PD CEN/TS 1317-8:2012

BSI Standards Publication

Road restraint systems

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

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National foreword

This Published Document is the UK implementation of CEN/TS 1317-8:2012.

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

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

Dispositifs de retenue routiers - Partie 8 : Dispositifs de retenue routiers pour motos réduisant la sévérité de choc en cas de collision de motocyclistes avec les barrières de sécurité

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

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The period of validity of this CEN/TS is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the CEN/TS can be converted into a European Standard.

CEN members are required to announce the existence of this CEN/TS in the same way as for an EN and to make the CEN/TS available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the CEN/TS) until the final decision about the possible conversion of the CEN/TS into an EN is reached.

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Foreword

This document (CEN/TS 1317-8:2012) has been prepared by Technical Committee CEN/TC 226 "Road equipment", the secretariat of which is held by AFNOR.

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

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

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* [1)];

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

— CEN/TR 1317-6, *Road restraint systems — Part 6: Pedestrian restraint systems — Pedestrian parapets* [2)];

— prEN 1317-7, *Road restraint systems — Part 7: Performance classes, impact test acceptance criteria and test methods for terminals of safety barriers*;

— CEN/TS 1317-8, *Road restraint systems — Part 8: Motorcycle road restraint systems which reduce the impact severity of motorcyclist collisions with safety barriers*.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to announce this Technical Specification: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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1) ENV 1317-4:2001 will be superseded by future EN 1317-4, *Road restraint systems — Part 4: Performance classes, impact test acceptance criteria and test methods for transitions of safety barriers* (under preparation).

2) Under preparation.

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.

EN 1317-2 contains performance classes, impact test acceptance criteria and test methods for barriers. Whereas EN 1317-2 covers the performance of these systems with respect to cars and heavy vehicles, this Technical Specification 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 Technical Specification 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 as a subsequent addition.

This Technical Specification shall be read in conjunction with EN 1317-1 and EN 1317-2.

1 Scope

This Technical Specification specifies requirements for the impact performance of systems designed for the reduction of impact severity for PTW riders impacting safety barriers whilst sliding along the ground, having fallen from their PTW vehicle. The protection systems concerned are those fitted to barriers or barriers that have an inherent PTW rider protection or risk reduction capability. This Technical Specification excludes the assessment of the vehicle restraint capabilities of barriers and the risk that they represent to the occupants of impacting cars. The assessment of performance of impacting vehicles is covered by EN 1317-1 and EN 1317-2.

This Technical Specification 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 since the performance will not necessarily be the same if the system is fitted to a different barrier.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 including vehicle parapets*

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 4762)*

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

3 Terms and definitions

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

3.1
biomechanical indices
indices obtained from the registers measured in the ATD, which are used to evaluate the severity of the impact

3.2
clothing
see 6.5.2

3.3
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, and that 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

3.4
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

Note 1 to entry: 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

3.5
dummy working width
W_d
distance between the foremost part of the un-deformed system and the maximum dynamic lateral position of any part of the system or ATD

Note 1 to entry: see 7.4.

3.6
impact severity
risk level of physical injury to a rider resulting from an impact

3.7
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

3.8
helmet
see 6.5.1

3.9
motorcyclist
rider of any powered two-wheeler

3.10
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

4 Abbreviations

For the purposes of this document, the following abbreviations apply.

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

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 shall be used.

The sign convention shown in Figure 1, according to SAE J1733, shall be adopted.

5.2 Index representing the head injury risk: Head injury criterion (HIC_{36})

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

$$HIC = \max\left[\frac{1}{t_2 - t_1} \times \int_{t1}^{t2} a \times dt\right]^{2,5} \times \left(t_2 - t_1\right) \tag{1}$$

where

a is the resultant acceleration at the centre of gravity of the head expressed as units of gravity (1 g = 9,81 m/s^2)

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

a_x is the acceleration X-axis;

a_y is the acceleration Y-axis;

a_z is the 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., ($t_2 - t_1$) ≤ 36 ms.

5.3 Indices representing neck injury risk

The indices representing neck injury risk are

— 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:

$$Moc_x = M_x + F_y \times D \qquad (3)$$

$$Moc_y = M_y - F_x \times D \qquad (4)$$

where

M_x is the lateral bending moment on the neck;

M_y is the flexion/extension moment on the neck;

D is the distance for the transfer to the occipital condyle of the moments of bending measured. It shall adopt the specific value mentioned in 6.4.

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 ear towards left shoulder (lateral bending),
- $+M_Y$: chin towards sternum (flexion).

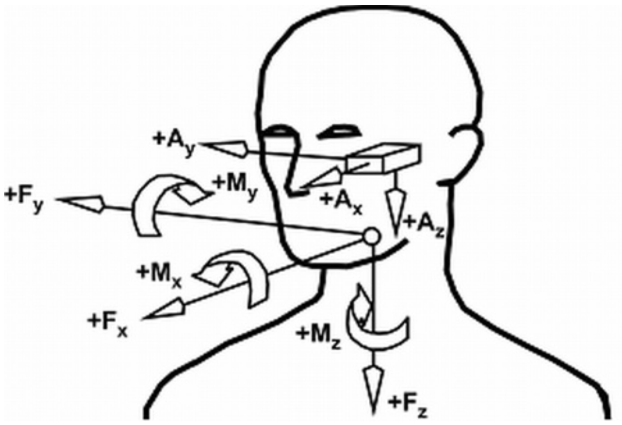


Figure 1 — Sign convention for accelerations, forces and moments in the ATD

6 Test methods

6.1 General

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.

6.2 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.

6.3 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.

6.4 ATD and instrumentation

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

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

The resultant acceleration measured at the centre of gravity of the ATD's head shall 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 ATD. These forces and moments shall be recorded as follows:

— F_x and F_y with a CAC of 8 kN and a CFC of 1 000,

— F_z with a CAC of 13 kN and a CFC of 1 000;

— M_x, M_y and M_z with a CAC of 280 N m 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 0,017 78 m shall be adopted for those load cells installed in the existing space at the base of the skull and 0,008 763 m 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).

6.5 ATD clothing and equipment

6.5.1 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. A reference helmet model is given in Annex E. The helmet shall meet the specifications given in Annex F. Annex E gives alternative helmet models that have been found to meet the requirements 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.

The helmet shall be fitted onto the head of the ATD in accordance with Annex C. If helmet models other than those given in Annex E are used, the size shall be chosen in order to ensure that the fit of the helmet on the ATD head is as snug as possible, with the helmet held firmly onto the head.

NOTE Care should be taken to choose a helmet that will leave visible traces on the test item during contact, i.e. helmet with paint of a colour which contrasts with the test item colour.

6.5.2 Clothing

The ATD shall be dressed in a long-sleeved cotton t-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 fit the ATD correctly.

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.

6.6 ATD mass including equipment

The total test ATD mass, including instrumentation, helmet, shirt, suit, gloves and boots, shall be 87,50 kg ± 2,50 kg.

6.7 Installation

For continuous systems, the length of the test item shall be sufficient to demonstrate the full performance characteristics of the MPS. After the test, the adequacy of the length of installation shall be checked by determining whether there is any permanent lateral or longitudinal displacement of the test item at its extremities.

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.

6.8 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.

6.9 Launch configurations

6.9.1 General

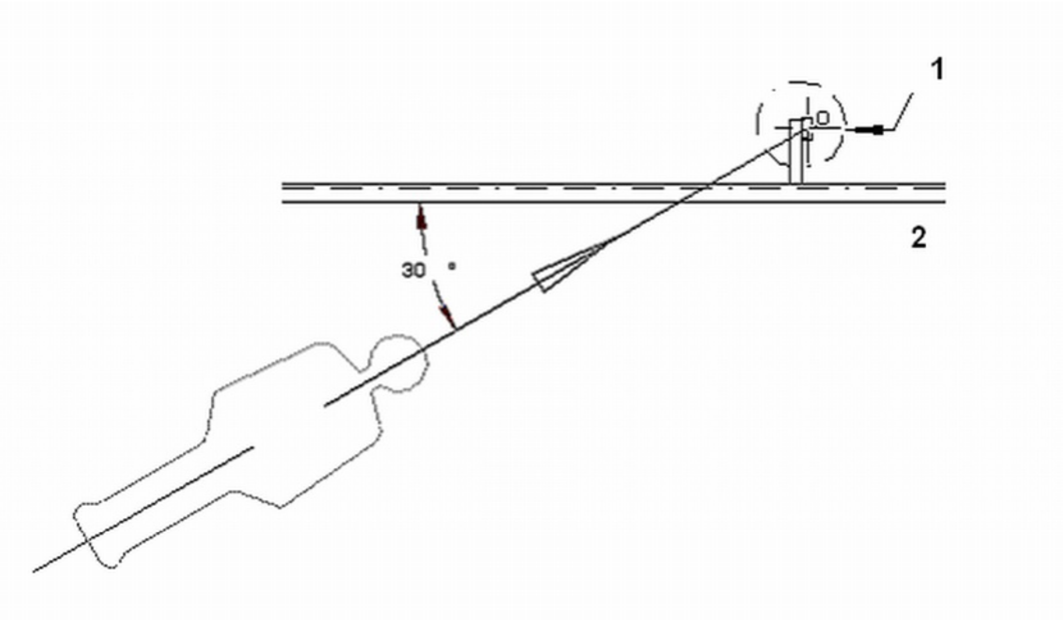
Three theoretical approach paths are defined as below. If the test laboratory judges that the impact point identified in this Technical Specification for a given test is not representative of the most severe testing conditions, the laboratory may change the impact point accordingly. In all cases, the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

6.9.2 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, point 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

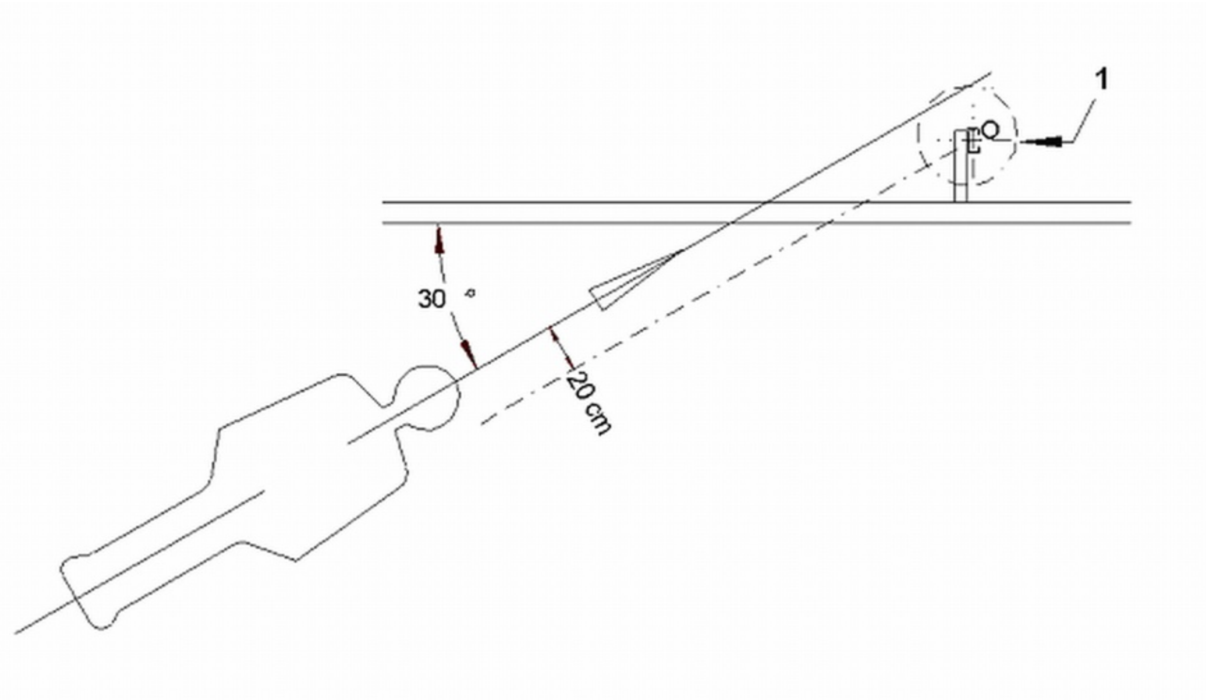
Figure 2 — Launch configuration 1: post-centred impact

6.9.3 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 point 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.

