

**"Crash barriers, safety fences, guard rails and bridge parapets"**

**CEN/TC 226/WG 1**

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**Convenor :**  
Martin PAGE

**Secretary:**  
Frédérique RIGAH  
Direct line: +33 (0) 1 60 52 32 49  
Fax: +33 (0) 1 60 52 83 49  
[frederique.rigah@cerema.fr](mailto:frederique.rigah@cerema.fr)

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**"Road restraint system - Part 7: Test methods for the terminals of safety barriers"**

**April 2014 version**

**Comments /  
Decisions**

Working document.

As explained in the document N 148, you will find hereinafter the version of the part 7 dealing with terminals that was sent to the CEN/TC 226 secretary recommending its submission to the final stage approval (formal vote).

**Follow up**

- For information
- For discussion during the 44<sup>th</sup> meeting (Dublin, 2014-05-14 & 15)

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## **Road restraint systems — Part 7: Test methods for the terminals of safety barriers**

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## Foreword

This document (prEN 1317-7:2014) has been prepared by Technical Committee CEN/TC 226 "Road equipment", the secretariat of which is held by AFNOR.

This document is a working document.

This document, with (and only with) prEN 1317-4:\_, will supersede ENV 1317-4:2001.

This part of EN 1317 does not (and cannot) replace ENV 1317-4:2001 in isolation.

This European Standard consists of the following Parts under the general title:

*Road restraint systems* —

- Part 1: *Terminology and general criteria for test methods*;
- Part 2: *Performance classes, impact test acceptance criteria and test methods for safety barriers*;
- Part 3: *Performance classes, impact test acceptance criteria and test methods for crash cushions*;
- Part 4: *Performance classes, impact test acceptance criteria and test methods for transitions* (under preparation: this document will supersede ENV 1317-4:2001 for the clauses concerning transitions);
- Part 5: *Product requirements, test and assessment methods and acceptance criteria* (under preparation);
- Part 6: *Pedestrian restraint system - Pedestrian parapets* (CEN/TR);
- Part 7: *Performance classes, impact test acceptance criteria and test methods for terminals* (under preparation: this document will supersede ENV 1317-4:2001 for the clauses concerning terminals);
- Part 8: *Motorcycle road restraint systems which reduce the impact severity of motorcyclist collisions with safety barriers* (CEN/TS).

This part of EN 1317 is to be read in conjunction with EN 1317-1 and prEN 1317-5:\_.

Annex A to C are informative.

The significant technical changes incorporated in this revision are:

- Product requirements, assessment methods and acceptance criteria have been moved to prEN 1317-5:\_;
- Introduction of Approach 6 testing;
- Introduction of uni- and bi-directional terminal concept;
- Introduction of single and double sided terminal concept;
- Definition for the structural and total length of terminals;
- Introduction of a 50 km/h class;
- Deletion of PHD.

## **prEN 1317-7:2014 (E)**

- Clarification of the vehicle exit box requirements;
- Reduction in tolerance for impact speed and approach angle;
- Introduction of Informative Annexes related to:
  - Detailed test report template;
  - Objective of each of the impact tests and guidelines for determination of impact points and exit box;
  - Points to consider when selecting the Critical Impact Point for Terminals.

## Introduction

The design purpose of safety barriers installed on roads is to contain errant vehicles that either leave the carriageway or are likely to encroach into the path of oncoming vehicles. EN 1317-2 deals with the impact performance of a safety barrier to which a terminal may be attached.

Terminals, which are defined as the beginning and/or end treatment of a safety barrier, may be required to have specified impact performances without introducing additional hazards for passenger cars.

## 1 Scope

This part of EN 1317 specifies requirements for the vehicle impact testing of terminals of safety barriers.

## 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 1317-1:2010<sup>1)</sup>, *Road restraint systems – Part 1: Terminology and general criteria for test methods*

EN 1317-2: 2010<sup>2)</sup>, *Road restraint systems – Part 2: Performance classes, impact test acceptance criteria and test methods for safety barriers including vehicle parapets*

## 3 Abbreviations

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

ASI:	Acceleration Severity Index
ATD:	Anthropomorphic Test Device
BDT:	Bi-Directional Terminal
CFC:	Channel Frequency Class
CIP:	Critical Impact Point
DST:	Double Sided Terminal
EA:	Energy Absorbing Terminal
Lb:	Length of barrier connected to a terminal
Ld:	Length of terminal deformation
Ls:	Structural length of a terminal
Lt:	Total length of a terminal
NEA:	Non-Energy Absorbing Terminal
SST:	Single Sided Terminal
THIV:	Theoretical Head Impact Velocity
TT:	Type Test
UDTA:	Uni-Directional Terminal - Approach

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1) An amendment to this EN 1317-1 is currently being elaborated in order to restructure this supporting standard to bring it into line with prEN 1317-5:\_\_

2) An amendment to this EN 1317-2 is currently being elaborated in order to restructure this supporting standard to bring it into line with prEN 1317-5:\_\_

UDTD: Uni-Directional Terminal - Departure

VCDI: Vehicle Cockpit Deformation Index

For the purposes of this document, test vehicle mass codes are

- 1 900 kg,
- 2 1 300 kg,
- 3 1 500 kg.

