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MILITARY SPECIFICATION

MOUNTS, RESILIENT; GENERAL SPECIFICATIONS AND TESTS FOR (SHIPBOARD APPLICATION)

1. SCOPE

1.1 This specification covers general design and performance requirements as well as specific tests for determining the suitability and performance characteristics of resilient mounts for use on Naval vessels. This specification is intended:

(a) To provide testing procedures for obtaining performance data on resilient mounts that will be useful to Naval and equipment designers in the proper selection and application of mounts. This performance data is required to determine if compatibility can be made to exist with the characteristics of the equipment to be mounted and other limitations governing shipboard mounting installations.
(b) To determine the suitability of mounts for Naval use with respect to minimum strength requirements.
(c) To provide a specification containing quality assurance provisions for procurement of mounts should tests and performance characteristics indicate them suitable for application to specific items of shipboard equipment.

This specification does not cover methods for section and application of resilient mounts to items of shipboard equipment.

2. APPLICABLE DOCUMENTS

2.1 The following specifications, standards, drawings and publications, of the issue in effect on date of invitation for bids, form a part of this specification:

SPECIFICATIONS

FEDERAL
NN-B-591 - Boxes, Fiberboard, Wood-Cleated (for Domestic Shipment).
NN-B-621 - Boxes, Wood, Nailed and Lock-Corner.
QQ-M-151 - Metals; General Specification for Inspection of.
LLL-B-631 - Boxes; Fiber Corrugated (for Domestic Shipment).
LLL-B-636 - Boxes; Fiber, Solid, (for Domestic Shipment).
PPP-B-585 - Boxes, Wood, Wirebound.
PPP-B-601 - Boxes, Wood, Cleated-Plywood.

MILITARY
JAN-P-103 - Packaging and Packing for Overseas Shipment - Boxes; Wood Cleated; Solid Fiberboard.
JAN-P-100 - Packaging and Packing for Overseas Shipment - Boxes; Wood, Nailed.
JAN-P-108 - Packaging and Packing for Overseas Shipment - Boxes, Fiberboard (V-Board and W-Board), Exterior and Interior.
MIL-P-116 - Preservation, Methods of.

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MILITARY (cont'd.)
MIL-S-901 - Shockproof Equipment, Class HI (High-Impact), Shipboard Application.
MIL-I-983 - Interior Communication Equipment; Basic Design Requirements for.
MIL-B-10377 - Boxes: Wood-Cleated, Veneer, Paper Overlaid.
MIL-L-10547 - Liners, Case, Waterproof.
MIL-E-16400 - Electronic Equipment, Naval Ship and Shore: General Specification.

NAVY DEPARTMENT
General Specifications for Inspection of Material.

STANDARDS

FEDERAL
FED-STD-791 - Lubricants, Liquid Fuels, and Related Products; Methods of Testing.

MILITARY
MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129 - Marking for Shipment and Storage.

DRAWINGS

BUREAU OF SHIPS
S9102-129997 - Shock Mount Test Apparatus for Lightweight HI Shock Machine.
S9102-129998 - Shock Mount Test Apparatus for Medium Weight HI Shock Machine.

PUBLICATIONS

BUREAU OF SHIPS
NAVSHIPS-250-357-1 - Conditions Governing Tests in Naval Laboratories.

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

2.2 Other publications. - The following document forms a part of this specification. Unless otherwise indicated the issue in effect on date of invitation for bids shall apply.

CONSOLIDATED CLASSIFICATION COMMITTEE
Consolidated Freight Classification Rules.

(Application for copies should be addressed to the Consolidated Classification Committee, 202 Chicago Union Station, Chicago 6, Ill.)

3. REQUIREMENTS

3.1 Where provisions of this specification conflict with the test procedures of the individual specifications for equipment employing mounts, the latter should take precedence. Detail requirements for materials, design and performance of a particular mount shall be as specified in the detail specification, drawing or contract or order (see 4.3 and 6.1).

3.2 Definitions. - Definitions shall be as follows:

3.2.1 Resilient mounts. - A resilient mount is defined as an item made of materials having elastics properties. It is designed to isolate shock, noise, or vibration or both of a continuous or intermittent origin and to serve as a support for the item to be isolated.

3.2.2 Equivalent static acceleration. - Equivalent static acceleration is defined as the multiple of the acceleration due to gravity (g's) which will produce the same total deflection of a reed in a reed-gage as would be obtained under acceleration due to shock (see appendix of this specification).

3.2.3 Shock acceleration spectrum. - A shock acceleration spectrum is defined as the equivalent static accelerations which are experienced by single degree-of-freedom systems, having various frequencies, when subjected to a shock motion. The spectrum is a curve of equivalent static accelerations plotted against natural frequencies as would be obtained from reed-gages. The appendix of this specification illustrates the derivation of shock spectra from reed-gage data.

3.3 Material. -

3.3.1 Component parts of mounts. - The component parts of mounts shall be sturdily constructed of material of the lightest practicable weight consistent with strength required for serviceability, safety, and reliability. The acceptance or approval of any constituent material or design by the bureau or agency concerned shall not, prior to evaluation tests, be construed as a guaranty or the acceptance of the finished mount.

3.3.2 Protection against corrosion. - Materials used in the construction of mounts shall be resistant to, or protected against, corrosion by salt water or spray or other atmospheric conditions encountered in service. Where dissimilar metals are used in intimate contact with each other, provisions shall be made to provide protection against electrolysis and corrosion. As a qualitative guide to what may be expected when different metals and alloys are combined in seawater refer to "Seawater Corrosion of Galvanic Couples" of Specification MIL-I-983. The latter specification as well as Specification MIL-E-16400 also specifies certain corrosion-resisting treatment of metal surfaces. Such corrosion-resisting treatments have been used with satisfactory results but do not limit the mount manufacturer to their use alone. Other corrosion-resisting treatments will be satisfactory, provided the mounts meet the requirements of the salt spray test specified in 4.7.7.4.

3.4 Design. -

3.4.1 Captive features. - All mounts shall have incorporated in their design "captive features" which, will prevent the mounted equipment or load from becoming free in case of failure of the resilient element due to high impact shock or normal service conditions.(see 3.5.4). Mounts not possessing such features will not be considered for tests under this specification.

3.4.2 Directional features. - Mounts shall be so designed that under motions due to vibration or shock, deflections can occur in any direction.

3.4.3 Mounting size. - Mounts that occupy the minimum of space in the axial and radial directions and provide optimum performance characteristics will be favored by the design activity selecting and applying resilient mounts to shipboard equipment. Figure 1 illustrates the general overall dimensions of typical mounts presently used aboard ship.

3.4.3.1 Size factor. - The size factor of an acceptable resilient isolation mount, within the load range, shall not exceed the maximum value shown by the curve on figure 2. The size factor is computed from the formula "$d + \frac{h}{3}$", where; d is the maximum deflection in inches which occurs during shock tests (see 4.7.7.4), and h is the free height of the mount in inches from the top surface of the mount which fits against the equipment or equipment support and the bottom of the mount which may or may not be the supporting base of the mount. (Typical illustrations are shown on figure 3.)

3.5 Performance.-

3.5.1 Examination.- All mounts submitted for tests shall be examined in accordance with 4.5.4. The mount shall conform to all details specified on the mount drawing and shall not exhibit any external flaws or defects.

3.5.2 Static load deflection[1].- The mounts, when subjected to static load deflection tests in accordance with 4.7.7.1, shall not show any separation, or break in or between component parts, or appreciable deformation of metal parts.

3.5.3 Vibration.- Mounts when subjected to vibration tests in accordance with 4.7.7.2 shall not show any failure or deterioration of the resilient elements, metal parts, or fastenings. The resonant frequencies of mounts submitted in a lot shall not vary more than plus or minus 15 percent when tested at rated load in accordance with 4.7.7.2. The following vibrational characteristics along the three principal axis of the mount shall be determined and reported for design application purposes:

(a) Transmissibility (4.7.7.2.1).
(b) Resonant frecuencies (4.7.7.2.1).
(c) Uniformity (4.7.7.2.2).
(d) Spring constants (stiffness) (4.7.7.2.3).

3.5.4 Shock isolation.- The mount shall be of such design that under the hammer blows of the applicable shock test (see 4.7.7.3), no separation, or break in/or between components of the mount shall occur which will permit the mounted equipment to become free. The natural frequency of the mount after shock test in the axial and radial direction shall vary not more than plus or minus 15 percent from the average resonant frequency versus load curve determined in the uniformity test (see 4.7.7.2.3). Minor yielding in the metal components of the mount may be permitted. The shock data obtained during these tests shall be used for comparative purposes by design activities in the selection and application of mounts for shock protection purposes.

