
**Road vehicles — Test procedures —
Evaluating small female dummy arm and
forearm interactions with driver frontal
airbags and side airbags**

*Véhicules routiers — Méthodes d'essai — Évaluation des interactions
du bras et de l'avant-bras du mannequin femme de petite taille avec les
sacs gonflables conducteur frontal et latéral*

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

- an ISO Publicly Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50 % of the members of the parent committee casting a vote;
- an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote.

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An ISO/PAS or ISO/TS is reviewed after three years in order to decide whether it will be confirmed for a further three years, revised to become an International Standard, or withdrawn. If the ISO/PAS or ISO/TS is confirmed, it is reviewed again after a further three years, at which time it must either be transformed into an International Standard or be withdrawn.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TS 15827 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 10, *Impact test procedures*.

Introduction

Driver frontal airbags and side airbags are inflatable devices intended to help reduce the risk of injury to the head and/or the chest and/or the pelvis of vehicle occupants. During its inflation process an airbag generates a considerable amount of energy and, as a result, substantial forces can be developed between the deploying airbag and the nearby occupant. Preliminary laboratory tests indicate that these forces can potentially, in certain circumstances, be sufficient to injure the vehicle occupant. A considerable but unknown portion of the occupant population does not drive/ride in exactly the vehicle design position, but rather leans/rests in various ways against the steering wheel, armrest, door or vehicle side interior, where airbag reaction forces can be particularly high. Through normal occupant preferences or during turning manoeuvres, the hand/forearm can be in various locations on/across the steering wheel rim, and thus interact with a deploying driver frontal airbag. These test procedures were developed to improve the understanding of such interactions and to help aid in the assessment of future airbag designs.

References [2], [4], [5], [8], [9], [12], [13] and [18] in the bibliography give some background on human impact tolerance and criteria, while references [15] and [17] describe scaling techniques for different size occupants and offer interpretations of dummy responses relative to human injury potential that might be helpful in the evaluation. References [1], [3], [7], [10], [11], [14], [16] and [19-22] describe the dummies used, and references [6] and [23] describe the filtering techniques used, in this test procedure.

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Road vehicles — Test procedures — Evaluating small female dummy arm and forearm interactions with driver frontal airbags and side airbags

1 Scope

This Technical Specification describes test procedures for evaluating the effects of the interactions between driver frontal airbags or side airbags (excluding curtains) and small female arms.

This Technical Specification recommends dummies, procedures, instrumentation and test configurations that can be used for investigating the interactions that occur between a deploying airbag and a vehicle occupant. Driver frontal airbags deploy from the steering wheel and side airbags can deploy from the door, side trim panel, armrest, seat back or seat cushion. Occupants can range in size from young children to very large adults. However, the small adult female is considered to be the most at risk of arm injury from airbags. Therefore, this test procedure only addresses the small adult female occupant.

Recommended measurements are summarized in Clause 5. This Technical Specification encourages the use of a wide range of test configurations and conditions, while recognizing that the range of possible airbag interactions is essentially limitless and beyond testing capability.

2 Normative references

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The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6487, *Road vehicles — Measurement techniques in impact tests — Instrumentation*

ISO 7862, *Road vehicles — Sled test procedure for the evaluation of restraint systems by simulation of frontal collisions*

ISO TR 12349-1, *Road vehicles — Dummies for restraint system testing — Part 1: Adult dummies*

SAE J211, *Instrumentation for impact test — Part 1: Electronic instrumentation*

SAE J1733, *Sign convention for vehicle crash testing*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

driver frontal airbag

airbag attached to the steering wheel designed primarily to help reduce occupant injury potential where the significant collision force vector is longitudinal and from the front of the vehicle

3.2
side airbag
SAB

seat or door-mounted airbag (excluding curtains) designed primarily to help reduce occupant injury potential where the significant collision force vector is lateral

3.3
SAE small female instrumented arm

fully instrumented arm developed to measure the impact response of the small female arm interacting with a deploying airbag(s)

NOTE See references [16] and [21] in the bibliography.

3.3.1
upper arm

portion of the dummy's arm between the elbow and the shoulder

3.3.2
forearm

portion of the dummy's arm from the elbow to the wrist, including the hand

3.4
enhanced airbag interaction arm

modified version of the SAE small female instrumented arm with additional measurement capabilities

NOTE See reference [3] in the bibliography.

