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Road restraint systems - Part 8: Motorcycle road restraint systems which reduce the impact severity of motorcyclist collisions with safety barriers

Rückhaltesysteme an Straßen - Teil 8: Rückhaltesysteme für Motorräder, die die Anprallheftigkeit an Schutzplanken reduzieren

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Road restraint systems - Part 8: Motorcycle road restraint systems which reduce the impact severity of motorcyclist collisions with safety barriers

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 226.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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CONTENTS

Foreword

This document (prEN 1317-8:2010) has been prepared by Technical Committee CEN/TC 226 “Road equipment”, the secretariat of which is held by AFNOR.

This document is currently submitted to CEN Enquiry.

This document will supersede ENV 1317-4:2001

EN 1317 consists of the following parts:

- EN 1317-1, *Road restraint systems - Part 1: Terminology and general criteria for test methods*;
- EN 1317-2, *Road restraint systems - Part 2: Performance classes, impact test acceptance criteria and test methods for safety barriers including vehicle parapets*;
- EN 1317-3, *Road restraint systems - Part 3: Performance classes, impact test acceptance criteria and test methods for crash cushions*;
- ENV 1317-4, *Road restraint systems — Part 4: Performance classes, impact test acceptance criteria and test methods for terminals and transitions of safety barriers*;
- prEN 1317-4, *Road restraint systems – Part 4: Performance classes, impact test acceptance criteria and test methods for transitions of safety barriers* (under preparation: this document will supersede ENV 1317-4:2001 for the clauses concerning transitions)*;*
- EN 1317-5, *Road restraint systems – Part 5: Product requirements and evaluation of conformity for vehicle restraint systems*;
- prEN 1317-6, *Road restraint systems – Pedestrian restraint systems — Part 6: Pedestrian Parapet* (under preparation);
- prEN 1317-7, *Road restraint systems – Part 7: Performance classes, impact test acceptance criteria and test methods for terminals of safety barriers* (under preparation: this document will supersede ENV 1317-4:2001 for the clauses concerning terminals);
- prEN 1317-8, *Road restraint systems - Part 8: Motorcycle road restraint systems which reduce the impact severity of motorcyclist collisions with safety barriers* (under preparation).

Annexes A to D and Annex F are normative and Annex E and G are informative.

Introduction

In order to improve safety the design of roads may require the installation of road restraint systems, which are intended to contain and redirect errant vehicles safely for the benefit of the occupants and other road users, or pedestrian parapets designed to restrain and to guide pedestrians and other road users not using vehicles, on sections of road and at particular locations defined by the national or local authorities.

Part 2 of this standard contains performance classes, impact test acceptance criteria and test methods for barriers. Whereas the aforementioned part covers the performance of these systems with respect to cars and heavy vehicles, this part of the standard addresses the safety of the riders of powered two-wheeled vehicles impacting the barrier having fallen from their vehicle.

As powered two-wheeler riders may impact a barrier directly (in which case no protection is offered by the vehicle) special attention is given to these vulnerable road-users. In order to minimise the consequences to a rider of such an impact, it may be necessary to fit a barrier with a specific PTW rider protection system. Alternatively, a barrier might specifically incorporate characteristics limiting the consequences of a PTW rider impact.

Rider protection systems may be continuous (including barriers specifically designed with the safety of PTW riders in mind) or discontinuous. A discontinuous system is one which offers rider protection in specific localised areas of a barrier judged to be of higher risk. The most common example of a discontinuous system is one fitted locally to the posts of a post and rail type guardrail - adding nothing between the posts.

The purpose of this part of the standard is to define the terminology specific to it, to describe procedures for the initial type-testing of rider protection systems and to provide performance classes and acceptance criteria for them.

Accident statistics from several European countries have shown that riders are injured when impacting barriers either whilst still on their vehicles or having fallen and then sliding along the road surface. Whilst different statistical sources show one or the other of these configurations to be predominant, all known studies show both to constitute a major proportion of rider to barrier impact accidents. Some studies showing the sliding configuration to be predominant have led to the development and use of test procedures in some European countries, evaluating systems with respect to the sliding configuration. At the time of writing, a number of such protection systems were already on the European market. It is for this reason that it was decided to address the issue of sliding riders initially, in order to bring about the adoption of a European standard in as timely a manner as possible. However, the rider on vehicle configuration should also be considered as soon as possible for a subsequent revision of this part of the standard.

