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Motorcycles — Test and analysis procedures for research evaluation of rider crash protective devices fitted to motorcycles —

Part 3: Motorcyclist anthropometric impact dummy

Motocycles — Méthodes d'essai et d'analyse de l'évaluation par la recherche des dispositifs, montés sur les motocycles, visant à la protection des motocyclistes contre les collisions —
Partie 3: Mannequin anthropométrique de motocycliste pour essais de choc

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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.

ISO 13232-3 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 22, *Motorcycles*.

This second edition cancels and replaces the first version (ISO 13232-3:1996), which has been technically revised.

ISO 13232 consists of the following parts, under the general title *Motorcycles — Test and analysis procedures for research evaluation of rider crash protective devices fitted to motorcycles*:

— *Part 1: Definitions, symbols and general considerations*

— *Part 2: Definition of impact conditions in relation to accident data*

— *Part 3: Motorcyclist anthropometric impact dummy*

— *Part 4: Variables to be measured, instrumentation and measurement procedures*

— *Part 5: Injury indices and risk/benefit analysis*

— *Part 6: Full-scale impact-test procedures*

— *Part 7: Standardized procedures for performing computer simulations of motorcycle impact tests*

— *Part 8: Documentation and reports*

Introduction

ISO 13232 has been prepared on the basis of existing technology. Its purpose is to define common research methods and a means for making an overall evaluation of the effect that devices which are fitted to motorcycles and intended for the crash protection of riders, have on injuries, when assessed over a range of impact conditions which are based on accident data.

It is intended that all of the methods and recommendations contained in ISO 13232 should be used in all basic feasibility research. However, researchers should also consider variations in the specified conditions (for example, rider size) when evaluating the overall feasibility of any protective device. In addition, researchers may wish to vary or extend elements of the methodology in order to research issues which are of particular interest to them. In all such cases which go beyond the basic research, if reference is to be made to ISO 13232, a clear explanation of how the used procedures differ from the basic methodology should be provided.

ISO 13232 was prepared by ISO/TC 22/SC 22 at the request of the United Nations Economic Commission for Europe Group for Road Vehicle General Safety (UN/ECE/TRANS/SCI/WP29/GRSG), based on original working documents submitted by the International Motorcycle Manufacturers Association (IMMA), and comprising eight interrelated parts.

This revision of ISO 13232 incorporates extensive technical amendments throughout all the parts, resulting from extensive experience with the standard and the development of improved research methods.

In order to apply ISO 13232 properly, it is strongly recommended that all eight parts be used together, particularly if the results are to be published.

Motorcycles — Test and analysis procedures for research evaluation of rider crash protective devices fitted to motorcycles —

Part 3:
Motorcyclist anthropometric impact dummy

1 Scope

This part of ISO 13232 specifies the minimum requirements for the:

— biofidelity of the motorcyclist anthropometric impact dummy;

— compatibility of the dummy with motorcycles, helmets, multi-directional impacts, and the instrumentation;

— repeatability and reproducibility of the dummy properties and responses.

ISO 13232 specifies minimum requirements for research into the feasibility of protective devices fitted to motorcycles, which are intended to protect the rider in the event of a collision.

ISO 13232 is applicable to impact tests involving:

— two-wheeled motorcycles;

— the specified type of opposing vehicle;

— either a stationary and a moving vehicle or two moving vehicles;

— for any moving vehicle, a steady speed and straight-line motion immediately prior to impact;

— one helmeted dummy in a normal seating position on an upright motorcycle;

— the measurement of the potential for specified types of injury, by body region;

— evaluation of the results of paired impact tests (i.e. comparisons between motorcycles fitted and not fitted with the proposed devices).

ISO 13232 does not apply to testing for regulatory or legislative purposes.

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 13232-1, *Motorcycles — Test and analysis procedures for research evaluation of rider crash protective devices fitted to motorcycles — Part 1: Definitions, symbols, and general considerations*

ISO 13232-4, *Motorcycles — Test and analysis procedures for research evaluation of rider crash protective devices fitted to motorcycles — Part 4: Variables to be measured, instrumentation and measurement procedures*

ISO 13232-6, *Motorcycles — Test and analysis procedures for research evaluation of rider crash protective devices fitted to motorcycles — Part 6: Full-scale impact test procedures*

ISO 13232-8, *Motorcycles — Test and analysis procedures for research evaluation of rider crash protective devices fitted to motorcycles — Part 8: Documentation and reports*

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

49 CFR Part 572, subpart E: 1993, Anthropomorphic test dummies, United States of America Code of Federal Regulations issued by the National Highway Traffic Safety Administration (NHTSA). Washington, D.C.

