SAE INTERNATIONAL

SURFACE VEHICLE RECOMMENDED PRACTICE

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Ambulance Equipment Mount Device or Systems

RATIONALE

This SAE Recommended Practice was developed by members of the SAE Truck Crashworthiness Committee in support of the ambulance industry's need to apply science to the design and testing of the equipment mount devices or systems used in the ambulance patient compartment. The Recommended Practice was validated collaboratively by industry and government partners through extensive testing funded and managed by the National Institute for Occupational Safety and Health, the Department of Homeland Security and the Ambulance Manufacturers Division of the NTEA. Input loading for the dynamic testing was generated using the vehicle specific crash pulses described in SAE J2917 and SAE J2956, respectively. An independent analysis of the testing methodology and resulting data was performed by government and private members of the automotive testing community.

1. SCOPE

This SAE Recommended Practice describes the dynamic and static testing procedures required to evaluate the integrity of an equipment mount device or system when exposed to a frontal or side impact (i.e., a crash impact). Its purpose is to provide equipment manufacturers, ambulance builders, and end-users with testing procedures and, where appropriate, acceptance criteria that, to a great extent, ensure equipment mount devices or systems meet the same performance criteria across the industry. Prospective equipment mount manufacturers or vendors have the option of performing either dynamic testing or static testing. Descriptions of the test set-up, test instrumentation, photographic/video coverage, test fixture, and performance metrics are included.

2. REFERENCES

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1 Applicable Documents

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-806-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

SAE J211-1 Instrumentation for Impact Test - Part 1: Electronic Instrumentation

SAE J211-2 Instrumentation for Impact Test - Part 2: Photographic Instrumentation

SAE J2917 Occupant Restraint and Equipment Mounting Integrity - Frontal Impact System-Level Ambulance Patient Compartment

SAE J2956 Occupant Restraint and Equipment Mounting Integrity - Side Impact System-Level Ambulance Patient Compartment

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
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SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/J3043_201407

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

Center for Advanced Product Evaluation (CAPE) Report CTR06963 – NIOSH Dynamic-Static Factor, March 22, 2013

3. DEFINITIONS

3.1 "Dynamic Amplification Factor": The dynamic amplification factor is a multiplier used to convert the peak dynamic load to an equivalent static load.

3.2 "Equipment Mounting Device or System": A retention system that utilizes a temporary or permanent means of fixation, which may have fixed or adjustable positions. Also includes all hardware provided for holding the intended device(s).

3.3 "Fracture" means cracking or tearing of the equipment mount system.

3.4 "Load Bearing" means any component of the equipment mounting device or system, hardware and fixtures, or litter-mounted device or system that is required to maintain the equipment in a secured position.

3.5 "Load Path" means a series of load bearing components.

3.6 "Mounting Hardware": Fasteners and other associated components that are used to affix an equipment mounting device or system to the interior of an ambulance or to a litter.

3.7 The "Peak Acceleration" is the maximum "g" loading for the applicable pulse corridor as described in either SAE J2917 or SAE J2956.

3.8 "Test Analog/Device": A rigid inert structure that represents the physical dimensions, weight and center of gravity in all axes of the equipment for which the mounting device or system was designed to restrain. It provides connection points to attach to the intended mounting device or system that match those found on the actual piece of equipment to be mounted in the equipment mounting device or system.

3.9 The "Quasi Static Applied Load (QSAL)" is the load to be applied in the static test of an equipment mounting device or system in lieu of a dynamic test. The QSAL is defined mathematically as the Equipment Weight times the Peak Acceleration times the Dynamic Amplification Factor

4. DYNAMIC TEST REQUIREMENTS

Equipment mounting device or system shall be tested using the pulse corridors defined in SAE J2917, Occupant Restraint and Equipment Mounting Integrity – Frontal Impact System-Level Ambulance Patient Compartment and/or SAE J2956, Occupant Restraint and Equipment Mounting Integrity – Side Impact System-Level Ambulance Patient Compartment. The equipment mounting device or system will then be evaluated in accordance with section 8.