1 Scope

This part of the European standard shall be read in conjunction with EN 1317 Parts 1 and 2. These parts of the standard all support EN 1317-5.

This part of the standard specifies requirements for the impact performance of PTW rider protection systems to be fitted to barriers or for the rider protection aspect of a barrier itself. It excludes the assessment of the vehicle restraint capabilities of barriers and the risk that they represent to the occupants of impacting cars. The performance of impacting vehicles must be assessed according to EN 1317-1 and 2.

This part of the standard defines performance classes taking into account rider speed classes, impact severity and the working width of the system with respect to rider impacts.

For systems designed to be added to a standard barrier, the test results are valid only when the system is fitted to the model of barrier used in the tests. EN 1317-5 describes how it may be determined whether other barrier models are sufficiently similar to the barrier tested to allow their use in conjunction with the tested system without the need for additional testing. Guidelines for making this judgement are given in Annex G.

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.

EN 1317-1, Road restraint systems - Part 1: Terminology and general criteria for test methods

EN 1317-2, Road restraint systems – Part 2: Performance classes, impact test acceptance criteria and test methods for safety barriers

EN 1317-5, Road restraint systems - Part 5: Product requirements and evaluation of conformity for vehicle restraint systems

EN 1621-1, Motorcyclists' protective clothing against mechanical impact - Part 1: requirements and test methods for impact protectors.

EN ISO 4762, Hexagon socket head cap screws

ISO 6487 - Road vehicles - Measurement techniques in impact tests – Instrumentation

E/ECE/TRANS/505 Regulation No. 22 – Uniform provisions concerning the approval of protective helmets and of their visors for drivers and passengers of motorcycles and mopeds

3 Abbreviations

PTW:	Powered Two-Wheeler
MPS:	Motorcyclist Protection System
CMPS:	Continuous Motorcyclist Protection System
DMPS:	Discontinuous Motorcyclist Protection System
W_d:	Dummy working width

4 Terms and definitions

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

4.1
motorcyclist
for the purposes of this document, the term “motorcyclist” is intended to mean the rider of any powered two-wheeler

4.2
motorcyclist protection system
any device installed on a barrier or in its immediate surroundings, the purpose of which is to reduce the severity of a PTW rider impact against the barrier, the rider having fallen from a PTW and then sliding along the road surface

4.3
continuous motorcyclist protection system
any MPS placed continuously along a barrier with the purpose of retaining and redirecting an impacting rider, usually preventing direct impact with aggressive elements of the barrier such as posts, anchorages or module connections. It also prevents a sliding rider from passing between the posts of a barrier and coming into contact with any potential hazard that may be behind the barrier.

4.4
discontinuous motorcyclist protection system
any MPS placed locally around a potentially aggressive element of a barrier, such as a post, anchorage or module connection, with the purpose of reducing the severity of a direct impact of the rider against it. This type of system is not intended to contain fallen PTW riders since the system is not present continuously along the length of the barrier.

4.5
integrated motorcyclist protection system:
motorcyclist protection system, either continuous or discontinuous, which forms an integral part of a barrier design rather than being a separate add-on fitted to an existing barrier

4.6
impact severity
risk level of physical injury to a rider resulting from an impact

4.7
biomechanical indices
indices obtained from the registers measured in the ATD, which are used to evaluate the severity of the impact

4.8
dummy working width (Wd)
distance between the foremost part of the un-deformed system and the maximum dynamic lateral position of any part of the system or ATD (see 7.4)

5 Biomechanical indices for assessing the impact severity of a PTW rider against an MPS

5.1 General

In order to assess the severity and define the acceptance criteria, the following biomechanical indices will be used.

NOTE: The sign convention shown in Figure 1, according to SAE J1733, will be adopted.

