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13 December 1984
SUPERSEDING
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MILITARY SPECIFICATION

MOUNT, SHIPPING CONTAINER, RESILIENT: SHOCK AND VIBRATION DAMPING

This specification is approved for use by US Army Tank-Automotive Command, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for resilient mounts of the type used for securing engines, transmissions, and similar assemblies in reusable metal shipping containers. The spring rates of resilient mounts covered by this specification range from 100 to 10,000 pounds per inch of deflection.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. Unless otherwise specified, the following specifications, standards, and handbooks 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.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: US Army Tank-Automotive Command, ATTN: AMSTA-GSS, Warren, MI 48090, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document, or by letter.

FSC 5340

STANDARDS
MILITARY

MIL-STD-105	- Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-130	- Identification Marking of U.S. Military Property.
MIL-STD-45662	- Calibration System Requirements.

2.1.2 Other Government documents, drawings, and publications. The following documents, drawings, and publications form a part of this specification to the extent specified herein.

NATIONAL BUREAU OF STANDARDS

NBS Handbook H28	- Screw-Thread Standards for Federal Services.

(Application for copies of National Bureau of Standards documents should be addressed to the Superintendent of Documents, US Government Printing Office, Washington DC, 20402.)

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

2.2 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 First article. Unless otherwise specified, the contractor shall furnish 12 sample mounts individually numbered from 1 to 12, which shall be subjected to first article inspection (see 4.4). First article inspection samples, properly marked with identifying information shall be representative of the mounts to be furnished to the Government. All subsequent mounts delivered to the Government shall conform to these samples in all of their pertinent physical and performance attributes.

3.2 Materials. Materials shall be as specified herein and on applicable mount drawings. All material including materials not designated on applicable drawings and not specifically covered by this specification shall be uniform in quality and free from imperfections or defects which adversely affect performance or serviceability of the mounts (see 4.1.2).

3.2.1 Elastomers. The elastomeric material comprising the resilient elements of the mounts shall be of an elastomer compounded to meet the performance requirements of this specification (see 4.1.2).

3.2.2 Steel plates and studs. The mechanical properties of the steel used in manufacture of mount plates and studs shall be such as to enable these components to withstand, without damage, the stresses applied in connection with performance requirements and tests specified herein (see 4.1.2).

3.3 Design and construction. The resilient mounts shall be of the type designed for shear loading in the vertical planes (see 4.1.2).

3.3.1 Interchangeability. All mounts furnished under this specification shall be dimensionally and functionally interchangeable with all other such mounts having the same part number (see 4.1.2).

3.3.2 Dimensions. Mount dimensions shall be in accordance with the applicable drawings, as specified by the acquisition activity (see 6.2).

3.3.3 Threaded parts. Mounting stud threads and tapped holes shall be in accordance with NBS Handbook H28. The thread form, number of threads per inch, and class of fit shall be as specified on applicable drawings (see 4.5.2.2).

3.3.4 Bond. All metal components of the mounts shall be completely bonded to the resilient element with which it makes contact (see 4.5.2.2).

3.4 Performance.

3.4.1 Static load deflection. The mounts shall exhibit static load deflection characteristics (spring rate) in accordance with nominal values and allowable tolerances specified on the applicable drawing. There shall be no evidence of mount damage (see 4.6.1).

3.4.1.1 Proof. The mount shall withstand, without damage, deflection to the maximum extent specified on applicable drawing (see 4.6.2).

3.4.2 Dynamic performance. A pair of mounts shall perform as specified below while supporting a load as specified on the applicable drawing.

3.4.2.1 Vibration resistance. The mounts shall be capable of withstanding, without damage, vibration at the frequencies and amplitudes, and for the duration of periods specified (see 4.6.3).

3.4.2.2 Resonance vibration frequency. The mounts shall be such as to preclude a natural or resonant vibration frequency within the carrier (railway or motor freight) vibration frequency range of 2 to 7 cycles per second (cps) (see 4.6.3.1).

3.4.2.2.1 Resonance vibration fatique. The mounts shall be capable of withstanding, without damage, the total duration period of 21 $\pm$ 2 minutes when exposed to the entire frequency range of 2 to 60 cps and return to 2 cps (see 4.6.3.1.1).

3.4.2.3 Shock attenuation. The mounts shall show no evidence of damage when dropped flat to a hard non-yielding surface three times from a height of 12 inches. The shock transmitted to the supported load shall not exceed 12 gravity units (g) (see 4.6.4).

3.4.2.4 Durability. The mounts shall be capable of withstanding without evidence of damage 50 drops from a height of 18 ± 1/2 inches (see 4.6.5).

