

# Road vehicles — Sled test procedure for evaluating occupant head and neck interactions with seat/head restraint designs in low-speed rear-end impact

ICS 43.020

# National foreword

This British Standard reproduces verbatim ISO 17373:2005 and implements it as the UK national standard.

The UK participation in its preparation was entrusted to Technical Committee AUE/15, Safety related to vehicles, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

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## Summary of pages

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# INTERNATIONAL STANDARD

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17373**

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## **Road vehicles — Sled test procedure for evaluating occupant head and neck interactions with seat/head restraint designs in low-speed rear-end impact**

*Véhicules routiers — Mode opératoire d'essai sur chariot pour évaluer  
les interactions de la tête et du cou de l'occupant avec le siège et  
l'appuie-tête lors d'un choc arrière à faible vitesse*



Reference number  
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# Contents

Page

|                                                                          |    |
|--------------------------------------------------------------------------|----|
| Foreword.....                                                            | iv |
| Introduction .....                                                       | v  |
| 1     Scope .....                                                        | 1  |
| 2     Normative references .....                                         | 1  |
| 3     Terms and definitions.....                                         | 1  |
| 4     Testing equipment.....                                             | 2  |
| 4.1   Test facility .....                                                | 2  |
| 4.2   Anthropomorphic test device (ATD) .....                            | 2  |
| 4.3   Test objects .....                                                 | 3  |
| 5     Requirements .....                                                 | 3  |
| 5.1   Anthropomorphic test device instrumentation and measurements ..... | 3  |
| 5.2   Test temperature.....                                              | 4  |
| 6     Test preparation .....                                             | 4  |
| 6.1   Mounting of the seat and seat belt system on the sled .....        | 4  |
| 6.2   Positioning of the ATD on the seat .....                           | 5  |
| 6.3   Additional considerations.....                                     | 6  |
| 6.4   Film targets.....                                                  | 6  |
| 6.5   Test report .....                                                  | 7  |
| 6.6   Camera positions.....                                              | 8  |
| 7     Test conditions .....                                              | 8  |
| 7.1   Acceleration/deceleration pulse.....                               | 8  |
| 7.2   Active systems .....                                               | 8  |
| 8     Data recording.....                                                | 9  |
| 8.1   General.....                                                       | 9  |
| 8.2   Post-test measurements .....                                       | 9  |
| Annex A (normative) Positioning procedure for BioRID II.....             | 10 |
| Annex B (normative) Positioning procedure for RID2.....                  | 14 |
| Annex C (normative) Positioning procedure for Hybrid III .....           | 22 |
| Annex D (informative) Test report .....                                  | 23 |
| Bibliography .....                                                       | 25 |

## 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.

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 17373 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 10, *Impact test procedures*.

## Introduction

Most head restraints of current vehicles are designed to minimize the risk of severe neck injuries such as bony fractures, luxations and ligament ruptures. However, so called “whiplash associated disorders” (WAD) of an AIS 1 injury severity degree still occur in considerable numbers. The majority of persons with such minor neck disorders soon recover without ongoing symptoms. Some victims, however, report long term impairment after even a “minor” event, also called “low-speed rear-end impact”. These injuries are difficult to diagnose – even a careful medical examination including CT scan and MRI often reveals no visible reason for a reported disorder – and the complexities involved are often misunderstood. Therefore, legal and insurance related disputes are common.

It has been shown in the relevant scientific literature that:

- whiplash associated disorders (WAD) predominantly occur in the struck vehicle in rear-end impacts;
- discussions about better seat and head restraint design in order to reduce WAD have been ongoing for a long time, given the complexity of the subject;
- many organizations interested in seat design (manufacturers of automobiles or seats, universities, accident investigators, consumer test houses) have devised their own dynamic test procedures;
- to date, no standard test procedure is available that covers minor neck loading in typical “low-speed rear-end impacts”;

accidentology analyses show that the majority of the neck disorders discussed here occur during rear-end impacts which result in a velocity change of 10 km/h to 15 km/h for the struck vehicle.



# Road vehicles — Sled test procedure for evaluating occupant head and neck interactions with seat/head restraint designs in low-speed rear-end impact

## 1 Scope

The sled test procedure described in this International Standard simulates low-speed rear-end impact resulting in a velocity change of the struck vehicle of 15 km/h. Its main purpose is the evaluation of the whiplash associated disorders due to seat occupant interactions with seat systems during the loading phase under standard conditions.

Seat-belts shall be used unless it is proven that they do not affect the occupant response.