5.2 Index representing the head injury risk: Head injury criterion (HIC36)

The Head Injury Criterion (HIC_{36}) is an acceleration-based criterion defined by equation 1:

$$HIC = \max\left[\frac{1}{t_2 - t_1} \cdot \int_{t1}^{t2} a \cdot dt\right]^{2.5} \cdot \left(t_2 - t_1\right) \qquad (1)$$

Where:

a = resultant acceleration at the centre of gravity of the head expressed as units of gravity (1 g = 9.81 m/s^2)

$$a = \sqrt{a_x^2 + a_y^2 + a_z^2}$$

a_x = acceleration x axis
a_y = acceleration y axis
a_z = acceleration z axis

The (HIC_{36}) values for calculation intervals (t_2-t_1) greater than 36 are not taken into account for the calculation of maximum values, i.e., (t_2-t_1) $\leq$ 36 ms

5.3 Indices representing neck injury risk

Anterior-posterior shear force (F_x)
Lateral shear force (F_y)
Tension-compression force (F_z)
Lateral bending moment calculated about the occipital condyle (Moc_x)
Flexion/extension moment calculated about the occipital condyle (Moc_y)
Torsion moment (M_z)

The above indices shall be determined using the “upper neck load cell”

The moments about the occipital condyles Moc_x and Moc_y are calculated from the moments M_x and M_y expressed in N-m and the forces F_x and F_y expressed in N according to the expressions:

$Moc_x = M_x + F_y \cdot D$
$Moc_y = M_y - F_x \cdot D$

Where:

M_x = lateral bending moment on the neck.
M_y = flexion/extension moment on the neck.
D = Distance for the transfer to the occipital condyle of the moments of bending measured. It will adopt the specific value mentioned in 6.3.

The types of movement resulting in positive values of neck forces and moments are:

$+F_X$: Head backwards, chest forward (forward-backward shear)
$+F_Z$: Head upwards, chest downward (traction)
$+M_X$: Left shoulder towards left ear (lateral bending)
$+M_Y$: Chin towards sternum (flexion)

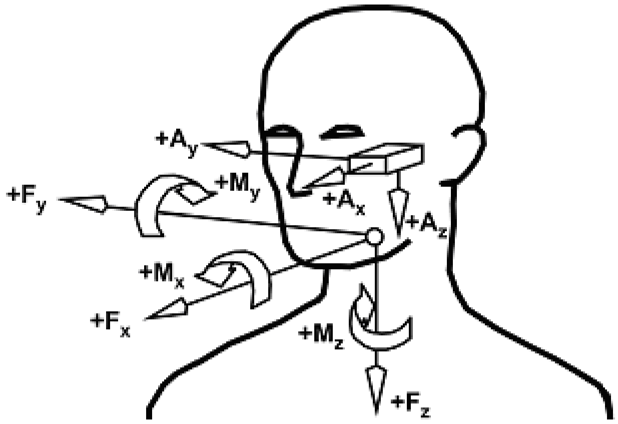


Figure 1 - Sign convention for accelerations, forces and moments in the ATD

6 Test methods

The full-scale impact test consists of launching an ATD at a given speed against a barrier with MPS (or integrated system), in a suitable test area. At the moment of impact, the ATD is sliding with its back and legs stably in contact with the ground.

6.1 Test Site

The test area shall comply with requirements of EN 1317-1, with the following exceptions and additions:

The test area shall be clear of dust, debris, standing water, ice and snow at the time of the test in the entire area over which the ATD is displaced during the test. No part of the test item shall be in contact with any ice or snow that could modify the deformation or performance of the test item during the test.

The test zone shall incorporate a smooth area along the approach path of the ATD to facilitate sliding of the ATD before impact.

6.2 Propulsion system

The ATD shall not be restrained, other than by the friction of the paved surface, guided or propelled by any force external to it at the point of impact.

6.3 ATD and instrumentation

The ATD used for the tests shall be a modified Hybrid III 50th percentile male dummy as described and according to the conditions of use given in Annex B.

All necessary measurements to evaluate the biomechanical indices will be carried out with measurement systems compliant with the standard ISO 6487.

The resultant acceleration measured at the centre of gravity of the ATD’s head will be calculated from the tri-axial components of the acceleration recorded with Channel Frequency Class 1 000 (CFC 1 000) and a Channel Amplitude Class of 500 g (CAC 500 g).

The neck forces and moments shall be measured by a six channel upper neck load cell specifically designed to be fitted to the Hybrid III dummy. These forces and moments shall be recorded as follows:

- Fx and Fy with a CAC of 8 kN and a CFC of 1000 and Fz with a CAC of 13 kN and a CFC of 1000
- Mx, My and Mz with a CAC of 280 Nm and a CFC of 600.