3.4.3 Environmental.

3.4.3.1 Accelerated aging. After exposure to accelerated temperatures of 158 to 160 degrees Fahrenheit (°F) for a period of 7 days, the mounts shall meet the requirements of 3.4.1 within 20% of the original room temperature values. There shall be no evidence of mount failure (see 4.6.6.1).

3.4.3.2 Low temperature. While stabilized at a temperature of -38° to -40°F, the mounts shall meet the requirements of 3.4.2.3, except that shock transmitted to the supported load shall not exceed 25 g's. There shall be no evidence of mount failure (see 4.6.6.2).

3.4.3.3 High temperature. While stabilized at a temperature of 158° to 160°F, the mounts shall meet the requirements of 3.4.2.3. There shall be no evidence of mount failure (see 4.6.6.3).

3.5 Identification and marking. The mounts shall be marked for identification in accordance with MIL-STD-130. In addition, the cure date (month and year) and the manufacturer's identification shall be molded into the resilient element (see 4.7).

3.6 Workmanship. Workmanship shall be of a quality which will assure a product free of burrs, rust, dirt, sharp edges, loose or defective studs, or other defects which affect the serviceability or appearance of the mounts. The elastomer shall be free of back-rinding, air traps, blisters, and excessive flash (see 4.8).

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 (see 6.2), 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 or witness any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Inspection equipment. Unless otherwise specified in the contract (see 6.2), the supplier is responsible for the provision and maintenance of all inspection equipment necessary to assure that supplies and services conform to contract requirements. Inspection equipment must be capable of repetitive measurements to an accuracy of 10 percent of the measurement tolerance. Calibration of inspection equipment shall be in accordance with MIL-STD-45662.

4.1.2 Materials and construction. To determine conformance to 3.2 through 3.3.4, inspection and material certification records shall be maintained by the contractor. Records shall be subject to review by the Government and shall include date, part, or characteristic identification, inspection results, and disposition of lot (accepted or rejected). Corrective action taken on noted defects shall be subject to approval by the Government.

4.2 Classification of inspection:

a. First article inspection (see 4.4).
b. Quality conformance inspections (see 4.5).
    1. Examination (see 4.5.2).
    2. Acceptance tests (see 4.5.3.1).
    3. Control tests (see 4.5.3.2).

4.3 Inspection conditions. Unless otherwise specified, all inspections shall be conducted under the following conditions:

a. Air temperature 80° $\pm$ 10°F
b. Barometric pressure $\overline{28}.54$ $^{+2}_{-3}$ inches mercury (Hg)
c. Relative humidity 50 $\pm$ 30 percent

4.4 First article inspection. Unless otherwise specified (see 6.2), the Government shall select 12 mounts produced under the production contract (see 6.2) for first article inspection. First article samples shall be tested as specified in table I and examined as specified in table II. Approval of the first article sample by the Government shall not relieve the contractor of his obligation to supply mounts that are fully representative of those inspected as first article sample. Any changes or deviation of the production units from the first article sample shall be subject to the approval of the contracting officer.

4.4.1 First article inspection failure. Test item deficiencies during, or as a result of, the first article test, shall be cause for rejection of the items until evidence has been provided by the contractor that corrective action has been taken to eliminate the deficiency. Any deficiency found during, or as a result of the first article test, shall be prime facie evidence that all items already produced prior to completion of the first article test are similarly deficient unless evidence satisfactory to the contracting officer is furnished by the contractor that they are not similarly deficient. Such deficiencies on all items shall be corrected by the contractor at no cost to the Government. The Government shall not final accept products until first article testing is completed to the satisfaction to the Government.

TABLE I. Classification of tests.

Title	Mount Number	Requirement	Test	First article	Quality conformance	
					Acceptance (100%)	Control
Proof test	1 and 2	3.4.1.1	4.6.2	X	X	
Static load deflection	X	3.4.1	4.6.1	X		X
Proof test	X	3.4.1.1	4.6.2	X		
Proof test	3 and 4	3.4.1.1	4.6.2	X		
Vibration resistance	X	3.4.2	4.6.3	X		
Resonance vibration frequency	X	3.4.2.1	4.6.3.1	X		
Resonance vibration fatique	X	3.4.2.2	4.6.3.2	X		
Proof test	X	3.4.1.1	4.6.2	X		
Proof test	5 and 6	3.4.1.1	4.6.2	X		
Shock attenuation	X	3.4.3	4.6.4	X		
Proof test	X	3.4.1.1	4.6.2	X		
Proof test	7 and 8	3.4.1.1	4.6.2	X		
Durability	X	3.4.4	4.6.5	X		
Proof test	X	3.4.1.1	4.6.2	X		
Proof test	9 and 10	3.4.1.1	4.6.2	X		
Accelerated aging	X	3.4.5.1	4.6.6.1	X		
Static load deflection	X	3.4.1	4.6.1	X		
Proof test	X	3.4.1.1	4.6.2	X		
Proof test	11 and 12	3.4.1.1	4.6.2	X		
Low temperature	X	3.4.5.2	4.6.6.2	X		
High temperature	X	3.4.5.3	4.6.6.3	X		
Proof test	X	3.4.1.1	4.6.2	X		

