The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
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SURFACE VEHICLE RECOMMENDED PRACTICE

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Dolly Rollover Recommended Test Procedure

***Foreword*—**The objective of this procedure is to subject a test vehicle to a rollover condition. The vehicle and occupant dynamics are recorded using appropriate instrumentation and photographic/video coverage such that the vehicle and occupant kinematics can be observed.

***1. Scope*—**This SAE Recommended Practice describes the test procedure for conducting a rollover test using a dolly fixture designed to laterally trip a vehicle into a roll. Its purpose is to establish a recommended test procedure which will standardize the procedure between different test facilities. A description of the test procedure, test instrumentation, photographic/video coverage, and the rollover fixture 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 PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J211-1—Instrumentation for Impact Test—Part 1: Electronic Instrumentation

2.1.2 ASTM PUBLICATION—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 274-90—Standard Test Method for Skid Resistance of Paved Surfaces Using a Full-Scale Tire

3. Test Facilities

3.1 Test Site—The test site and facilities should be able to tow and guide the rollover dolly to a constant velocity, decelerate the dolly, and allow for free unobstructed rolling of the test vehicle until it comes to rest. Typically, the test site will be an outdoor, concrete, level surface with a guide rail, towing system, and an energy-absorbing snubber which will decelerate the moving dolly appropriately.

The surface, on which the vehicle will be tripped, and initially contact should be of a uniform concrete construction with a skid number of 75 when tested according to ASTM E 274-90 at 64.4 km/h (40 mph), omitting water delivery as specified in paragraph 8.1 of that method. Typically for a 48 km/h (30 mph) initial velocity, a surface which allows for 50 m (164 ft) of unobstructed rolling is sufficient for most passenger car applications.

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3.2 Dolly Rollover Fixture—The rollover fixture is constructed such that during its deceleration the test vehicle is tripped into a lateral unobstructed roll on the concrete surface. A diagram of a typical rollover fixture is included in Figure 1. The incline is at 23 degrees to the horizontal, and the lower flange, which trips the tires of the test vehicle, is 102 mm (4 in) deep measured from the top of the flange to the top of the inclined surface. It should be noted that the tire and rim interaction with the flange will depend upon the type of tire and will not be consistent for all vehicles. The intersection of the inner side of the flange and the top of the inclined surface should be 229 mm (9 in) above the concrete roll surface. The fixture should be constructed such that it will not pitch severely during the deceleration. One method of limiting the pitch is to utilize wheels which extend forward of the location of applied stopping force which will prevent severe rotation about the center of gravity. In addition, the rear of the dolly may be vertically constrained to the tow rails to prevent pitch.

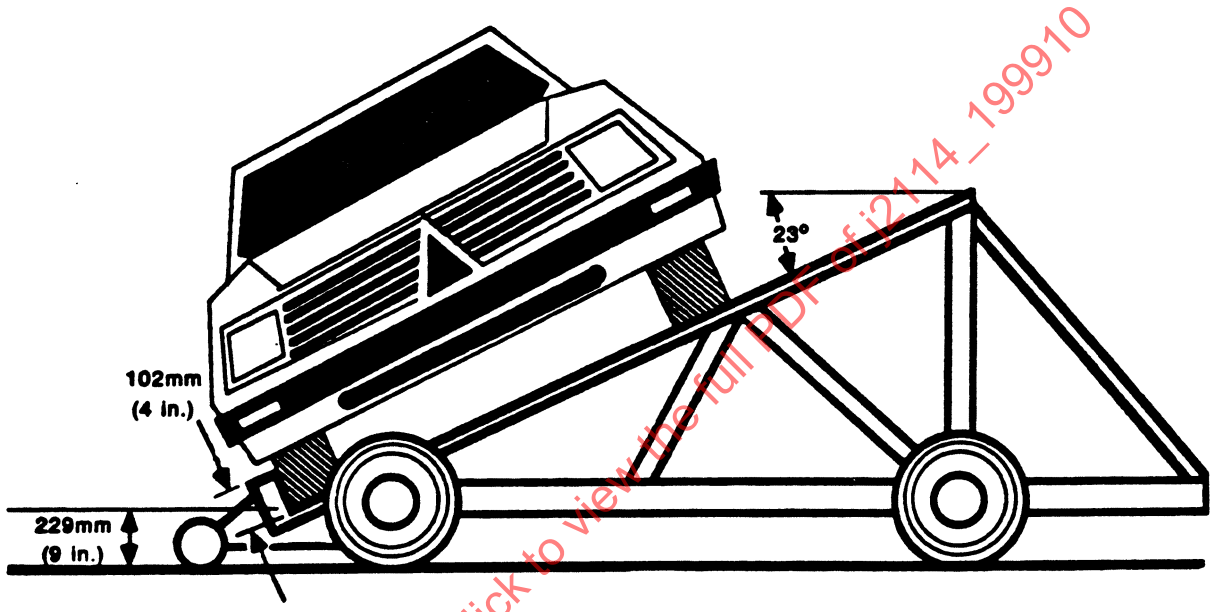

FIGURE 1—DOLLY ROLLOVER FIXTURE

A remote-controlled brake system should be installed on the fixture to allow for the test to be aborted following the beginning of the fixture tow. Moderate braking levels, as opposed to typical higher abort braking levels with barrier testing, may be necessary to maintain vehicle stability with a narrow track, high center of gravity vehicle.