## 4 Terms and definitions

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

### 4.1

#### **terminal**

product at the beginning and/or end of a safety barrier to reduce hazards for passenger cars that would result from the use of an un-treated beginning or end of the barrier

Note 1 to entry: In addition, it can provide an anchorage for the barrier system.

NOTE 1 A terminal may include a length of connecting barrier if it is required as part of the working mechanism of the terminal

NOTE 2 The performance of a terminal in general is dependent on the barrier connected.

### 4.2

#### **single sided terminal**

terminal which has performance in accordance with this European Standard, on one side only

### 4.3

#### **double-sided terminal**

terminal which has performance in accordance with this European Standard, on both sides

### 4.4

#### **datum point**

structural beginning of a terminal i.e. the first point at which the terminal offers significant resistance to a frontal impact

NOTE A method for quantifying 'significant resistance' is given in 5.1.

### 4.5

#### **total length of a terminal**

##### **L<sub>t</sub>**

total length of the terminal including all components

### 4.6

#### **structural length of a terminal**

##### **L<sub>s</sub>**

longitudinal distance from the terminal datum point to the end of the terminal

Note 1 to entry: The length of a terminal is measured in the direction of the traffic side of the barrier. The length is shown diagrammatically in Figure 1.



**4.7**  
**length of a connecting barrier**  
**Lb**  
length Lb of a barrier meeting the requirements of EN 1317-1 and EN 1317-2 and fixed to a terminal for the TT

NOTE This excludes any length of barrier used as part of the working mechanism of the terminal. This should be included in Lt and Ls as shown in Figure 3.

**4.8**  
**length of terminal deformation**  
**Ld**  
maximum dynamic longitudinal displacement of the terminal datum point after Approach 1 test

**4.9**  
**energy absorbing terminal**  
**EA**  
terminal which, in test Approach 1 (or 2 for T80/1), does not allow the first point of the car to pass over line R (see Figure 5), or which crosses line R at a speed less than or equal to 11 km/h

**4.10**  
**non-energy absorbing terminal**  
**NEA**  
terminal which in the test Approach 1 (or 2 for T80/1) allows the most first point of the car to pass over line R (see Figure 5), or which crosses line R at a speed greater than 11 km/h

**4.11**  
**family of terminals**  
**system type tested terminal**  
multiple performance product that can be assembled to form different models from the same set of components, to obtain performances in different classes, with the same working mechanism for the system and for its components

