SAE International™

SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J2420

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COE Frontal Strength Evaluation—Dynamic Loading Heavy Trucks

1. *Scope*—This SAE Recommended Practice describes the test procedures for conducting a dynamic frontal strength test for COE heavy truck applications. Its purpose is to establish recommended test procedures which will standardize the procedure for heavy trucks. Descriptions of the test set-up, test instrumentation, photographic/video coverage, and the test fixtures are 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—Electronic Instrumentation
SAE J211-2—Instrumentation for Impact Test—Photographic Instrumentation
SAE J826—Devices for Use in Defining and Measuring Vehicle Seating Accommodation
SAE J1516—Accommodation Tool Reference Point
SAE CRP-9—"Heavy Truck Crashworthiness (Statistics, Accident Reconstruction, Occupant Dynamics Simulation)", March 1995.
SAE CRP-13—"Heavy Truck Crashworthiness (Phase III)," November 1996.

2.1.2 OTHER PUBLICATIONS

ECE Regulation 29: Uniform Provisions Concerning the Approval of Vehicles with Regard to the Protection of the Occupants of the Cab of a Commercial Vehicle.

3. *Definitions*

3.1 Platen—A structurally stiff, flat plate.

3.2 Cab Mount—The component or components used to connect the cab to the chassis frame rails.

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4. ***Test Configuration—***The COE frontal strength test is designed to evaluate the resistance of a COE vehicle in an impact into the rear of a heavy truck trailer. The rear of the trailer is simulated as a rigid surface. With the cab attached to the ground through its cab mounts, a platen is forced to longitudinally move into the cab with the inertia of the platen and the structure carrying it. This loading configuration is shown in Figure 1.

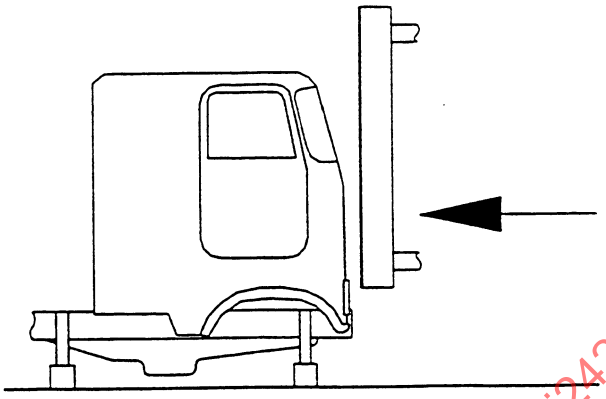

FIGURE 1—COE FRONTAL STRENGTH TEST CONFIGURATION

4.1 **Cab Mounting—**The cab shall be evaluated with its standard cab mounts. The cab mounts shall either be mounted to the vehicle's stock frame rails or to a simulated chassis that locates the cab mounts in their standard location and orientation. If testing is conducted using actual frame rails, the frame rails shall be rigidly attached to the ground. The forward attachment to the ground shall be not less than 15 cm (6 in) rearward of any front bumper or cab mounting hardware. If a simulated chassis is used, it shall not deform during the test. Hardware used to attach the cab mounts to the simulated chassis shall be the same type and strength as the standard hardware used to attach the cab mounts to the standard chassis.

Cab mounts employing pneumatic ride control should be pressurized to produce the manufacturer recommended ride height.

If the influence of the engine is to be included in the evaluation, it must be attached to the frame rails or simulated chassis with the stock mounting hardware. Space should be provided to allow for movement of the engine and transmission without interference with the test fixture or simulated chassis.

If the vehicle always includes a body or other structural member that will influence the cabs rearward longitudinal motion, the body or structure may be included on the simulated chassis. Care should be taken to insure that only the structural members always on the vehicle provide the load path to ground. Test fixtures should not influence the motion of the vehicles standard equipment.

4.2 **Platen—**A rigid platen simulates the rear of a heavy truck trailer. The height of the bottom of the platen is defined by the position on the cab that would first contact the lower structure of a trailer. For the vehicle at curb conditions, the position on the front of the cab 117 cm (46 in) above the ground defines the height of the platen. This is shown in Figure 2. The platen should be tall and wide enough so that the entire front of the cab is engaged, up to a width of 259 cm (102 in). The face of the platen is to be covered with a 19 mm (3/4 in) thick layer of plywood.

The combined weight of the platen and structure that carries it shall be 2268 to 6803.9 kg (5000 to 15 000 lb). Two recommended methods for supporting the platen are described in the following sections.