TABLE II. Classification of defects.

Category	Defect	Method of examination
Critical	None	
Major	AQL 1.0% Defective	
101	Dimensions affecting interchangeability, out of tolerance (see 3.3.1).	SIE 1/
102	Threads not as specified (see 3.3.3).	SIE 1/
103	Bond separation (see 3.3.4).	Visual
Minor	AQL 2.5% Defective	
201	Dimensions not affecting interchangeability, out of tolerance (see 3.3.2).	SIE 1/
202	Identification marking, improper (see 3.4).	Visual
203	Workmanship, faulty (see 3.5).	Visual

1/ SIE = Standard Inspection Equipment.

4.5 Quality conformance inspection.

4.5.1 Sampling.

4.5.1.1 Lot formation. An inspection lot shall consist of all the mounts of the same part number manufactured from one continuous process not to exceed one day's production, submitted at one time for acceptance.

4.5.1.2 Sampling for examination. Samples for quality conformance examination shall be selected in accordance with general inspection level II of MIL-STD-105.

4.5.2 Quality conformance examinations.

4.5.2.1 Acceptable quality level. Each sample selected in accordance with 4.5.1.2 shall be examined to determine conformance to the following acceptable quality levels (AQL) on the basis of percent defective (see 6.3).

Classification	AQL
Major	1.0
Minor	2.5

4.5.2.2 Classification of defects. For examination purposes, defects shall be classified as listed in table II.

4.5.3 Quality conformance tests.

4.5.3.1 Acceptance tests (100 percent). All mounts shall be subjected to the tests specified in table I.

4.5.3.1.1 Elastomer control. Elastomer shall conform to the minimum standards established for first article samples (see 3.2.1). Records of tests results shall be maintained for each batch of elastomer utilized in the fabrication of mounts. All elastomer in storage shall be identified to the test results.

4.5.3.2 Control tests. Control tests shall be conducted on two mounts selected at random from the total number of mounts made during each lot. Mounts selected in this manner shall be subjected to the tests specified in table I.

4.5.4 Failure. Failure of any mounts to pass any of the specified inspections shall be cause for the Government to refuse acceptance of the production quantity represented, until action taken by the contractor to correct defects and prevent recurrence has been approved by the Government.

4.6 Methods of inspection.

4.6.1 Static load deflection. To determine conformance to 3.4.1, two mounts numbers 1 and 2 shall be installed in a test fixture similar to that shown in figure 1. Prior to recording test data, the mounts shall be deflected twice in the shear direction a distance equal to the thickness of the resilient element. The load shall be applied by a standard universal test machine. The loading rate shall be 1/2 to 1 inch per minute. During the third deflection, load readings shall be recorded at each 1 inch deflection without interruption of the load application. Readings shall be taken to the maximum deflection specified on tne applicable drawing. If the recorded load readings are not within the tolerance specified on the applicable drawing, or if either of the mounts show evidence of damage due to the test, the mounts shall be rejected.

4.6.2 Proof test. To determine conformance to 3.4.1.1, two mounts shall be installed in a test fixture similar to that shown in figure 1 (see 4.6.1). The mounts shall be subjected to the maximum deflection specified on the applicable drawing, and while at maximum deflection the mount shall be inspected for cuts, tears, bond separation and metal deformation. Damaged or defective mounts shall be rejected. The loading and unloading rate shall be 25 $\pm$ 5 inches per minute. Period of dwell at maximum deflection shall be between 30 seconds and one minute.

4.6.3 Vibration resistance. To determine conformance to 3.4.2.1, two mounts numbers 3 and 4 shall be installed on a vibration test setup similar to that shown in figure 2. The dummy load shall be equal to the weight the mounts are required to support statically in the specific container application. Vibration shall be conducted only in the direction parallel to the vertical shear axis of the mounts. Vibration pickups, monitored with a direct reading meter or oscillograph, shall be mounted on both the dummy load and the input platform.

