SAE INTERNATIONAL

SURFACE VEHICLE RECOMMENDED PRACTICE

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Superseding J3027 NOV2016

Ambulance Litter Integrity, Retention, and Patient Restraint

RATIONALE

This revision of the Recommended Practice adds a requirement to conduct rear impact testing of the patient cot, cot mount and occupant restraint utilizing the pulse curve described in SAE J3044. In addition, this revision deletes the requirement to utilize an instrumented anthropomorphic test device, or ATD, as the existing pass fail criteria does not rely on the measurement of ATD data. An instrumented ATD may be used at the discretion of component manufacturer(s).

SAE J3027 has been reaffirmed to comply with the SAE Five-Year Review policy.

1. SCOPE

This SAE Recommended Practice describes the testing procedures required to evaluate the integrity of a ground ambulance-based patient litter, litter retention system, and patient restraint when exposed to a frontal, side or rear impact. Its purpose is to provide litter manufacturers, ambulance builders, and end-users with testing procedures and, where appropriate, acceptance criteria that, to a great extent ensures the patient litter, litter retention system, and patient restraint utilizes a similar dynamic performance test methodology to that which is applied to other vehicle seating and occupant restraint systems. 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

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.

2.1.1 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 J2856 Users' Manual for the 50th-Percentile Hybrid-III Dummy

SAE J1727 Calculation Guidelines for Impact Testing.

SAE J1733 Sign Convention for Vehicle Crash Testing

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
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SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/J3027_202206/

SAE J2570 Performance Specifications for Anthropomorphic Test Device Transducers

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

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

SAE J3044 Occupant Restraint and Equipment Mounting Integrity – Rear Impact Ambulance Patient Compartment

SAE ARP5482 Photometric Data Acquisition Procedures for Impact Test

2.2 Related Publications

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

Code of Federal Regulations, Title 49, Part 572.

3. DEFINITIONS

3.1 LITTER

A wheeled patient transport device affixed using a litter retention system. This does not include wheelchairs, stair chairs, transport chairs, backboards, incubator transport cots, or carry stretchers.

3.2 LITTER RETENTION SYSTEM

A system that provides means for securing a litter to the floor and/or side wall of an ambulance.

3.3 ANTHROPOMORPHIC TEST DEVICES (ATD)

A biofidelic test device which represents a variety of human forms and sizes including men, women, and children. Physical characteristics of the ATD are described in 49 CFR 572.

3.4 LITTER-BASED PATIENT RESTRAINT SYSTEM

The patient–restraining members and the attaching hardware provided by the litter manufacturer as original equipment.

3.5 FRACTURE

The cracking or tearing of litter or litter retention system.

3.6 LOAD BEARING

Any component of the litter, litter retention system, and patient restraint system that is required to secure both the ATD to the litter and the litter to the floor.

3.7 LOAD PATH

A series of load bearing components.

3.8 FOWLER

The adjustable backrest of the litter.

4. REQUIREMENTS

Each litter, litter retention system, and litter-based patient restraint shall be capable of meeting the requirements set forth under this standard when tested in accordance with test conditions and procedures outlined in SAE J2917, Occupant Restraint and Equipment Mounting Integrity – Frontal Impact Ambulance Patient Compartment, SAE J2956, Occupant Restraint and Equipment Mounting Integrity – Side Impact Ambulance Patient Compartment and SAE J3044, Occupant Restraint and Equipment Mounting Integrity – Rear Impact Ambulance Patient Compartment. The ATD used for all test procedures contained in SAE J2917, SAE J2956 and SAE J3044 shall be the Hybrid III 50th percentile male, with abdomen and pedestrian pelvis.

5. TEST CONDITIONS.

The following conditions apply:

5.1 The rigid sled test platform shall be in a horizontal plane.

5.2 These tests are considered destructive tests. At the option of the manufacturer, a new production litter, litter retention system, and litter-based patient restraint may be used for each individual test.

5.3 A 50th percentile male Hybrid III ATD, with abdomen and pedestrian pelvis, shall be used in each test. Recommended instrumentation is described in Appendix A, Table 1. The Injury Assessment Reference Values (IARVs) established for other automotive test applications are recommended as guidance only for patient litter developers. As research evolves to better understand injury mechanisms of the supine occupant, application specific IAVRs may be established.