3.5.5 Salt spray deterioration.- The mount when subjected to salt spray test in accordance with 4.7.7.4 shall show no appreciable corrosion of the metal parts, or cracking, chipping, or scaling of any protective coating. In addition there shall be no failure of any rubber-to-metal bond, deterioration of rubber stock, or corrosion of steel springs or metal parts which will appreciably alter the static load deflection curve of the mount or the natural frequency under upper and lower rated loads.

3.5.6 Oil effects.- The mounts when subjected to oil tests in accordance with 4.7.7.5 shall show no failure of any rubber-to-metal bond, deterioration or swelling of rubber stocks which will appreciably alter the static load deflection curve of the mount, or the natural frequency under upper and lower rated loads.

3.5.7 Drift and cold storage tests.- The data obtained during tests specified in 4.7.7.6 and 4.7.7.7 shall be used for comparative purposes by design activities in the selection and application of mounts.

[1]Should it be determined that shock is not a consideration in the design and application of a particular mounting, peak loadings equal to 5 times the upper load rating of the mounting shall be used in lieu of those specified in 4.7.7.1.3.1 and 4.7.7.1.3.2.

3.6 Mount identification. - The mount number, load rating (pounds), manufacturer's name, and date of manufacture shall be permanently and legibly marked on the mount in a location where it can be readily observed, when installed. When it is not practicable to mark the mount directly, a metal tab shall be marked and secured to the mount (see 6.1). Where only resilient elements are provided for tests or replacement purposes, they likewise, shall be identified by an attached metal tab.

3.7 Request for mount evaluations. - A manufacturer shall familiarize himself with the contents of NAVSHIPS publication 250-357-1 relative to conditions governing tests in Naval laboratories. A manufacturer shall offer for evaluation only those designs of mountings which he has reasonable assurance will meet the specific requirements of this specification. When a request is submitted to the bureau or agency concerned for evaluation tests, the manufacturer shall provide four copies of a report containing the following information:

(a) A detail drawing of the mount showing identification, dimensions, shape, materials, and load ratings with corresponding natural frequencies. Notes on the drawing shall indicate if the natural frequencies were calculated from a static load deflection curve or obtained from tests on a vibration machine. If obtained from a vibration machine, the impressed double amplitude at which the natural frequency was obtained shall be specified.
(b) A static load deflection curve obtained in accordance with 4.7.7.1.

3.8 Workmanship. - The mount shall be manufactured and processed in a careful and workmanship manner in accordance with good manufacturing practice.

4. QUALITY ASSURANCE PROVISIONS

4.1 Inspection procedures. - For Naval purchases, the general inspection procedures shall be in accordance with General Specifications for Inspection of Material.

4.2 Evaluation tests. - These tests are conducted on manufacturer's mounts to determine if this product meets certain minimum basic requirements and to obtain performance characteristics of the mounts which can be employed by Naval and equipment designers in the proper selection and application of mounts. Where a manufacturer's mounts meet the requirements of this specification, the performance characteristics shall be disseminated by the testing agency to the bureau or agency concerned, Shipyards, Superintendents of Shipbuilding, Inspector of Naval Materials and other Military activities as specified by the bureau or agency concerned. These tests shall not be considered qualification tests since the utilization of any mount is contingent upon the proper relationship between the performance characteristics of the mount and those of the equipment as well as other shipboard requirements.

4.3 Performance data. - Where performance data obtained from evaluation tests indicates the use of a particular mount for shipboard installation, lot acceptance examination and tests of production mountings at the place of manufacture are provided for procurement purposes.

4.4 Sampling. -

4.4.1 Sampling for evaluation tests. - Unless otherwise specified, twelve resilient mountings of the same design, type, and load rating selected at random from a production run shall be furnished without expense to the Government for the evaluation tests specified in 4.7.2 to 4.7.6, inclusive.

4.4.2 Sampling for lot acceptance. -

4.4.2.1 Lot. - For purpose of sampling, a lot shall consist of all mounts of the same design, type, and load rating offered for delivery at one time.

4.4.2.2 Sampling for lot acceptance examination. - A random sample of mounts shall be selected by the Government inspector in accordance with table I from each inspection lot of material offered for Government inspection of visual and dimensional characteristics with lot acceptance based on the sampling inspection requirements in accordance with Standard MIL-STD-105.

Table I - Sampling for visual and dimensional examination
AQL (approx.) = 1.5 percent defective.

Number of mounts in lot	Number of mounts in sample	Acceptance number (defectives)	Rejection number (defectives)
40 or under	10	0	1
41 to 110	15	0	1
111 to 300	25	1	2
301 to 500	35	1	2
501 to 800	50	2	3
801 to 1300	75	3	4
1301 to 3200	110	4	5

Note. - At the option of the Government inspector, the equivalent double or multiple sampling plan from Standard MIL-STD-105 may be used.

4.4.2.3 Sampling of mounts for physical tests. - For the tests specified in 4.5.5, samples shall be selected in accordance with table II by or under the supervision of the Government inspector.

Table II - Sampling of mountings and number of samples and failures permitted.

Number of mounts in lot	Sample quantities			Maximum allowable number of failures			
				In first sample quantity		In first and second sample quantities combined	
	First sample quantity	Second sample quantity	First and second sample quantities combined	For any one test	For all tests combined	For any one test	For all tests combined
2 to 8	Use single sampling plan for these lots		3	-	-	0	0
9 to 15			4	-	-	0	0
16 to 25			5	-	-	0	0
26 to 40			6	-	-	0	0
41 to 65	4	4	8	0	0	1	1
66 to 110	5	5	10	0	0	1	1
111 to 180	6	6	12	0	0	1	1
181 to 300	8	8	16	1	1	1	2
301 to 500	10	10	20	1	1	2	2
501 to 800	12	12	24	1	1	2	3
801 to 1300	15	15	30	1	2	2	3
1301 to 3200	20	20	40	2	2	3	4

4.4.2.3.1 Number of samples and failures permitted. - For lots consisting of 40 mounts or less, a single sampling plan for these lots shall be used. The number of mounts shown in the column marked "1st and 2nd sample quantities combined" shall be selected at random and subjected to tests. For lots consisting of more than 40 mounts, the quantities shown in column marked "First sample quantity" shall be selected.

4.5 Lot acceptance examination and tests. -

4.5.1 Test equipment and inspection facilities. - The manufacturer shall furnish and maintain all necessary facilities and equipment for making all examinations and tests. The test equipment shall be adequate in quantity and shall be of sufficient accuracy and quality to permit performance of the required tests.

4.5.2 Use of commercial facilities. - Manufacturers not having test equipment and facilities satisfactory to the bureau or agency concerned shall engage the services of a commercial laboratory acceptable to the bureau or agency concerned.

4.5.3 Examination responsibility. -

4.5.3.1 Manufacturer. - The manufacturer shall offer for examination and acceptance only such lots as he has assured himself, before such submission, meet the requirements of this specification.

4.5.3.2 Inspector. - Acceptance of the lot shall be based upon the determination by the Government inspector of the manufacturer's conformance with the requirements of this specification. The samples may be selected and tests made by the Government inspector or, at his option, by the manufacturer under the supervision of the Government inspector.

4.5.4 Visual and dimensional examination. - Each of the sample mounts selected in accordance with 4.4.2.2 shall be visually and dimensionally examined by the Government inspector to verify compliance with the requirements of this specification. Any mount in the sample containing one or more visual or dimensional defects shall be rejected, and if the number of defective mounts in any sample exceeds the acceptance number for that sample, the lot represented by the sample shall be rejected. Rejected lots may be offered again for Government examination, provided the contractor has repaired or removed all nonconforming mounts. The Government inspector shall again select and examine samples from such resubmitted lots to verify compliance with the requirements of this specification.

4.5.5 Lot acceptance tests of mounts. - The samples selected in accordance with 4.4.2.3 shall be subjected to the tests specified in table III in the order listed.

Table III - Lot acceptance tests on mountings.

Test	Paragraph
Uniformity	Tests shall be in accordance with 4.7.7.2.2 in the axial direction only.
Static load deflection	Test shall be in accordance with 4.7.7.1 modified as follows: The mounts shall be subjected to four loading and unloading cycles in the axial direction. For each loading cycle, loads shall be applied up to the load specified in curve No. 2 of figure 1 for the particular upper load rating for the mount. Deflection rate shall not exceed 0.3 inch per minute.

4.6 Production check tests. - Production check tests at a Government laboratory may be required by the bureau or agency concerned on any contract or order. These tests shall consist of the tests specified in 4.7.

