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1. OBJECTIVE

This SAE Recommended Practice describes a method to be used when performing linear impact testing for the benchmarking of Passenger Airbag (PAB) modules. The results obtained from the linear impact tests will be used to verify design requirements and/ or specifications, and for other engineering purposes such as module performance comparisons, and/ or correlation to CAE models. The objective of this testing is to obtain the loading and unloading elastic slopes and the plastic limit for the passenger airbag module. The purpose for this procedure is to describe recommended test methods to ensure, to the extent possible, reliable and reproducible test results. Performance limits or acceptance criteria are not established as they are typically defined based on specific vehicle design requirements and/or manufacturer specifications. It is intended to be a general procedure for repetitive testing and suggests only general guidelines for the safe conduct of tests and reliable data correlation.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

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

SAE J211-2 Instrumentation for Impact Test - Part 2: Photographic Instrumentation

SAE J1538 Glossary of Automotive Inflatable Restraint Systems

3. DEFINITIONS

3.1 PAB SIZE CLASSIFICATION:

For the purpose of this test procedure, PAB modules have been divided into four classes as shown in Table 1. The test method outlined in this SAE Recommended Practice applies to PAB modules of Class III and Class IV.

TABLE 1 - PASSENGER AIRBAG MODULE CLASSIFICATION

	CLASS I	CLASS II	CLASS III	CLASS IV
Bag Volume (L)	$V \leq 40$	$40 < V \leq 80$	$80 < V \leq 110$	$V > 110$
Coverage	Head Only	Head & 'light' Thorax	Head & Thorax (belted)	Head & Thorax (unbelted)

3.2 DATA POLARITY AND SIGN CONVENTION

Data polarity and sign convention is consistent with SAE standard J211, as shown in Figure 1, and is as follows:

The origin for the vehicle coordinate system is defined in the lateral (y-axis) direction as the longitudinal centerline for the vehicle.

Polarities:

- The x-axis is positive in the forward longitudinal direction.
- The y-axis is positive in the right lateral direction.
- The z-axis is positive in the downward vertical direction.
- All ATD (Anthropomorphic Test Device) data is recorded with reference to the ATD in standing position or per ISO 4130.

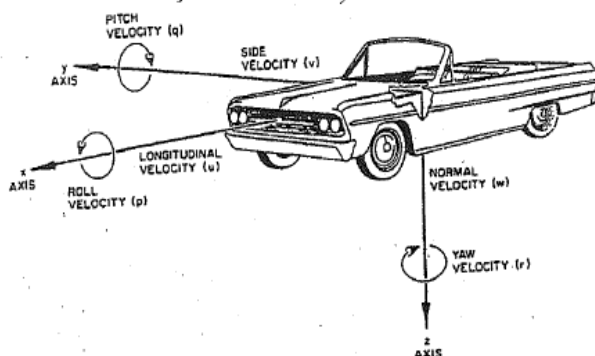


FIGURE 1 - COORDINATE SYSTEM USED IN THIS TEST PROCEDURE

3.3 PROCESSING UNITS

Except as noted, all data collected, will utilize standard SI (System International) units, except those noted with '*'. Due to past industry standards, these SI units are not commonly used and have been replaced by alternate units.

TABLE 2 - SUMMARY OF MEASUREMENT UNITS USED IN THE PROCEDURE

<u>Quantity</u>	<u>Name</u>	<u>Symbol</u>
*length	millimeter	mm
mass	kilogram	kg
*time	millisecond	ms
current	ampere	A
*temperature	Celsius	C
energy	joule	J
force/weight	Newton	N
frequency	hertz	Hz
power	watt	W
*pressure	kilo-Pascal	kPa
*velocity	meters/sec	m/s
*acceleration	g's (9.81 m/sec ²)	g
moment/torque	Newton-meter	Nm

4. GENERAL TEST REQUIREMENTS

Linear Impact test methods used for acceptance and performance evaluation of airbag module assemblies shall provide accurate, repeatable, and reproducible results, with considerations made to minimize the effects of test-to-test and/or lab-to-lab variability in test equipment, module fixturing, and ambient conditions of the lab and/or specimen storage areas (temperature, humidity, and atmospheric pressure). Toward this end, and with the added incentives of cost and time efficiencies, these tests are generally performed outside the actual vehicle – using only those portions of the actual vehicle that directly influence the applicable performance of the module or the outcome of the test.