5.4 Upon request from the manufacturer, uni-axial accelerometers may be installed on the rigid floor structure within 5 inches of both the fore and aft litter attachment points oriented in line with the primary axis for the ensuing test. Likewise, accelerometers may be installed on structural member(s) of the litter as needed for data gathering per consultation / recommendation with the equipment manufacturer of the sample being tested.

5.5 All digital instrumentation channels shall meet the performance requirements of SAE J211-1 Instrumentation for Impact Test. Examples include accelerometer orientation, filter frequencies and sampling rate and calibration metrics. Optical channels shall meet the performance requirements of SAE J211-2 Instrumentation for Impact Test--Part 2: Photographic Instrumentation. If an instrumented ATD is utilized, instrumentation shall meet the performance requirements described in SAE J2570 Performance Specifications for Anthropomorphic Test Devices. All data acquisition channel polarities shall be set in accordance with SAE J1733, Sign Conventions for Vehicle Crash Testing. The numerical methods used to process impact test data such as the calculation of Head Injury Criteria (HIC) or N_{ij} shall be performed in accordance with the guidance provide in SAE J1727 Calculation Guidelines for Impact Testing.

5.6 A motion capture, grid system or other methodology shall be used to accurately measure ATD motion as outlined below. (Note: If a motion capture or grid system is used, the test facility will need to compensate for the distance and angle of the grid system relative to the ATD to minimize the effects of lens distortion, parallax error, correct for measurement in different planes, and other potential optical measurement errors. Use common photogrammetric methods as described in SAE J211-2 and SAE ARP5482, as applicable.)

5.6.1 The grid system shall be constructed on a rigid surface that is placed and attached to the sled at 90 degrees in the background of the viewing camera.

5.6.2 The grid system shall consist of a series of horizontal and vertical lines constructed to form a series of 1” X 1” squares to analyze captured 2-D motion. Products such as ‘inch tape’ are acceptable for construction of the grid system.

5.6.3 In addition to the grid system, a “go/no-go” method should be utilized to be able to visually determine if the longitudinal excursion limit has been reached. The “go/no-go” limit shall be placed 14 inches from the leading edge of the litter.

5.6.4 Figure 1, shown below, shall be used for definition of litter orientation, reference axis, and longitudinal excursion measurement.