For the transfer of moments measured by the neck load cell to the occipital condyle, both the forces and moments shall have a CFC of 600.

For the distance D, the value of 0.01778 m shall be adopted for those load cells installed in the existing space at the base of the skull and 0.008763 for those load cells mounted on the lower surface of the base of the skull.

An event indicator shall be used to signal the moment of first ATD contact with the test item. However, the method used shall not modify the ATD to test item contact (e.g. the use of a tape switch on the helmet is not acceptable).

6.4 ATD clothing and equipment

6.4.1 Helmet

The ATD shall be equipped with an integral type, production motorcycle helmet weighing 1.300 kg ± 0.050 kg and with a polycarbonate shell. The helmet shall meet the specifications given in Annex G. Alternative helmet models can be used on condition that the chosen model has been tested and found to conform to the procedure described in Annex F. In all cases the helmet used shall comply with the requirements set out in regulation 22 of ECE/TRANS/505.

The surface of the helmet in contact with the test item shall be smooth, and free from protruding parts, vents, roughness or any other kind of unevenness, so that the contact conditions between the helmet and the test item are not influenced by any such feature.

The helmet shall be new for each test. No alteration of the original production helmet shall be undertaken. No stickers, paint or any other item or substance shall be applied to the helmet in any area of its surface which will be in contact with the test item.

6.4.2 Clothing

The ATD shall be dressed in a long-sleeved cotton tee-shirt to be worn under a leather, one-piece motorcycle suit (or two-piece suit if the two pieces are joined together) conforming to EN 1621-1, leather gloves, and leather boots. The leather suit shall not be fitted with any additional protection devices (e. g. back supports or neck restraints) or features that influence the behaviour of the ATD or restrict the movement of its limbs any more than would be the case with a simple leather suit.

The sizes of all items of clothing shall be appropriate so as to correctly fit the ATD.

The upper and lower extremities shall be clearly visually identified by painting the clothing, boots and gloves using a paint colour contrasting with the test zones surroundings. Each lower extremity shall be identified by painting the trouser leg and boot from the knee down. Each upper extremity shall be identified by painting the sleeve, and if necessary part of the glove, from the centre of the elbow joint to the centre of the wrist joint. There shall be a clear, visible distinction between the hand (from the wrist joint to the fingertips) and the rest of the upper extremity.

6.5 ATD mass including equipment

The total test ATD mass, including instrumentation, helmet, shirt, suit, gloves and boots, shall be 87.5 kg ± 2.5 kg.

6.6 Installation

For continuous systems, the length of the test item shall be equal to that of the barrier installation tested according to EN 1317-2.

Any end conditions (for example end anchorages) of the barrier or integrated MPS shall be identical to those used in the vehicle impact tests performed on the same barrier according to EN 1317-2. Any fixings (for example fixing of a CMPS to a barrier) of the MPS, or end conditions of a CMPS, shall be provided in accordance with the design of the MPS.

For DMPS, the minimum installation length of the supporting barrier shall be determined by the test house and agreed to by the manufacturer before the test. A minimum of two DMPS shall be installed on consecutive posts (or whichever other element supports the DMPS): one corresponding with the impact point and the other downstream of the impact.

Foundations for the test item shall meet the design specification.

When testing pretensioned MPSs, for which tension can be adjusted, any measurable applied tension or torque shall conform to that which is specified in the MPS installation manual and shall be recorded in the test report.

The height above the ground of the lower edge of the elements designed to restrain the PTW rider shall be measured in the impact zone and noted in the test report

NOTE This distance can influence the capacity of the system to restrain a rider. If the distance is different when the system is installed at the roadside, then the system performance may be affected. This should be taken into account when considering the use of the tested system on the road network. It should also be noted that the performance a tested system may be affected if the barrier with MPS or integrated MPS is installed on a curb.

6.7 Impact conditions

The full-scale impact tests are carried out by launching an ATD against the test item (in the case of a CMPS, against a straight length of test item) in accordance with a determined approach path and test conditions.