4.1 Test Facility

Airbag module assemblies (containing an inflator) are typically Department of Transportation (DOT) classified. Therefore, the facility for conducting tests on pyrotechnic devices must comply with all local and state building codes, including all necessary certifications/permits for receipt, storage, and shipping of these materials.

A suitable floor plan and work area design is important for proper execution of tests. Features shall include a physical safety barrier between test personnel and the device under test. Ambient laboratory temperature of 22 ± 2 °C shall apply unless otherwise noted for a specific test. The relative humidity (% R.H.) and atmospheric pressure (kPa) for each test shall be clearly stated in the test data and/or test report. An exhaust fan is recommended to vent smoke and particulate from the test bay prior to re-entry by test personnel.

4.2 Safety Requirements

In consideration of safety for test personnel working with experimental devices, appropriate facilities and training must be provided. Examples of the necessary safety equipment include remote airbag triggering systems, shielding for personnel; test warning system (i.e., siren and/or light); and personal safety equipment (PSE) such as eye protection, gloves, hearing protection, respirators, and grounding straps, if required. Proper written safety procedures should be followed in accordance with standard ordinance and pyrotechnic industry practice. All applicable OSHA safety standards must be followed.

4.3 Equipment List

The equipment will typically consist of the following basic components:

- a. Mounting Fixture (Anvil) – The physical structure to which the module is mounted for the test, and those portions of the actual vehicle that directly influence the applicable performance of the module or the outcome of the test.
- b. Body Block – provides a loading surface for the PAB module
- c. Linearly guided impactor – propels the body block into the deployed PAB
- d. Accelerometer to measure the acceleration characteristics of the body block
- e. Displacement measurement shall be recorded using a non-contact displacement sensor.
- f. Data Acquisition System - Records and displays test data, such as the internal bag and/or inflator pressure versus time results, and temperature versus time of the module components during conditioning, when applicable
- g. High-Speed Video Equipment
- h. Lighting System - Intensity matched to video specifications and desired capture rate.
- i. Deployment Source - Provides the proper stimulus to actuate the inflator
- j. Strobe Light - To denote time zero on high-speed video for use during analysis
- k. Pressure Transducer (optional) - Measures the pressures inside the bag and/or inflator



5. EQUIPMENT SPECIFICATION

5.1 Linear Impactor

This test requires a linearly guided impactor that meets the following specifications:

- Must be able to propel the body at the required velocity (4.5 m/s, 6.7 m/s, and 7.7 m/s) within ± 0.1 m/s.
- Must be able to linearly guide the body block through its full stroke while allowing no more than 10 mm deflection under a radial load of 50 kg, and with a coefficient of friction ≤ 0.3 . (0.3 is standard for linear impact bearing material).
- Must have sufficient stroke to allow the impactor to have achieved the target impact speed prior to reaching the target trigger distance “D_o” (per Table 2 in Section 6).
- Must contain some means for triggering the deployment of the PAB module when the body block is at distance “D_o” (per Table 2 in Section 6) within ± 5 mm away from first contact with the IP.
- Must include a rigidly constructed positioning system that can align the impactor laterally (Y-dimension) with the geometric center of the module opening, and parallel with the vehicle’s longitudinal centerline. Vertical and lateral positioning is described later in this specification.
- Maintain a gap of 40 mm (± 5 mm) between the anvil’s simulated windshield and the body block to ensure no contact is made during the test and the air bag is not pinched between the body block and the wind-screen.
- Must be able to align impactor at a 15 degree (± 1 degree) downward with the anvil by either [1] rotating the impactor 15 degrees from the horizontal or [2] rotating the anvil. Both options are shown in Figure 2.