SAE INTERNATIONAL

SURFACE VEHICLE RECOMMENDED PRACTICE

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Occupant Restraint and Equipment Mounting Integrity – Side Impact Ambulance Patient Compartment

RATIONALE

This revision updates the titling to eliminate the term “System-Level” from the document. It adds a reference to SAE J1727 in section 2.1.1, data processing in accordance with SAE J1727 in section 5, and adds a requirement to utilize SAE J211-2 in section 6, Photographic Instrumentation. Further, it expands section 4 to allow component-level testing in addition to system-level testing to be consistent with changes made to SAE J2418. Finally, it provides additional references in section 2.2 which describe the testing used to develop the pulse curves described in section 4.2.

1. SCOPE

This SAE Recommended Practice describes the test procedures for conducting side impact occupant restraint and equipment mounting integrity tests for ambulance patient compartment applications. Its purpose is to describe crash pulse characteristics and establish recommended test procedures that will standardize restraint system and equipment mounting testing for ambulances. Descriptions of the test set-up, test instrumentation, photographic/video coverage, and the test fixtures are included.

2. REFERENCES

2.1 Applicable Documents

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

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (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 J1727 Calculation Guidelines for Impact Testing

SAE Engineering Aid 23 “Users’ Manual for the 50th-Percentile Hybrid-III Test Dummy,” June 1985

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2.2 Other Publications

Code of Federal Regulations, Title 49, Part 571.208. Occupant Crash Protection.

Code of Federal Regulations, Title 49, Part 571.214. Side Impact Protection.

Code of Federal Regulations, Title 49, Part 572. Anthropomorphic Test Devices.

Current, R., Moore, P., Green, J., Yannaccone, J. et al., "Crash Testing of Ambulance Chassis Cab Vehicles," SAE Technical Paper 2007-01-4267, 2007, doi:10.4271/2007-01-4267

IIHS Side Impact 2001 Ford E-350 Type II Ambulance, Curb Side, Published by NTIS #PB2013102946

IIHS Side Impact 2001 Ford E-350 Type II Ambulance, Street Side, Published by NTIS #PB2013102947

IIHS Side Impact 2006 Ford F450 Type III Ambulance, Curb Side, Published by NTIS #PB2013102948

IIHS Side Impact 2006 Ford F450 Type III Ambulance, Street Side, Published by NTIS #PB2013102949

3. ANTHROPOMORPHIC TEST DEVICES

For the dynamic tests described in the following sections, restraint systems should be evaluated with the aid of an Anthropomorphic Test Device (ATD). The ATD should be of a type that will closely represent the size, weight, and articulation characteristics of a 50th percentile male in a seated position. Examples of such an ATD include the Hybrid-III and Euro SID2 with rib extensions 50th percentile male ATD. The ATD should be selected appropriately based on the orientation of the seat relative to the direction of travel and the purpose of the test. The physical characteristics of these ATD's are described in 49 CFR 572 subparts E and U.

Applicable measurement capabilities of the Hybrid-III 50th percentile male ATD are described in 49 CFR 571.208 and applicable measurement capabilities of the Euro SID2-re 50th percentile male ATD are described in 49 CFR 571.214.

ATDs of other sizes (i.e., 95th-percentile male, 5th-percentile female, etc.) may be used to evaluate restraint system performance for various occupant sizes.

4. DYNAMIC SLED TESTS

For component-level restraint system tests, only the subject seat or patient cot, and associated restraint system hardware are installed on the test sled fixture. No other patient compartment components need to be installed on the test sled fixture. Proper restraint anchorage geometry, relative to the seat or patient cot, should be maintained. Tethers should be set according to the manufacturer's specifications. The primary purpose of component-level testing is to evaluate seat or patient cot structural integrity, restraint component performance and occupant excursion when subjected to vehicle deceleration from a representative side impact crash pulse. Component-level testing is also appropriate to evaluate equipment mounting system integrity and cabinet content retention.

For system-level restraint system tests, all interior patient compartment components that are potential occupant contact surfaces (cabinets, countertops, patient cots) shall be installed on the test sled where practical. Proper geometry relative to the components being tested should be maintained. Wherever practicable, actual production components should be used. If not, components with performance characteristics near those expected for production should be used. Seat or patient cot tethers should be set according to the manufacturer's specifications. The primary purpose of system-level testing is to evaluate restraint system performance, seat or patient cot structural integrity, occupant excursion, equipment mounting integrity, and occupant interaction with interior components when subjected to a representative side impact crash pulse.

4.1 Test Fixture

For the side impact tests, a sled fixture mounted on a uni-directional tracking system is required. Typical sled fixture systems are of the deceleration and acceleration types. For the deceleration system, the sled fixture is accelerated to a desired speed and then decelerated through the programmed pulse via energy-absorbing methods (i.e., honeycomb, extruded steel rods, etc.). For the acceleration system, the programmed pulse is applied as a rearward acceleration to the sled fixture, which is initially at rest.

4.2 Side Impact Sled Pulse Specification

For side impact tests, a sled deceleration pulse is applied perpendicular to the vehicle longitudinal axis. The pulse profile must fall within the corridor delineated by the plots in Figure 1 and the values in Table 1. Total velocity change during the test shall be 15 mph ± 1 mph.