At the moment of the initial impact of the ATD against the test item, the surfaces of the helmet and the test item in the impact area shall be clean, dry, and free of any item or substance that may affect the contact between both surfaces.

The ATD shall impact the test item at a point approximately at the mid-point along the length of the test item or, in the case of a DMPS fitted to a barrier, approximately at the mid-point of the barrier. The exact position of the impact along the length of the test item shall be chosen by the test house in order to demonstrate the most severe impact conditions and the choice shall take into account any potentially hazardous feature of the test item.

The test shall be deemed to be completed when, following the impact (or impacts) the ATD has come completely to rest. Any secondary impacts, including any with the ground or hardened test zone surface, occurring before the ATD comes to rest shall be considered when determining the test results. If the ATD is connected to the data acquisition system by an umbilical cable, the ATD may be arrested to avoid damage occurring to the umbilical cable. Any such arresting of the ATD shall take place once the ATD is no longer in contact with the test item, after all injury criterion measurements have started to decrease or after any event resulting in a negative test result for the test item.

6.8 Launch configurations

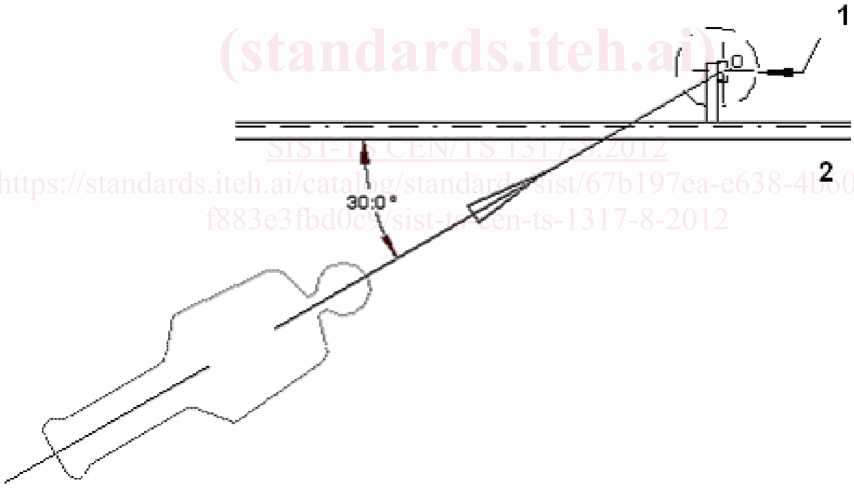
Three theoretical approach paths are defined as below. If the test laboratory judges that the impact point identified in this standard for a given test is not representative of the most severe testing conditions, the laboratory may change the impact point accordingly. In all cases, the impact point shall be identified in the test report its choice justified.

For each configuration, the ATD shall be launched lying face-up in a “supine decubitus” position, i.e. face up in a horizontal position and completely stretched out on its back, with its upper limbs parallel and adjacent to its trunk, with the palms of its hands oriented towards its trunk. The longitudinal centreline of the ATD spine shall coincide with the direction of the approach path and the head shall be oriented towards the theoretical impact point.

6.8.1 Launch configuration 1: Post-centred impact.

The approach path of the ATD is defined by a line, parallel to the ground, passing through the centre (O) of the post section and forming a 30° angle with respect to the centreline of the un-deformed test item (see Figure 2). For a CMPS, if the test item is not, or is not fitted to, a post-and-rail type safety barrier, point O shall be the centre of an anchorage, a connection between elements of the test item or any other point deemed to result in the highest severity impact. For a DMPS, O is the centre of the item onto which the MPS is fitted.

This launch configuration is applicable to all types of MPS and, is generally intended to represent the configuration resulting in the most severe impact-related injuries.



Key

1 Discontinuous system 2 Continuous system

Figure 2 - Launch configuration 1: post-centred impact

6.8.2 Launch configuration 2: Post offset impact.

The approach path of the ATD is defined by a line parallel to the ground and parallel to a line at 30° to the centreline of the un-deformed test item, passing through the point O (centre of the post section). The approach path shall be 20 cm upstream of the 30° line passing through O (see Figure 3).

This configuration is only applicable when the test item is a DMPS. If the test item is not fitted to a post-and-rail type safety barrier, point O shall be the centre of the item onto which the MPS is fitted.