3 Definitions

The following terms are defined in ISO 13232-1. For the purposes of this part of ISO 13232, those definitions apply. Additional definitions which could apply to this part of ISO 13232 are also listed in ISO 13232-1:

— abdominal foam insert;

— alternative products;

— certification, compliance;

— knee compliance element;

— load cell simulator;

— lot;

— specimen.

4 Mechanical requirements for the motorcyclist anthropometric impact dummy

4.1 Basis dummy

The basis dummy shall be the Hybrid III 50th percentile male dummy[1)]. The dummy shall be equipped with:

— the sit/stand construction[2)];

— the head/neck assembly which is compatible with the six axis upper neck load cell which is specified in 4.4.1.2 of ISO 13232-4[2)];

— standard, non-sliding knees[2)].

The basis dummy specified components shall be modified or replaced as described below.

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1) Basis dummy as specified in 49 CFR Part 572, subpart E, or equivalent.

2) A list describing one or more example products which meet these requirements is maintained by the ISO Central Secretariat and the Secretariat of ISO/TC 22/SC 22. The list is maintained for the convenience of users of ISO 13232 and does not constitute an endorsement by ISO of the products listed. Alternative products may be used if they can be shown to lead to the same results.

4.2 Motorcyclist dummy head and head skins

The head skin components shall include the two basis Hybrid III head skins, plus two extensions which provide helmet compatibility. The geometries of the head skins and extensions are shown in Figure A.1, where 1 and 2 are the basis Hybrid III head and rear skull cap skins and 3 and 4 are the jaw and nape extensions which provide helmet compatibility. The masses of the jaw and nape skin extensions shall be 0,27 kg ± 0,05 kg and 0,15 kg ± 0,05 kg, respectively[2)]. The head-neck skin modifications to the Hybrid III head shall be attached by means of any suitable adhesive. Such an adhesive shall be shown to provide a bond between the mating parts in which the parent material will fail under tensile loading before the bond itself. Cyanoacrylate is an example of a suitable adhesive.

The complete assembly of the head, head skins, head skin extensions, head accelerometer mount, head accelerometers and cables, and neck load cell and cables shall have a mass of 5,35 kg ± 0,1 kg.

4.3 Motorcyclist dummy neck components

The complete assembly of the neck, nodding blocks, head attachment pin, bib simulator, and the upper half of the serrated lower neck mount shall have a mass of 1,55 kg ± 0,1 kg.

4.3.1 Neck shroud

The neck shroud shall be as specified in Figure A.2[2)]. The upper half of the zipper of the neck shroud shall be attached to the jaw skin extension by means of any suitable adhesive. Such an adhesive shall be shown to provide a bond between the mating parts in which the parent material will fail under tensile loading before the bond itself.

Note - “Loctite® 401”[2)] cyanoacrylate is an example of a suitable adhesive.

4.3.2 Lower neck mount

When mounting the motorcyclist neck the lower neck mount shall be set at the 5,25 degree extension position. This is appropriate for most dummy rider positioning. However, in cases of extreme dummy posture, the basis Hybrid III lower neck mount may be modified as shown in Figure A.3 to increase head position adjustability[2)].

4.3.3 Motorcyclist neck

The standard Hybrid III neck and its interfaces with the head and upper torso assembly shall be replaced by the neck shown in Figure A.4[2)].

NOTE The neck shown in Figure A.4 is designed specifically for use in motorcycle crash testing. Use and limitation information is contained in B.2.5.

4.3.4 Replacement nodding blocks

The standard Hybrid III nodding blocks shall be replaced with the pair of nodding blocks shown in Figure A.4[2)].

4.3.5 Neck initial conformity of production

For certification of a new neck and nodding block production design, material specification or manufacturing process which otherwise meet the specifications given in Figure A.4, one neck shall be dynamically tested according to the procedures described in 6.8. The neck responses shall be within the corridors described in 6.8 and shown in figures 1, 2, 3, 4, 5, 6, and 7.

4.3.6 Neck subsequent conformity of production

Once a production design, material specification or manufacturing process has been certified according to 4.3.5, each manufactured neck and nodding block assembly produced thereafter shall be tested according to the procedures in 6.9 to verify the characteristics specified in Table 1.