4.7 Test procedures. - Tests shall normally be conducted on a mount along each of its three principal axes. Some mounts, however, are designed to be loaded in only one direction. Consequently, certain tests need not be conducted along all principal axes. Unless otherwise specified herein, it shall be the responsibility of the test engineer to determine the axes along which tests shall be conducted.

4.7.1 Standard test conditions. - Unless otherwise specified herein, all tests shall be made within an ambient air temperature range of 80 ± 10° F. Within this range, the temperature from the beginning to the end of any one test shall not vary more than plus or minus 5° F.

4.7.2 Four of the mounts specified in 4.4.1 shall be subjected to the following tests:

(a) Examination (4.5.4).
(b) Vibration (4.7.7.2).
(c) Shock isolation (4.7.7.3).

4.7.3 Two of the mounts specified in 4.4.1 shall be subjected to the following tests:

(a) Examination (4.5.4).
(b) Static load-deflection (4.7.7.1).
(c) Salt spray (4.7.7.4).

4.7.4 Two of the mounts specified in 4.4.1 shall be subjected to the following tests:

(a) Examination (4.5.4).
(b) Static load-deflection (4.7.7.1).
(c) Oil test (4.7.7.5).

4.7.5 Three of the mounts specified in 4.4.1 shall be subjected to the following tests:

(a) Examination (4.5.4).
(b) Drift (4.7.7.6).

4.7.6 One of the mounts specified in 4.4.1 shall be subjected to the following tests:

(a) Examination (4.5.4).
(b) Cold storage (4.7.7.7).

4.7.7 Methods of tests. -

4.7.7.1 Static load deflection test. - Static load deflection tests shall be conducted on sample mounts in both the axial and radial directions. Should the mounting be non-symmetrical about the vertical axis, tests shall be conducted in two radial directions, 90 degrees apart. The mounts shall be subjected to four loading and unloading cycles. The fourth loading and unloading curve obtained from the test of four mounts shall be averaged and reported as the static load-deflection curve for the mount design. In addition, a brief sketch shall be provided showing direction of loading and manner in which the mount(s) were supported for tests. The load at which any yielding of the metal parts or failure of the resilient element occurs shall be indicated on the load-deflection curve with brief notations as to extent of damage.

4.7.7.1.1 Load deflection methods. - Load-deflection tests shall be conducted employing either one of the following methods:

4.7.7.1.2 Incremental load method. - This method is considered optional and may be used satisfactorily for testing mounts having low load ratings. This method involves the loading of mount(s) by means of weights and the measurement of the deflection 1 minute after each load increment is applied. The deflection of the mounting shall be measured with a dial gage having a one-mil sensitivity.

4.7.7.1.3 Standard universal test machine method. - This method is preferred and involves the use of a testing machine which can load the mount in tension or compression. When used for testing mounts it shall be equipped with a "pacing drive" which will load the mount(s) at a constant deflection rate.

4.7.7.1.3.1 Test in the axial (vertical) direction. - When load deflection tests are conducted in the axial direction, a single mount shall be secured in a suitable jig and subjected to four loading and unloading cycles. The loading shall not exceed a deflection rate of 0.3 inch per minute. Unless otherwise specified, the peak loading for the first three loading cycles shall be the load[1] specified on curve 2 of figure 4 for the upper load rating of the mount. For the fourth loading cycle, the mount shall be loaded up to the peak load[1] specified in curve 1 of figure 4, unless otherwise specified herein.

4.7.7.1.3.2 Test in the radial (horizontal) direction. - When load deflection tests are conducted in the radial direction, two mounts shall be secured in a jig simulating that shown in figure 5. Each mount shall be compressed axially to that amount which its upper load rating deflected the mount during static load deflection test in the axially direction. In event the jig shown in figure 5 is used, the compression is obtained by adjusting nuts on four rods which changes the distance between the angle-bracket supports with respect to the loading bar. After the two mounts have been assembled in a jig and secured, they shall be subjected to four loading and unloading cycles in accordance with the procedure specified in 4.7.7.1.3.1. The loads[1] determined from curves Nos. 1 and 2 in figure 4 for testing a single mount in the axial direction shall also be used for the test of two mounts in the radial direction.

4.7.7.2 Vibration tests. -

4.7.7.2.1 Transmissibility and resonant frequency. - An average vibration transmissibility curve shall be determined by tests on sample mounts when loaded at upper and lower rated loads. Tests shall be conducted in the axial and radial directions as applicable (see 4.7). If the resilient element is not symmetrical about its vertical axis, tests shall be conducted in two radial directions, 90 degrees apart. The number of mounts to be tested shall be as specified in 4.7.2. Tests shall be conducted by vibrating the base of the mount, or the load on the mount, over a frequency range from zero to at least 1.5 times the resonant frequency of the mount under rated loads. The amplitude of vibration across of the mounting shall be sufficient to insure an accurated determination of resonant frequency and transmissibility. The following single amplitudes of vibration may be used as a guide for mounts having natural frequencies in the ranges indicated below:

Natural frequency (c.p.s.)	Single amplitude of mass load on mount (inches)
Below 15	0.024 ± 0.006
15 to 25	.012 ± .004
Above 25	.008 ± .002

The amplitudes of vibration used in conducting tests on mounts shall be reported.

[1]For example, a mount having a designated upper load rating of 100 pounds would be subjected to peak loadings of 3300 pounds for the first three cycles. For the fourth loading cycle, the mount(s) would be subjected to a peak loading of 4350 pounds.

4.7.7.2.2 Uniformity test. - The uniformity of mounts submitted in a sample lot shall be evaluated by determining the resonant frequencies when loaded at the upper and lower rated loads and at two intermediate loads equally spaced between the upper and lower rated loads. The resonant frequencies obtained on the mounts under the same load shall be averaged. From this data a curve of average resonant frequencies versus loads shall be plotted for the axial and radial directions. Where the resonant frequencies under upper and lower rated loads are obtained from the transmissibility tests, these data may be used in plotting the average resonant frequency versus load curve. Where the resonant frequencies have not been determined for the specified loads, they shall be obtained by the same method specified for the vibration transmissibility tests. Where the mount is not symmetrical about the vertical axis, tests shall be conducted in two radial directions 90 degrees apart.

4.7.7.2.3 Stiffness. - From the resonant frequency data obtained, the stiffness of the mount along its three principal axis shall be calculated from the following formula:

$$K = \frac{4\pi^2 W f^2}{g} = 0.102\ W f^2$$

Where:

K = Stiffness (spring constant) pounds per inch.
W = Weight of equipment or load, pounds.
f = Resonant frequency, cycles per second (obtained from tests).
g = Acceleration of gravity, inches per second^2 (386 in/sec^2).

4.7.7.3 Shock isolation tests. -

4.7.7.3.1 Test on lightweight shock machine. - Mounts with load ratings less than 75 pounds per mount shall be evaluated on the lightweight shock machine using either one of the test set-ups described below:

(a) Testing apparatus shown on Drawing S9102-1293998 shall be used when a mount is to be tested singly.
(b) When four or more mounts are to be tested, they shall be secured by suitable means to a shelf-type platform shown on figure 6. This platform is bolted to the anvil plate of the lightweight shock machine as specified in Specification MIL-S-901. The mounts shall then be bolted to a square base plate tray as shown on figure 7 to which plates of varying weights can be attached to impose correct loadings on the mounts. The height of the center of gravity of the mass load above a horizontal plane through the mid-height of the mounts shall not exceed one-half the distance between the mounts attached to the corners of the square base. Lead plates for mass loading may be required to maintain a low center of gravity height.

4.7.7.3.1.1 Number of hammer blows. - The mounts shall be subjected to a total of 13 hammer blows. For each test run shown in table IV, 2 hammer blows each of 3 feet and 5 feet heights shall be a applied.

Table IV - Outline for conducting shock tests.

Test run Number	Rated load	Direction of test [1]	Notes
1	Upper	Axial	Immediately following test runs No. 2 and 4, the testing engineer shall repeat uniformity test at upper and lower rated loads.
2	Lower	Axial	
3	Upper	Radial	
4	Lower	Radial	

[1] When tests are conducted on four or more mounts using the shelf type platform on the light weight shock machine, the "Axial" and "Radial" direction of tests will be complied with if "Top" and "Back" hammer blows, respectively, are applied.

