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SAE J850 NOV88

Fixed Rigid Barrier Collision Tests

SAE Recommended Practice
Revised November 1988

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Submitted for Recognition as
an American National Standard

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Ø FIXED RIGID BARRIER COLLISION TESTS

1. SCOPE AND PURPOSE:

Barrier collisions represent the most severe type of automotive impacts. Deceleration conditions during barrier collisions are more readily reproducible than those occurring during other types of impacts. Barrier collision tests are conducted on automotive vehicles to obtain information of value in reducing occupant injuries and in evaluating structural integrity. The purpose of this SAE Recommended Practice is to establish sufficient standardization of barrier collision methods that results of tests conducted at different facilities may be compared.

2. OBJECTIVES:

The primary objective of this standard test method is to provide realistic simulation of the forces which act on vehicles and occupants during accidental collisions with fixed objects. Measurements of structural loads and deflections, determinations of occupant dynamics, and photographic and post-collision observations of pertinent special events may be useful in establishing design criteria.

3. CRASH TEST FACILITY:

3.1 Test Site, General: The test site should encompass sufficient area to provide accommodations for the barrier, location of various photographic (or video recording) equipment, a protected observer area, and accelerating the test vehicle to desired speed at impact.

3.1.1 The immediate crash site should be level.

3.1.2 The approach and surface at the barrier should be paved.

3.1.3 Allowances for precise positioning of photographic (or video) equipment should be made.

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3.1.4 A pit may be installed in front of the barrier to accommodate undervehicle photography.

3.2 Barrier: A barrier suitable for impact testing of passenger cars and light trucks should have the characteristics listed as follows:

3.2.1 The barrier face should be at least 10 ft (3 m) wide and 5 ft (1.5 m) high, but shall be large enough to accommodate the entire frontal crush area of the vehicle.

3.2.2 The barrier face should be normal to the final approach path and shall be faced with 0.75 in (1.9 cm) plywood.

3.2.3 The barrier size and construction should be sufficient to limit barrier face motion to less than 1% of the permanent crush of the vehicle.

3.2.4 The effective mass of the barrier can be achieved with reinforced concrete and compacted fill.

3.2.5 The barrier face may include a load measuring device provided the combination of the barrier and load measuring device shall conform to 3.2.1, 3.2.2, and 3.2.3.

3.3 Barrier Approach: The type approach required depends upon the technique employed to obtain desired crash velocity of the test vehicle. Practical barrier approaches include the following:

3.3.1 Suitable grade of sufficient slope and length to accelerate the test vehicle to crash speed.

3.3.2 Level approach of sufficient length to permit any one of the following:

3.3.2.1 Test vehicle to be towed to crash speed.

3.3.2.2 Test vehicle to be driven to crash speed under a remote or other control system.

3.3.2.3 Test vehicle to be towed or driven with suitable guidance.

3.4 Protective Measures: Protective measures should be taken to insure the safety of test personnel and observers.

4. METHODOLOGY:

4.1 Vehicular collision responses are complex by nature even during a relatively simple barrier collision. Careful control of the impact parameters must be exercised. As a standard evaluation procedure, an impact speed of 30 mph is recommended; however, other impact speeds may be chosen for special studies.

In order that neither acceleration nor deceleration inertial effects may possibly influence vehicle attitude on deformation characteristics and subsequent occupant reactions, the impacting vehicle should hit the collision barrier while moving at essentially constant velocity. The test vehicle should impact into the barrier target center so that the test

4.1 (Continued):

vehicle's longitudinal axis is perpendicular to the plane of the barrier, except where the independent variable under investigation is angle of approach to the barrier. The longitudinal center of the test vehicle should align within ± 12 in (300 mm) of the target center of the barrier for a standard barrier approach so that pretest high speed camera focus may be maintained.

Other requirements for acceptable photographic coverage are adequate lighting and a clear background, preferably of consistent texture and void of any moving objects.

- 4.2 Test vehicle directional control may be achieved by use of a guide track or by following a pretest tracking trial with remote systems or similar safe procedures that accomplish the desired objectives.

5. INSTRUMENTATION AND EQUIPMENT:

To obtain meaningful information from a barrier collision test, it is important that adequate means be provided to observe and record test results. Inasmuch as the objectives of any one impact are limited, the instrumentation to be used will need to be tailored to the type of instrumentation and equipment which can be employed to obtain desired data on the movements and loads experienced by the vehicle, its components, or its occupants during a test impact. It is essential that the recording system, including transducers and mounting systems, contain no resonant frequencies within the frequency response range of data interest. It is desirable to record data on magnetic type or equivalent media so that it can be readily filtered and computer processed.

- 5.1 Vehicle Accelerations Measurements: Accelerations may be measured by accelerometers located on the floor pan, frame, body sill, or body components. Accelerometers should not be mounted in areas of localized resonant vibrations or distortion such as seat belt anchorages. For nonperpendicular collision approach angles, accelerometers on both sides of the car are recommended, as well as multiple installations for purposes of backup.