The purpose of this configuration is to impact the edge of the DMPS which may be potentially aggressive and/or to achieve maximal deceleration of the ATD.



Key

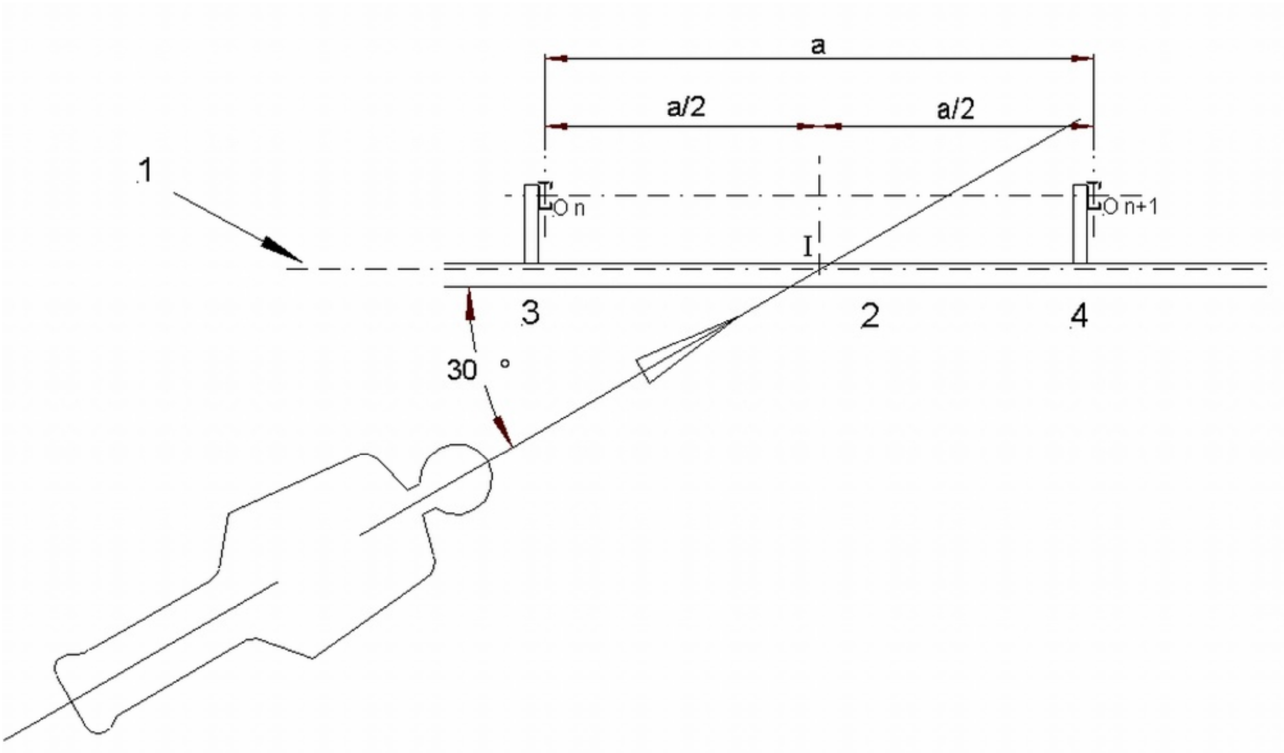
1 discontinuous system

Figure 3 — Launch configuration 2: post-offset impact

6.9.4 Launch configuration 3: mid-span impact

The approach path of the ATD is defined by a line, parallel to the ground, passing through point I and forming a 30° angle with respect to the centreline of the un-deformed test item (see Figure 4). Point I is the intersection of the surface in contact with ATD during the test and the perpendicular bisector of the segment joining points O_n and O_{n+1} (see Figure 4). Points O_n and O_{n+1} are the centres of the sections of two consecutive posts of the barrier. If the system is not a post-and-rail type safety barrier, points O_n and O_{n+1} shall be the centres of two consecutive anchorages or element connections of the test item or any other point deemed to result in the highest severity impact.

This launch configuration is only applicable to CMPS and is primarily intended to test the robustness of the test item where it is most flexible and to evaluate the potential for the trapping of limbs in the area where this is most likely to occur. However, in some cases, the injury criteria values measured on the ATD may be higher for this configuration than for Configuration 1.



Key

1 contact surface of system

2 continuous system

3 post n

4 post n+1

Figure 4 — Launch configuration 3: mid-span impact

When a complete system comprising CMPS and barrier, or an integrated MPS, is longitudinally homogeneous, regarding its material, geometry and structure (i.e. it has no potentially aggressive points such as posts), it shall be sufficient to carry out one ATD impact test, at the centre of the length of the test item with the ATD at an angle of 30º to the test item.

6.10 Accuracies and deviation of impact speeds and angles

6.10.1 ATD impact speed

Two nominal impact speeds are defined: 60,0 km/h and 70,0 km/h.

ATD impact speed shall be measured along the ATD approach path with the ATD back and legs stably in contact with the ground and no further than 0,5 m from the theoretical impact point. The overall accuracy of speed measurement shall be within ± 1 %.

The impact speed limit deviation shall be: + 6 %
– 0 %

6.10.2 ATD approach angle

The approach angle shall be measured at not more than 0,5 m from the theoretical impact point.

The overall accuracy of approach angle measurement shall be within ± 0,5°.

The approach angle limit deviation shall be ± 2°.

6.10.3 ATD orientation

The ATD shall be oriented so that its mid-sagittal plane is aligned with the 30° approach path (see Figure 2, Figure 3 and Figure 4) with a tolerance of ± 2°. This angle requirement can only be an approximation because there is no accessible fixed reference on the ATD to determine this angle (the ATD is mostly covered by clothing which can move relative to the ATD and the ATD flesh can move with respect to the ATD structural parts). However, the orientation requirement shall be observed in as far as is possible.

It is recommended that the ATD mid-sagittal plane be approximately indicated by affixing self-adhesive reference markers to the thorax and pelvis areas of the ATD.

6.10.4 ATD impact point

The lateral displacement of the actual ATD impact point, with respect to the theoretical impact point, shall be measured with an accuracy of ± 15 mm by a suitable method. The permitted deviation of the actual impact point measured longitudinally along the test item is ± 60 mm (see Figure 5).

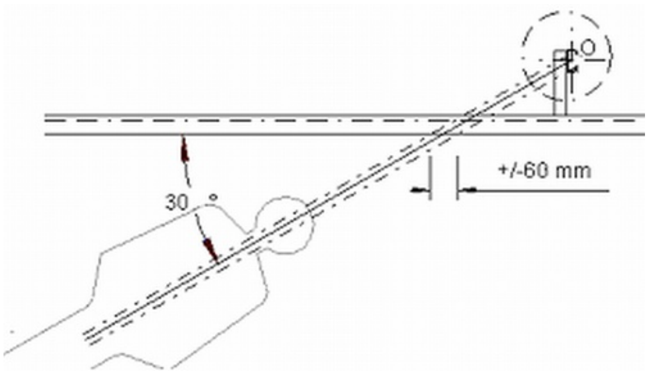


Figure 5 — Impact point position tolerance

6.11 Photographic coverage

Photographic coverage shall be sufficient to describe clearly the MPS, barrier and ATD behaviours during and after the impact.

High-speed cameras shall be operated at a minimum of 200 frames per second.

Normal-speed cameras shall be operated at a minimum of 24 frames per second.

The minimum camera layout below, as shown in Figure 6, shall be adopted:

a) one high-speed camera positioned behind the test item, filming the deflection of the test item and the penetration of the ATD into the system. This camera shall be positioned in order to achieve the most informative view of the system and ATD behaviour, but shall generally be positioned obliquely and upstream of the impact point. If the presence of the barrier precludes any of the deflection from being visible from this camera position, then the laboratory shall consider any other possible camera positions that permit suitable alternative views. If no other meaningful views can be identified then camera 4) shall be used;

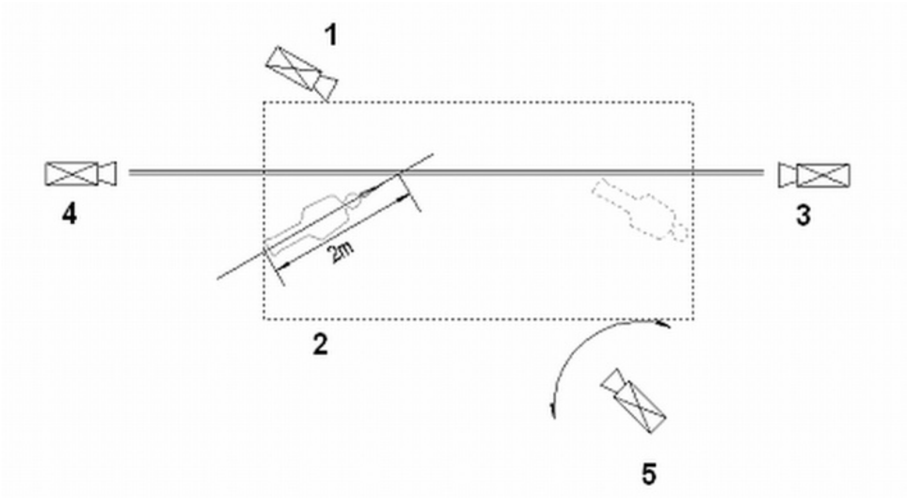
b) one overhead high-speed camera located in such as way as to cover the ATD motion from at least 2 m along the approach path before the impact point until the ATD is no longer in contact with the test item following the test;

c) one high-speed camera filming along the length of the test item, positioned downstream of the impact point;

d) one high-speed camera filming along the length of the test item, positioned upstream of the impact point (optional);

e) one panned camera at normal speed giving a general view showing the whole test (optional).

The need for additional cameras should be considered to cover areas of special interest.