4.7.7.3.2 Shock test on medium weight shock machine. - Mounts with lower load ratings of 75 pounds or more, and upper loading ratings up to 2000 pounds, shall be tested four at a time on the medium weight shock machine. Tests shall be conducted in the axial and radial directions employing the testing apparatus shown on Drawing S9102-1299997 (Naval Research Laboratory Drawing No. D-137 This testing apparatus consists of two loading frames, one for testing mounts with load ratings from 75 pounds to 549 pounds and the other for mounts with load ratings from 550 pounds to 2000 pounds per mount. The required number of channels for supporting the mounts and mass loads shall be selected from table V. The arrangement of the channels for supporting the mount system on the anvil table of the shock machine shall be in accordance with that shown on figure 4 employing, insofar as possible, the size of support brackets and plates shown. The mounts shall be subjected to a total of 16 hammer blows. For each test run shown in table V, the intensity and number of hammer blows as

specified for groups II and III for medium-weight equipment, of Specification MIL-S-901 shall be applied. For loads on the shock machine anvil table that exceed 5600 pounds, 5.5 feet hammer blows shall be applied for each group specified herein.

Table V - The number of supporting 4-inch car building Channels required for a given load and spacing.

Weight of mass load on mounts (load rating x 4)	Center distance between bolt holes on test load frame	
	24 inches	32 inches
	Number of channels required	Number of channels required
260 to 999	2	
1000 to 1399	3	
1400 to 1899	4	
1900 to 2196	5	
2200 to 2699		4
2700 to 3399		5
3400 to 4199		6
4200 to 4599		7
4600 to 5599		8
5600 to 6599		9
6600 to 7099		10
7100 to 8099		11

4.7.7.3.3 Shock test mounts in the radial direction. - Should the resilient element of a mount be nonsymmetrical about the vertical axis, the shock test shall be applied in the radial direction which, in the opinion of the test engineer, will result in the most severe loading of the mount.

4.7.7.3.4 Shock test data. -

4.7.7.3.4.1 Deflection measurements. - The deflection of the mounts measured in inches from the initial equilibrium position of the mount under load before test shall be recorded for each hammer drop. From this data the maximum deflections occurring on each side of the initial equilibrium position during each test run shall be reported.

4.7.7.3.4.2 Reed-gage measurements. - For each hammer blow, reed-edge measurements shall be obtained and shock spectra computed as specified in the appendix herein. The spectra computed for identical blows, load, and direction of deflection shall be averaged and reported. The reed-gage on the mass load shall be oriented so that the reeds are in a plane parallel to that of the swinging hammer of the shock machine.

4.7.7.3.4.3 Damage. - The testing agency shall report the extent of damage sustained by the mounts resulting from each hammer blow.

4.7.7.4 Salt spray tests. - Salt spray tests for mounts shall be one of the following types:

Type I - Mounts installed top side on ships and exposed directly to weather shall be subjected to salt spray test as specified in Specification MIL-I-983.
Type II - Mounts installed below decks on ships and protected from weather shall be subjected to 50 hours of salt spray test as specified in Specification QQ-M-151.

Where the choice between the types of salt spray tests is not indicated specifically by the bureau or agency concerned, the testing engineer shall subject the mounts to type II salt spray test. During these tests, the mounts shall be deflected axially to that amount which the upper rated load would produce. After subjection to the salt spray test, the mounts shall be dipped in fresh water, dried, and visually examined for corrosion. The mounts shall then be subjected to static load-deflection tests as specified in 4.7.7.1. If there is a significant variation in the load-deflection curves taken before and after salt spray test, the mounts shall be subjected to vibration test to determine if the natural frequencies under upper and lower rated loads are within the plus or minus 15 percent limits of the average curve obtained during uniformity tests specified in 4.7.7.2.2. Mounts that pass the above tests shall be stored under no load for 20 days at room temperature after which visual inspection, static load-deflection, and vibration tests specified herein shall be repeated.

4.7.7.5 Oil test. - The sample mounts loaded at upper rated load shall be immersed for 72 hours in petroleum base oil at 158 $\pm$ 2° F. The oil (see 6.7) shall conform to the following properties as determined by methods specified in Standard FED-STD-791:

Saybolt universal viscosity: 155 $\pm$ 5 seconds at 100° F.
Flash point: 330 $\pm$ 5° F.
Aniline point: 157.1 $\pm$ 1.8° F.

After the expiration of the immersion time, the mounts shall be removed from the test liquid and immediately immersed in fresh oil at room temperature for 30 $\pm$ 5 minutes. After the cooling period, the mounts shall be removed from the fresh oil and immediately subjected to static load-deflection tests in the axial and radial directions. If there is significant variation in the load-deflection curves taken before and after the oil tests, the mounts shall be subjected to vibration tests to determine whether the natural frequencies under upper and lower rated loads are within the plus or minus 15 percent limit of the average curve obtained during uniformity test specified in 4.7.7.2.2.

4.7.7.6 Drift tests. - Three sample mounts shall be selected from the lot submitted for evaluation and their natural frequency under upper rated load determined at room temperature, 80° $\pm$ 5° F. The three mounts shall then be divided into groups I and II consisting of 1 and 2 mounts, respectively, for tests as follows:

NOTE: Should the mount design be such that it is to be loaded in only one direction, then the three sample mounts for drift tests may be divided into one for each of the tests specified in 4.7.7.6.1.1, 4.7.7.6.1.2 and 4.7.7.6.1.3. These tests may then be conducted concurrently.

4.7.7.6.1 Group I tests in the axial direction. -

4.7.7.6.1.1 Drift at room temperature. - The mount height shall be measured from an arbitrarily selected datum line, usually the base or top side of a center support plate. The upper load rated of the mount shall then be applied and 1 hour after loading the deflection of the mount from the no load position shall be measured in mils. Thereafter, drift and ambient air temperature measurements shall be made every hour for 6 hours followed by measurement at 24 hour intervals for at least

10 days. At the end of this period the mount shall be subjected to the vibration test and the natural frequency determined under rated load. The load shall be removed and the mounting allowed to recover in height before being used in the test described in 4.7.7.6.1.2.

4.7.7.6.1.2 Drift at elevated temperature. - At room temperature the mount height shall be measured from an arbitrarily selected datum line. After recording this measurement, the mounting shall be conditioned at 160° ± 2° F. until all parts of the mount have reached the test temperature. The height of the mount shall again be measured and recorded. The upper rated load for the mount shall then be applied, and after 1 hour at a temperature of 160° ± 2° F., the deflection of the mount from no load position shall be measured in mils. Thereafter, at this temperature, the drift of the mount shall be measured every hour for 6 hours followed by measurements at 24 hour intervals for at least 10 days. At the end fo this period, the mount shall be immediately subjected to the vibration test and the natural frequency under upper rated load determined within 3 minutes, if practicable. The mount shall then be conditioned under upper rated load at room temperature of 80° ± 5° F. for 48 hours after which the natural frequency of the mount shall be determined. The load shall then be removed and the mount allowed to recover in height before being used in the test described in 4.7.7.6.1.3.

4.7.7.6.1.3 Drift at low temperature. - This test shall be conducted as specified in 4.7.7.6.1.2 except that 30° ± 2° F. shall be used in lieu of 160° ± 2° F.

4.7.7.6.2 Group II tests in the radial direction. - Mounts may be tested singly or in pairs using a testing jig simulating that is shown in figure 5. If tested singly, the mount shall be loaded at the upper rated load. If tested in pairs, the mounts shall be loaded at twice the upper load rating of one mount. Using either one of these testing arrangements the mounts shall be evaluated in the radial direction of least stiffness under the same temperature and test conditions specified in 4.7.7.6.1.1, 4.7.7.6.1.2, and 4.7.7.6.1.3.

4.7.7.7 Cold storage test. - The natural frequency of the mount shall be determined under upper rated load at room temperature of 80 ± 5° F. After this determination, the mount shall then be deflected axially with a strong-back to that mount which the upper rated load will produce. Under this condition, the mount shall then be placed in a cold box for 3 days at a temperature of minus 80 ± 2° F. At the end of this period the mount shall be conditioned for 3 days at minus 20 ± 2° F. After this conditioning period, the strongback shall then be removed, the upper rated load applied, and the natural frequency of the mounting determined in the axial direction within three minutes if practicable. Where facilities are available the natural frequency of the mount shall be determined at the temperature at which the mount is conditioned. The mount shall then be conditioned under upper rated load at room temperature of 80 ± 5° F. for at least 48 hours, after which the natural frequency under upper rated load shall again be determined. Before and after vibration tests, visual inspection shall be made, to detect any damage to the mount.

4.7.7.8 Disposition of test samples. - Unless otherwise specified in the contract or order, sample mounts submitted for evaluation tests shall not be delivered as a part of any contract or order. The manufacturer shall notify the testing agency within 30 days from date of receipt of test report if the sample mounts are to be returned to the manufacturer at his expense. After thirty days and without notification from the mount manufacturer, the testing agency shall dispose the sample at its discretion.

5. PREPARATION FOR DELIVERY

5.1 Packaging. -

5.1.1 Level A. - Mounts shall be packaged in accordance with method III of Specification MIL-P-116. Contact preservative is not required.