- 5.2 Occupant Data: To obtain data on occupant loading, deflection and movement during the test, anthropomorphic test devices may be used. These test devices should be of a type that will closely represent size, weight, and articulation characteristics of a human being in a seated position. Physical characteristics of one such device are described in SAE's Engineering Aid 23, "Users' Manual for the 50th Percentile Hybrid III Test Dummy," June 1985.

Accelerometers or deflection measurement devices may be placed in the head, chest, and, when possible in the pelvic cavity, to record data at these points. Significant vertical and/or lateral accelerations generally accompany the strong longitudinal decelerations of the crashing car; therefore, occupant accelerometers should be biaxial or triaxial.

- 5.3 Loadings on Occupant Restraint Devices: To measure the dynamic loads sustained by occupant restraint devices installed in the vehicle transducers may be used. The number of transducers used in each crash test should be sufficient to provide adequate recording of the loads imposed on these devices.
- 5.4 Contact Recordings: Conducting surfaces can be installed on the head, chest and knees of the appropriate dummies so that a time history of their contact with conducting surfaces on sunvisors or header, windshield, instrument panel, and steering wheel may be recorded with respect to the vehicle impact time.
- 5.5 Velocity: Provisions should be made to measure the velocity of the vehicle immediately prior to the barrier impact. Refer to current SAE J211.
- 5.6 Photographic Instrumentation: It is desirable to provide comprehensive photographic coverage of each barrier crash test. However, in cases where this is not possible, the following represent the recommended minimum coverage for meaningful information. Equivalent video equipment may be substituted.
- 5.6.1 High Speed Cameras: A minimum of two high-speed cameras is required.
- 5.6.1.1 Broadside Cameras: At least one high-speed camera should be located on each side of the crash site. Locating axes for precise positioning of photographic equipment should be provided. These cameras should be positioned so that the field of view is large enough to include only the test vehicle and is perpendicular to the path of that vehicle at the instant of barrier contact. Each camera should have provision for recording a timed pulse signal on the film and should have a framing rate sufficient to facilitate accurate micromotion analysis of the film. (Film frame rates of 200-1000 frames/s are normally employed.) Suitable calibration and position reference targets, both stationary and on the vehicle and occupants, should be provided. Information obtainable from this film through micromotion analysis include total vehicle displacement, velocity, and deceleration. In addition, micromotion studies of the kinematics of the various occupants of the vehicle with respect to their transducer records may be performed.
- 5.6.1.2 Overhead Cameras: Cameras may also be placed directly above the crash site. Film from these cameras may also be used for motion analysis if provisions stated in 5.7.1.1 are included.
- 5.6.1.3 Underneath Cameras: Cameras may also be placed directly beneath the crash site to photograph the chassis and components which are visible only from beneath the vehicle. Film from these cameras may also be used for motion analysis if provisions in 5.7.1.1 are included.
- 5.6.1.4 Passenger Compartment: A suitable high "g" camera may be installed onboard to view the passenger compartment of the test vehicle to record the kinematics of the front seat occupants.

5.7 Miscellaneous:

- 5.7.1 Electronic and Photographic Instrumentation Coordination: Provision should be made for synchronizing electronic and photographic instrumentation.
- 5.7.2 Vehicle Deformation: Measurements should be made after the barrier impact test to determine the total permanent deformation and the dimensional change recorded.

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RATIONALE:

1. Change title to "Fixed Rigid Barrier Collision Tests".
2. Section 3.1 - Change ...photographic equipment... to ...photographic (or video recording) equipment...
3. Section 3.1.3 - Change ...photographic equipment... to ...photographic (or video) equipment...
4. Section 4.1 - First paragraph, last sentence, delete "where speed is the independent variable".

Second paragraph, first sentence, change "collapse" to "deformation", and "subsequently" to "subsequent".

5. Section 5 - Last sentence, change ...magnetic tape so... to ...magnetic tape or equivalent media so...
6. Section 5.2 - First paragraph, heading, change "Occupant Loading" to "Occupant Data".

First paragraph, first sentence, change ...loading and... to ...loading, deflection and... and change ...devices can... to ...devices may...

Third sentence, update reference to SAE J963 (cancelled in 1979) by changing the sentence to read: "Physical characteristics of one such device are described in SAE's Engineering Aid 23, "User's Manual for the 50th Percentile Hybrid III Test Dummy", June 1985."

Second paragraph, first sentence, change ...accelerometers may... to ...accelerometers or deflection measurement devices may... and ...acceleration at... to ...data at...

Second paragraph, last sentence, change ...these accelerometers... to ...occupant accelerometers...

7. Section 5.5 - Append "Refer to current SAE J211."
8. Section 5.6 - Append "equivalent video equipment may be substituted."
9. Section 5.7.2 - Append "and the dimensional change recorded..."

RELATIONSHIP OF SAE STANDARD TO ISO STANDARD:

Not applicable.

REFERENCE SECTION:

SAE J211 OCT88, Instrumentation for Impact Tests