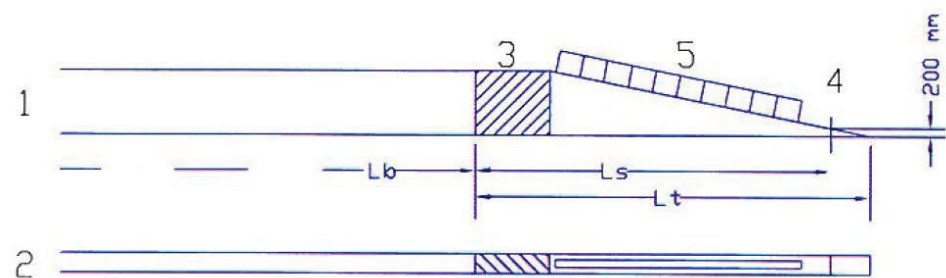
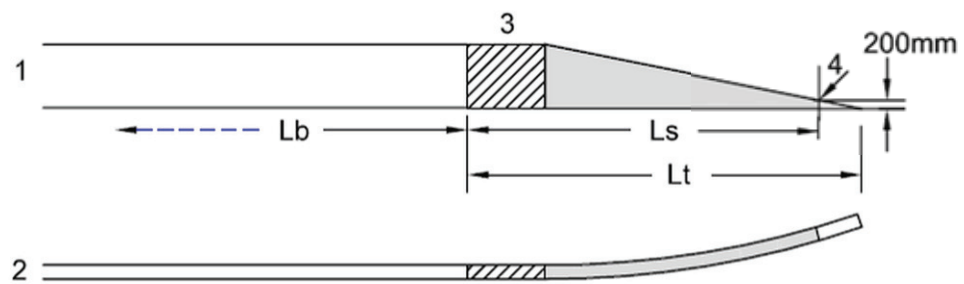
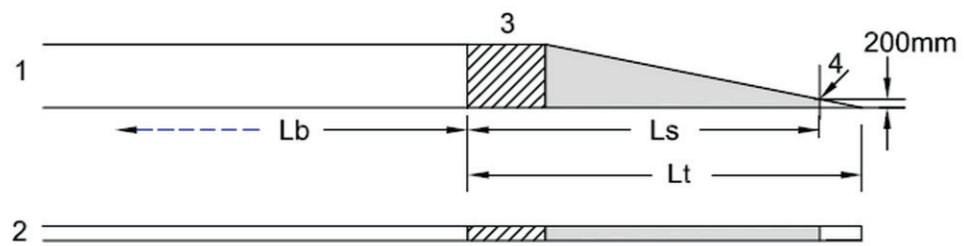
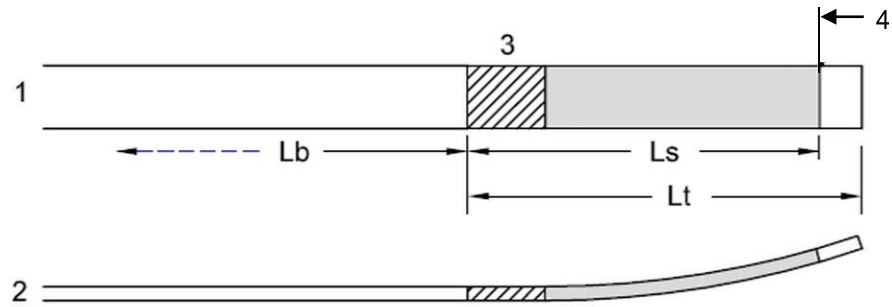
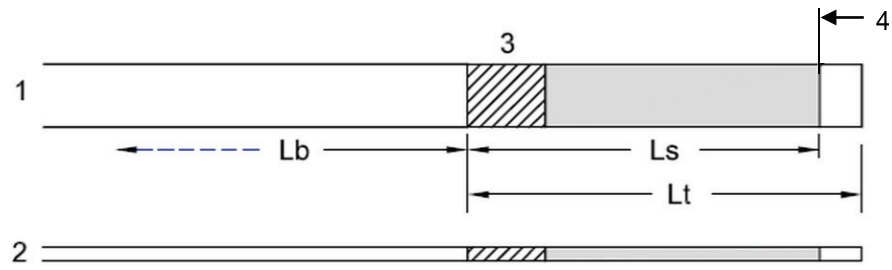
**4.12**  
**critical impact point**  
**CIP**  
impact point identified to reasonably represent the worst case for testing, see Annex C

**4.13**  
**uni-directional terminal – approach**  
**UDTA**  
terminal designed and tested to perform at the approach end of a barrier only

**4.14**  
**uni-directional terminal – departure**  
**UDTD**  
terminal designed and tested to perform at the departure end of a barrier only

**4.15**  
**bi-directional terminal (BDT)**  
terminal designed and tested to perform at both the approach and departure ends of a barrier

**4.16**  
**Sloped down terminal**  
a terminal which slopes down towards the ground at the end



**Key**

- 1 side view
- 2 plan view
- 3 minimum length of connecting barrier required as part of the working mechanism of the terminal in Approach 1 test
- 4 datum point (see Clause 5.2)
- 5 energy absorbing element(s)

**Figure 1 — Diagram of a Terminal**

## **5 Terminal performance**

### **5.1 Determination of the Datum Point, Structural Length (L<sub>s</sub>) and Length of Barrier (L<sub>b</sub>)**

NOTE Some designs may incorporate a non-structural beginning (nose) which offers no significant resistance to an impact.

For sloped down terminals, the terminal datum point shall be defined as the first point 200 mm above ground level, as shown in Figure 1.

In all other cases, the location of the terminal datum point shall be agreed between the manufacturer and the test house before tests are conducted, and this shall be reported in the test report.

If no agreement is reached between the manufacturer and the test house regarding the location of the datum point, the Approach 1 test shall be carried out before the Approach 4, 5, and 6 tests. The x-direction acceleration shall be filtered at CFC60 for the Approach 1 test, and the time at which the vehicle first experiences a deceleration equal to 5g shall be determined. The location of the vehicle impact point at the time at which the 5 g value is reached shall be the datum point for the terminal.

For performance classes T50 and T80/1, this information shall be derived from the Approach 2 test.

In those cases where no agreement is reached between the manufacturer and the test house regarding the location of the datum point, and the terminal is a sloped down terminal, the datum point shall be defined as the first point 200 mm above ground level, as shown in Figure 1, or the point at which the vehicle starts to experience a deceleration equal to 5 g, whichever is reached first by the test vehicle.