5.1.2 Level C. - Mounts shall be packaged in accordance with the manufacturer's commercial practice.

5.2 Packing. -

5.2.1 Level A. - Mounts, packaged in accordance with level A or C as specified (see 6.1), shall be packed in wood cleated fiberboard, nailed wood, wirebound wood (style 3 for type 2 load), corrugated or solid fiberboard, wood cleated paper overlaid (overseas type), or wood cleated plywood plywood (overseas type) boxes conforming to Specification JAN-P-103, JAN-P-108, PPP-B-585, JAN-P-108, MIL-B-10377, and PPP-B-601, respectively. Shipping containers shall have caseliners conforming to Specification MIL-L-10547 and appendix thereto. Caseliners for boxes conforming to Specification JAN-P-108 may be omitted provided all joints of the boxes are sealed with tape as specified in the appendix of the box specification. Box closures shall be as specified in the appexdix of the applicable box specification. The gross weight of wood boxes shall not exceed 200 pounds; fiberboard boxes shall not exceed the weight limitations of the applicable box specification.

5.2.2 Level B. - Mounts, packaged in accordance with level A or C as specified (see 6.1), shall be packed in wood cleated fiberboard, nailed wood, wirebound wood (for type 2 load), corrugated or solid fiberboard, wood cleated plywood (domestic type), or wood cleated paper overlaid (domestic type) boxes conforming to Specification NN-B-591, NN-B-621, PPP-B-585, LLL-B-631, LLL-B-636, PPP-B-601, and MIL-B-10377, respectively. Closures shall be as specified in the applicable box specification, or appendix thereto. Fiberboard boxes shall conform to the special requirements of the applicable box specification. The gross weight of wood boxes shall not exceed 200 pounds: fiberboard boxes shall not exceed the weight limitations of the applicable box specification.

5.2.3 Level C. - Mounts, packaged in accordance with level A or C as specified (see 6.2) shall be packed in containers in a manner to insure safe delivery and acceptance at destination. Containers shall comply with the Consolidated Freight Classification Rules or other carrier regulations applicable to the mode of transportation.

5.3 Marking. - In addition to any special marking specified in the contract or order, each unit and intermediate package and shipping container shall be marked in accordance with Standard MIL-STD-129.

6. NOTES

6.1 Ordering data. - Procurement documents should specify the following:

(a) Title, number, and date of this specification.
(b) Detail requirements for materials, design and performance (see 3.1 and 4.3).
(c) Mount identification required (see 3.6).
(d) Level of packaging and packing required (see 5.1 and 5.2).

6.2 A knowledge of the performance characteristics of mounts is essential to determining whether they can be employed aboard Naval vessels. Manufacturers are urged to communicate with the Bureau of Ships and arrange to have the mounts which they propose to offer to the Bureau of Ships in the future tested.

6.3 This specification is not restrictive with respect of the details of construction, except where such details are specified. When exceptions are not clearly specified and indicated as such, it will be assumed that the bidders are offering mounts in strict accordance with this specification.

6.4 This specification has been prepared for the purpose of facilitating the production of mounts and the shipboard equipment with which they are used. The characteristics of mounts obtained under this specification should be used in the early design of shipboard equipment, and insofar as is practicable, for the replacement of mounts in existing equipment.

6.5 Matters relating to mounts evaluated in accordance with this specification and the use in connection with equipment should be addressed to the Chief, Bureau of Ships, Navy Department, Washington 25, D.C.

6.6 As a guide to the selection of metal materials for mounts, it has been found from tests that steel components when suitably designed and constructed from materials in accordance with the following specifications generally provide acceptable shock strength:

For steel components in general: Specification MIL-S-857, class B steel.
For holding down bolts: Specification MIL-S-857, class B steel.
For high strength bolts: Specification MIL-S-890, alloy No. 2.

Holding down bolts are usually machined with American National coarse threads having a class 3 fit. Bolts employed for securing the mounts to the equipment are sometimes manufactured from high strength material to provide greater resistance to bending.

6.7 The oil specified in 4.7.7.5 is the same as No. 3 oil specified in American Society for Testing Materials Specification D471-54T.

Notice.- When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Preparing activity:
Navy - Bureau of Ships

APPENDIX

10. This appendix is for derivation of shock spectra from reed-gage data.

10.1 In order to obtain the shock spectrum of a given shock by use of the reed-gage, the excitation is applied to the base of the gage, and the maximum deflections of the reeds, relative to the base are recorded.

10.2 If the reeds are considered to be simple systems, then for each reed there is a static deflection D_s (due to the action of gravity) which is related to the natural frequency F_n of the reed by the following equation:

$$F_n = 3.13\sqrt{\frac{1}{D_s}} \quad \text{c.p.s.}$$

10.3 Let X be the deflection of a reed tip relative to the base of the instrument under shock.

$$\text{Then} \quad \frac{X\,(\max.)}{D_s} = N$$

Where:

N is the "equivalent static acceleration".

10.4 This value of N is plotted against the primary natural frequency of the reed. This plot of N against F_n is called the shock spectrum of the shock to which the reed gage was subjected.

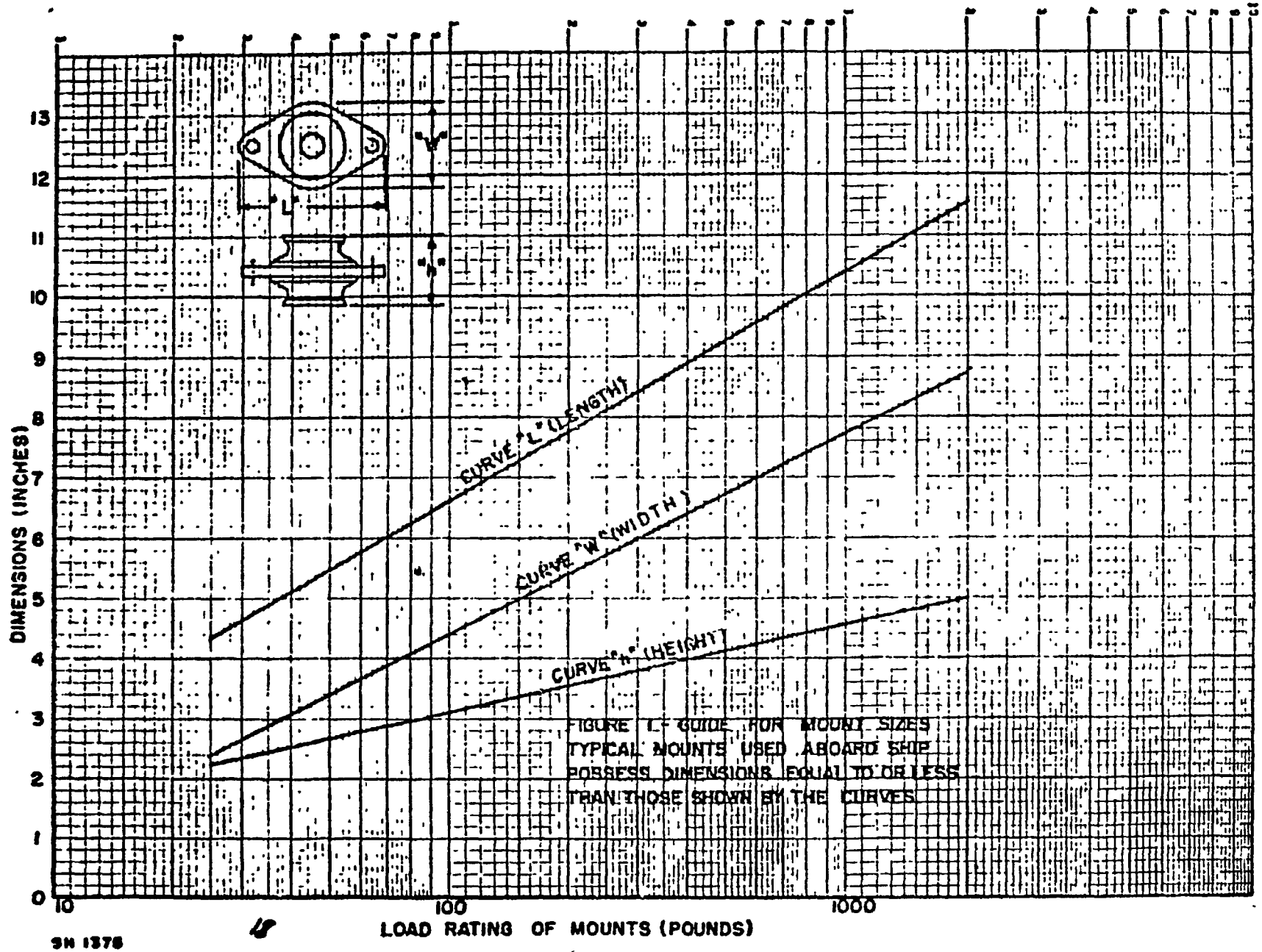

FIGURE 1 - GUIDE FOR MOUNT SIZES
TYPICAL MOUNTS USED ABOARD SHIP
POSSESS DIMENSIONS EQUAL TO OR LESS
THAN THOSE SHOWN BY THE CURVES