3.5
midsagittal plane

imaginary vertical plane that separates the dummy into equal left and right halves

3.6
coronal plane

imaginary vertical plane that separates the dummy into front and back halves

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4 Test devices

The Hybrid III small female dummy shall be used for driver frontal airbag interactions. It is briefly described in 4.1. The SID-IIs dummy shall be used for side airbag interactions. It is briefly described in 4.2. These dummies will be instrumented with one of the two optional small female instrumented arms described in 4.3.

4.1 Hybrid III small female dummy

The Hybrid III small female dummy [16, 20] is representative of the fifth percentile adult female, designed to evaluate injury potential to the head, neck, shoulder, arm, chest, abdomen, lumbar spine, pelvis, thighs and legs. For these tests, the Hybrid III small female dummy will be instrumented with the SAE small female instrumented arm or the enhanced airbag interaction arm on the outboard side of the dummy.

4.2 SID-IIs small adult/adolescent side impact dummy

The SID-IIs is representative of the fifth percentile adult female and also approximates the height and weight of a 12–13-year-old adolescent child. It is a generic dummy designed to indicate injury potential to the head, neck, shoulder, arm, chest, abdomen, lumbar spine, pelvis, thighs and legs [1, 7, 14]. For these tests, the SID-IIs will be instrumented with the SAE small female instrumented arm or the enhanced airbag interaction arm on the outboard side of the dummy.

4.3 SAE small female instrumented arm and the enhanced airbag interaction arm

The SAE small female instrumented arm [16, 21] and the enhanced airbag interaction arm [3] can be used to indicate injury potential to the upper arm, forearm, elbow and wrist. They were specifically designed to help evaluate the injury potential of driver frontal airbags and side airbags while being used with the Hybrid III small female or SID-IIs dummies, respectively.

5 Instrumentation

Measurements applicable to driver frontal airbag testing and to SAB testing can be made using the anthropomorphic test devices listed in 4.1 and 4.2, respectively. Both driver frontal airbag testing and side airbag testing will include the use of one of the two interchangeable small female instrumented arms listed in 3.3, 3.4 and 4.3. All measurements should be recorded and filtered according to the latest version of ISO 6487 and SAE J211, Part 1. These measurements should be continuous functions of time, so that other quantities referred to in the references can be derived.

As an option, the airbag deployment and dummy interactions may be monitored by high-speed cameras (or equivalent video equipment) operating at a minimum speed of 1 000 frames per second.

5.1 Hybrid III small female dummy

See ISO/TR 12349-1 and references [16] and [20] in the bibliography.

5.2 SID-IIs small adult/adolescent side impact dummy

See ISO/TR 12349-1 and references [1], [7] and [14] in the bibliography.

5.3 SAE small female instrumented arm

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A recommendation for which arm to use is being developed by ISO/TC 22/SC 12/WG 5. Until such a recommendation becomes available the reader is referred to SAE Engineering Aid 36, which describes the SAE instrumented arm, and to ISO/TC 22/SC 12/WG 5/N622 and reference [17] in the bibliography, which describe the enhanced airbag interaction arm. These arms are available for the SID-IIs and the Hybrid III small female dummies.

5.4 Impact response measurements

5.4.1 Dummy instrumentation measurements

Data acquisition shall be in accordance with ISO 6487. Obtain the data specified in Tables 1 and 2 for driver frontal airbag tests and side airbag tests, respectively. The data not specific to the arm are used to evaluate the quality of the test and to obtain a view of the overall dummy–airbag interaction [11].

5.4.2 Dummy instrumentation filter classifications

Forces, moments and accelerations obtained with the instrumented arms are to be filtered using a CFC 600 filter [6, 23].

5.5 Dummy injury criteria

A recommendation for injury criteria for the arm and forearm has been developed by ISO/TC 22/SC 12/WG 6 and is specified in ISO/TC 22/SC 12/WG 6/N573. References [2], [4], [5], [8], [9], [12], [13] and [18] in the bibliography provide a resource recommended by ISO/TC 22/SC 12/WG 6 for further development of reference values. It should be noted that the forearm bending moment cited in N573 is the resultant forearm bending moment.