If no agreement is reached between the manufacturer and the test house regarding the location of the datum point, and a deceleration of 5 g is not achieved, the datum shall be located at the start of the terminal's approach end.

If a part of the barrier overlaps with the terminal or is required to deform in a controlled manner as part of the normal functioning of the terminal, then this length of the barrier shall be included in the structural length of the terminal (L<sub>s</sub>). It shall also be considered the length to reach the barrier height, in sloped down systems.

For tests, the terminal shall be installed with the terminal manufacturer's minimum specified length of safety barrier (L<sub>b</sub>) so as to demonstrate the full performance of the terminal. The minimum length of safety barrier shall be not less than 20 m. The same barrier type shall be used within all of the testing for a particular terminal product.

In the case described in 6.3.2 for tests with Approach 1, the terminal can be installed without safety barrier.

Table 1 — Vehicle impact test configurations

Tests				
Test code <sup>a</sup>	Approach	Approach reference Figures 2 and 3	Vehicle mass kg	Velocity km/h
TT1.2.80	frontal, 0°, head centred	1	1 300	80
TT1.2.100	frontal, 0°, head centred	1	1 300	100
TT1.3.110	frontal, 0°, head centred	1	1 500	110
TT2.1.50	frontal, 0°, offset by ¼ of the vehicle width to the traffic side	2	900	50
TT2.1.80	frontal, 0°, offset by ¼ of the vehicle width to the traffic side	2	900	80
TT2.1.100	frontal, 0°, offset by ¼ of the vehicle width to the traffic side	2	900	100
TT3.2.80	head (centre) at 15°	3	1 300	80
TT3.2.100	head (centre) at 15°	3	1 300	100
TT3.3.110	head (centre) at 15°	3	1 500	110
TT4.2.80	side, 15° 2/3 Ls	4	1 300	80
TT4.2.100	side, 15° 2/3 Ls	4	1 300	100
TT4.3.110	side, 15° 2/3 Ls	4	1 500	110
TT5.1.80	side, 165° 1/2 Ls	5	900	80
TT5.1.100	side, 165° 1/2 Ls	5	900	100
TT6.2.80	side, 165° at the critical impact point	6	1 300	80
TT6.2.100	side, 165° at the critical impact point	6	1 300	100
TT6.3.110	side, 165° at the critical impact point	6	1 500	110
<sup>a</sup> Test code notation is as follows:				
TT	1	2	100	
Test of Terminal	Approach	Test vehicle mass	Impact speed	

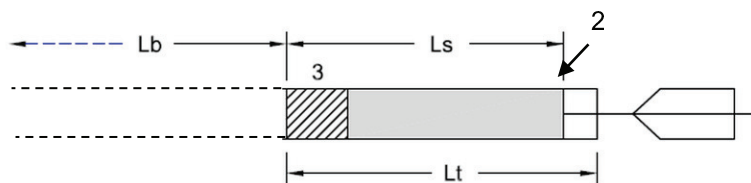
The vehicle width shall be the maximum width of the vehicle at its widest point, excluding any side mirrors.

After a successful test with Approach 6, the Approach 6 test shall not be repeated if the terminal is connected to a barrier with a lower dynamic deflection (in the EN 1317-2 TB11 test), but shall be retested with Approach 6 if connected to a barrier with a greater dynamic deflection (in the EN 1317-2 TB11 test).

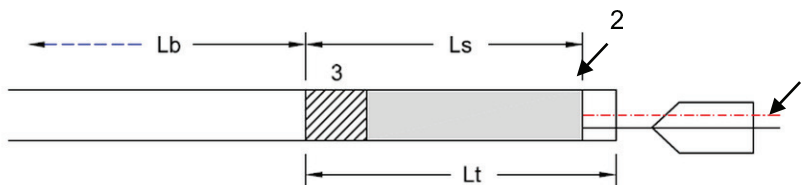
## **prEN 1317-7:2014 (E)**

If the difference between the two dynamic deflections is less than 20%, the Approach 6 test shall not be performed with the barrier with a greater dynamic deflection.

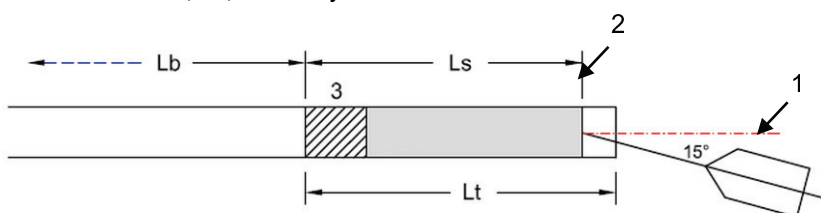
Impact shall be at the points indicated in Figures 2 and 3 unless the test house chooses a different impact point, within the length  $L_s$ , to demonstrate the worst-case testing conditions of the terminal, in terms of the essential characteristics of the transition under test (i.e. performance under impact, containment level, impact severity, normalised working width and normalised dynamic deflection) and shall include any sensitive feature of the design, following the guidelines set out in Annex C. If the test house chooses an impact point other than those outlined below, in order to ensure worst-case conditions, then this choice shall be justified in the test report.