4.6.3.1 Resonance vibration frequency. To determine conformance to 3.4.2.2, with the mounts installed as specified in 4.6.3, shall be subjected to vibration at 0.06 inch double amplitude over a frequency range of 2 to 60 cps. The frequency range shall be scanned in increments of approximately 1 cps until the amplitude ratio of the dummy load to the input platform is greatest. The resonant vibration frequency is thus determined. Any mount having a resonant vibration frequency within the carrier range of 2 to 7 cps shall be rejected.

4.6.3.1.1 Resonance vibration fatique. To determine conformance to 3.4.2.2.1, with the mounts installed as specified in 4.6.3, the mounts shall be vibrated when the resonant frequency is within the range of 2 to 20 cps as follows: The entire frequency range, from 2 to 60 cps and return to 2 cps, shall be traversed in 7 $\pm$ 1 minutes, including a dwell at resonance of 5 minutes. The range shall be traversed 3 times for a total test period of 21 $\pm$ 2 minutes. If the resonant frequency is above 20 cps, vibration shall be steady state at resonance for a single period of 15 minutes at applicable input. Intermittent dwell testing is permitted to avoid overheating of the elastomeric mounts.

4.6.4 Shock attenuation. To determine conformance to 3.4.2.3, with the two mounts numbers 5 and 6, installed as specified in 4.6.3, the mounts and the dummy load shall form a center of gravity system along the vertical axis. An accelerometer shall be mounted on the dummy load directly over the center of gravity. The entire assembly shall be raised to a height of 12 $\pm$ 1/2 inches and dropped flat to a hard, nonyielding surface. The drop shall be repeated three times. If a shock of more than 12 g's is registered or if there is any evidence of damage resulting from the test, the mounts shall be rejected.

4.6.5 Durability. To determine conformance to 3.4.2.4, with the two mounts numbers 7 and 8, installed and tested as specified in 4.6.4, except that instrumentation shall not be required, the drop height shall be 18 $\pm$ 1/2 inches, and the total number of drops shall be 50. Mount failure or any evidence of damage resulting from the test shall be cause for rejection of the mounts.

4.6.6 Environmental.

4.6.6.1 Accelerated aging. To determine conformance to 3.4.3.1, two mounts numbers 9 and 10, shall be placed in a ventilated oven and subjected to a temperature of 158° to 160°F for a period of not less than 7 days. The mounts shall then be allowed to cool to room temperature and shall be subjected to tests specified in 4.6.1. If the static load deflection characteristics are not within 20% of the original room temperature values and allowable tolerances specified on the applicable drawing, or if the mounts show evidence of damage resulting from the test, the mounts shall be rejected.

4.6.6.2 Low temperature. To determine conformance to 3.4.3.2, with two mounts numbers 11 and 12, prepared for test as specified in 4.6.4, shall be placed in a cold chamber. The entire assembly shall be subjected to a temperature of -38° to -40°F for a period of approximately 16 hours. While still in the cold chamber, at the specified temperature, or within 30 seconds after removal therefrom, the mounts shall be subjected to the test specified in 4.6.4. If the registered shock is more than 25 g's, or if there is any evidence of damage resulting from the test, the mounts shall be rejected.

4.6.6.3 High temperature. To determine conformance to 3.4.3.3, with two mounts numbers 11 and 12, prepare for test as specified in 4.6.4, shall be placed in a ventilated oven. The entire assembly shall be subjected to a temperature of 158° to 160°F for a period not less than 4 hours. The assembly shall then be removed from the oven and the mounts immediately subjected to the test specified in 4.6.4. If the registered shock is more than 12 g's, or if there is any evidence of damage resulting from the test, the mounts shall be rejected.

4.7 Identification and marking. The mounts shall be visually examined to verify conformance to the marking requirements of 3.5.

4.8 Workmanship. Visual examination shall be preformed on each mount of the inspection lot at all phases of inspection testing to verify conformance to requirement 3.6.

4.9 Preparation for delivery. The mounts shall be inspected by the Government at unscheduled intervals to determine if all materials and processes involved in preparation for delivery conform to requirements in Section 5. Sampling inspections shall be limited to those characteristics that can be determined by visual examinations.

5. PACKAGING

5.1 Preservation, packaging, packing, and marking. Preservation, packaging, packing, and marking for the desire level shall be in accordance with the applicable packaging standard or packaging data sheet specified by the contracting authority (see 6.2).

6. NOTES

6.1 Intended use. Mounts furnished under this specification are intended for use in securing major components of military aircraft and vehicles (engines, transmissions, etc.) in reusable shipping containers. The mount functions as a shock absorber and vibration damper between the container and the component mounted therein.

