 Shipping containers. In addition to the marking specified in MIL-STD-129, shipping containers shall be marked in black waterproof ink on two adjacent sides with the following information completed:

MOUNT IDENTIFICATION _____
MILITARY SPEC. NO. _____
DATE OF MFG. _____
LOT NO(s). _____

6. NOTES

6.1 Intended use. The mount assembly covered in this specification is intended for noise and vibration attenuation. The mount is primarily for use in submarines, and where applicable in surface ships.

6.2 Ordering data. Acquisition documents should specify the following:

(a) Title, number, and date of this specification.
(b) Type of material to be used in the manufacture of metal parts (see 3.2.1).
(c) Protective treatment, if different from that specified on NAVSEA Drawing 803-1385873 (see 3.2.3).
(d) Preservation, packaging, packing, or marking requirements other than those required by 5.1 (see 5.2).

6.3 With respect to products requiring qualification, awards will be made only for products which are, at the time set for opening of bids, qualified for inclusion in Qualified Products List QPL-21649 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 purchase orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362 and information pertaining to qualification of products may be obtained from that activity. Application for Qualification tests shall be made in accordance with "Provisions Governing Qualification SD-6" (see 6.3.1).

6.3.1 Copies of "Provisions Governing Qualification SD-6" may be obtained upon application to Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

6.4 Definitions.

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

6.4.2 Radial direction. Tests specified in the radial direction shall be interpreted to mean a direction perpendicular to the bolt axis of the assembled mount. When the mount is in service, the radial direction is normally the horizontal direction.

6.5 The compression, shear, and snubber components of this mount assembly are not intended to be used separately. All three components are required for shipboard installation unless otherwise specified.

6.6 Information on the technique for manufacturing mount (see 6.9). Information on the technique for manufacturing the type 5M10,000-H mount is available 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 (see 6.9).

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	1	1
Zinc oxide	5	5
CPB (Dibutyl vanthogen disulfide)	8	
DBA (dibenzyl amine)		8
Sulfur		4
Methyl ethyl ketone	656	674

6.7.2 Suggested procedure for application of coating to shear and compression components. 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 of the blended formulations to the entire component, including metal parts, by brushing or dipping.
(i) Allow the first coat to dry for at least 1 hour and the second coat to dry for at least 4 days before handling the mount; alternatively, the second 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 Formulations of rubber stocks (see 6.9). The following are suggested formulations of rubber stocks for the 5M10,000-H mount:

Shear and compression components

Smoked sheet	100
N990 carbon black	15
Stearic acid	1
Zinc oxide	5
Octamine	1
Altax	1
Unads	0.4
Sulfur	1.5
Sulfasan R	0.5
	125.4

Snubber component

Hycar 1041	100
N770 black	75
Stearic acid	1
Zinc oxide	5
Durex resin 12687	15
Cumar P-10	30
Retarder W	0.5
Altax	1.5
Sulfur	1.5
	229.5

Bonding cement for snubber component

Durez resin 12987	100
Methyl ethyl ketone	150
Methanol	150
	400

Suitable bonding cements for adhering the shear and compression components to steel is Chemlok 250, sold by Hughson Chemical Company Corporation, P.O. Box 68, Washington, WV 26181.

6.9 The furnishing of information (see 6.6) and the formulations and procedures (see 6.7 and 6.8) are solely for assistance in fabrication of the 5M10,000-H mount 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 source for an ingredient, or inferred that one proprietary product is better than another.