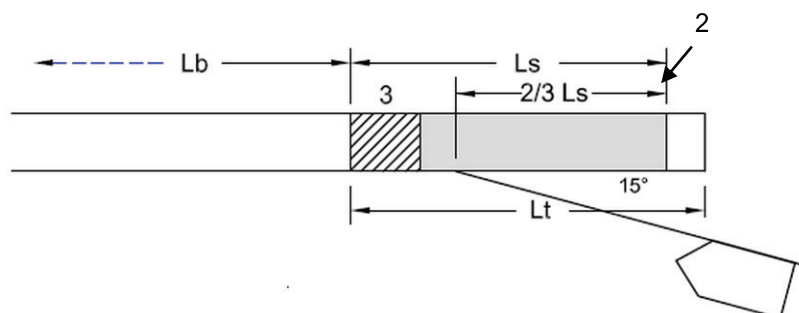
a) **Approach 1:** Frontal, 0° centre of terminal head



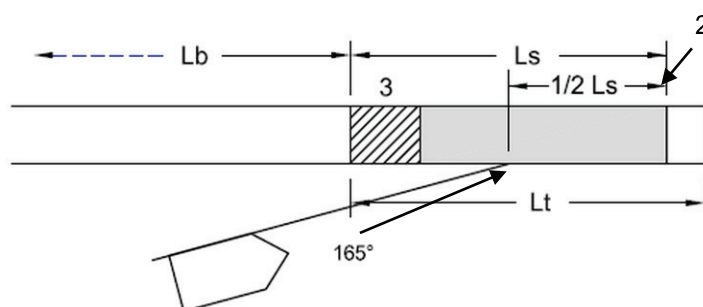
b) **Approach 2:** Frontal, 0°, offset by  $\frac{1}{4}$  of the vehicle width to the traffic side



c) **Approach 3:** 15° vehicle centreline on centre of terminal head

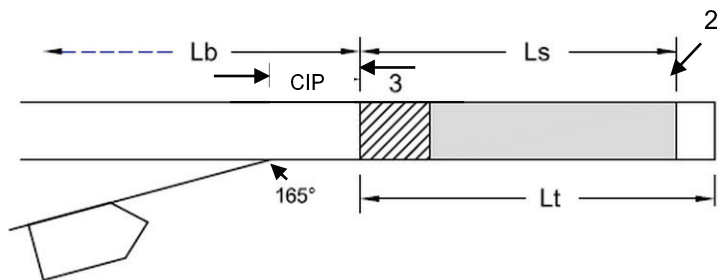


d) **Approach 4:** 15° vehicle side impact at  $\frac{2}{3}$  Ls terminal front side



e) **Approach 5:** 165° vehicle side impact at  $\frac{1}{2}$  Ls terminal front side reverse

**Figure 2 — Vehicle approach paths (1/2)**



f) **Approach 6:** 165° vehicle side impact on barrier before connection to terminal, at critical impact point

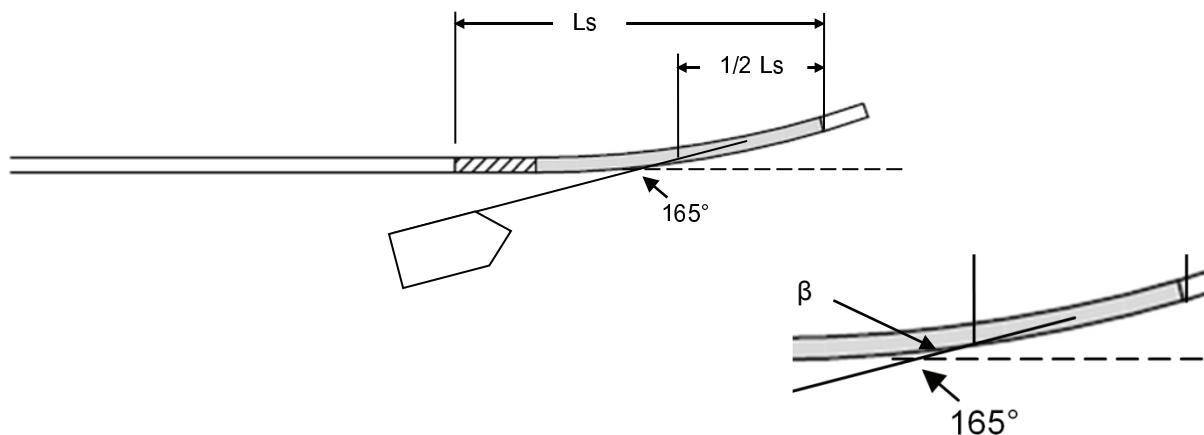
**Key**

- 1 centre line of terminal
- 2 datum point
- 3 minimum length of connecting barrier required as part of the working mechanism of the terminal in Approach 1 test or Approach 2 for T80/1

**Figure 3 — Vehicle approach paths (2/2)**

Approaches 3, 4 and 5 shall be run after determination of  $L_s$  through Approach 1 test.