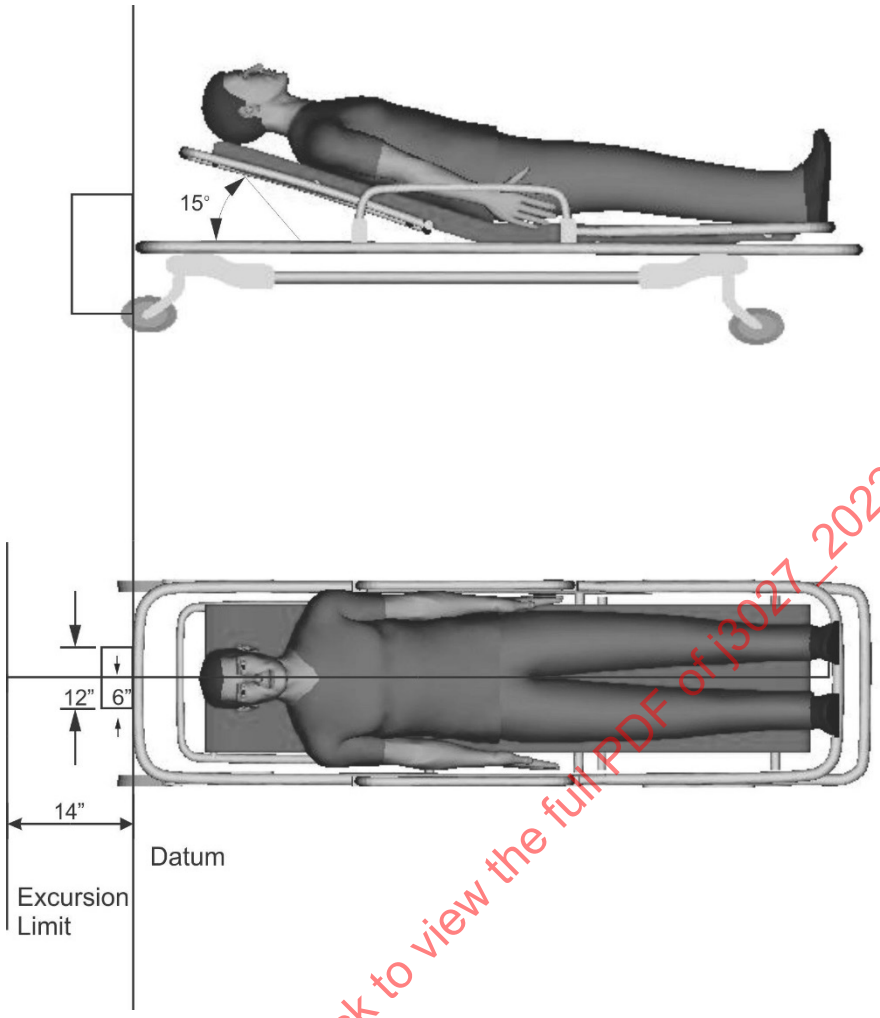

Figure 1

5.7 The camera system shall be placed such that lateral excursion of the ATD beyond the edge of the litter shall be measured and provided as part of the manufacturer's dataset when the load application is perpendicular to the side of the patient litter. The location of the reference plane or "Lateral Edge Reference" shall be provided by the manufacturer. The maximum lateral excursion shall be defined as the distance from the outer edge of the litter structure to the maximum travel point for the outer edge of the ATD's head. The data package will include the head path as depicted in Figure 2.

5.8 Measurement of occupant excursion to the rearmost edge of the litter is not required.

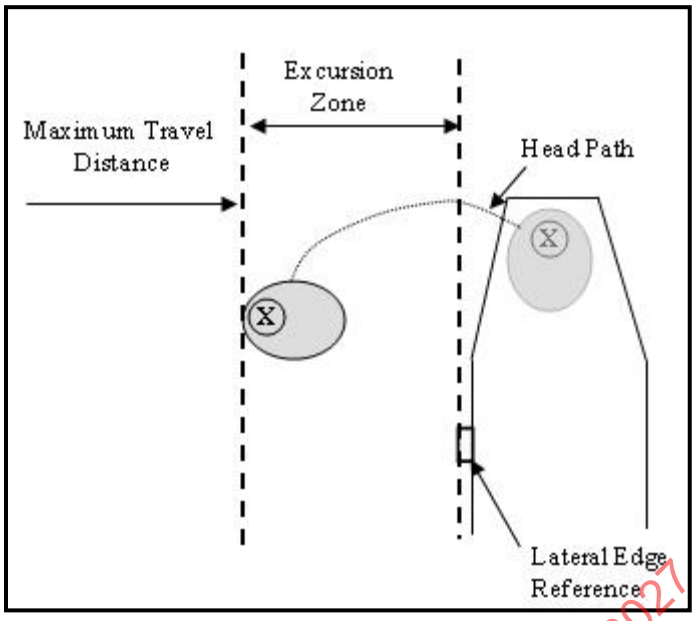

Figure 2

6. TEST PROCEDURES

6.1 Complete all pre-test checklist items identified in Appendix B, Table 1, as appropriate.

6.2 Install litter retention system as provided by manufacturer to sled device.

6.3 Install litter per manufacturer provided instructions.

6.4 Place ATD on litter.

6.4.1 Before restraining the ATD on the litter, place a 24” long x 21” wide x 3/16” thick smooth rubber pad made of Neoprene Shore 60A material over the chest region of the ATD and under the garment. The pad should cover the chest cavity and pelvic region of the ATD. Be sure to tape completely so the rubber is secured during the test. This is done to prevent the restraint system from catching the mid portion of the ATD during the test event.

6.4.2 A flexible material shall also be wrapped and taped over the knee joints of the ATD to prevent belts from intruding on knee joints during the test events.

6.4.3 Positioning of the ATD on the litter shall be consistent with the following procedures.

6.4.3.1 Place the ATD on the litter so that it is positioned according to manufacturer specifications longitudinally.

6.4.3.2 Laterally, the head cg shall be located +/- 0.5 inch from the centerline of the cot unless otherwise specified by the manufacturer.

6.4.3.3 If belt load cells are to be used, install them prior to initiating belt tightening procedures.

6.4.3.4 Place a 24” long x 12” wide x 1/2” thick smooth rubber pad made of Neoprene Shore 90A material on top of the ATD’s chest cavity.