Key

1 rear oblique coverage
2 overhead coverage
3 downstream coverage
4 upstream coverage (optional)
5 panned (optional)

Figure 6 — Camera coverage

7 Performance classes

7.1 General

MPSs shall conform to the requirements of 7.2, 7.3, 7.4 and Clause 8 when tested in accordance with the relevant impact tests selected from Table 1 with respect to the type of MPS (CMPS or DMPS) and the speed class required.

The performance of an MPS is determined by two performance classes:

— **the speed class**, which is determined by the impact speed of the tests performed;

— **the severity level**, which is determined by the level of the biomechanical indices determined from data obtained from the ATD instrumentation during the test.

A tested MPS which satisfies the requirements of a given speed class shall be deemed to comply with the test conditions corresponding to the speed classes of lower speeds, with the same severity levels, unless it contains some mechanism that does not work acceptably at a lower impact speed.

Table 1 — Tests

Test	MPS type	Launch configuration (see 6.9)	Speed km/h
TM.1.60	CMPS and DMPS	Post-Centred (1)	60
TM.2.60	DMPS	Post offset (2)	60
TM.3.60	CMPS	Mid-span (3)	60
TM.1.70	CMPS and DMPS	Post-Centred (1)	70
TM.2.70	DMPS	Post offset (2)	70
TM.3.70	CMPS	Mid-span (3)	70

NOTE These tests only evaluate the reduction of impact severity for PTW riders; the vehicle restraint capability of the complete system is assessed as described in 8.4.

7.2 Speed classes

The speed classes for MPSs are defined by the impact speed and are described in Table 2 and Table 3 for DMPSs and CMPSs respectively.

Table 2 — Speed classes for DMPS

Class	Tests required	
D60	TM.1.60	TM.2.60
D70	TM.1.70	TM.2.70

Table 3 — Speed classes for CMPS

Class	Tests required	
C60	TM.1.60	TM.3.60
C70	TM.1.70	TM.3.70

An MPS tested according to the requirements of this Technical Specification shall be identical for each of the tests performed for a given speed class.

7.3 Severity levels

The severity level of an MPS is determined by the maximum values of the biomechanical indices given in Table 4. For each impact test, two severity levels are defined (level I and level II), according to the maximum values indicated in Table 4.

The severity level is achieved only when the values of all the biomechanical indices in Table 4 are equal to or less than the corresponding maximum limits. Thus, for example, in order to comply with severity level I, all of the biomechanical indices of an MPS must be less than or equal to the maximum levels corresponding to level I defined in Table 4.

The severity level that shall be applied to an MPS, for a given speed class, is the highest of the severity levels obtained from the impact tests performed, according to Table 2 or Table 3. (i.e. if severity level I is achieved for one test and severity level II achieved for the other, the MPS shall be classed as severity level II).

If an MPS has been successfully tested for a given speed class and with a certain severity level, it shall be deemed to comply with lower speed classes with the same severity level, unless it has been successfully tested according to this Technical Specification for a lower speed class and with a lower severity level. In the latter case, the MPS will have a certain severity level for the higher speed class, and another – lower – severity level for the lower speed class.

All severity indices shall be rounded to the nearest whole number using standard mathematical rounding.

The filtering frequency applied to the raw data and those used in graphical representations shall be stated.

Table 4 — Severity levels

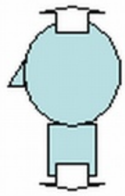
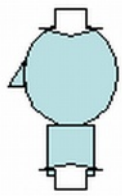
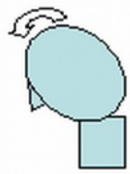
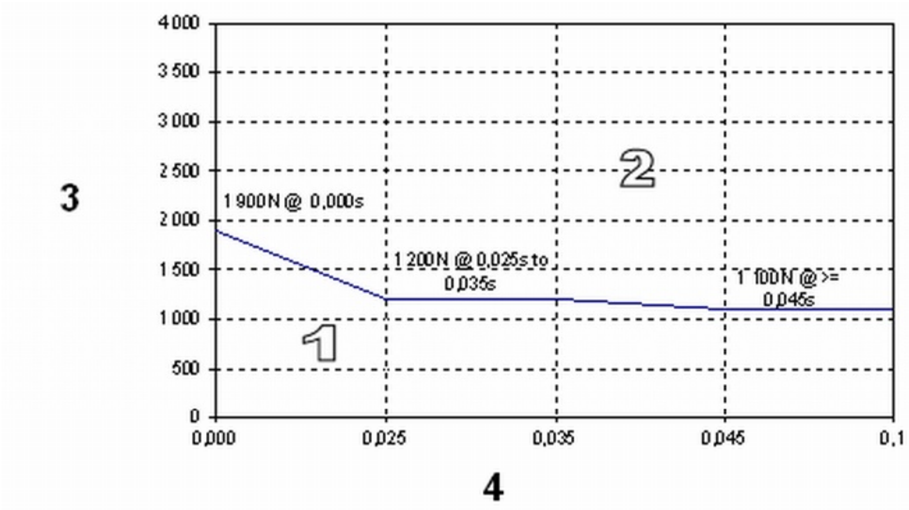
Severity level	**Maximum admissible values**						
	Head	**Neck**					
		F_x N	$F_{z\ tension}$ N	$F_{z\ compression}$ N	Moc_x N m	$Moc_{y\ extension}$ N m	$Moc_{y\ flex}$ N m
	HIC_{36}						
I	650	Figure 7	Figure 8	Figure 9	134	42	190
II	1 000	Figure 10	Figure 11	Figure 12	134	57	190

Figure 7 to Figure 12 show graphs giving maximum permissible load durations for given neck load levels (as referred to by Table 4).



Key

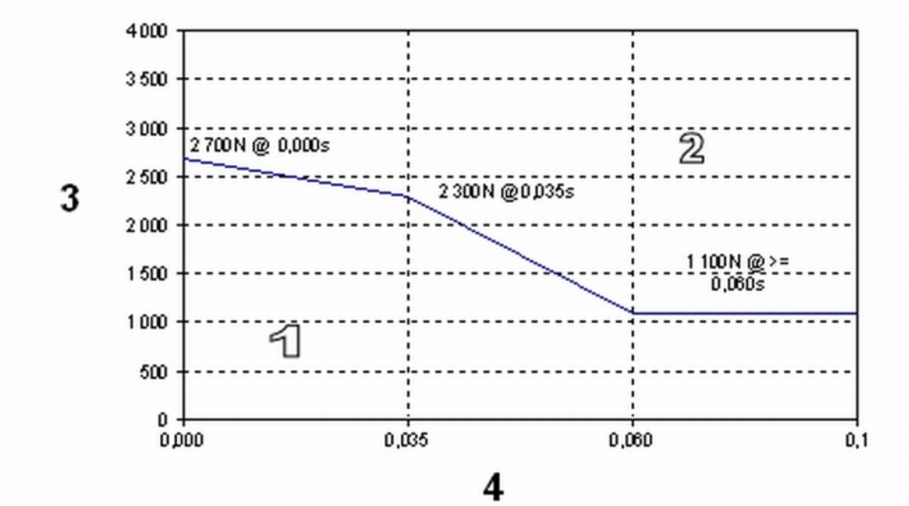
1 PASS

2 FAIL

3 anterior-posterior neck shear force (N)

4 permitted duration for a given shear force (s)

Figure 7 — Anterior-posterior neck shear force criterion for level I



Key

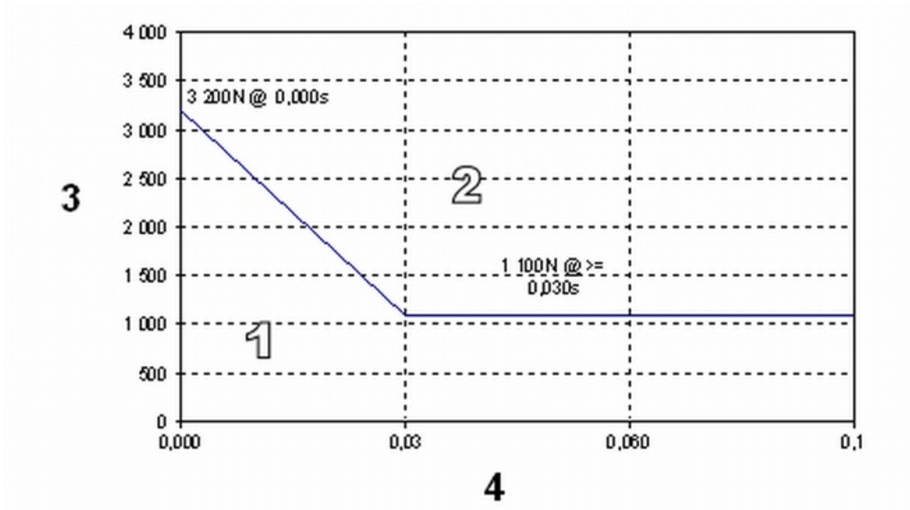
1 PASS

2 FAIL

3 axial neck tension (N)

4 permitted duration for a given axial neck tension (s)

Figure 8 — Axial neck tension criterion for level I



Key

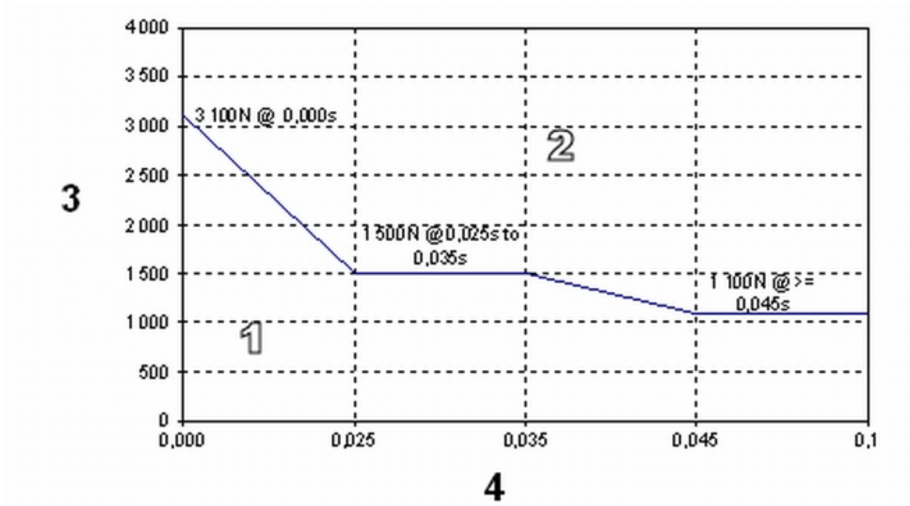
1 PASS

2 FAIL

3 axial neck compression (N)

4 permitted duration for a given axial compression (s)