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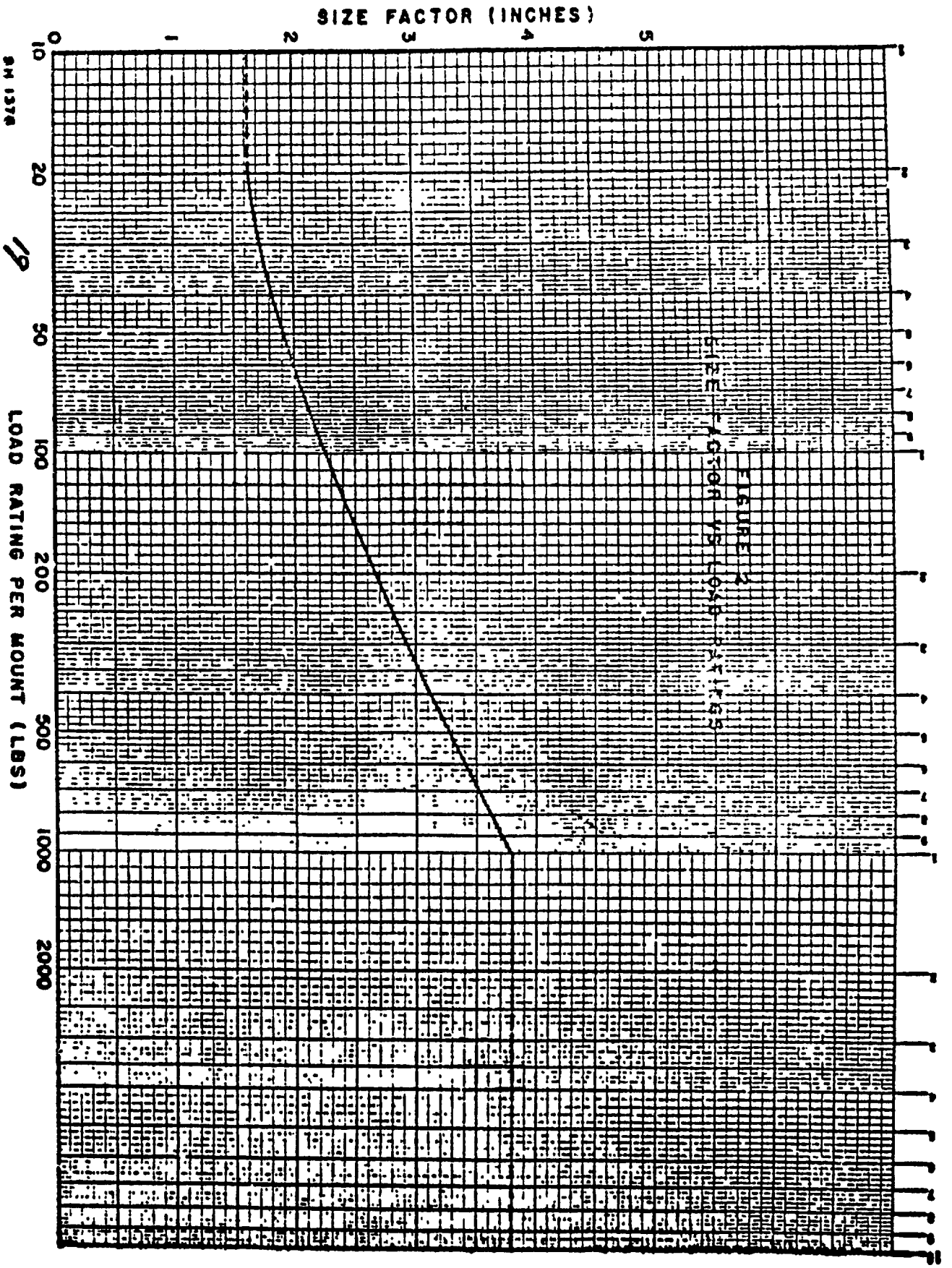

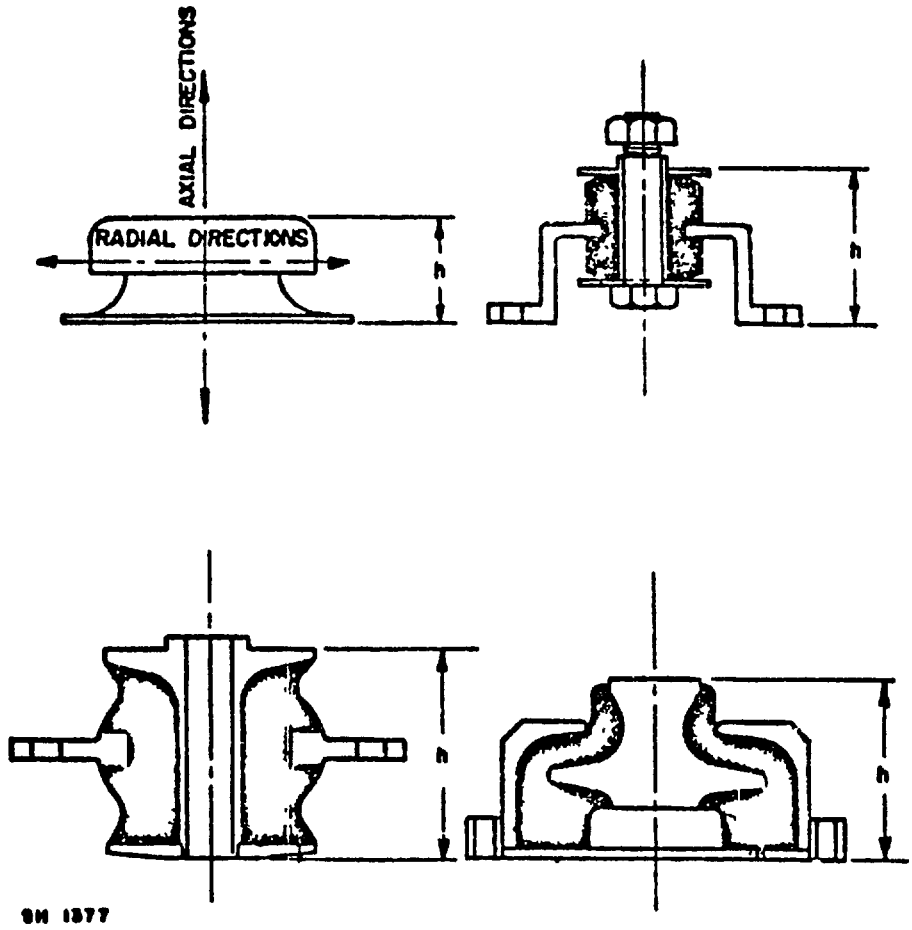

Figure 3 - Typical illustrations of mount height "h" for use in computing size factor for various designs of isolation mounts.

