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SURFACE VEHICLE RECOMMENDED PRACTICE

An American National Standard

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Free Motion Headform Impact Tests of Heavy Truck Cab Interiors

1. ***Scope—***This SAE Recommended Practice describes the test procedures for conducting free motion headform testing of heavy truck cab interior surfaces and components. A description of the test set-up, instrumentation, impact configuration, target locations, and data reduction is included.

2. ***References***

2.1 **Applicable Publications—**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, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J211-1—Instrumentation for Impact Test—Part 1: Electronic Instrumentation
SAE J211-2—Instrumentation for Impact Test—Part 2: Photographic Instrumentation
TP-201U-00—Laboratory Test Procedure for FMVSS 201—Occupant Protection in Interior Impact, Upper Interior Head Impact Protection
SAE CRP-9—"Heavy Truck Crashworthiness Testing and Analysis for Recommended Practice Development", November 1996

3. ***Test Set-Up***

3.1 **Free Motion Headform—**The free motion headform is a 10-lb modified Hybrid III dummy head with the nose removed that conforms to the specifications of TP-201U-00.

3.2 **Impact Zone—**The free motion headform is impacted with the interior components such that impact occurs within the forehead impact zone. This impact zone consists of a 100 mm (4 in) by 125 mm (5 in) rectangular area on the forehead of the free motion headform as described in TP-201U-00, Section 11.4.

3.3 **Test Temperature Conditions—**The free motion headform must be within the temperature range of 19 °C to 26 °C (66 °F to 78 °F) at any relative humidity between 10% and 70%. The free motion headform must be soaked in an ambient air environment in the specified range for a minimum of 4 h prior to the test.

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4. ***Instrumentation—***The instrumentation requires measurement of time, three accelerations, and the time when the headform contact occurs. Analog data is prefiltered (Class 1000) and then digitized at a minimum rate of 8 000 samples per second.

4.1 **Time System—**A precision time system compatible with the test equipment shall be used to provide a time reference for all recorded data.

4.2 **Accelerometers—**Three accelerometers shall be installed in the head cavity to measure orthogonal accelerations (a_x, a_y, and a_z) at the center of gravity of the free motion headform. The three accelerometers shall be mounted in an orthogonal array, and the intersection of the planes containing the sensitive axis of the three sensors will be the origin of the array. Each data channel will be comprised of a sensor, signal conditioner, data acquisition device, and all interconnecting cables, and must conform to the requirements of the most recent version of SAE J211-1 and SAE J211-2, with data Class 1000 for head acceleration data.

4.3 **Event Time—**A system that identifies the precise instant of headform contact will be incorporated with the time reference signal. The system should not effect the response of the free motion headform impact with the interior component.

5. ***Impact Configuration—***Any means of propelling the headform can be used as long as the impactor design is capable of impacting the selected target at a minimum velocity of 24 km/h (15 mph). The impactor must be able to launch the headform from inside the vehicle at the desired approach angle. At the time of launch, the midsagittal plane of the headform is vertical and the headform upright. The headform shall travel freely through the air, without rotation, along a velocity vector perpendicular to the headform's skull cap plate, not less than 25 mm (1 in) before making contact with the vehicle target. The free motion headform MUST travel in free flight at least 25 mm (1 in) prior to impact. The forehead impact zone must contact the target circle at the time of initial contact. A single test vehicle may be impacted multiple times subject to the following:

a. Impacts with 300 mm (12 in) of a prior impact may not occur less than 30 min apart.
b. No impacts may occur with 150 mm (6 in) of any other impact.
c. The distance between impacts is measured from the center of the target circles along the vehicle interior surface.
d. Allow at least 3 h between successive impacts on the same headform.

6. ***Target Locations—***It is recommended that targets be chosen on the following interior components;

a. Roof Side Rail
b. Front Header
c. Rear Header
d. Cab Roof
e. Dashboard or Instrument Panel
f. Steering Wheel Rim
g. Steering Wheel Hub
h. A - Pillar
i. B - Pillar
j. Upper Seat Belt Anchor for Torso Belt

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7. ***Data Reduction—***As the data is recalled for integration or plotting, the appropriate filter is applied. The filters are in accordance with SAE J211-1 and SAE J211-2. Velocity and displacement data is plotted after application of an SAE Class 180 filter. Before plotting, the event time must be determined from the event time system. When a velocity or displacement trace is to be plotted, integration for the appropriate acceleration signal is performed digitally.

7.1 **Impact Speed—**The impact speed will be determined by integrating the free motion headform x-axis acceleration (acceleration perpendicular to headform's skull cap plate).

7.2 **Head Injury Criterion (HIC)—**The HIC(d) is calculated in accordance with TP-201U-00, Section 2.

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