Figure 9 — Axial neck compression criterion for level I



Key

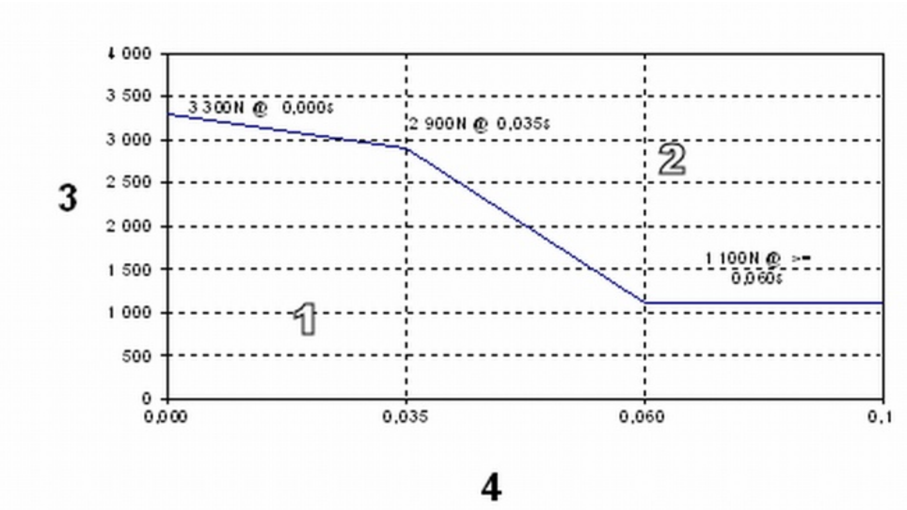
1 PASS

2 FAIL

3 anterior-posterior neck shear force (N)

4 permitted duration for a given shear force (s)

Figure 10 — Anterior — Posterior neck shear force criterion neck for level II



Key

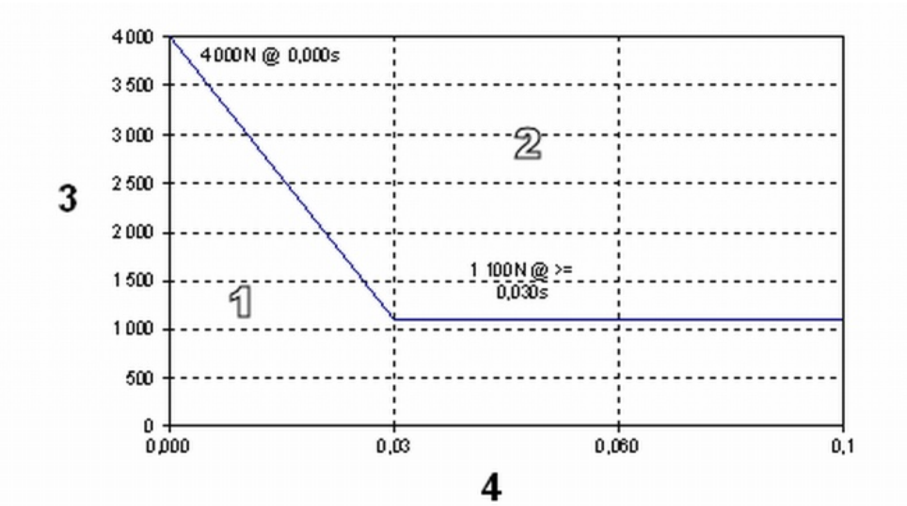
1 PASS

2 FAIL

3 axial neck tension (N)

4 permitted duration for a given axial tension (s)

Figure 11 — Axial neck tension criterion for level II



Key

1 PASS

2 FAIL

3 Axial neck compression (N)

4 Permitted duration for a given axial compression (s)

Figure 12 — Axial neck compression criterion for level II

7.4 Deformation of the CMPS

For CMPS only (including integrated MPS) the dynamic deformation of the test item during the test with an ATD is characterised by the working width: W_d. The W_d is the distance between the foremost part of the un-deformed system and the maximum dynamic lateral position of any part of the system (see Figure 13). If the hand of the ATD protrudes past the rearmost part of the system during the test then the position of this ATD part shall be taken into account in the determination of W_d. Protrusion of any other ATD part shall constitute a failure of the test as stated in 8.2.

8 Acceptance criteria of the impact test

8.1 MPS behaviour

There shall be no complete rupture of any longitudinal element of the test item.

If W_d (see Figure 13) exceeds the working width of the complete test item, the barrier alone or the integrated MPS tested according to EN 1317-2 then the working width of the complete system shall be equal to W_d.

8.2 ATD behaviour

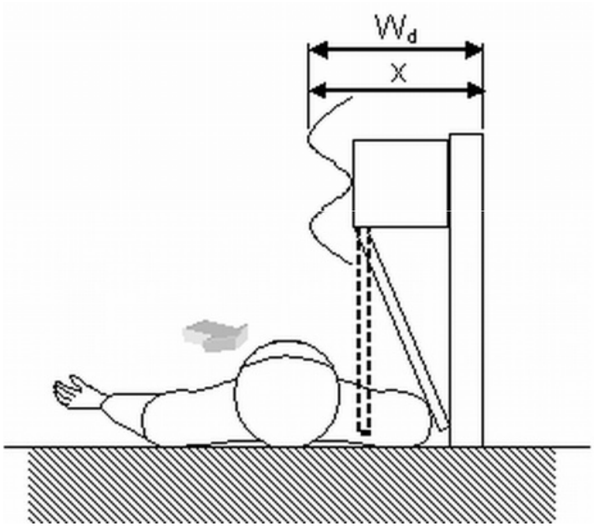
Following the test, the ATD shall not remain trapped in the test item. The ATD shall be deemed to be trapped when in contact with the test item in such a way as to require further deformation or displacement of the test item, or dismantling of the ATD, in order to remove the ATD from the test item.

No limb, or part of a limb, nor the head or neck of the ATD shall become totally detached from the ATD following impact with the test item except for detachment of the upper extremity due to rupture of the frangible screws in the shoulder assembly of the ATD.

There shall be no lacerations to the ATD flesh resulting from the test.

NOTE The ATD flesh is not designed to have humanlike resistance to this form of damage. Therefore, it is not possible to evaluate the severity of any injuries that would be suffered by a human rider on the basis of the seriousness of any lacerations to the ATD flesh. However, if lacerations to the ATD flesh occur during the test then it can be concluded that the protective clothing has been sufficiently penetrated to expose the flesh of a rider to a significant risk of serious laceration. Thus, laceration is considered to be an unacceptable result.

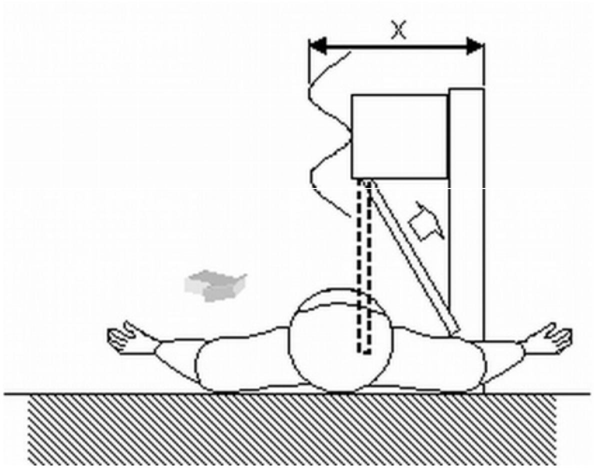
For CMPS only, during the test, no ATD body parts, with the exception of the hand, shall protrude rearwards of the elements in contact with the ATD. Protrusion of the hand only is acceptable provided that the ATD is not trapped by the test item after the test. No other ATD part shall protrude rearwards of the elements in contact with the ATD even if they subsequently return in front of the test item.



a) Example: barrier + MPS

No protrusions rearward of complete system

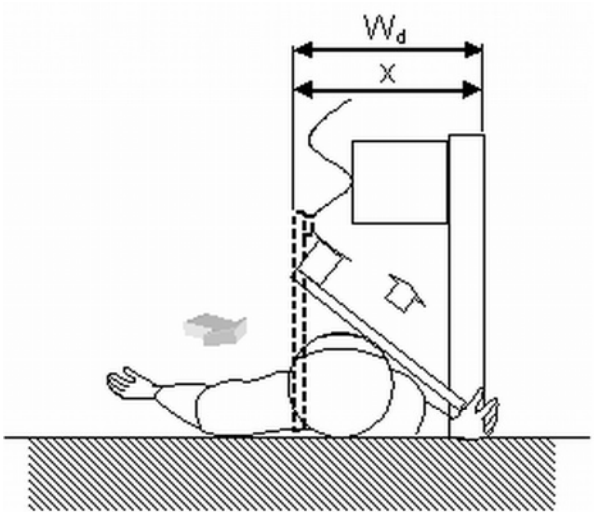
→ ACCEPTABLE PERFORMANCE



b) Example: barrier + MPS

Arm protrudes rearward of complete system

→ SYSTEM FAILS TEST

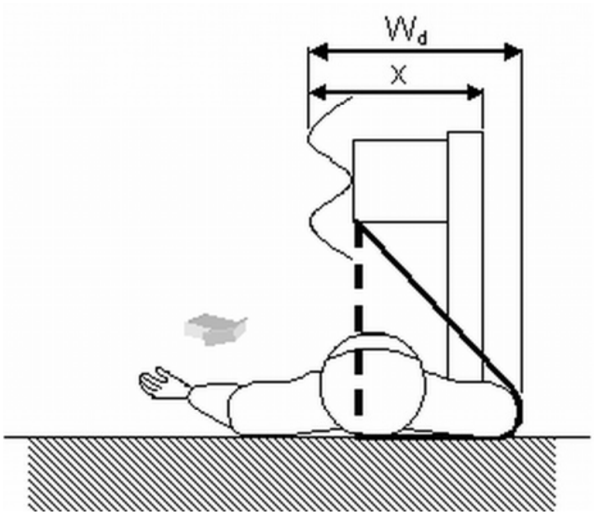


c) Example: barrier + MPS

Hand protrudes rearward of complete system
but is not trapped in system after test

→ ACCEPTABLE PERFORMANCE

W_d determined by rearmost part of system



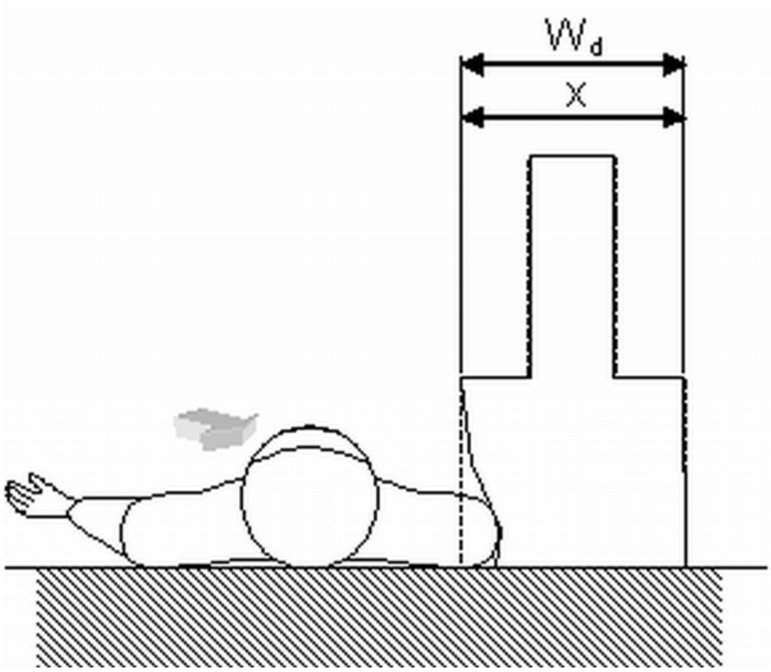
d) Example: barrier + flexible MPS

ATD contained by MPS and
MPS protrudes behind barrier

→ ACCEPTABLE PERFORMANCE

W_d determined by rearmost part deformed MPS

Figure 13 — Determination of W_d



e) Integrated MPS or MPS on modular or wall-type barrier

No protrusions rearward of complete system

→ ACCEPTABLE PERFORMANCE

W_d determined by rearmost part of system

Key

x initial width of un-deformed system (MPS + barrier or integrated MPS)

W_d dummy test working width

Dotted lines show un-deformed MPS.

