

Cab Roof Strength Evaluation—Dynamic Loading Heavy Trucks

1. Scope—This SAE Recommended Practice describes the test procedures for conducting dynamic cab roof strength tests for 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—Part 1: Electronic Instrumentation

SAE J211-2—Instrumentation for Impact Test—Part 2: 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)," April 1997.

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.

3.3 Static Stability Position—The roll position at which a vehicle would be statically balanced on either left- or right-side wheels.

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4. **Test Configuration**—The cab roof strength test is designed to evaluate the resistance of a heavy truck cab in a 180-degrees rollover. The loading is divided into two phases, a dynamic pre-load that simulates the side loading on the upper cab as the vehicle rolls past 90 degrees, and a roof loading that simulates the loading on the cab when the vehicle is inverted. Both phases are conducted on a cab attached to actual or simulated frame rails with its standard cab mounts. The loading is applied to the cab with a platen. The loading for both phases is generated with the inertia of the platen and the structure carrying it.

To assist with the description of the platen orientation and direction of motion, a reference system is defined for the cab and chassis relative to its original orientation on the vehicle. This is illustrated in Figure 1.

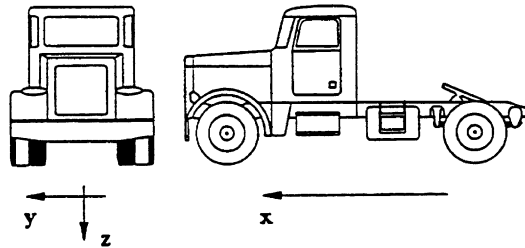


FIGURE 1—REFERENCE FRAME

5. **Dynamic Pre-Load**—In the dynamic pre-load, the platen impacts one side of the cab, with the cab mounted at an angle so that the platen initially contacts the upper portion of the cab. The platen is oriented vertically, and aligned parallel to the chassis's longitudinal axis. Either side of the cab may be loaded, depending on whether a driver side or passenger side leading rollover is to be simulated. The chassis of the test cab shall be affixed to the ground at a roll angle of 20 degrees. The longitudinal axis of the chassis shall be perpendicular to the direction of travel of the platen. The pre-load configuration is shown in Figure 2. The target speed of the platen and its supporting structure is computed as described in the following sections.

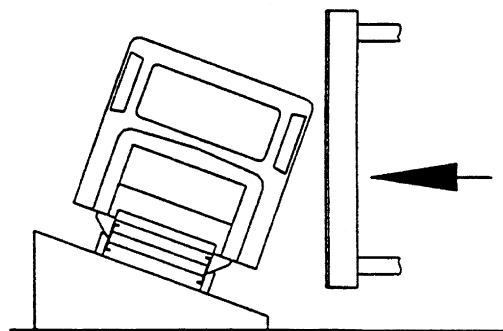


FIGURE 2—DYNAMIC PRE-LOAD CONFIGURATION

- 5.1 **Pre-Load Energy Computation**—The energy to pre-load the cab comes from the kinetic energy of the platen and its supporting structure. For the pre-load phase of the test, the target energy level is 1.6 times a reference energy level up to a maximum recommended target level of 17 625.6 J (13 000 ft-lb). The recommended maximum is based upon the limited testing performed to evaluate this test procedure and to produce cab damage consistent with rollover accidents. Manufacturers can, at their discretion, exceed this maximum. The reference energy level is an approximation of the kinetic energy developed when a vehicle is tipped from its static stability position to a rest position on its side. Both positions are illustrated in Figures 3 and 4.

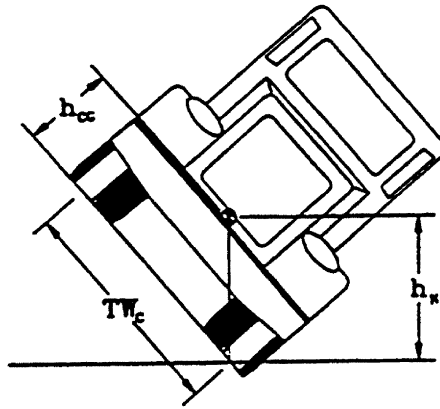


FIGURE 3—STATIC STABILITY POSITION

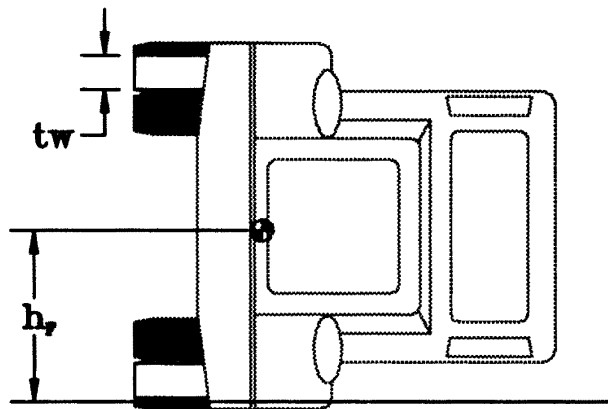


FIGURE 4—90-DEGREE ROLL POSITION

The calculation assumes that all the potential energy at the static stability position is converted to kinetic energy at the ground contact point. Basic dimensions, weight, and the center of gravity (cg) height of the vehicle are needed for this calculation. This computed energy level shall be used in the following sections in determining the platen impact speed.

$$TW_c = \frac{(TW_F + TW_R)}{2} \quad (\text{Eq. 1})$$

$$h_n = \sqrt{\left(\frac{TW_c}{2}\right)^2 + h_{cg}^2}$$

$$h_f = \frac{(TW_c + tw)}{2}$$

$$KE = mg^*(h_n - h_f)$$