Approach 5 will not be run for a terminal which is not parallel to the line of the original traffic face of the barrier if the angle  $\beta$  of the vehicle path to the traffic face of the terminal is less than 5°, at the relevant impact point and from this point to the head of the terminal, for example



**Figure 4 — Terminal configuration not requiring an Approach 5 test (if  $\beta < 5^\circ$ )**

In the case of non symmetrical double sided terminals, tests for Approaches 2, 3, 4, and 5 shall be carried out on both sides of the terminal, when they are intended for bilateral traffic situations.

**5.2 Impact severity**

The vehicle occupant impact severity assessment indices, ASI and THIV, shall be evaluated. These indices are defined in EN 1317-1.

**5.3 Permanent and dynamic displacement of terminal**

The permanent and dynamic displacement of the terminal or barrier (whichever is the greater), or any detached part greater than 2,0 kg, shall be measured perpendicularly from the traffic side of the undeformed barrier. The permanent and dynamic displacement shall be recorded in the test report. The permanent displacement shall be measured not less than 10 min and no more than two hours after the impact, and shall be included in the determination of the permanent displacement zone.

## **5.4 Impact test acceptance criteria**

### **5.4.1 General**

For completion of a successful test, the following impact acceptance criteria and measurements shall be met.

### **5.4.2 Terminal behaviour**

Elements of the terminal shall not penetrate the passenger compartment of the vehicle. Deformations of, or intrusions into, the passenger compartment that could cause serious injuries are not permitted. Any penetration or deformation into the vehicle shall be reported.

All totally detached parts of the terminal with a mass greater than or equal to 2,0 kg shall be included in the determination of the displacement classification (see 5.4).

For Approaches 4, 5 and 6, there shall be no complete breakage of any of the principal longitudinal elements of either the terminal or the connected safety barrier system.

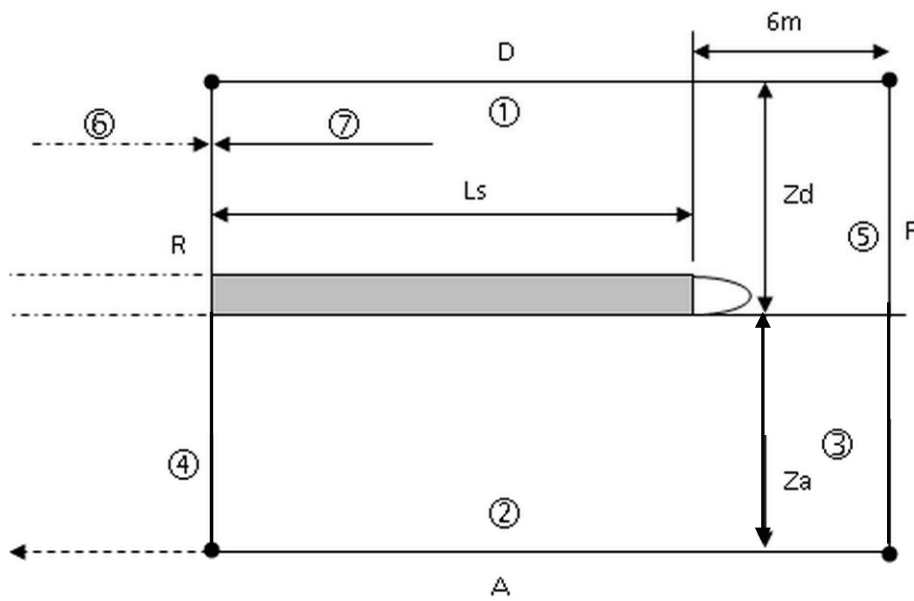
Anchorage and fixings shall perform to the terminal design specifications and other specified requirements as listed in the test report.

### **5.4.3 Test vehicle behaviour**

#### **5.4.3.1 General**

The vehicle shall not roll over (including rollover of the vehicle onto its side) during or after impact. The post-impact trajectory of the test vehicle shall be reported by means of the exit box shown in Figures 5, 6; 7 and 8, and in Table 2 including if the wheel crosses the line but without contact with the ground.