Figure 13 — Determination of W_d *(continued)*

8.3 Severity indices

The maximum values of the biomechanical indices shall in no case exceed the values indicated in Table 4 for severity level II.

8.4 Vehicle impact performance

Any barrier with an MPS added to it, or any integrated system shall also conform to the requirements of EN 1317-2 for the appropriate containment level.

EXAMPLE 1 An H3 barrier, already meeting the requirements of EN 1317-2, fitted with an add-on MPS, will also have to meet the requirements of EN 1317-2 with MPS fitted (TB11 and TB61) in addition to meeting the requirements of this Technical Specification.

EXAMPLE 2 An N2 level VRS with integrated MPS function will also have to meet the requirements of EN 1317-2 (TB11 and TB32) in addition to meeting the requirements of this Technical Specification.

9 Test report

The test report shall comply with Annex A.

Annex A
(informative)

Detailed test report template

In addition to the video records in accordance with 6.11, the test report should include the following information as a minimum, in the order given. All drawings and associated documents should be clearly numbered and dated.

Test report cover

— Name of test laboratory

— Date of report

— Name of client

— Name of test item

— Name of barrier (in the case of an MPS fitted to a barrier)

— Date of test

— Test number and/or test report number (version number if applicable)

— Test type and reference to Technical Specification

— Number of pages including annexes

— Official test report language

— Approval of report

Table of contents

1 Test laboratory

1.1 Name

1.2 Address

1.3 Telephone number

1.4 Facsimile number

1.5 Internet address

1.6 Test site location

1.7 Name and address of body which accredited the test laboratory

1.8 Notification/accreditation number with date of approval, valid at the time of testing

1.9 Additional information

2 Client

2.1 Name

2.2 Address

2.3 Telephone number

2.4 Facsimile number

2.5 Internet address

2.6 Additional information

3 Test item

3.1 Name of MPS

3.2 Name of barrier used in test

3.3 Date(s) of installation (Include, where relevant, dates for the total completion of installation of MPS and barrier.)

3.4 Date of test

3.5 Laboratory's test reference number

3.6 Additional information

4 Test procedure

4.1 Test type (according to Table 1)

4.1.1 Type of impact test (for example, TM.1.60)

4.1.2 Nominal impact speed

4.1.3 Nominal impact angle

4.1.4 Additional information

4.2 Test area

4.2.1 Description of type and condition of test area

4.2.2 Schematic plan of ATD approach including angle, impact point and test item (including position of nominal impact point with respect to a reference point on the test item)

4.2.3 Justification of impact point choice

4.2.4 Where the tested system includes a vehicle parapet, the distance between the contact surface of the MPS and the bridge deck edge

4.2.5 Type of underground (soil or foundation type into which the system is installed)

4.2.6 Class/condition of underground

4.2.7 Additional information

4.3 Installation and detailed description of test item

4.3.1 Conformity between test item drawings and item tested (giving details of those characteristics that have been checked and methods used [e.g. checking by tape measure, calliper] noting any non-conformities identified)

NOTE Conformity between test item drawings and the item tested is to be checked by the test laboratory with respect to the assembly of the test item and to overall component dimensions. However, more detailed analysis may be required following the test in order to meet the requirements for the evaluation report of the test item.

4.3.2 Conformity between installation manual and item installation (giving details of those characteristics that have been checked and methods used, noting any non-conformities identified)

4.3.3 Description of the MPS tested which shall include the following.

4.3.3.1 General description of the MPS and of the barrier onto which it fixed for the test

4.3.3.2 Details of fixing the MPS to the barrier and/or to the ground

4.3.3.3 Total length of test item in metres

4.3.3.4 Height of lower edge of restraining part of system with respect to the ground (as a minimum at the nominal impact point and at 1 m intervals throughout the expected impact zone with a minimum of 8 m)

4.3.3.5 Support spacing and/or unit length (in metres)

4.3.3.6 Value(s) of the applied tension(s) where the MPS and/or the barrier is pre-tensioned

4.3.3.7 Any additional information to describe the tested system sufficiently (e.g. fastening torques)

4.4 Description of ATD and equipment

4.4.1 Type of ATD used (refer to 6.4 of this Technical Specification)

4.4.2 Helmet type (brand, model, size, date of purchase)

4.4.3 Description of ATD clothing

4.4.4 ATD mass (without clothing and helmet)

4.4.5 Helmet mass

4.4.6 Clothing mass (suit, gloves and boots)

4.4.7 Total ATD mass including helmet and clothing

5 Results

5.1 Test conditions

5.1.1 Actual impact speed in kilometres per hour

5.1.2 % difference from nominal speed

5.1.3 Actual impact angle in degrees

5.1.4 Difference from nominal angle in degrees

5.1.5 ATD orientation angle within tolerance? (Yes/No)

5.1.6 Distance of actual impact point from nominal impact point

5.1.7 Impact point position within tolerance? (Yes/No)

5.1.8 Ambient temperature

5.1.9 Relative humidity

5.1.10 General description of test sequence

5.1.11 Any additional information

5.2 Test item behaviour

5.2.1 Complete rupture of any principal longitudinal elements of the test item? (Yes/No) – if yes, description is required.

5.2.2 Working width (W_d) in metres

5.2.3 Length in metres of ATD contact with tested system from initial impact point to the point of contact furthest downstream from the initial impact point

5.2.4 Description of damage to the tested system (including to barrier where appropriate) e.g. permanent deformation, relative displacement of elements

5.2.5 ATD trapped in test item following test? (Yes/No) – if yes, give details

5.2.6 Parts of ATD protruding rearwards of contact elements of test item during test? (Yes/No) – if yes give details

5.2.7 Parts of ATD protruding rearwards of contact elements of test item after test? (Yes/No) – if yes give details

5.2.8 Elements of ATD detached during test (other than detachment of upper extremities due to rupture of frangible shoulder screws)? (Yes/No) – if yes give details

5.2.9 Lacerations to flesh of ATD? (Yes/No) – if yes give details (including details of damage to clothing)

5.2.10 General description of ATD trajectory

5.2.11 ATD final resting position (indicate whether ATD brought to rest by a restraining system – if so, indicate that ATD was brought to rest after the end of the test event).

5.2.12 Graphical representations of x, y, z and resultant head accelerations

5.2.13 Head injury criterion

5.2.14 Graphical representations of neck loads and neck moments (levels and durations)

5.2.15 Summary of head and neck severity levels:

- all severity indices shall be rounded to the nearest whole number using standard mathematical rounding;
- the filtering frequency applied to the raw data and those used in graphical representations shall be stated.

6 General statements

6.1 The test results in this report relate only to the MPS and the corresponding supporting system (e.g. barrier) tested.

6.2 This report may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

7 Approval of report

7.1 Signature(s)

7.2 Name(s) of authorised and responsible person(s) of test laboratory

7.3 Position(s)

7.4 Date

8 Annexes

A General test item arrangement drawings (overview drawing) of the complete item tested and all component drawings, including drawing number and date of issue, dimensions, tolerances and materials. All drawings to be authorised by the client, by signing the drawings.

B MPS and supporting barrier installation manual including dimensions and tolerances.

C Dimensioned plan of test installation

D Ground conditions

E Helmet calibration curve

F Photographs

F.1 Photographs of the complete system to be tested before the test

F.2 Photographs of ATD, clothing and helmet before test

F.3 Sequences and additional photographs of the test event (stating frame rate for films)

F.4 Photographs of the complete system after the test (including damage to the system)

F.5 Photographs of the ATD after the test in its final rest position

G Video records (give frame rate)

Annex B
(informative)

Anthropomorphic test device

The ATD used in this Technical Specification (excluding the modifications below) shall be a Hybrid III 50th percentile male ATD in conformance with U.S. Department of transportation Code of Federal Regulations Title 49, Part 572, Subpart E [11].

The ATD neck regulating system (neck bracket) shall be adjusted to a nominal angle of - 7º.

The Hybrid III ATD used in this Technical Specification shall incorporate the following modifications:

— substitution of the original pelvis and lumbar spine by the pelvis reference 78051-60P and the lumbar spine reference 78051-66P and their accessories to allow the ATD to adopt an upright position;

— substitution of both of the original shoulder assemblies by the modified shoulder described in Annex D;

— installation of a foam neck shield, reference 1039006, on the neck to ensure correct adjustment of the chin strap buckle.

For the purposes of this Technical Specification, the certification tests defined in the U.S. Department of transportation Code of Federal Regulations Title 49, Part 572, Subpart E [11] (frontal impact requirements including both flexion and extension for the neck) and in Title 49, Part 572, Subpart M [12] (side impact requirements) shall have been successfully performed for at least the head and neck. These certification tests shall be successfully performed after the corresponding ATD parts have been used in no more than ten impact tests, or if one of the injury criterion limits described in Clause 7 of this Technical Specification has been exceeded.

In accordance with 49 CFR Part 572 Subpart E, 572.36 (l), Limb joints are set at 1G, barely restraining the weight of the limb when it is extended horizontally. The force required to move a limb segment shall not exceed 2G throughout the range of limb motion.

The air temperature of the area used for long-term storage of the ATD shall be between 13 °C and 30 °C. Beginning at least 3 h before the planned time of impact, the air temperature wherever the ATD and helmet are being stored or prepared shall be measured and documented. If the temperature measured remains between 13 °C and 30 °C, then no additional temperature soaking procedures shall be used. If the temperature in any of the ATD preparation or storage areas is outside this range, and the total exposure time to the out of range temperature exceeds the time t given by Formula (B.1) below, where first area is the soak area and the second area is the out of range area, then the ATD and helmet shall be soaked according to the following temperature soaking procedure.