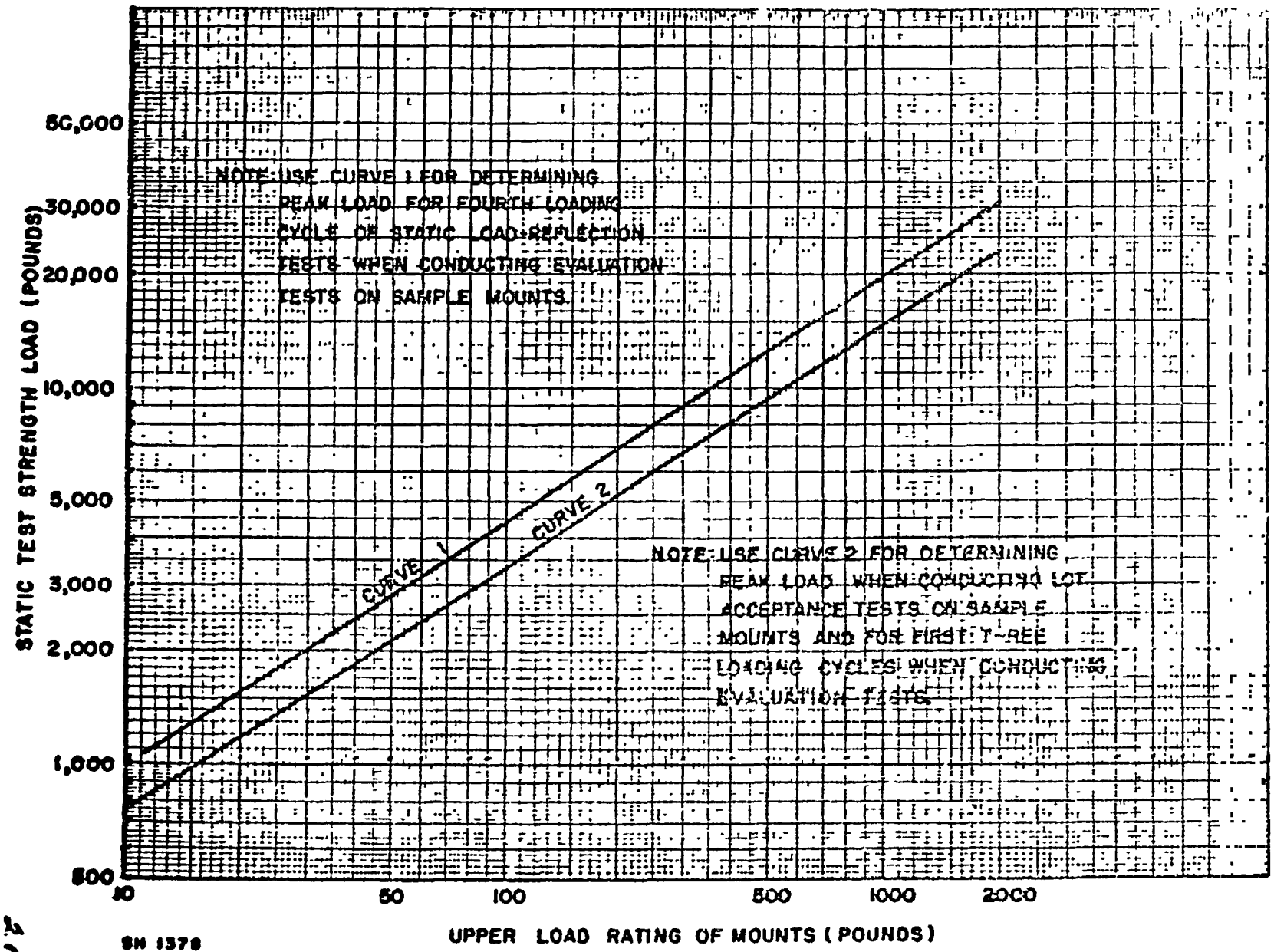

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Figure 4 - Minimum static test strength loads for resilient mounts.

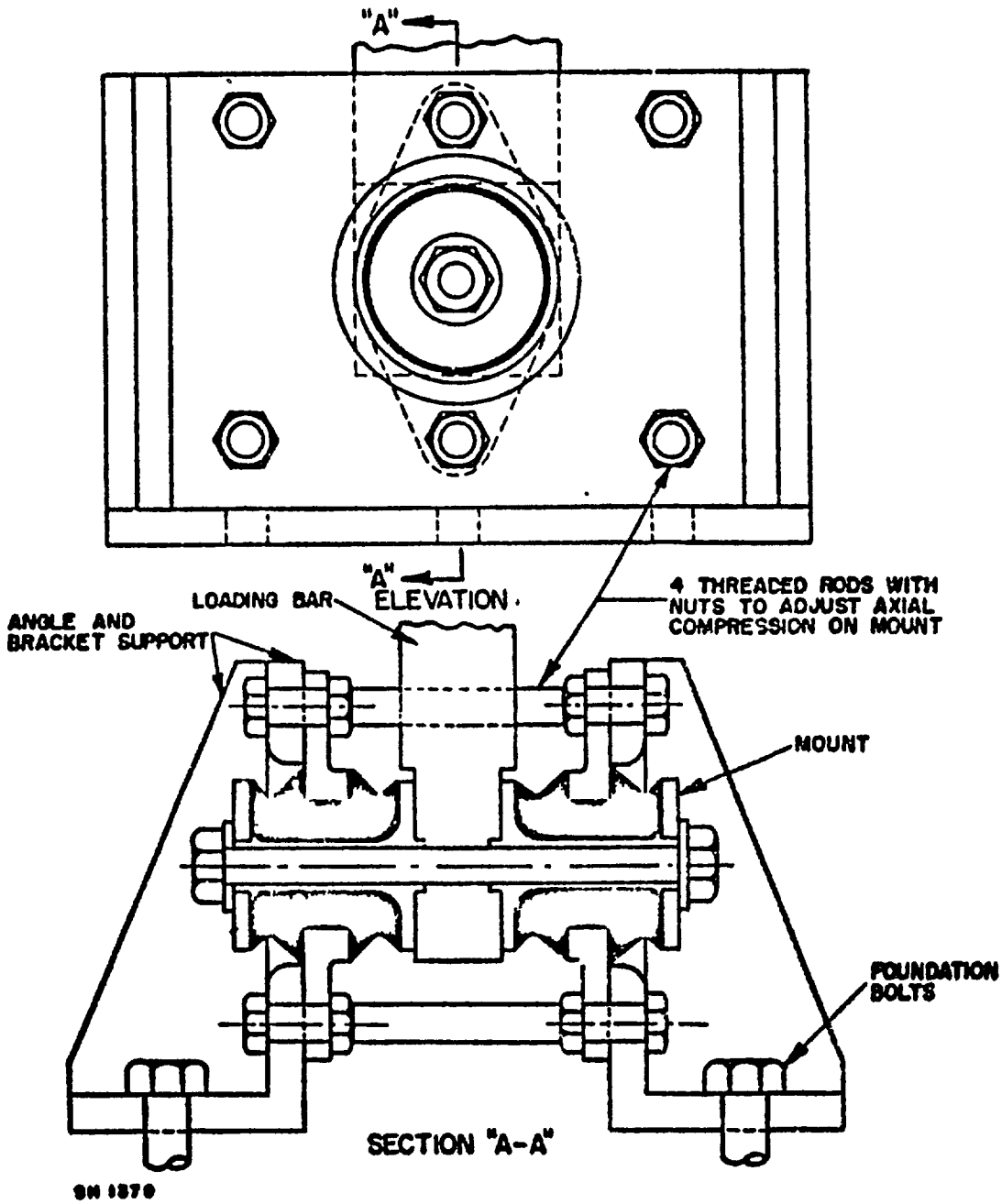

Figure 5 - Jig for holding mounts when conducting static load deflection tests in the radial direction.

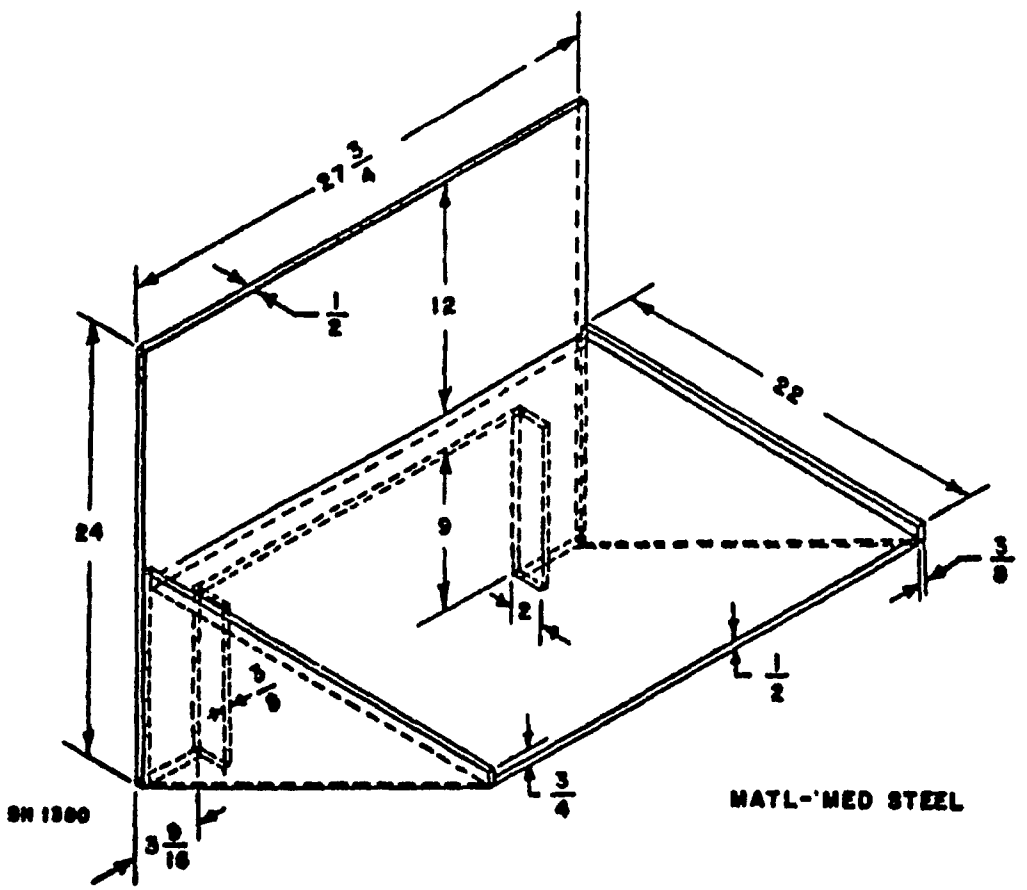

Figure 6 - Shelf platform for lightweight shock machine.