5. DYNAMIC TEST CONDITIONS

The following conditions apply:

5.1 Due to the large number of mounting locations for each mounting device or system, a rigid sled test fixture shall be used. For example, a horizontal surface would represent a countertop or floor mount while a vertical surface would represent a wall.

5.2 These tests are considered destructive therefore, deformation and fracture shall be expected and considered acceptable within the criteria of Section 8. At the option of the manufacturer, a new production equipment mounting device or system may be used in each test attitude.

6. DYNAMIC TEST PROCEDURES

The equipment mounting device or system manufacturer is responsible for determining all recommended product or product mount orientations relative to the patient compartment of the ambulance. In lieu of testing all orientations, the equipment mount device or system manufacturer may determine the worst case orientation to be tested where other orientations can be shown sufficient by comparative analysis. In most cases a minimum of two tests (tension and shear) should be anticipated. The exception would be a completely symmetrical installation such as a cylindrical pole mount.

6.1 Install the equipment mounting device or system directly to the sled device as described in the manufacturer's instructions. Preservation of the mount design intent must be maintained in order to replicate performance when mounted in an ambulance or to a litter.

6.2 Install test analog/device per manufacturer provided instructions.

6.3 For equipment mounting devices or systems that retain compressed gas cylinders, such as oxygen tanks or fire extinguishers, the installed cylinders should be made non-volatile or an analog device of equivalent weight shall be used.

6.4 Test in accordance with dynamic sled test facility protocol to achieve dynamic loading as defined in SAE J2917 and/or SAE J2956.

7. POST DYNAMIC-TEST INSPECTION

7.1 Inspect the equipment mounting device or systems structure and hardware for evidence of material fracture and deformation. Any instances of deformation or fracture should be noted in the report through photos. Parts breaking free from the equipment mounting device or system should also be documented through photos and noted in the report.

7.2 It should be noted if the equipment or test analog/device was retained in the equipment mounting device or system.

7.3 It should be noted if the equipment mounting device or system and tested analog or device remained fastened to the sled test fixture or surface.

8. DYNAMIC TEST ACCEPTANCE CRITERIA

The following acceptance criteria are applied per Section 4 REQUIREMENTS to determine the "pass" or "fail" state of the test.

8.1 Deformation and displacement of equipment mounting device or system, installed equipment, or analog device is acceptable.

8.2 Fracture is acceptable as long as load bearing components are not completely detached or fully severed.

8.3 Equipment mounting device or system shall retain the equipment or analog device for the duration of the test.

8.4 Data resulting from instrumentation installed per a manufacturer's request will NOT be a part of the pass/fail criteria associated with this testing procedure.

9. STATIC TEST REQUIREMENTS

If a prospective equipment mount device or system manufacturer or vendor chooses the option to perform static tests on an equipment mount device or system, the equipment mounting device or system shall be tested to the quasi-static applied load (QSAL) calculated as follows:

QSAL = Equipment Weight x Peak Acceleration x Dynamic Amplification Factor

The Dynamic Amplification Factor shall be 1.5. The equipment mounting device or systems will be evaluated in accordance with Section 13. The mounting device or system shall comply with the following:

9.1 The equipment or analog shall be retained in the equipment mount device or system.

9.2 The equipment mounting device or system shall remain attached to the test surface.

10. STATIC TEST CONDITIONS

The following conditions apply:

10.1 Due to the large number of mounting locations for each mounting device or system, a rigid test fixture shall be used. For example, a horizontal surface would represent a countertop or floor mount while a vertical surface would represent a wall.

10.2 These tests are considered destructive; therefore, deformation and fracture shall be expected and considered acceptable within the criteria of Section 13. At the option of the manufacturer, a new production equipment mounting device or system may be used in each test attitude.

11. STATIC TEST PROCEDURES

Mounting devices or systems that are temporary or permanent mounts with fixed or adjustable positions are to be tested as described below. Each mounting device or system shall be capable of meeting the requirements of Section 9. The equipment mounting device or system manufacturer is responsible for determining all recommended product or product mount orientations relative to the patient compartment of the ambulance. Each product must pass in all possible orientations offered by the manufacturer. In lieu of testing all orientations, the equipment mount device or system manufacturer will determine the worst case orientation to be tested where other orientations can be shown sufficient by comparative analysis.

