

TECHNICAL REPORT

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Road vehicles — Anthropomorphic side impact dummy —

Part 4 :

Lateral shoulder impact response requirements to assess biofidelity of dummy

Véhicules routiers — Mannequin anthropomorphe pour essai de choc latéral —

Partie 4 : Caractéristiques de réponse de l'épaule à un choc latéral permettant d'évaluer la biofidélité d'un mannequin



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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.

The main task of ISO technical committees is to prepare International Standards. In exceptional circumstances a technical committee may propose the publication of a technical report of one of the following types:

- type 1, when the necessary support within the technical committee cannot be obtained for the publication of an International Standard, despite repeated efforts;
- type 2, when the subject is still under technical development requiring wider exposure;
- type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical reports are accepted for publication directly by ISO Council. Technical reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/TR 9790-4, which is a technical report of type 3, was prepared by Technical Committee ISO/TC 22, *Road vehicles*.

ISO/TR 9790 consists of the following parts, under the general title *Road vehicles — Anthropomorphic side impact dummy*:

- *Part 1: Lateral head impact response requirements to assess biofidelity of dummy*
- *Part 2: Lateral neck impact response requirements to assess biofidelity of dummy*
- *Part 3: Lateral thoracic impact response requirements to assess biofidelity of dummy*
- *Part 4: Lateral shoulder impact response requirements to assess biofidelity of dummy*
- *Part 5: Lateral abdominal impact response requirements to assess biofidelity of dummy*
- *Part 6: Lateral pelvis impact response requirements to assess biofidelity of dummy*

Road vehicles — Anthropomorphic side impact dummy —

Part 4 :

Lateral shoulder impact response requirements to assess biofidelity of dummy

1.0 INTRODUCTION

The impact response requirement presented in this Technical Report is the result of a critical evaluation of data selected from experiments agreed to by experts as being the best and most up-to-date information available.

A single dynamic response requirement is defined for lateral loading of the shoulder. It is based on impact tests conducted by Association Peugeot-Renault using unembalmed cadavers (1). A second requirement is implicit in the lateral neck bending requirement that is based on Ewing et al (2) human volunteer data. In those sled tests, the dummy must mimic the human volunteer's shoulder reaction with the rigid vertical side board in order for the kinematics of its upper thoracic spine to meet the T1 response requirements. Note that the Ewing data may be incompatible with the APR data because the Ewing volunteers were tensed in anticipation of the shoulder loading while the APR cadavers were unembalmed making them quite flaccid.

2.0 SCOPE AND FIELD OF APPLICATION

This Technical Report is one of six reports that describe laboratory test procedures and impact response requirements suitable for assessing the impact biofidelity of side impact dummies. This Technical Report provides information to assess the biofidelity of lateral impact response of the shoulder.

*Numbers in parentheses denote papers listed in References, Section 5.0

3.0 ISO REFERENCES

ISO DP 9790-1 Road Vehicles - Anthropomorphic Side Impact Dummy - Lateral Head Impact Response Requirements to Assess the Biofidelity of the Dummy.

ISO DP 9790-2 Road Vehicles - Anthropomorphic Side Impact Dummy - Lateral Neck Impact Response Requirements to Assess the Biofidelity of the Dummy.

ISO DP 9790-3 Road Vehicles - Anthropomorphic Side Impact Dummy - Lateral Thoracic Impact Response Requirements to Assess the Biofidelity of the Dummy.

ISO DP 9790-5 Road Vehicles - Anthropomorphic Side Impact Dummy - Lateral Abdominal Impact Response Requirements to Assess the Biofidelity of the Dummy.

ISO DP 9790-6 Road Vehicles - Anthropomorphic Side Impact Dummy - Lateral Pelvis Impact Response Requirements to Assess the Biofidelity of the Dummy.

4.0 REQUIREMENT

4.1 Original Data

Researchers of the Association Peugeot-Renault subjected 4 cadavers to lateral impacts delivered to the shoulder by the flat end of a 23 kg rigid cylinder of 150 mm diameter (1). Each cadaver was seated on a horizontal hardwood surface with a vertical backrest. The impact was delivered laterally to the shoulder. The force of the impactor was recorded. Results of these tests are given in Appendix A.

4.2 Response Requirements

The original force-time curves of the impactor were normalized (see Appendix A) using the technique suggested by Mertz (3). The normalized force-time curves and the proposed response corridor are shown in Figure 1. The maximum normalized deflection should be between 34 and 41 mm.

4.3 Test Setup

A 23 kg rigid, 150 mm diameter cylinder with a flat impact face is required. The dummy is to be seated upright and the impactor adjusted to strike the dummy's shoulder laterally between 4.4 m/s and 4.6 m/s. The axis of the impactor is to be aligned with the center of the shoulder joint.

4.4 Instrumentation

Instrument the dummy to monitor acceleration of the thoracic spine. Record the force of the impactor. Force and acceleration measurements are to meet SAE Channel Class 1000 filter requirements.

4.5 Normalization Procedure

Determine the impulse by integrating the force-time curve. Calculate the effective mass using the following relationship,

$$M_e = [\int_0^T F dt] / (V_0) \quad (1)$$

where $\int_0^T F dt$ is the impulse and V_0 is the impact velocity. The mass ratio defined in Appendix A is,

$$R_m = 20.5 \text{ kg}/M_e \quad (2)$$

Calculate the mass ratio for the test.