Table 1 — Neck subsequent conformity of production specifications

Static Test	Characteristics	Required average value	% Required standard deviation
Flexion	Flexion angle	17,6 ± 2,6 °	10% of average value
Flexion	Slider displacement	14,0 ± 3,0 mm	10% of average value
Extension	Extension angle	30,9 ± 4,6 °	10% of average value
Lateral	Lateral angle	28,7 ± 4,3 °	10% of average value
Torsion	Torsion angle	41,5 ± 6,2 °	10% of average value

4.4 Motorcyclist dummy upper torso components

4.4.1 Replacement thoracic spine

Either a standard Hybrid III thoracic spine, or a replacement thoracic spine[2)] shall be used. If a replacement spine is used, then the replacement thoracic spine shall be compatible with the internal data acquisition system described in ISO 13232-4. When combined with the internal data acquisition system, the replacement thoracic spine shall:

— maintain the same interface geometry and overall height as the standard Hybrid III spine box, including the shoulder, rib, lower neck mount, and lumbar spine attachment points;

— not interfere with the motion of the shoulders;

— provide at least 75 mm of sternum deflection in the sagittal plane, measured perpendicularly, relative to the front surface of the spine box;

— not exceed 125 mm in lateral width;

— result in the same upper torso mass and centre of gravity as specified for a standard Hybrid III upper torso except that the centre of gravity tolerance shall be ± 30 mm.

4.4.2 Modified chest skin

With the chest skin properly installed on the upper torso, the back of the chest skin may be modified with four holes which expose the two upper and two lower rib attachment screws in order to enable measurement of the upper torso angle, using a torso inclinometer such as the example shown in ISO 13232-6, Figure C.1.

4.5 Motorcyclist dummy lower torso components

When fully assembled, the lower torso assembly shall result in the same lower torso mass as specified for the standard Hybrid III lower torso[3)].

4.5.1 Modified straight lumbar spine

For use with either the six-axis or three-axis lumbar load cell, the straight lumbar spine and cable shall be FTSS part numbers 1260004 and 1260005[4)]. The lower lumbar spine transducer mount and ballast block shall be replaced with the part shown in Figure A.5 for a six-axis load cell[2)] and in Figure A.6 for a three-axis load cell[2)]. An

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3) Refer to General Motors Hybrid III drawing numbers 78051-70 and 78051-338 in 49 CFR Part 572.

4) Parts 1260004 and 1260005 are products supplied by First Technology Safety Systems, Plymouth, Michigan, USA. This information is given for the convenience of users of ISO 13232 and does not constitute and endorsement by ISO of the product named. Alternative products may be used if they can be shown to lead to the same results.

abdomen reaction plate, as shown in Figure A.7 revision 1 for the six-axis load[2)] cell or Figure A.8 for the three-axis load cell[2)], shall be mounted to the lower lumbar spine transducer mount and ballast block.

When assembling the pelvis and ballast block, if hard contact interference prevents the proper positioning of the parts either part may be trimmed as required to facilitate the assembly.

When using the dummy without either of the permissible lumbar load cells described in 4.4.1.4 of ISO 13232-4, the load cell shall be replaced with a lumbar load cell simulator[2)].

4.5.2 Motorcyclist dummy abdominal insert

The basis Hybrid III abdominal insert shall be replaced with a frangible solid abdominal insert, as shown in Figure A.9. The replacement insert shall have a mass of 53 g ± 3 g.

When tested according to the method described in 6.7, the specified values of force shall be as given in Table 2[2)].

Table 2 — Specified values for certification of replacement abdominal insert

Deflection mm	Force N
20	1 040
40	1 875
60	2 810

4.5.3 Sit/stand pelvis

The internal data acquisition system may be contained within a sit/stand pelvis which has been suitably modified to accommodate it[2)]. Whether modified or not, the sit/stand pelvis shall:

- maintain the same interface geometry and external dimensions as the standard Hybrid III sit/stand pelvis;
- not interfere with the motion of the legs.

4.6 Arms and modified elbow bushing

The Delrin elbow bushing, Hybrid III part number 78051-199[5)], shall be modified with scribe marks, as shown in Figure A.10.

The masses of the upper and lower arms shall be as specified for a standard Hybrid III.

4.7 Motorcyclist dummy hands

The basis Hybrid III hands shall be replaced with the Itoh-Seiki Co. part number 065-322048[6)].

4.8 Motorcyclist dummy upper leg components

The mass of the upper leg assembly shall be 4,89 kg ± 0,2 kg.

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5) Refer to General Motors Hybrid III drawing number 78051-199 in 49 CFR Part 572.

6) Part number 065-322048 is a product supplied by Itoh-Seiki Co., Tokyo, Japan. This information is given for the convenience of users of ISO 13232 and does not constitute an endorsement by ISO of the product named. Alternative products may be used if they can be shown to lead to the same results.

