



TECHNICAL REPORT

J980a

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BUMPER EVALUATION TEST PROCEDURE—SAE J980a SAE Recommended Practice

Report of Bumper Committee approved February 1968 and last revised by Bumper Committee and Automotive Safety Committee July 1971.

1. Purpose and Scope—This SAE Recommended Practice is to establish uniform impact test procedures for passenger vehicle bumpers by use of a pendulum as the impacting object. Other methods of impacting, or the use of other impacting objects, are acceptable.

2. Definitions

2.1 Passenger Vehicle Bumper—A system, the primary function of which is to provide protection against damage affecting the performance of front and rear external lamps and other components during low-speed impacts, as in vehicle parking maneuvers.

2.2 Pendulum—A weight of 4000 ± 100 lb which can be swung against vehicle bumpers on an arc with a 132 in minimum radius.

2.3 Impact Surface—A flat, solid hardwood vertical surface 24 in wide, minimum 2 in thick, and minimum 18 in high. The center of the impact surface should be at the approximate c.g. of the pendulum weight and 90 deg to the direction of travel.

2.4 Bumper Contact Point—The point of the vehicle bumper, either front or rear, which first contacts the pendulum impact surface when this surface is positioned vertically.

2.5 Bumper Corner—The point on the bumper established by a vertical plane which is tangent to the bumper and at an angle of 60 deg to the vehicle centerline.

2.6 Curb Weight—The vehicle weight in the drive-away condition, filled to at least 90% capacity by weight with fuel (nonflammable liquid may be substituted), lubricants, and coolants, and with all standard equipment but without luggage or passengers.

2.7 Test Vehicle—A complete vehicle of prototype or production configuration, or an equivalent simulated vehicle.

3. Test Equipment

3.1 Pendulum weighing 4000 ± 100 lb mounted in an area sufficiently large so that it can be swung against passenger vehicle bumpers mounted on the test vehicle. The radius of pendulum arc from pivot to bumper contact point should be 132 in minimum. The shaft should be adjustable so that the weight is approximately centered on the bumper contact point. The pendulum weight will be equipped with an impact surface. See Fig. 1.

3.2 Angleometer for measuring the swing angle of the pendulum.

3.3 A suitable pull-back and release mechanism arranged so there is no delay in the swing of the pendulum.

3.4 Headlamp aiming device per SAE J599.

4. Test Procedure

4.1 The test vehicle shall be weighted to the curb weight of the heaviest model of a particular style and be equipped with production options weighing 5 lb or more or their equivalent weight. A one-passenger load of 150 lb should also be added in driver position.

4.2 Check all lamps for function and set the headlamps to the mean aiming position per SAE J599. Turn off all lamps.

4.3 Adjust bumper to nominal design clearance to adjacent components.

4.4 Torque all bumper attachments to the low limit of specifications.

4.5 Position the test vehicle with the freely hanging pendulum touching the bumper contact point. Release the test vehicle brakes and place the transmission in neutral. (Some means should be used to prevent excessive vehicle movement.) Adjust the height of the pendulum and the position of the test vehicle so that the bumper contact point is at the approximate c.g. of the weight. The distance to the pendulum pivot point should be 132 in minimum.

4.6 The test vehicle should be placed so that the front and rear bumpers can each be struck in the longitudinal direction at the centerline of the test vehicle and the bumper corner can each be struck at one of the outer 30 deg positions. See Figs. 2A and 2B.