6.4.3.5 Set the fowler angle at 15 degrees, +2/-0 degrees relative to horizontal with ATD in place.

6.4.3.6 Manually tighten the belts as much as possible. A mechanical device shall not be used to increase belt tension.

6.4.3.7 Place a witness mark on each of the belts once they are tight (the belts will shift slightly otherwise).

6.4.3.8 Release the belt system and remove the rubber pad installed in step 6.4.3.4 from between the belts and ATD.

6.4.3.9 Buckle the restraint system normally and restore the belt lengths to the previously placed witness marks.

6.4.3.10 To record any belt slippage during testing, it is recommended to incrementally mark each belt with 1" lines up to 5".

6.4.3.11 Secure any remaining slack in the occupant restraint webbing so as to not interfere with the camera views.

6.5 Instrument litter and litter retention system per Appendix A, Table 1 requirements for each test, individually.

6.6 Check the fowler angle. If required, reset litter fowler to a 15 degree angle, +2/-0 degrees relative to horizontal with ATD in place.

6.7 If high speed motion capture is used, it is recommended that video camera coverage be sufficient to allow for post-test analysis of excursion values. Further, it is recommended that at least 2 side view cameras and one overhead camera be utilized. The cameras should allow for sufficient side-to-side coverage to be able to capture the full ATD movement. If motion capture is used to monitor the excursion of the ATD, at least one camera must be specifically targeted to monitor the excursion limit identified jointly by the manufacturer and test facility. Use common photogrammetric methods as described in SAE J211-2 and SAE ARP5482, as applicable.

6.8 Pretest photos will be taken to document the location of the ATD and restraint systems as described in Appendix B.

6.9 Test in accordance with dynamic sled test facility protocol to achieve dynamic loading as defined in SAE J2917, SAE J2956 and SAE J3044, as appropriate.

6.10 Verify proper recording of instrumented data within the data acquisition system. It is recommended that data processing of items such as head, chest and pelvis 3ms peak and resultant accelerations and the calculation of HIC, be accomplished by the test facility and be provided with the electronic data at the completion of each test event.

7. POST TEST INSPECTION

7.1 Complete all post-test checklist items identified in Appendix B, as appropriate.

7.2 Post-test photos will be taken to document location of ATD and restraint systems.

7.3 Visually inspect litter, litter retention system and litter-based patient restraint system for evidence of material fracture, deformation or tearing. Any instances should be noted in the report through photos.

7.4 Maximum head excursion shall be recorded. (Inches measured from the leading edge of the head of the ATD with respect to original datum as defined in Figures 1 and 2.)

8. 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 parts is acceptable.

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

8.3 Litter retention system shall retain the litter for the duration of the test.

8.4 Litter-based patient restraint system shall retain the ATD for the duration of the test.

8.5 Total longitudinal excursion of the ATD head off the foremost end of the cot shall not exceed a maximum of 14” as measured from a point on the test fixture floor, located at the intersection of the longitudinal centerline of the litter and a transverse, vertical plane, tangent to the foremost edge of the litter frame that resides within 6” of the longitudinal centerline. See Figure 1.

8.6 There is no defined limit or maximum lateral or rearward excursion distance in this Recommended Practice.

9. NOTES

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

APPENDIX A

Table A1 – Recommended instrumentation

		No. of Data Channels	
Description of Parameter	Sensor Type	Impact Parallel to Longitudinal Centerline of litter	Impact Parallel to Lateral Centerline of litter
Floor Structure, Primary Axis – Forward Attachment	Accelerometer	1	1
Floor Structure, Primary Axis – Aft Attachment	Accelerometer	1	1
Litter, Primary Axis – Forward Structure (optional – see S5.4)	Accelerometer	1	1
Litter, Primary Axis – Aft Structure (optional – see S5.4)	Accelerometer	1	1
Litter to Vehicle Attaching Bolts (optional)	Load Cell	(variable, based on number of fasteners)	(variable, based on number of fasteners)
Head Gx	Accelerometer	1	1
Head Gy	Accelerometer	1	1
Head Gz	Accelerometer	1	1
Thorax Gx	Accelerometer	1	1
Thorax Gy	Accelerometer	1	1
Thorax Gz	Accelerometer	1	1
Pelvis Gx	Accelerometer	1	1
Pelvis Gy	Accelerometer	1	1
Pelvis Gz	Accelerometer	1	1
Upper Neck Fx	Load Cell	1	-
Upper Neck Fy	Load Cell	1	-
Upper Neck Fz	Load Cell	1	-
Upper Neck Mx	Load Cell	1	-
Upper Neck My	Load Cell	1	-
Upper Neck Mz	Load Cell	1	-
Chest Deflection	Potentiometer	1	1