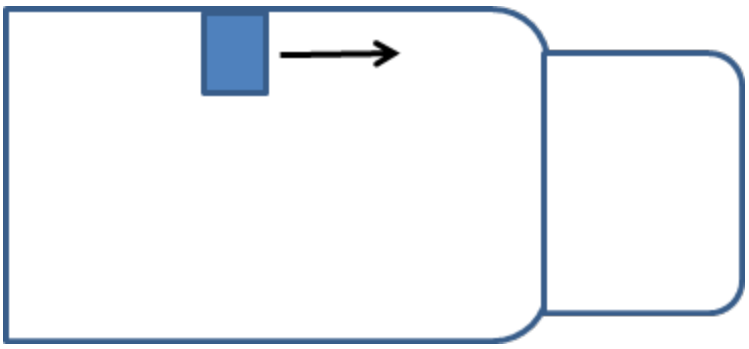
11.1 Install the mounting device or system and test analog or device into the mount as described in the manufacturer's instructions. It is recommended a new mount be used for each test.

11.2 Attach a cable with a calibrated in-line gauge to the test analog or device at a point representing the center of gravity of the equipment being tested.

11.3 For all quasi-static test cases, the peak quasi-static applied load (QSAL) shall be calculated as follows:

QSAL = Equipment Weight x Peak Acceleration x Dynamic Amplification Factor

EXAMPLE: The illustration below is the top view of an ambulance and is showing a 10 lb. piece of equipment mounted on a wall. The equipment is experiencing loading due to a frontal impact:



10 lbs. X 22.5 G (peak acceleration derived from SAE J2917) X 1.5 (Dynamic Amplification Factor) = 337.5 lbs. QSAL required

11.4 Apply the load to the test analog/device/asset to achieve the QSAL in no less than 30 seconds. When the QSAL has been attained; hold that load for a minimum of 5 seconds.

11.5 Release applied load, to achieve 0 lbs. in no more than 10 seconds.

11.6 Record the maximum quasi static applied load and any deformation or fracture of the equipment mounting device or system.

11.7 Replace damaged part(s), hardware, or entire mounting device or system as necessary for each test direction.

11.8 Evaluate the mounting device or system's performance as described in Sections 9 and 13.

11.9 Repeat the quasi static testing as described in paragraphs 11.1 - 11.8 to certify the installation of the equipment mounting device or system in each mounting attitude offered by the manufacturer. Note: The manufacturer shall determine all potential locations the equipment may be mounted in the ambulance with their concurrence and therefore the applicable quasi-static applied load. Examples include:

11.9.1 Mounted on a side wall or other side facing surface.

11.9.2 Mounted on the front bulkhead or other rear facing surface.

11.9.3 Mounted on the rear wall or other forward facing surface.

11.9.4 Mounted on a horizontal countertop or floor-like surface.

11.10 Record all resultant data.

12. POST STATIC-TEST INSPECTION

12.1 Inspect equipment mounting device or system structure and hardware for evidence of material fracture and deformation. Any instances should be noted in the report through photos of the deformation or fracture. Parts breaking free from the equipment mounting device or system should also be documented through photos and noted in the report.

12.2 It should be noted if the equipment or test analog or device was retained in the equipment mounting device or system.

13. STATIC TEST ACCEPTANCE CRITERIA

The following acceptance criteria are applied per Section 9 REQUIREMENTS to determine the "pass" or "fail" state of the test.

13.1 Deformation and displacement of equipment mounting device or system, installed equipment, or analog device is acceptable.

13.2 Fracture is acceptable as long as load bearing components are not completely detached or fully severed.

13.3 Equipment mounting device or system shall retain the equipment or analog device for the duration of the test.

13.4 Data resulting from instrumentation installed per a manufacturer's request will NOT be a part of the pass/fail criteria

14. NOTES

14.1 Marginal Indicia

A change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

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