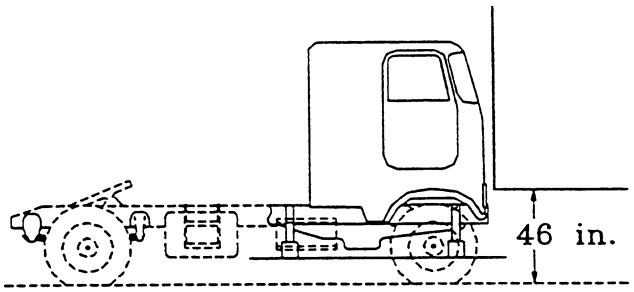

FIGURE 2—VERTICAL POSITION OF PLATEN CONTACT

4.3 Carriage Option—With this option, the platen is attached to the front of a carriage. The carriage is then towed to a target impact speed and released to roll into the cab. The platen shall be positioned far enough forward of the carriage structure so that there will be no interference between the over-ridden vehicle structure and the carriage. Ballast shall be added as necessary to the rear of the carriage to stabilize it and obtain the target mass.

4.4 Pendulum Option—With this option, the platen is attached to a pendulum. The pendulum is then pulled back to a height determined to obtain the target impact speed and released to swing into the cab. Ballast shall be added as necessary to the pendulum to reach the target mass. The pendulum should be positioned relative to the cab so that the platen is vertical at impact. The distance from the bottom of the platen to the pivot point should be at least 610 cm (20 ft) to ensure that there is relatively little vertical motion of the platen during the crush phase of the test. This will also ensure that the platen's orientation remains nearly vertical throughout the impact. A bifilar pendulum design may be used to constrain the platen in a vertical orientation.

5. Instrumentation—To record the load applied to the cab structure, load cells shall be used to mount the platen to its supporting structure. The measured load must be scaled to obtain the load applied to the cab as follows:

$$F_{CAB} = F_{MEASURED} * \frac{W_{TOTAL}}{W_{SUPPORT}} \quad \text{(Eq. 1)}$$

where:

F_{CAB} Load applied to the cab
$F_{MEASURED}$ Measured load
W_{TOTAL} Combined weight of the platen and supporting structure
$W_{SUPPORT}$ Total weight minutes the platen weight

The displacement of the platen shall also be measured and recorded. One method for measuring platen motion is to attach accelerometers to the platen or supporting structure. Displacement of the platen during the crush phase of the test can be determined by twice integrating the acceleration data. All measurements should be recorded and filtered according to the most recent version of SAE J211.

To be able to identify the amount of cab crush as part of the total platen displacement, the longitudinal displacement of the lower rear cab should be recorded. To quantify the amount of intrusion of the crush into the occupant compartment, longitudinal displacement of the steering wheel hub, header, and lower dash at the lateral position of the driver seat centerline should be measured. Any other locations of potential interest for cab intrusion should also be measured.

6. ***Photographic Documentation—***For the dynamic tests described previously, high-speed film or video cameras are recommended. The field of view of these cameras should be large enough to document the entire cab. Each camera should have provision for recording a time reference (timed pulse signal for film cameras) and should have an exposure rate sufficient to facilitate motion analysis of the film. Exposure rates of 200 to 1000 frames per second are acceptable. 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 platen motion.

7. ***Performance Requirements—***The performance requirements described herein are for NHTSA defined GVWR classes 6 and up (greater than 8845 kg (19 501 lbs)).

The platen shall be propelled or swung to impact the front of the cab with a minimum energy of 44.13 kJ (32 549 ft-lb).

During the test, components attaching the cab to the chassis frame may become distorted or broken, but the cab shall remain attached, and in an orientation similar to the original.

None of the doors shall open during the tests, but the doors shall not be required to open after testing.

Following the test, the cab of the vehicle shall exhibit a survival space allowing accommodation of the manikin defined in ECE Regulation 29 on the seat, with the seat in its median position, without contact between the manikin and non-resilient parts. The seat and manikin shall be adjusted so that the H point of the manikin lies within a 50 mm cube centered about the designed Seating Reference Point (per SAE J1516), and the torso angle of the manikin is within 5 degrees of the nominal design torso angle.

The manikin may be inserted in dismantled form and assembled in the cab. The seat and the manikin shall be adjusted to the median position prior to the assessment of survival space.

8. ***Notes***

8.1 **Marginal Indicia.** The change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

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