4.7 Swing the pendulum away from the bumper to a position that will produce the desired impact test speed on the bumper. The impact

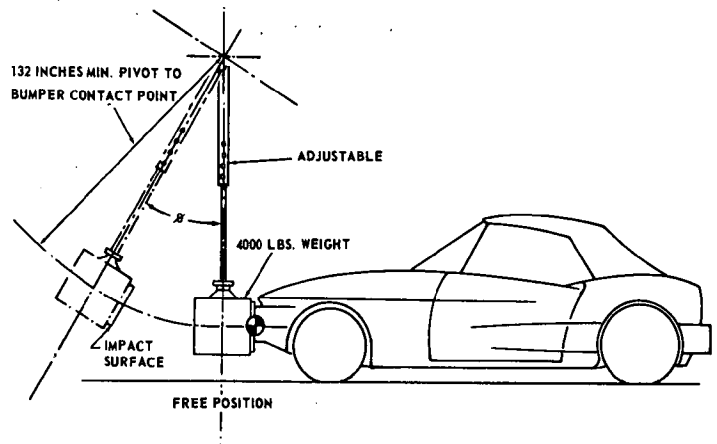


FIG. 1—BUMPER IMPACT TEST PENDULUM, SIDE VIEW, CENTERLINE HIT

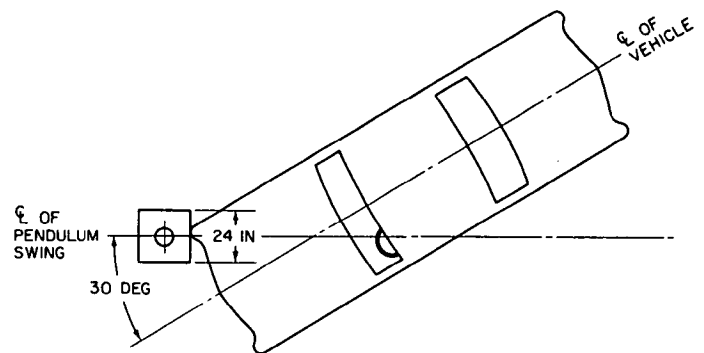


FIG. 2A—BUMPER IMPACT TEST PENDULUM, PLAN VIEW, CENTERLINE HIT

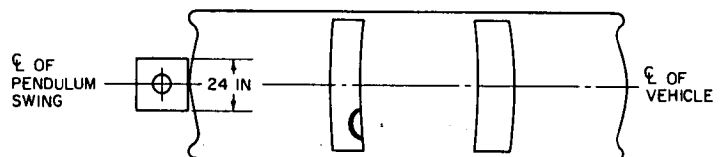


FIG. 2B—BUMPER IMPACT TEST PENDULUM, PLAN VIEW, 30 DEG ANGLE HIT

BUMPER EVALUATION TEST PROCEDURE

test speed can be related to the angle of the pendulum swing with the following formula:

$$\Theta = \text{Cosine}^{-1} \left(1 - 0.40082 \frac{V^2}{L} \right)$$

where: V = test speed, mph

L = pendulum length (pivot point to bumper contact point), in

Θ = angle of pendulum before release, deg (see Fig. 1)

4.8 Inspect headlamps aim per SAE J599. Check all lamps for function.

APPENDIX

To relate the pendulum test to car to car contact, the following formula and method is used:

V_2 = pendulum impact speed

ΔV = relative striking velocity of pendulum

M_1 = mass of pendulum, lb

M_2 = mass of vehicle, lb

R = mass ratio M_1/M_2

$$\Delta V = \sqrt{\frac{1+R}{R}} \cdot V_2$$

where: ΔV = relative striking velocity of two vehicles to achieve the same degree of crush as single vehicle impact into a wall

Thus, for equal masses ($M_1 = M_2$), R is 1.0 and $\Delta V = \sqrt{2} \cdot V_2$ or $(1.4) \cdot V_2$.

The crush from a pendulum test speed of (1.4) mph would be the crush expected from a (1.0) mph fixed barrier test for equal mass vehicle and pendulum.

NOTE: A new ΔV factor must be calculated when the masses are not equal. For example:

For $M_1 = 4000$, $M_2 = 3000$; $\Delta V = 1.32$

For $M_1 = 4000$, $M_2 = 5000$; $\Delta V = 1.50$

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