- Key**
- 1 departure side
  - 2 approach side
  - 3 traffic side of barrier
  - 4 end of terminal
  - 5 rebound line
  - 6 barrier
  - 7 terminal
- Ls structural length of terminal  
 A exit box limit (approach side)  
 D exit box limit (departure side)  
 R exit box limit (rear of terminal)  
 F exit box limit (front of terminal)  
 Za exit box width (approach side)  
 Zd exit box width (departure side)

**Figure 5 — Exit box**

For different tests, the vehicle post-impact trajectory shall be restricted in that no wheel of the vehicle shall not encroach the lines of the exit box specified in Table 2, unless the velocity of the vehicle centre of mass at the instant of encroachment is less than or equal to 11 km/h. In this case, for the determination of the redirection zone, the vehicle is considered not having passed the relevant exit box control line.

**Table 2 — Exit box**

Test approach	Exit box control lines
1, 2, 3	F, A, D
4, 5, 6	A

**5.4.3.2 Approaches 1, 2 and 3**

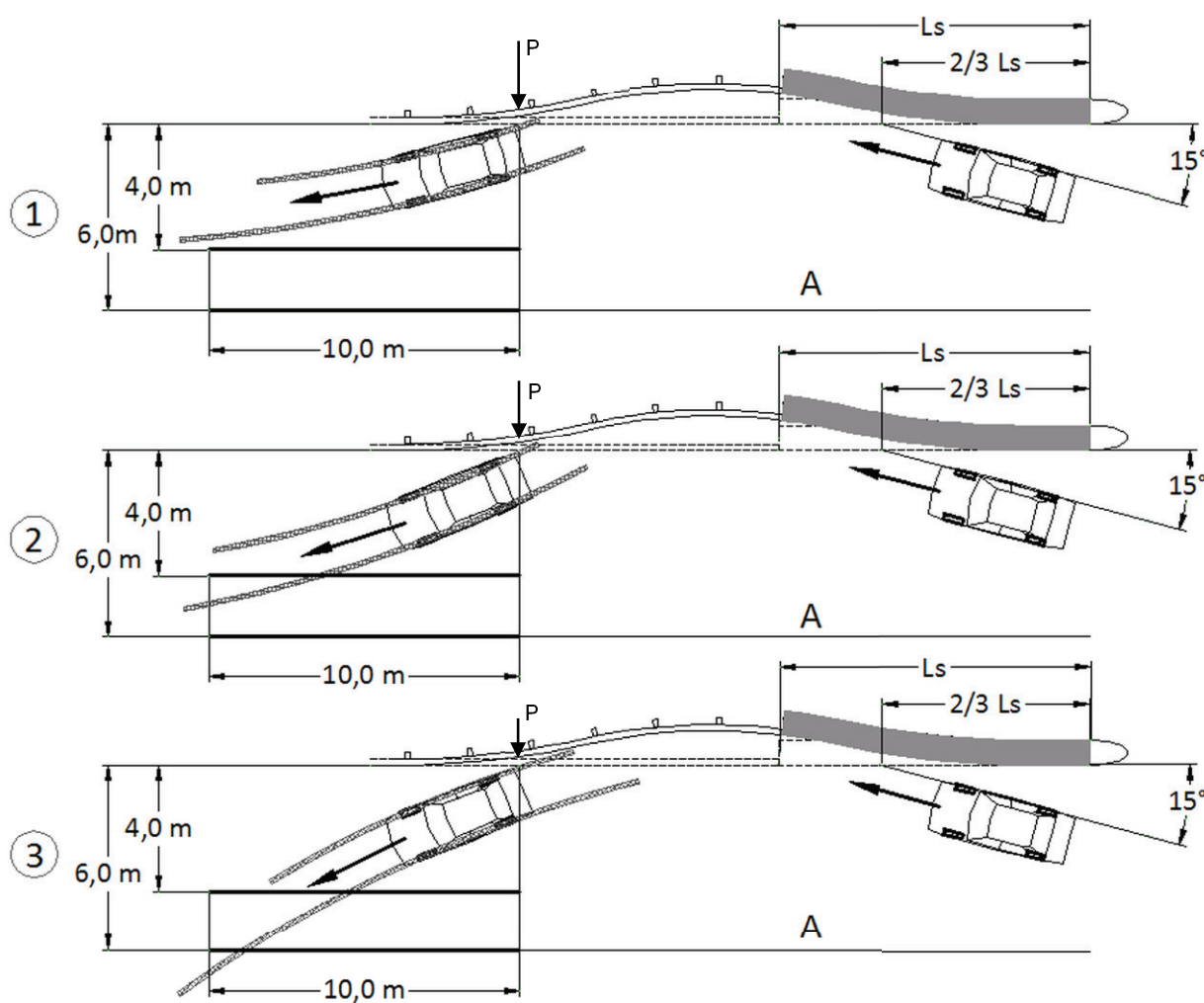
For Approaches 1, 2 and 3 the dimensions of the exit box are defined by

- the rebound line F, perpendicular to the barrier traffic side, 6 m ahead of the datum point of the terminal,
- the two-side lines A and D parallel to the barrier traffic side, at distances Za and Zd,

— the line R, perpendicular to the barrier traffic side at the end of the terminal, defines the end of lines A and D.