Place the ATD and helmet in an area which has an air temperature in the required range, for a period of time t, where the first area is the out of range area, and the second area is the soak area.

$$t = \tau \times \ln [T_2 - T_1 / T_2 - T_0] \tag{B.1}$$

where

t is the total exposure time required to reach the limit of the temperature range, in hours;

T_1 is the air temperature in the first area, in degrees Celsius;

T_2 is the air temperature in the second area, in degrees Celsius;

T_0 is the critical temperature, in degrees Celsius: 13 °C for moving to or from temperatures colder than the required range; 30 °C for moving to or from temperatures warmer than the required range;

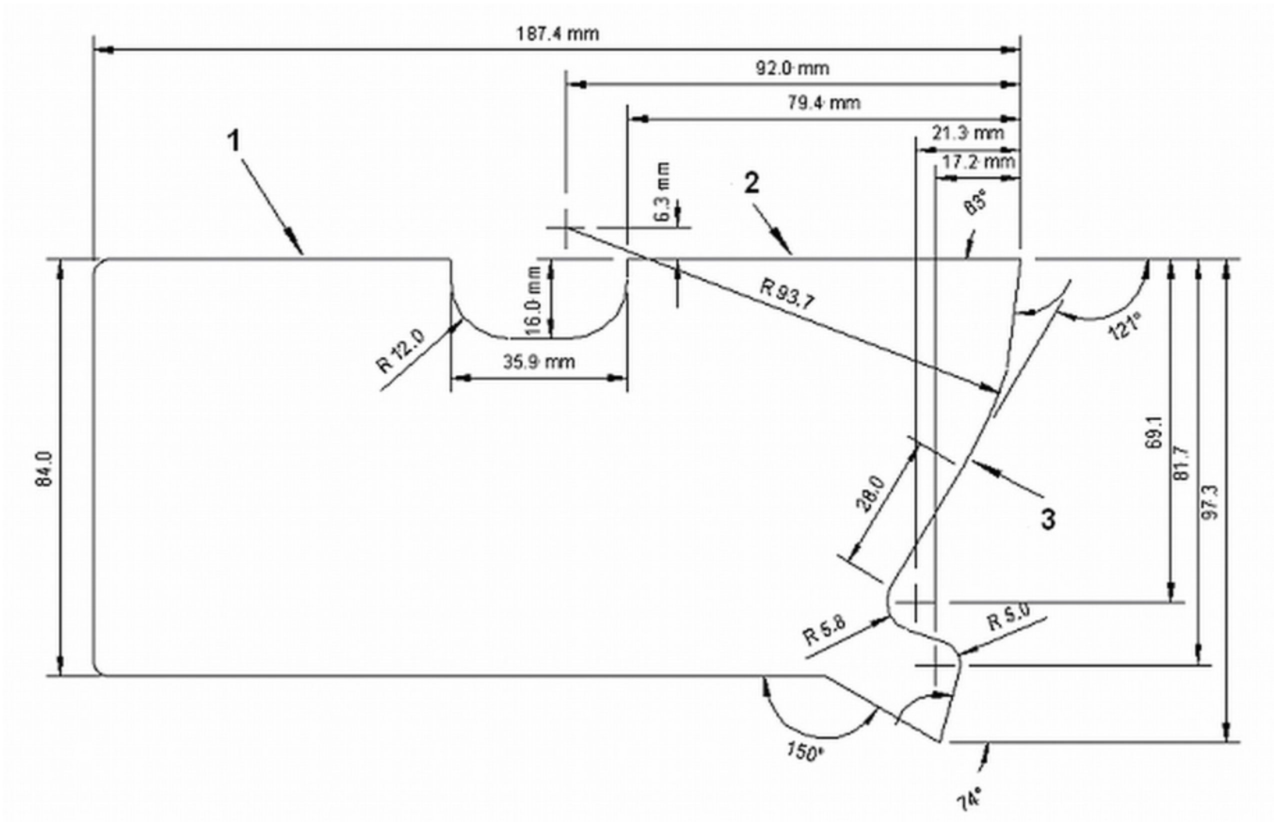
τ is 2,9, the ATD thorax thermal time constant, in hours.

Annex C
(informative)

Helmet alignment tool

Prior to the test, the helmet shall be located on the ATD head using the helmet alignment tool described in Figure C.1. This profiled template fits closely over the nose of the Hybrid III 50th Percentile Male and thus indicates the angle of the instrumentation plane of the ATD head (see Figure C.2).

In order to achieve the correct position of the helmet relative to the head, the helmet is fitted on the head. The helmet is positioned so that the vertical centreline of the visor aperture is aligned with the centreline of the face. The helmet is then rotated relative to the head in the mid-sagittal plane so that the alignment tool can be passed through the visor aperture and fits snugly onto the face. With the tool positioned in this way, the upper edge of the visor aperture is in contact with the upper edge of the tool. The 16 mm deep cut-out is provided in case the visor cannot be raised above the top edge of the tool



Key

1 edge parallel to instrumentation plane of ATD head

2 edge in contact with upper edge of helmet visor aperture

3 fit over ATD nose

Figure C.1 — Pattern for helmet alignment tool

Material: 3 mm aluminium sheet

The linear dimensions are in mm and have a ± 0,03 mm tolerance.

The angular dimensions have a ± 1° tolerance.

All the radii are 3,2 mm unless otherwise specified. Sharp edges shall be removed.

Figure C.2 — Use of helmet alignment tool

Annex D
(informative)

Modification of the anthropomorphic test device shoulder

Both standard shoulders of the Hybrid III ATD shall be replaced by a specific shoulder design with two parts of the shoulder assembly fixed together with frangible screws, as described in the drawings included in this Annex. This modification provides for the repeatable collapse of the shoulder during testing whereas the standard Hybrid III shoulder will exhibit unrepeatable modes of failure under the loading conditions applied in these tests, which could influence the test results.

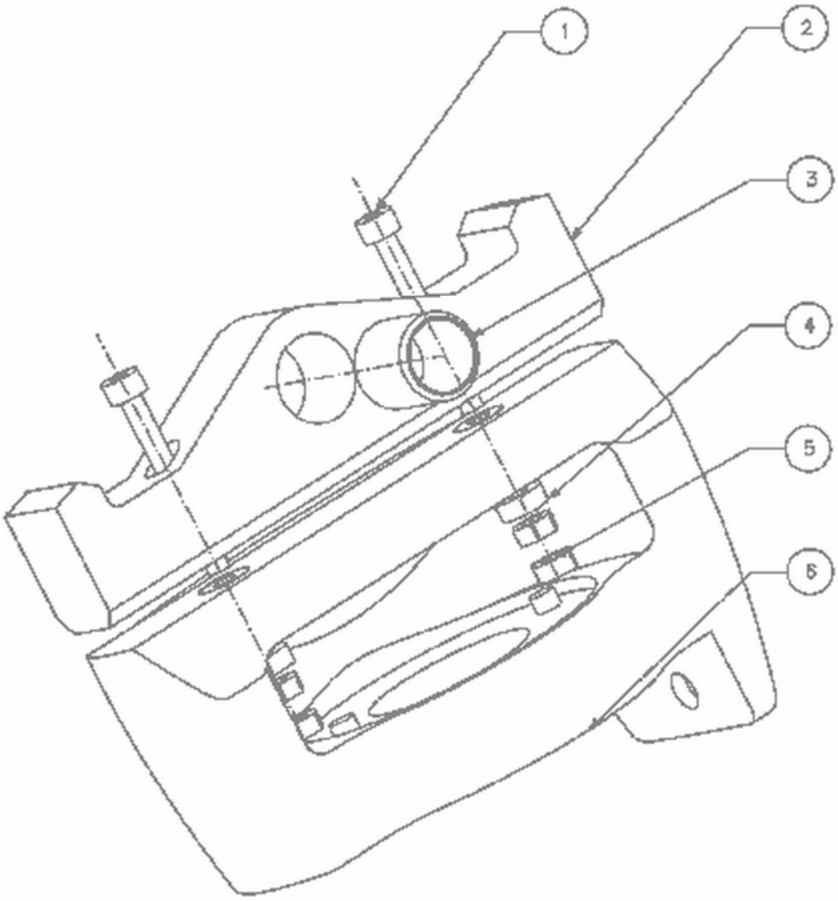
The reference of the part to be substituted is 78051-141 for the left shoulder or 78051-142 for the right.

The frangible screws used are two M4 × 35 mm screws as described by EN ISO 4762, with a maximum breaking load when statically tested of 7,600 N ± 5 % and a minimum displacement between clamps of 2 mm.

The test laboratory shall ensure, using suitable means, that the screws used in the tests fulfil the previously described requirements. The use of periodical static traction tests on samples of each batch of screws to be used in the tests is recommended.

The shoulder assembly, as shown in Figure D.1 to Figure D.5, shall be installed on both sides of the ATD with class 8.8 bolts and double nuts and tightened to a torque of 2,7 N m.

Dimensions in mm

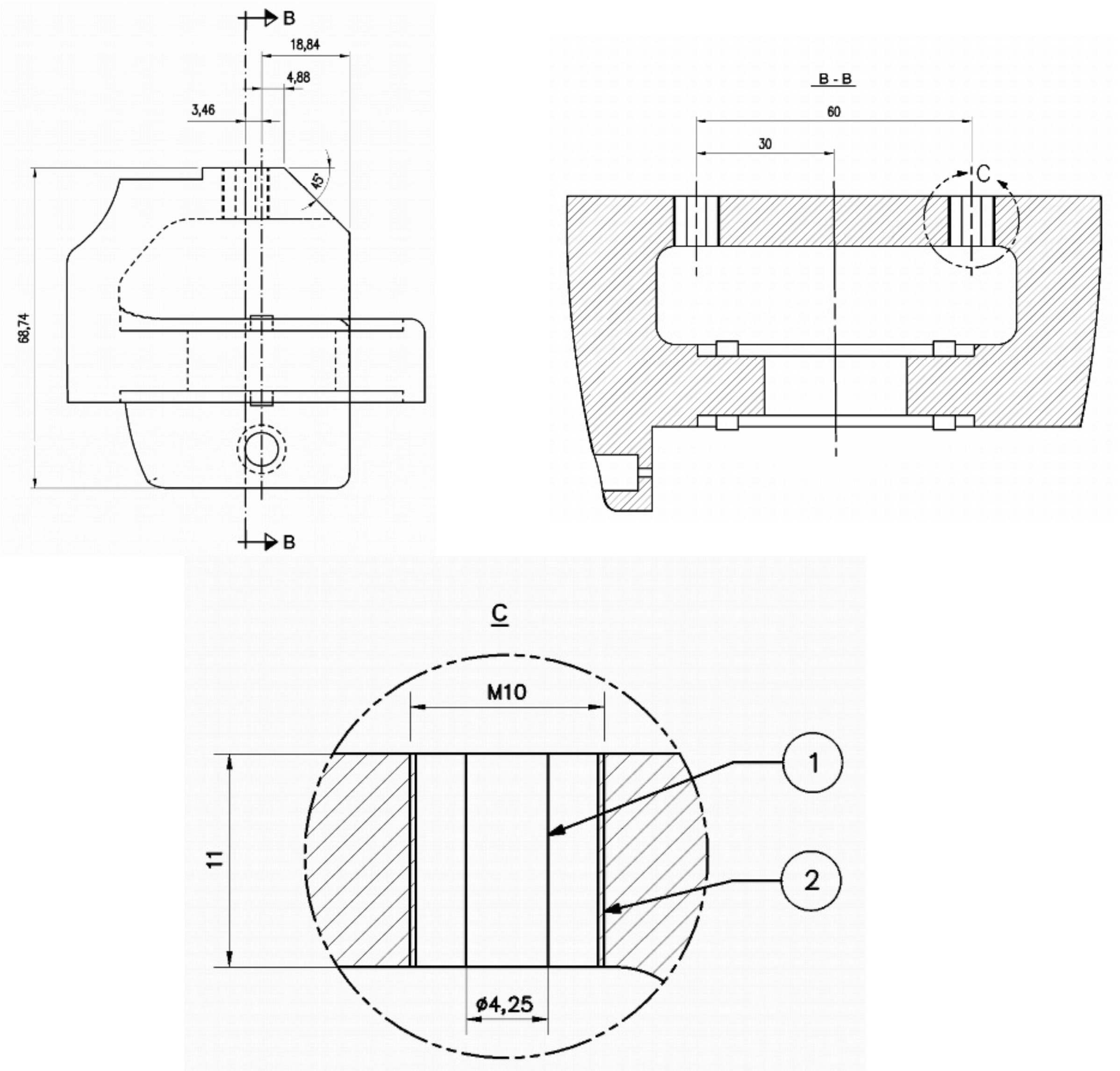


Brand	Denomination	Commercial Ref.	Drawing No.	No. of Parts	Material	Dimensions
6	PART B		1	1	ALUMINIUM	
5	NUT	M4 - DIN 934 - 8		4		
4	WASHER		2	2	F 1140	
3	BUSH		3	1	PVC	
2	PART A		4	1	AA5083	
1	SCREW	M4 X 35 - DIN 912 - 8.8		2		