6.2 Ordering data. Procurement documents should specify the following:

a. Title, number, and date of this specification.
b. If first article samples shall not be furnished (see 3.1).
c. If responsibility for inspection shall be other than as specified (see 4.1).
d. If responsibility for inspection equipment shall be other than as specified (see 4.1.1).

e. If test conditions shall be other than as specified (see 4.3).
f. If first article inspection shall not be conducted (see 4.4).
g. Selection of applicable level and packaging standard or packaging data sheet (see 5.1).

6.3 Process average. Sampling may be initiated if the process average value for the first twenty mount assemblies inspected is less than the AQL specified in the classification of defects for major and minor defects.

$$\text{Process average} = \frac{\text{Number of defects}}{\text{Number of mount assemblies}} \times 100$$

If the computed process average exceeds the specified AQL, 100 percent inspection shall be performed and continued until such time that the process average for twenty mount assemblies is less than the specified AQL (see 4.5.2.2).

6.4 Recycled materials. The use of recycled materials which meet the requirements of the applicable material specifications without jeopardizing the intended use of the item shall be encouraged (see 3.3).

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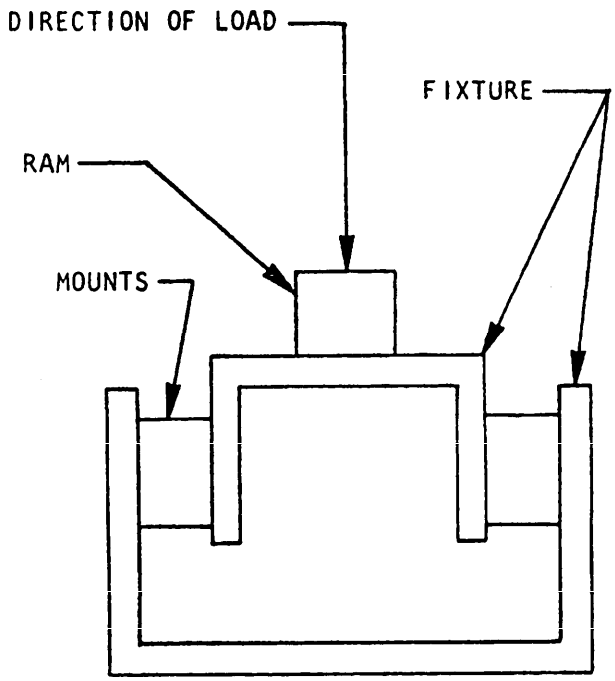

FIGURE 1. Static load deflection.

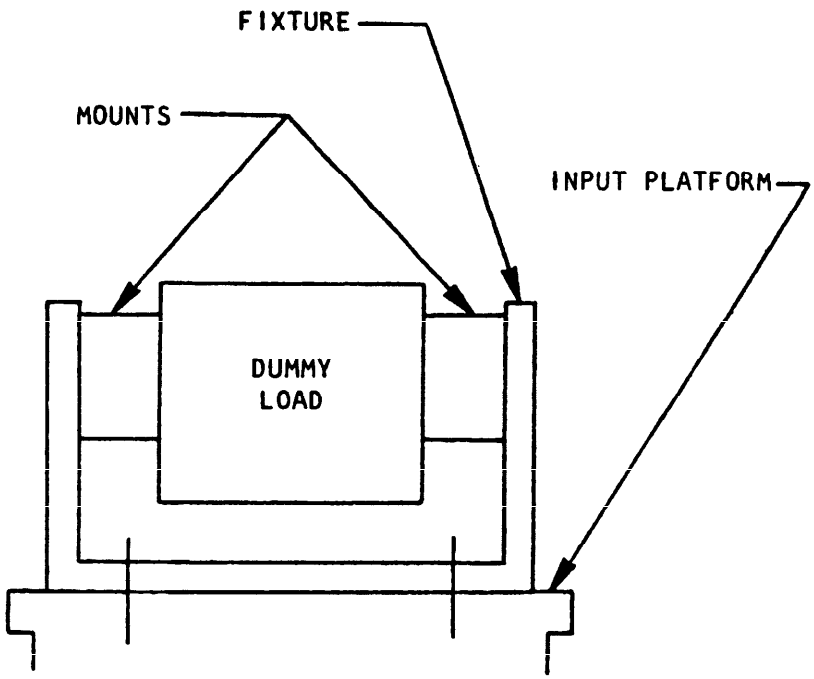

FIGURE 2. Vibration test.

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