The rollover fixture must be guided in a straight path during its acceleration and allowed to reach a constant velocity before deceleration. The vehicle must be motionless relative to the fixture before the deceleration of the fixture begins. Deceleration parameters should be chosen such that the vehicle leaves the dolly fixture appropriately. As an example, if the initial velocity is chosen to be 48 km/h (30 mph), a minimum deceleration rate of 20 g for at least 40 ms and allowing no more than 91 cm (3 ft) of dolly travel would be appropriate. Accelerometers should be mounted on the fixture to record the deceleration pulse. If energy-absorbing material is used to stop the fixture, it must exert adequate forces on the fixture to produce the desired deceleration rate.

The vehicle should be placed on the fixture with the vehicle's center of gravity centered between the tires of the fixture. The test vehicle's brakes are disengaged and the transmission placed in neutral. Care should be taken when placing the vehicle on the dolly so as to not significantly deform the tires laterally. Sliding the vehicle down into position should be avoided to insure the appropriate tire condition when it is resting against the flange.

4. Photographic or Video Coverage—Typical passenger vehicles can be expected to roll between 2-1/2 and 4 rolls lasting from 4 to 6 s. High-speed movie cameras or video cameras should be used to document the test. The camera layout is indicated in Figure 2.

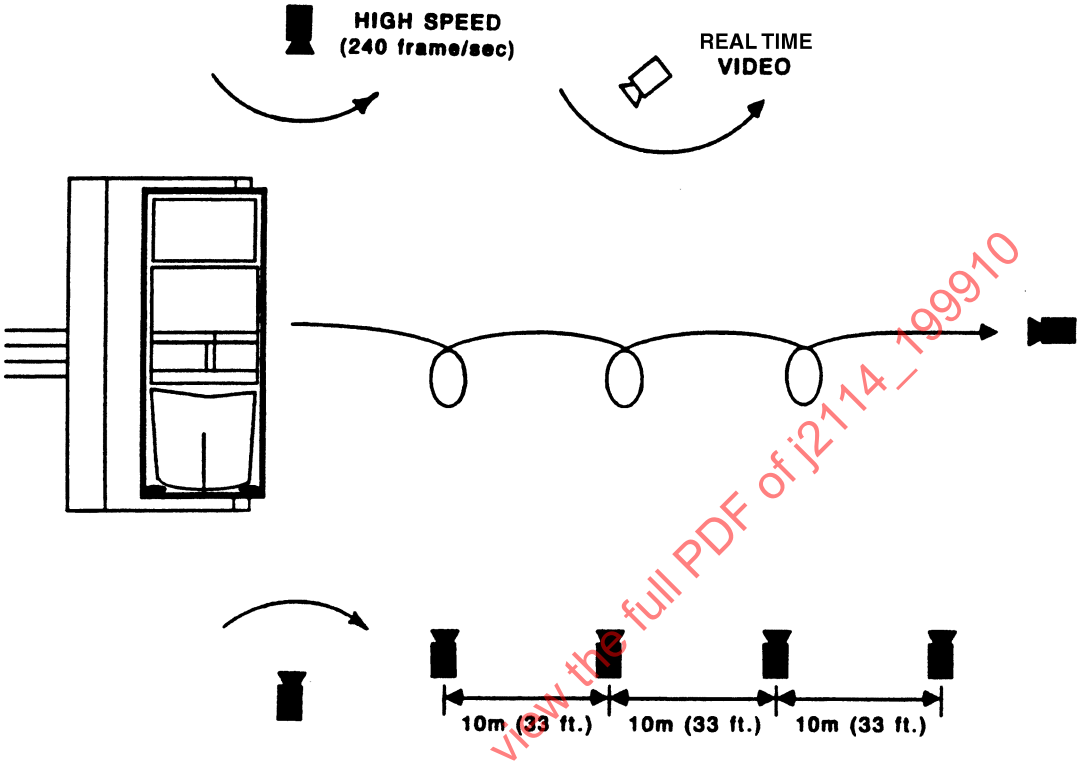

FIGURE 2—PHOTOGRAPHIC COVERAGE
(NOTE—2 ONBOARD CAMERAS NOT SHOWN)

At least nine high-speed movie cameras (240 frame/s) or video cameras are needed as well as a lower-speed movie camera or video recorder. Four high-speed cameras are mounted on the front of vehicle side of the roll at 10 m (33 ft) intervals, with each camera's field of view overlapping with the adjacent camera(s). The first camera's field should cover the vehicle leaving the dolly. Two high-speed cameras are located on each side of the fixture and follow the vehicle's roll during the test. One high-speed camera is used at the end of the roll path pointing back toward the fixture. At least two high-speed cameras which are shock mounted and fitted with wide angle lenses may be mounted in the interior of the vehicle to record occupant motion during the rollover. The lower-speed camera should be placed on one side of the roll path and should follow the vehicle as it rolls. One or more strobes to indicate the time at which the dolly begins to decelerate should be in the field of view of all cameras. A timing signal should be recorded on all high-speed cameras.

5. Instrumentation

5.1 Vehicle Dynamics—The test vehicle is instrumented with accelerometers to record the acceleration in the lateral and vertical (relative to the vehicle) directions. The vehicle accelerometers are typically mounted on the inside surface of the B pillar vertically in line with the center of gravity. Other vehicle accelerometers may be included; however, caution should be used to avoid locating accelerometers in areas where large deformation is expected, which may result in nonrepresentative acceleration signals. In addition to the vehicle accelerometers, an angular velocity transducer is used to record the rotational velocity during the test. This transducer should be mounted as close to the center of gravity as possible and in the longitudinal center of the vehicle.

The data should be processed and plotted for the entire test duration (up to 6 s). The roll velocity can be integrated to generate an angular displacement time history which can be compared to the vehicle accelerations and high-speed film to determine the kinematics of the vehicle roll. All instrumentation and data processing should conform to SAE J211-1.

6. Notes

6.1 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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