Revisions
Author
Date
R1
No.
Treatment:
General Tol. UNE 22768-mK
Scale 1:1
Denomination ASSEMBLY
UNE 1032
Date
Name
Drawn by
Approved by
UNE 22553 (If the opposite is not indicated in welded unions)
z = plate thickness / 2
UNE 1037
N9

Figure D.1 — Exploded view of frangible left shoulder assembly

Dimensions in mm



2	PART_B		1	1	ALUMINIUM	
1	BOLT	CYLINDRIC BOLT M10 X 15 DIN 912 – 8.8		2		
Brand	Denomination	Commercial Ref.	Drawing N°	N°Of Parts	Material	Dimensions

Revisions | Treatment: | Denomination: PART B

Author | General Tol. UNE 22768–mK | Scale 1:1

UNE 1032 | Date | Name

Drawn by

Approved by

Date | UNE 22553 (If the opposite is not indicated in welded unions) z= plate thickness / 2 | UNE 1037 = N9

R1 | N°

Figure D.2 — Drawing of the original left side shoulder component and the modification to it

Dimensions in mm

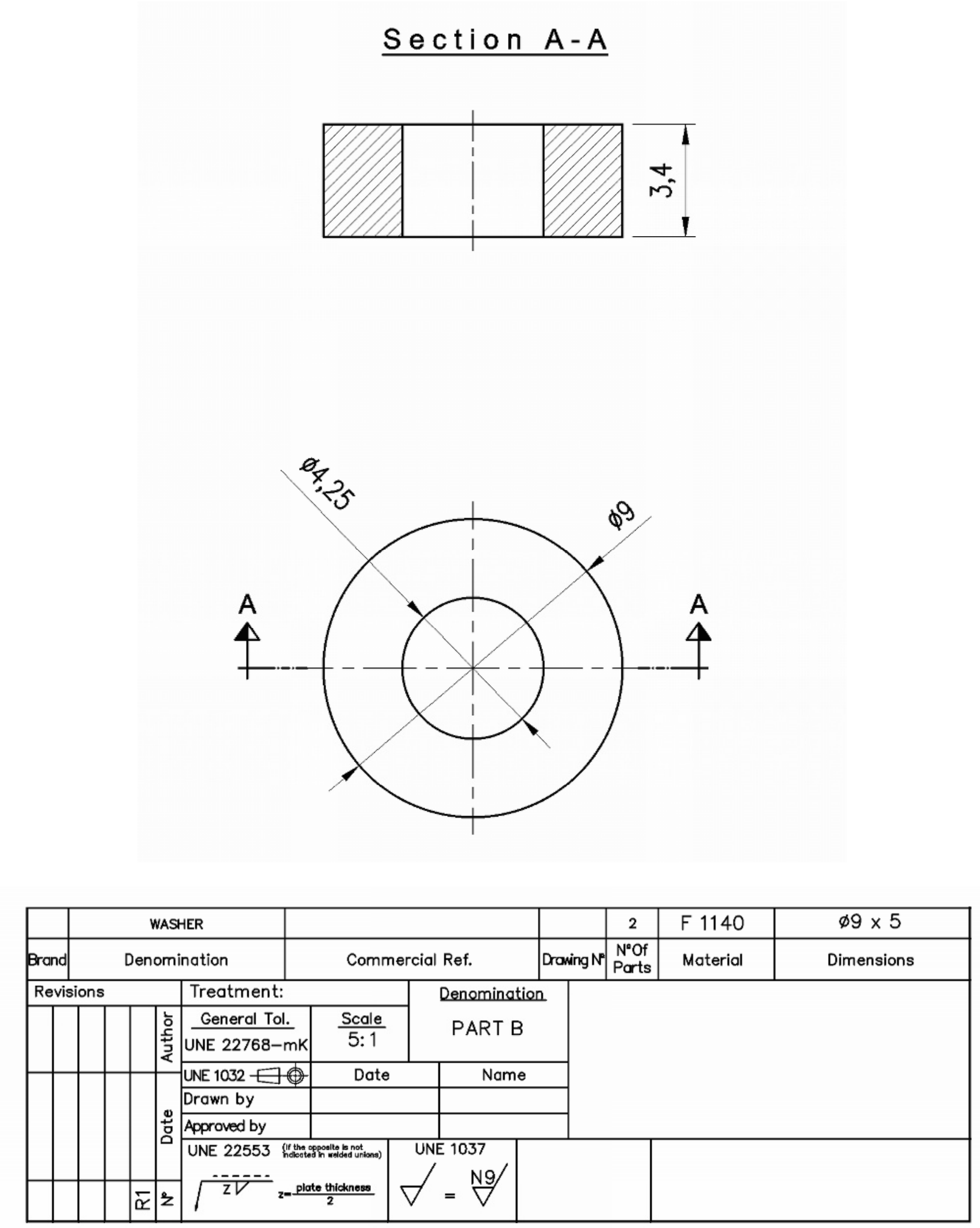


Figure D.3 — Drawing of the washer for the frangible shoulder

Dimensions in mm

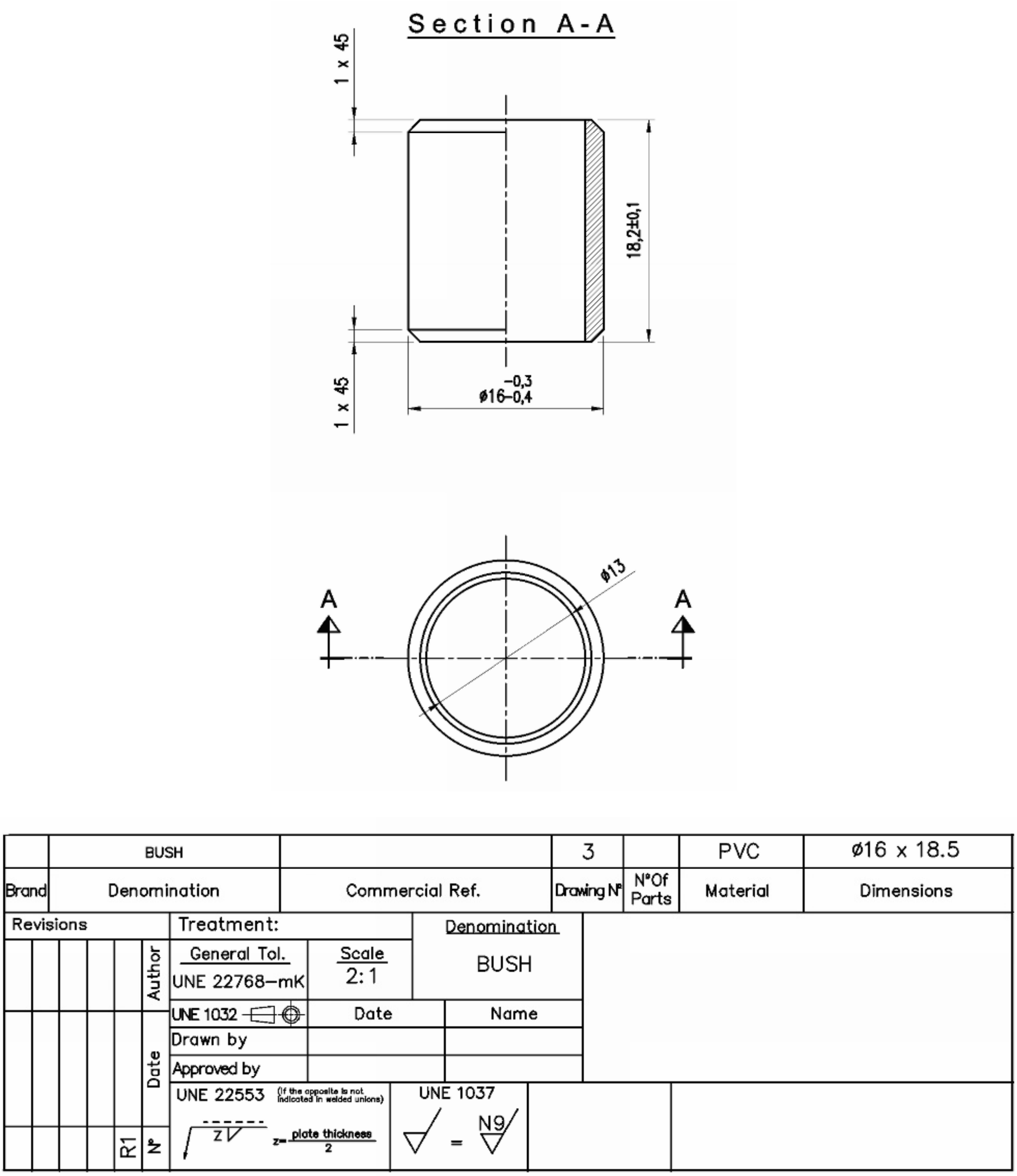
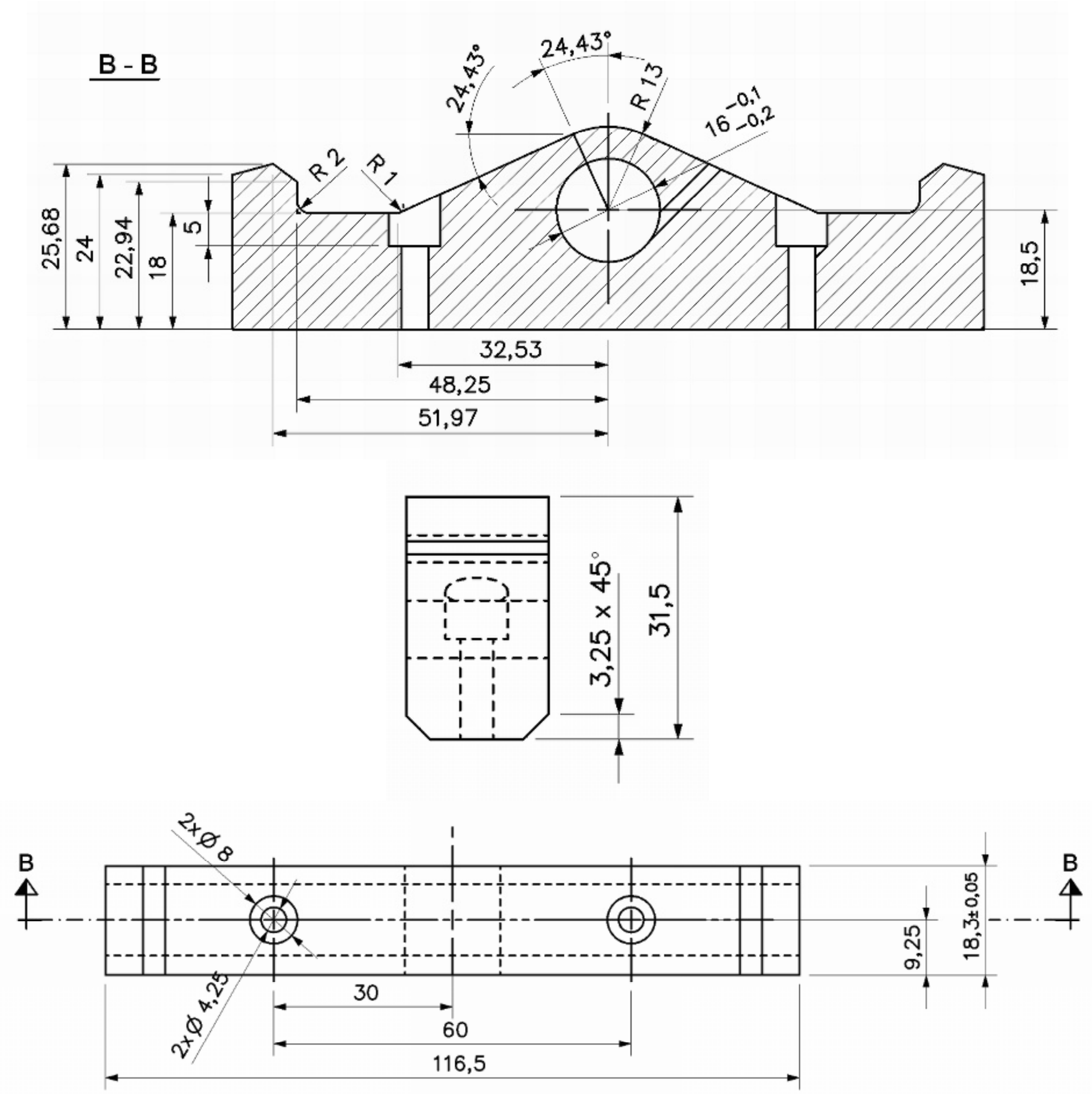