6.10 Sub-contracted material and parts. The preparation for delivery requirements of referenced documents listed in section 2 do not apply when material and parts are acquired by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.11 Changes from previous issue. Asterisks 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-N077)

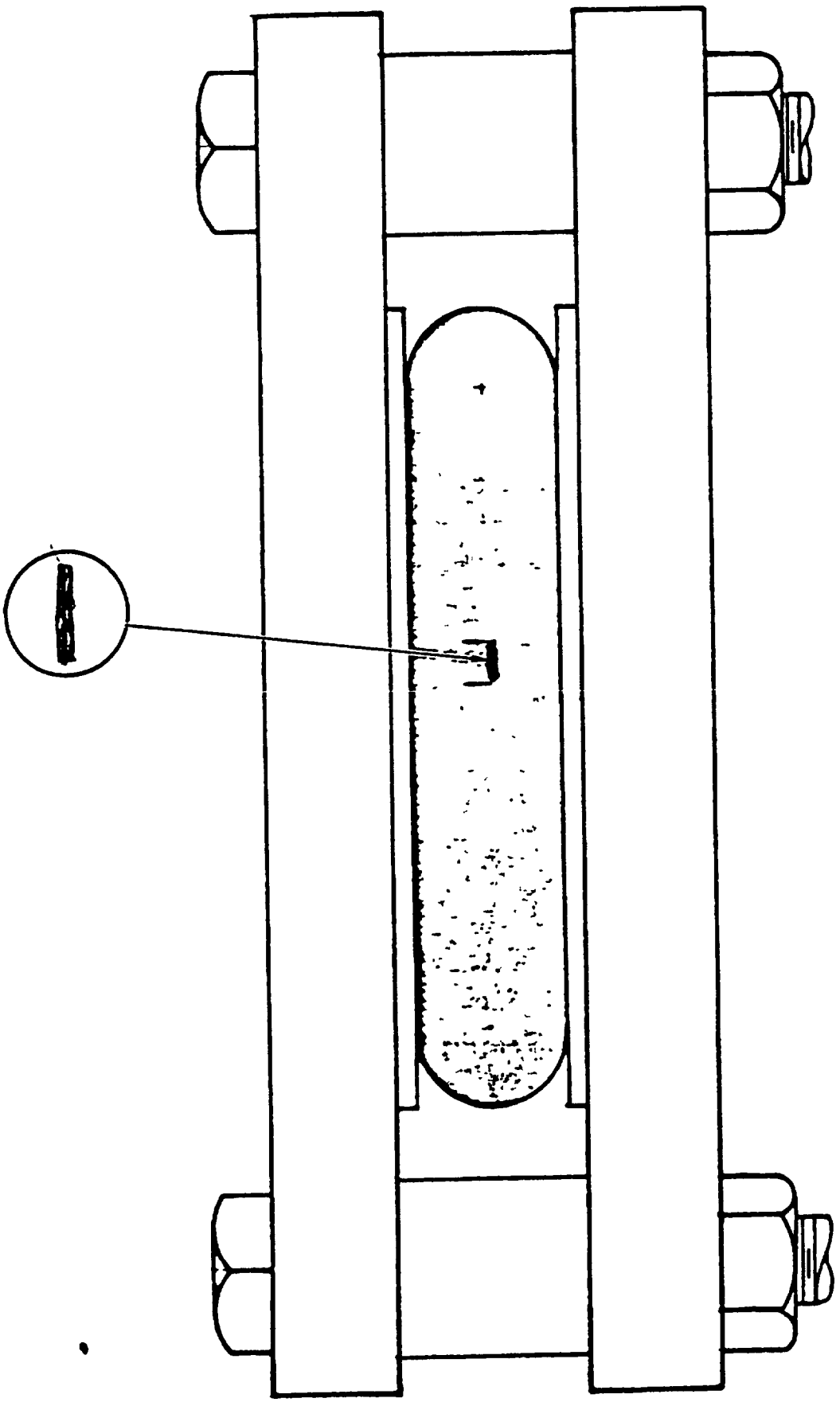
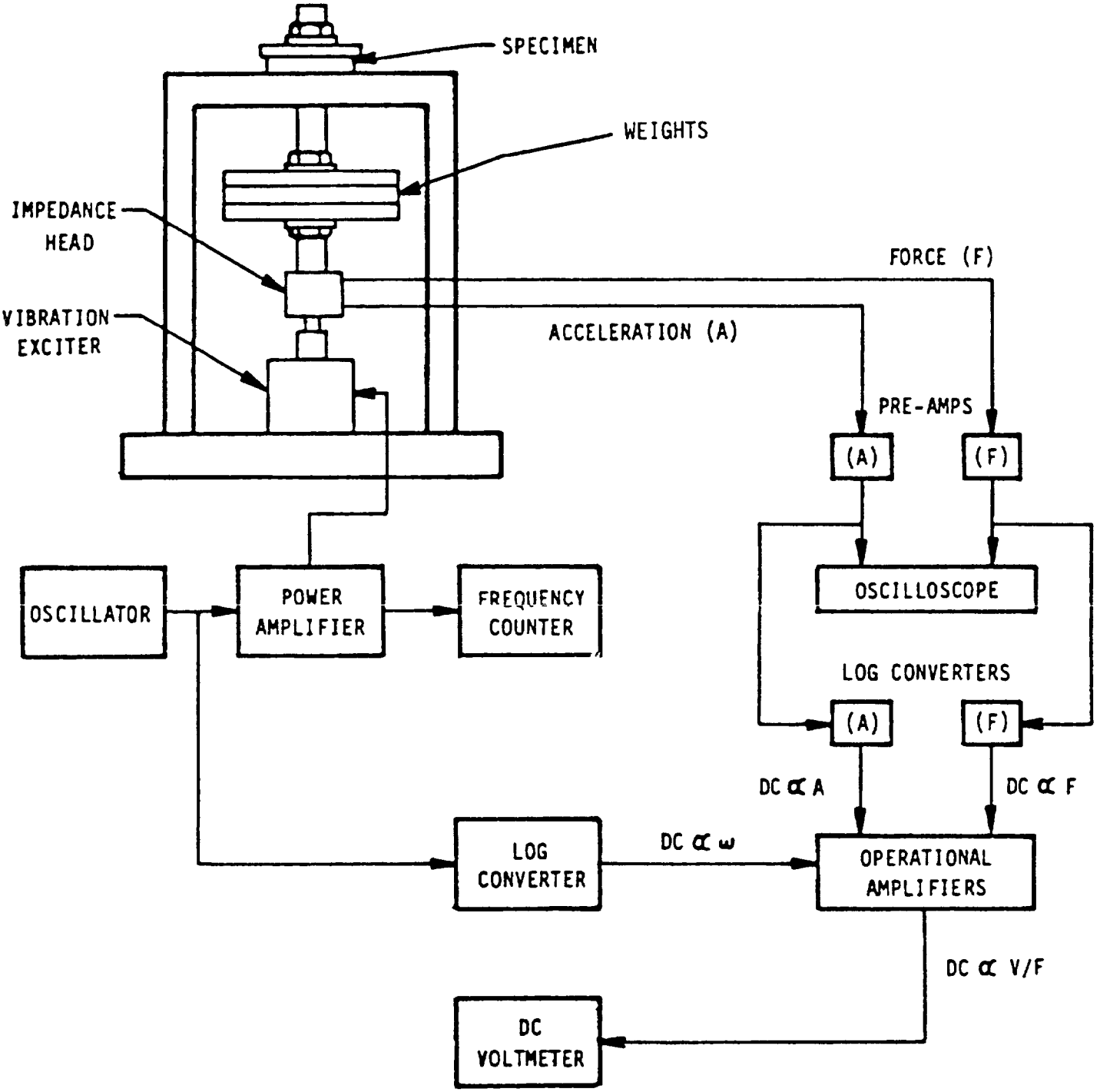