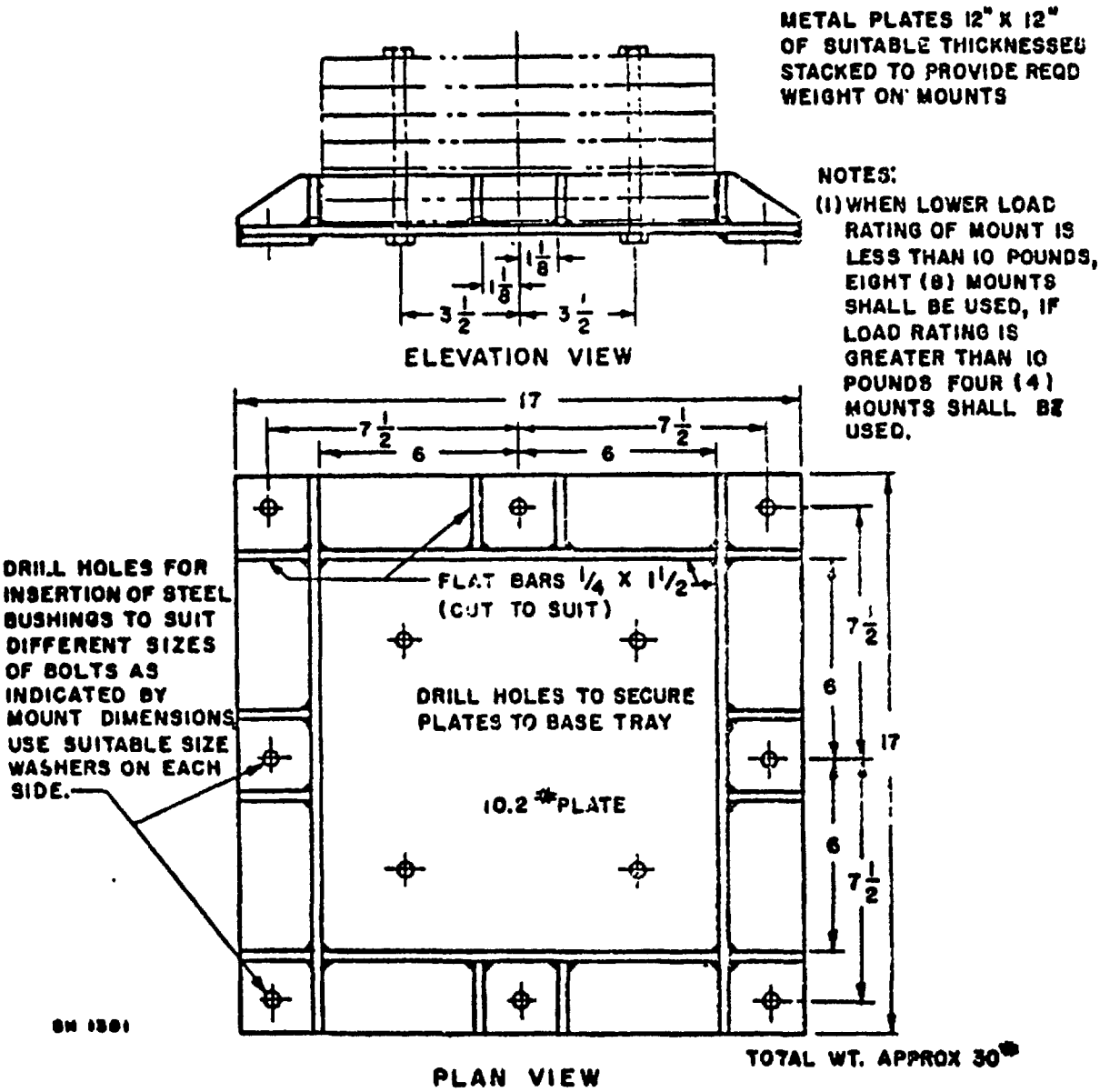

Figure 7 - Loading mounts for tests on lightweight shock machine.

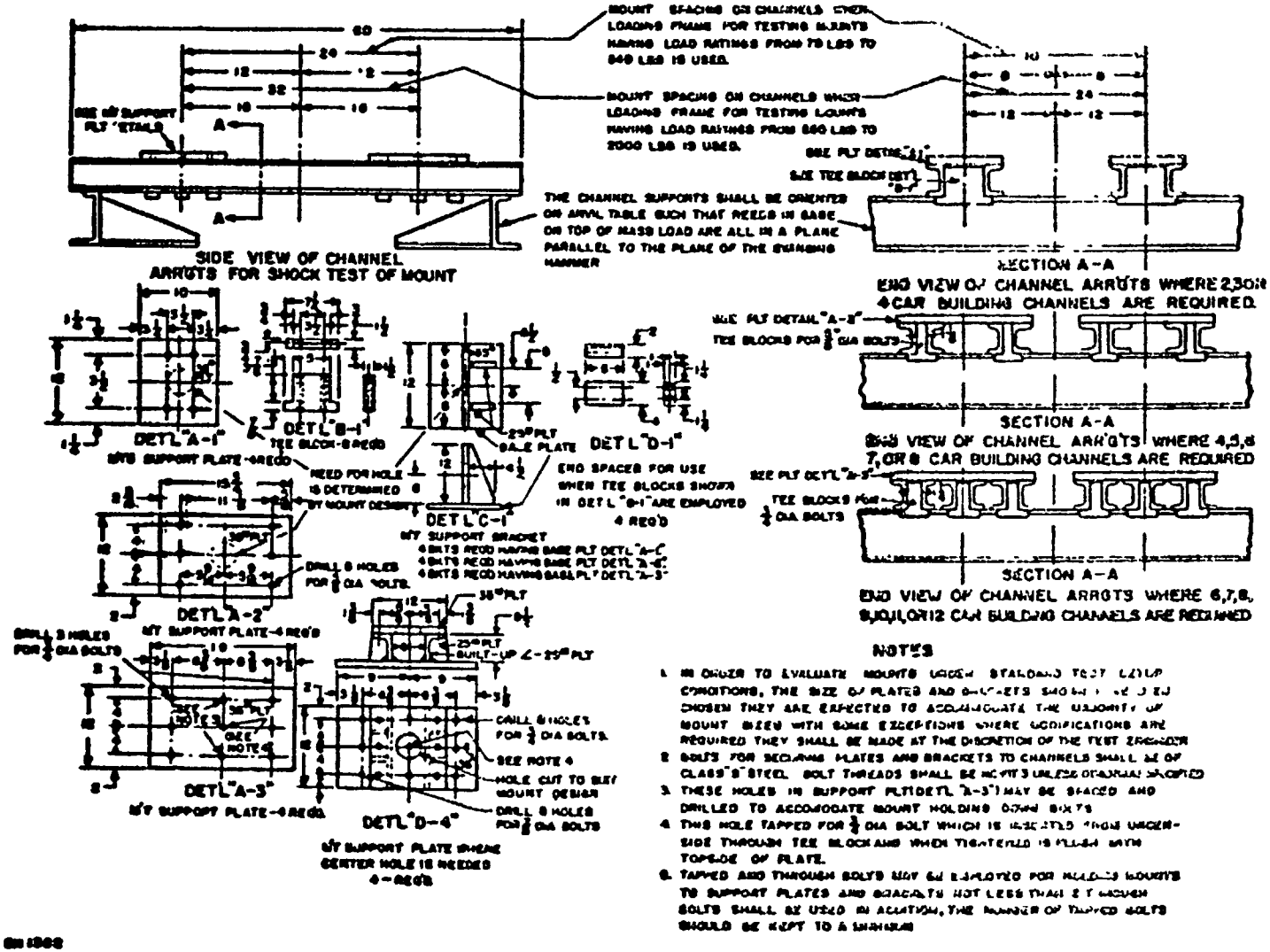

Figure 8 - Details of channel arrangements and standard support plates and brackets for testing resilient isolation mounts on the medium weight shock testing machine.

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