Figure D.4 — Drawing of the bushing for the frangible shoulder

Dimensions in mm



1	PART		4	2	AA5083	116.5 x 31.5 x 18.5
Brand	Denomination	Commercial Ref.	Drawing N°	N°Of Parts	Material	Dimensions

Revisions

Treatment:

General Tol. UNE 22768−mK

Scale 1:1

Denomination PART

Author

Date

UNE 1032

	Date	Name
Drawn by		
Approved by		

UNE 22553 (If the opposite is not indicated in welded unions)

z = plate thickness / 2

UNE 1037

N9

R1 N°

Figure D.5 — Drawing of the part A joining piece

Annex E
(informative)

Reference helmet

The reference crash helmet is the integral helmet of the NZI brand, model Zoom R, size 57, also available on the market under the HX brand, model Activy. An alternative model is the Eurus 600, size S.

Annex F
(informative)

Helmet calibration procedure

F.1 General

To ensure that the influential characteristics of the helmet are within a specific range, a calibration procedure shall be conducted. This procedure shall be considered valid only for helmets of same manufacturer, model, type, size and surface finish (matt, glossy, rubber, …).

F.2 Helmet description

The helmet used for testing shall be an integral type, with polycarbonate shell, round-shaped and free from protruding parts, vents roughness or any kind of unevenness, so that the contact conditions could not be influenced by any such feature.

The helmet shall comply with the requirements set out in Regulation 22 of ECE/TRANS/505 and shall be new for each test.

F.3 Procedure description and layout

Calibration procedure requires, for a calibration test that shall be repeated three times, using a new helmet identical for each repetition.

The calibration test shall be carried out in a horizontal configuration, as shown in Figure F.1, with a fully guided rigid plate (steel-made with a minimum thickness of 10 mm, and surface finish of 0,2 µm to 2 µm) impacting the helmet fitted on Hybrid III 50th percentile ATD head and neck. Steel plate dimensions shall be enough to assure appropriate contact with helmet's shell during the test.

The helmet and ATD neck and head shall be assembled and aligned according to Annex B and Annex C, with neck lower bracket firmly attached to a rigid structure. No displacement or deformation in that structure is allowed.

The rigid plate shall be guided during the impact in the vertical plane perpendicular to its approach path and shall be free of external propulsion from before the impact until the end of the calibration test. The approach path shall coincide with the centreline of the neck and head.

Test parameters:

— impactor total mass: 75^{+1}_{-1} kg (total moving mass: plate, guidance device and fixings);

— impact speed: $5{,}5^{+0{,}15}_{-0{,}15}$ m/s;

— impact angle: $30^{\circ}{}^{+1^{\circ}}_{-1^{\circ}}$.

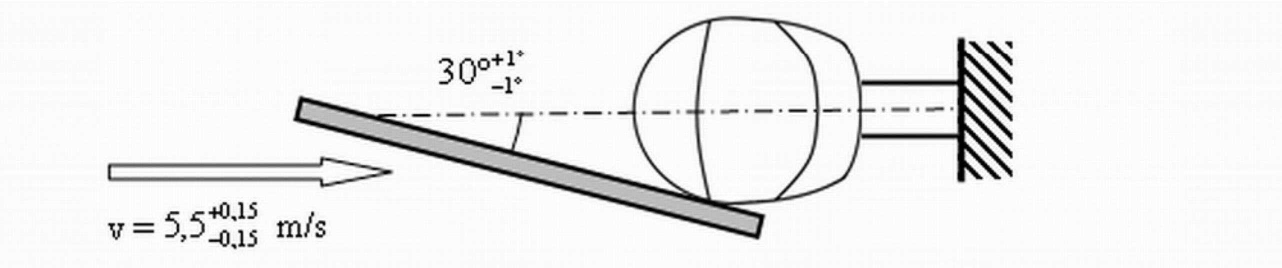


Figure F.1 — Calibration test configuration

The head, neck and helmet shall be conditioned at a temperature of 22^{+2}_{-2} ºC for at least two hours before test execution.

The surfaces of the helmet and the rigid plate shall be clean, dry and free of any item or substance (markers, stickers, …) that may affect the contact between both surfaces.

During the test, F_z and Moc_x shall be acquired and filtered according to 5.3 and 6.4 of this Technical Specification and to ISO 6487 requirements.

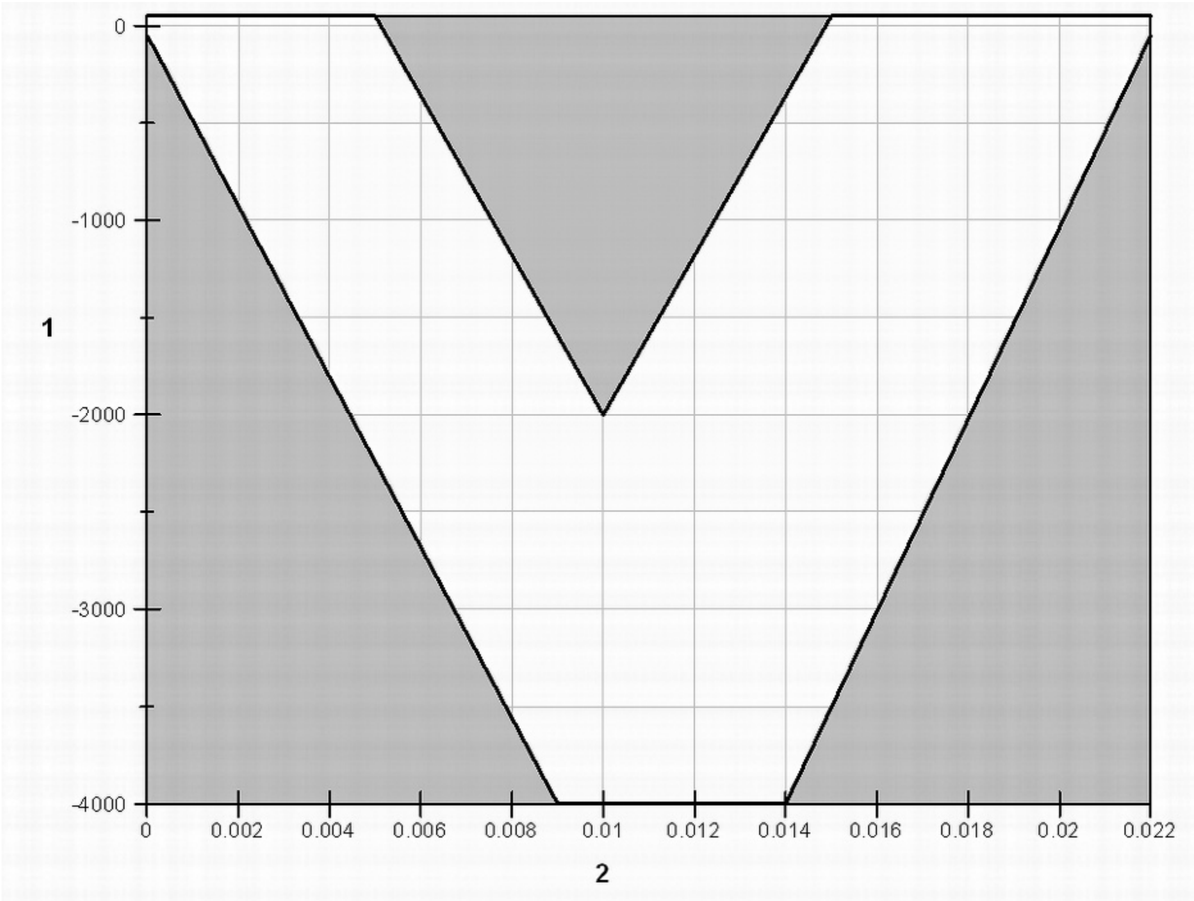
F.4 Helmet assessment

The following requirements shall be fulfilled for each of the three tested helmets.

— The helmet shell shall not become broken; however, detachment of the shield or vent covers is allowed.

— The F_z compression curve during first 22 ms of contact shall lie within the unshaded area of the time-force curve in Figure F.2. It is permitted to shift the force/time curve in time in order to obtain the best fit.

— The first peak of Moc_x shall lie within 20 N m and 80 N m.



Key

1 F_z (N)

2 time (s)

Time ms	**F_z lower limit** N
0	- 50
9	- 4 000
14	- 4 000
22	- 50

Time ms	**F_z upper limit** N
0	50
5	50
10	- 2 000
15	50
22	50

* Sign convention according to 5.3 of this Technical Specification.

Figure F.2 — Time F_z force curve

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