FIGURE 1. Compression sandwich of 5M10,000-H mount compressed in cut growth test apparatus.

SH 12095



SH 12096

FIGURE 2. Typical system for measurement of resonant frequency by the suspended mass method.

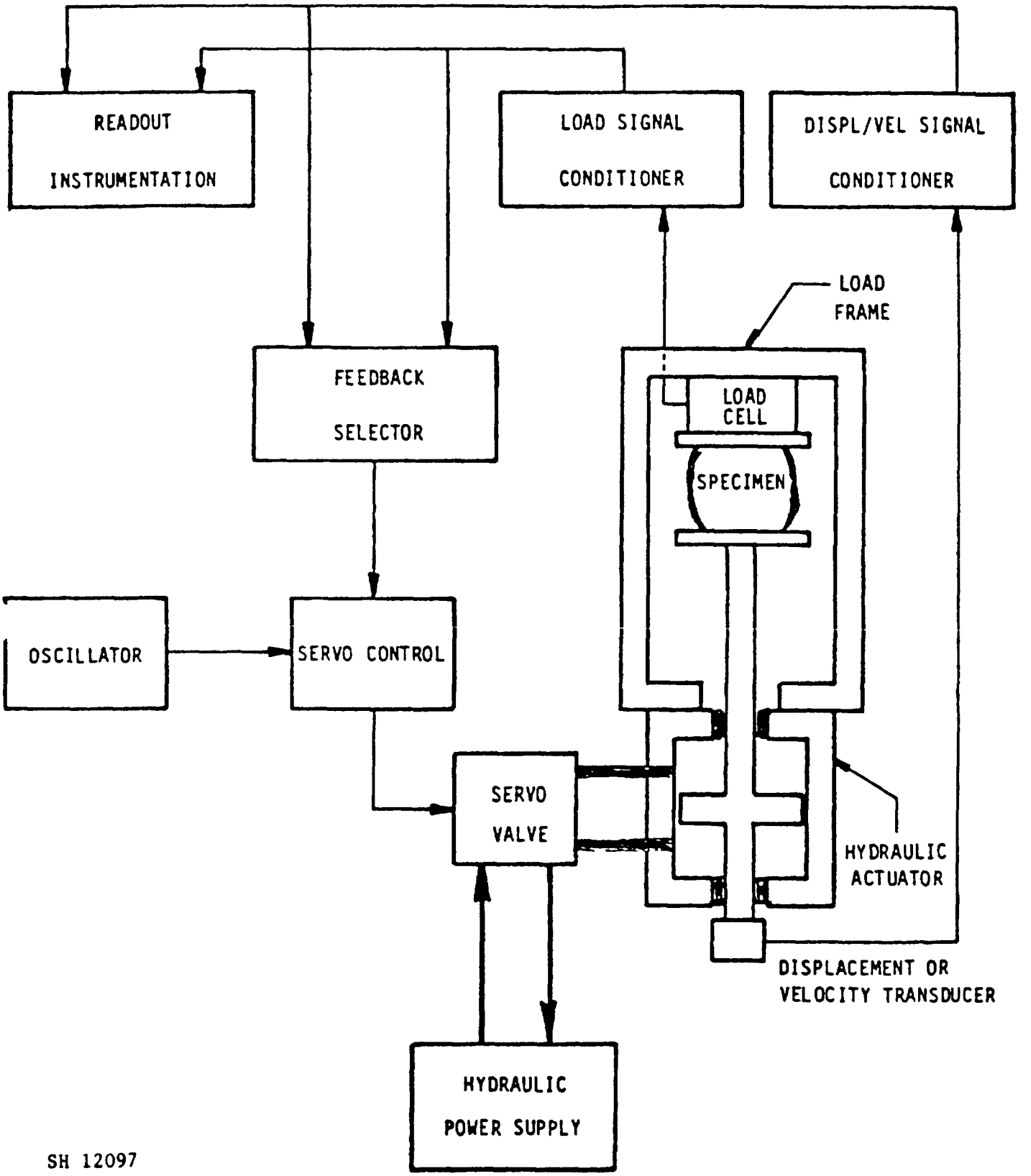
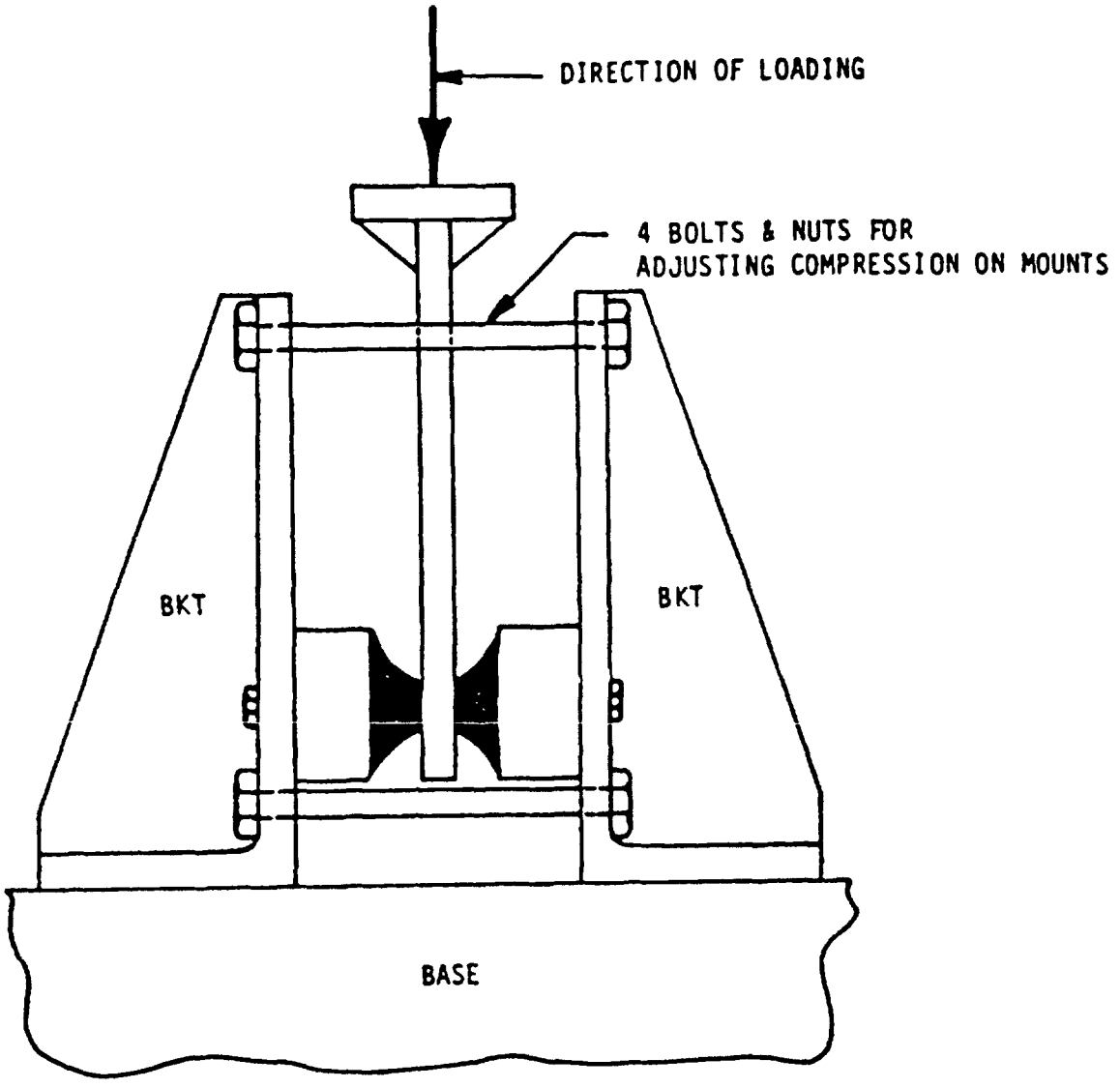
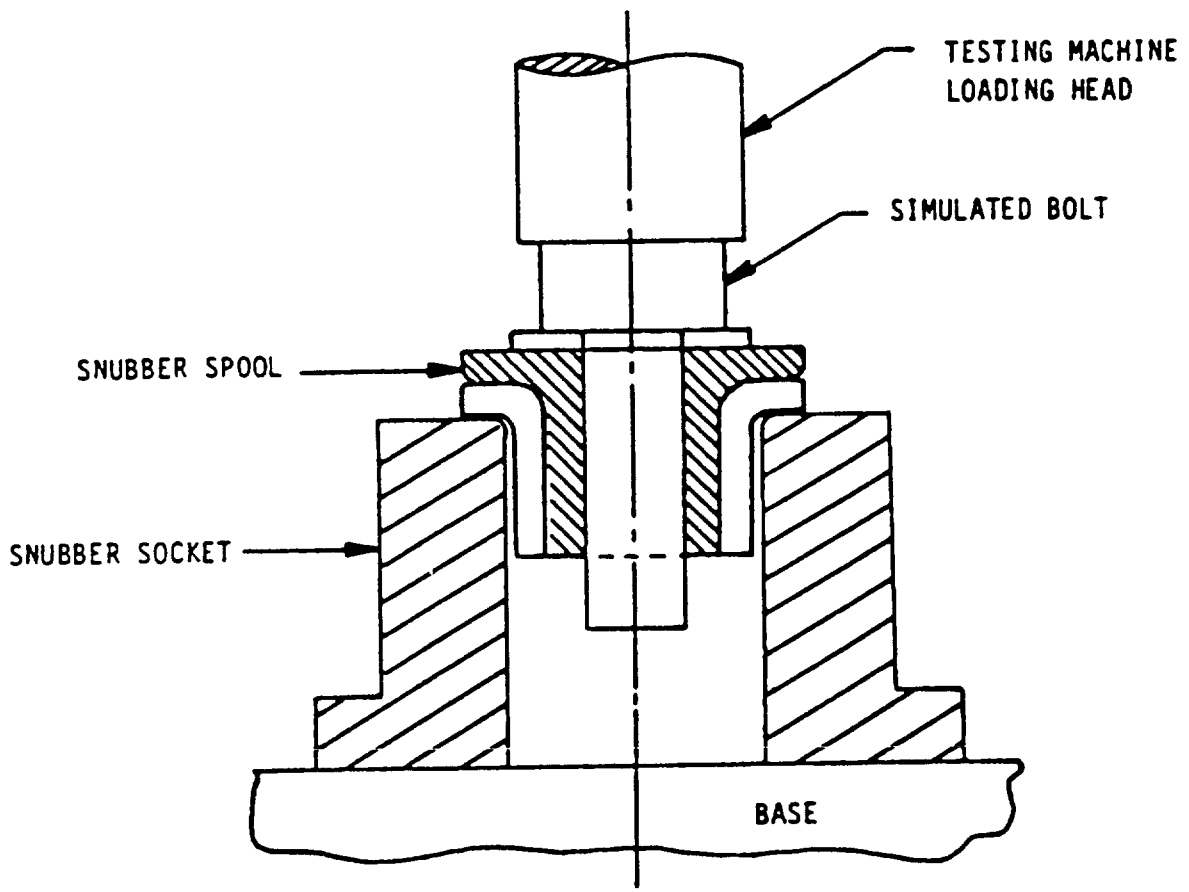


FIGURE 3. Schematic diagram of major components of electrohydraulic closed-loop test machine.



SH 4293

FIGURE 4. Arrangement for conducting load-deflection test on shear components in the radial direction.



SH 4291

FIGURE 5. Arrangement for conducting static load deflection tests on snubber in the axial direction.

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-M-21649C(SH)	MOUNT, RESILIENT, TYPE 5M10,000-H

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
	☐ USER
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ MANUFACTURER
	☐ OTHER *(Specify)* _____

5. PROBLEM AREAS

a. Paragraph Number and Wording.

b. Recommended Wording

c. Reason/Rationale for Recommendation

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

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NOTICE OF VALIDATION

MIL-M-21649C(SH)
NOTICE 1
27 March 1991

MILITARY SPECIFICATION

MOUNT, RESILIENT, TYPE 5M10,000-H

MIL-M-21649C(SH), dated 27 April 1983, has been reviewed and determined to be valid for use in acquisition.

Preparing activity:
Navy - SH

AMSC N/A

FSC 5340

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