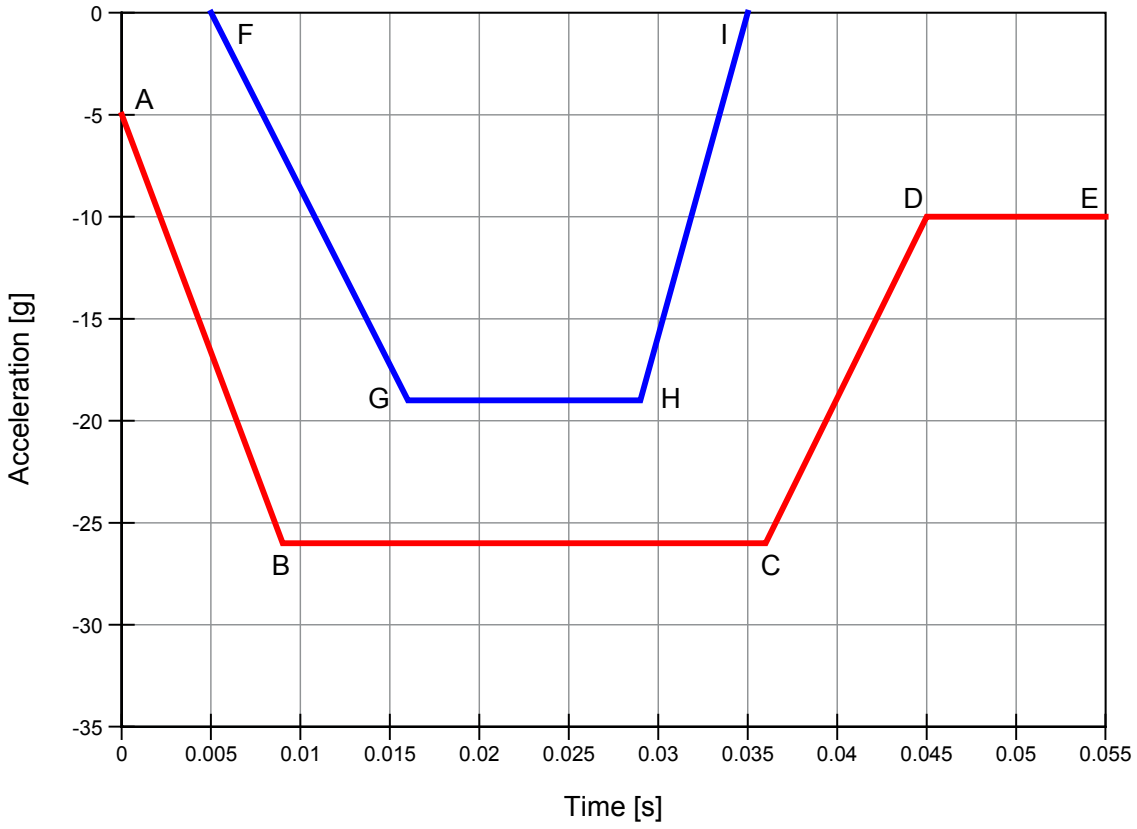

Figure 1 - Dynamic sled corridor

Table 1 - Dynamic sled corridor break points

Position	Time (sec)	Acceleration (g)
A	0	-5.0
B	0.009	-26.0
C	0.036	-26.0
D	0.045	-10.0
E	0.055	-10.0

Position	Time (sec)	Acceleration (g)
F	0.005	0.0
G	0.016	-19.0
H	0.029	-19.0
I	0.035	0.0

4.3 Anthropomorphic Test Device (ATD) Positioning

ATD positioning procedures for this testing should be consistent with the positioning procedures outlined in 49 CFR 571.208 and 49 CFR 571.214, where practicable.

5. INSTRUMENTATION

To record the deceleration pulse accelerometers may be mounted to the sled fixture. ATD instrumentation may include any of the measurements mentioned in Section 3. Dynamic seat belt loads may be recorded by installing webbing load transducers on the seat belts. All measurements should be recorded, filtered and processed according to the most recent version of SAE J211-1 and SAE J1727.

6. PHOTOGRAPHIC INSTRUMENTATION

High-speed cameras should be used to document the dynamic tests. The field of view of these cameras should be large enough to document the entire range of motion of the ATD and/or mounted equipment during the deceleration event. Wherever possible, off-board cameras should be used to allow for the use of longer focal-length lenses and, therefore, less lens distortion error when performing analysis of the high-speed footage.

If complete coverage of occupant kinematics is not possible with off-board cameras only, the use of on-board cameras will be required.

Each high-speed camera should operate at a frame rate sufficient to facilitate motion analysis of the film. A minimum frame rate of 500 frames per second is recommended. Sufficient reference targets, both stationary and on the test sled/fixture and ATD, should be provided. Provisions should be made for synchronizing electronic and photographic instrumentation. Wherever possible, the cameras should be mounted such that they are perpendicular to the axis of motion. All video shall be captured and processed according to the most recent version of SAE J211-2.

7. NOTES

7.1 Revision Indicator

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.

PREPARED BY THE SAE TRUCK AND BUS CRASHWORTHINESS COMMITTEE OF THE
SAE TRUCK AND BUS BODY AND OCCUPANT ENVIRONMENT STEERING COMMITTEE