The occupant protection potential of seat systems in other collision situations (e.g. higher velocity change/vehicle accelerations possibly resulting in large deformation of the seat back) is not covered by this International Standard.

## 2 Normative references

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*

SAE J211/1, *Instrumentation for impacts Tests — Part 1: Electronic Instrumentation*

## 3 Terms and definitions

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

### 3.1

#### **delta-v**

$\Delta v$

maximum velocity change of the sled

### 3.2

#### **active system**

any restraint system, including seat belt, triggered electronically or mechanically, designed to reduce the risk of occupant injuries

### 3.3

$t_0$

time corresponding to the first data point above 0,5 g as defined by the acceleration time curve measured on the sled filtered at CFC 60, on a specific sensor with a low amplitude range (e.g. 10 g)

[ISO 6487]

**3.4**  
**HRMD backset**  
horizontal measurement between the back surface of the HRMD head and the front surface of the head restraint as measured by the backset probe of the HRMD

See Annex A.

NOTE HRMD: head restraint measuring device.

**3.5**  
**dummy backset**  
horizontal distance between dummy's head and head restraint

See 6.5.

**3.6**  
**dummy height**  
vertical distance between dummy's head and head restraint

See 6.5.

## 4 Testing equipment

### 4.1 Test facility

The test shall be performed on an acceleration sled. If a deceleration system is used, film analysis shall be used to confirm proper dummy position immediately prior to  $t_0$ . Two sensors shall be used on the sled:

- one with a low amplitude range for the definition of  $t_0$ ;
- the second for the complete pulse.

NOTE Proper dummy position means the dummy has not moved outside tolerances specified in the seating procedure.

### 4.2 Anthropomorphic test device (ATD)

#### 4.2.1 Type

The test procedure is applicable to a 50th percentile male ATD.

Possible ATDs (dummies) that may be used are presented in Annexes A, B and C.

**IMPORTANT — It is not in the scope of this test procedure to determine which dummy is to be used.**

NOTE ISO experts in this field of standardization recommend using the BioRID II test dummy <sup>1)</sup>.

#### 4.2.2 Clothing and shoes

The dummy shall be clothed as defined by the dummy manufacturer.

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1) BioRID is the trade name of a product supplied by Denton. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results. See 6.2.

### 4.2.3 Temperature

The dummy temperature shall be in the range of  $22\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ , unless specified differently by the dummy's manufacturer.

This temperature shall be obtained by soaking the dummy in temperatures that are within the range specified above for at least 5 h prior to the test.

The dummy temperature shall be maintained within the specified range between the time of setting the limbs and up to a maximum of 10 min before the time of the test.

### 4.2.4 Dummy joints

Dummy joint frictions shall be set according to dummy manufacturer's specified procedure or as defined in Annexes A, B and C. The dummy joint stiffnesses shall be set as close as possible to the time of the test and, in all cases, not more than 24 h before the test.

### 4.2.5 Post test dummy inspection

The dummies shall be visually inspected immediately after the test. Any lacerations of the skin or breakages of the dummy shall be noted in the test report.

## 4.3 Test objects

These are seat assemblies of passenger cars, light truck vehicles and light commercial vehicles.

## 5 Requirements

### 5.1 Anthropomorphic test device instrumentation and measurements

The ATD shall be instrumented according to the requirements of the relevant ISO standards. Table 1 provides an example of ATD measurements.

**Table 1 — Examples of ATD measurements**

|                                 | Position                                                       | Measurement                         | Axes  |
|---------------------------------|----------------------------------------------------------------|-------------------------------------|-------|
| <b>Recommended measurements</b> | Head                                                           | Acceleration                        | x/y/z |
|                                 | Upper neck (C1)                                                | Force                               | x/z   |
|                                 |                                                                | Moment of torque                    | y     |
|                                 | Lower neck at the junction of the cervical and thoracic spines | Acceleration                        | x     |
|                                 |                                                                | Force                               | x/z   |
|                                 |                                                                | Moment of torque                    | y     |
|                                 | Chest                                                          | Acceleration                        | x/z   |
| <b>Optional measurements</b>    | Pelvis                                                         | Acceleration                        | x/y/z |
|                                 | Head                                                           | Rotational acceleration or velocity | y     |
|                                 | Upper neck (C1)                                                | Force                               | y     |
|                                 |                                                                | Moment of torque                    | x/z   |
|                                 | Lower neck at the junction of the cervical and thoracic spines | Force                               | y     |
|                                 |                                                                | Moment of torque                    | x/z   |