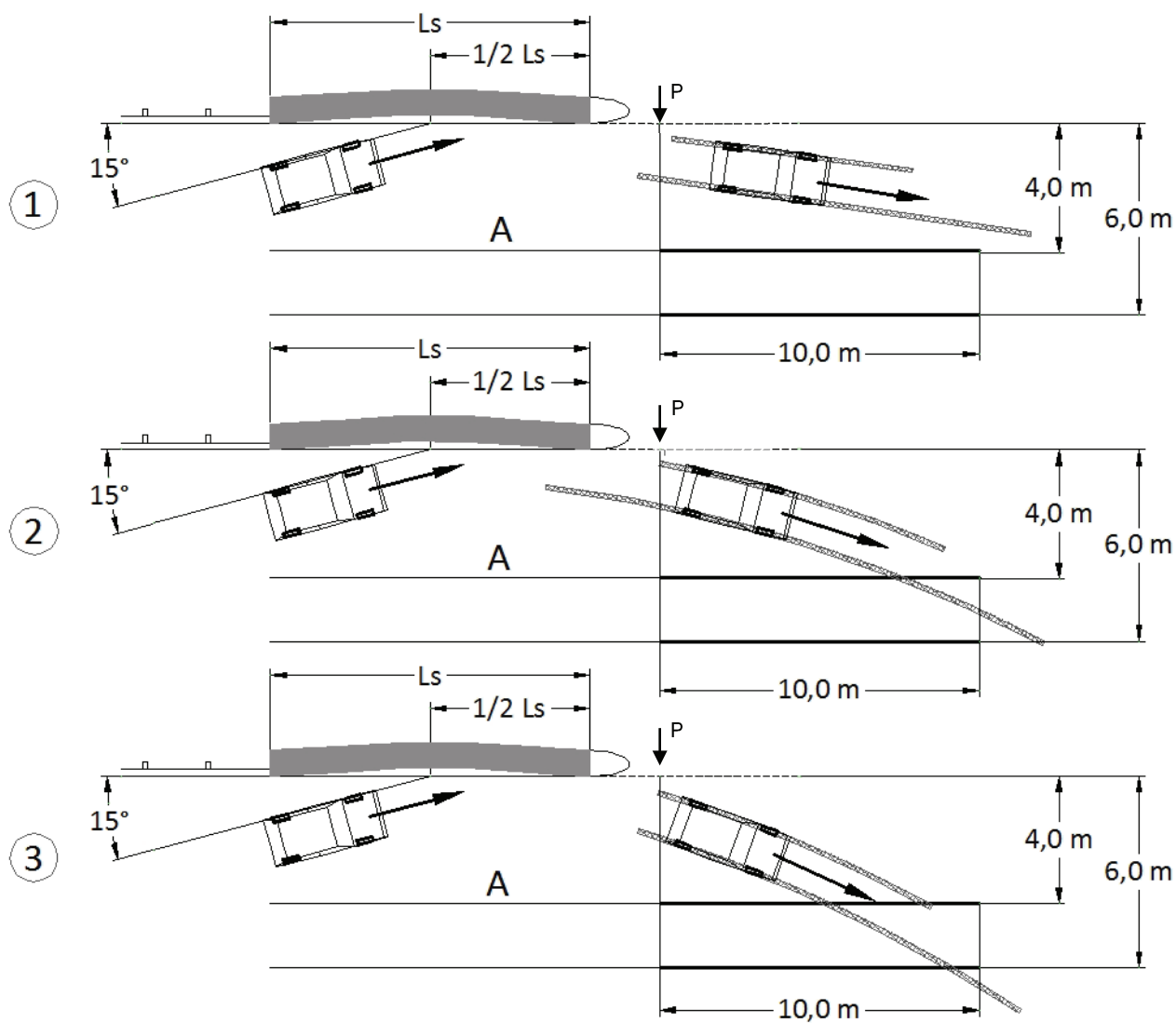
### 5.4.3.3 Approaches 4, 5 and 6

For Approaches 4, 5 and 6, the vehicle shall leave the terminal after side impact so that no wheel track crosses the line A or its extensions within 10,0 m from the point P, where the last of the vehicle wheel tracks re-crosses the original line of the traffic face of the terminal after initial impact, see Figures 6, 7 and 8.



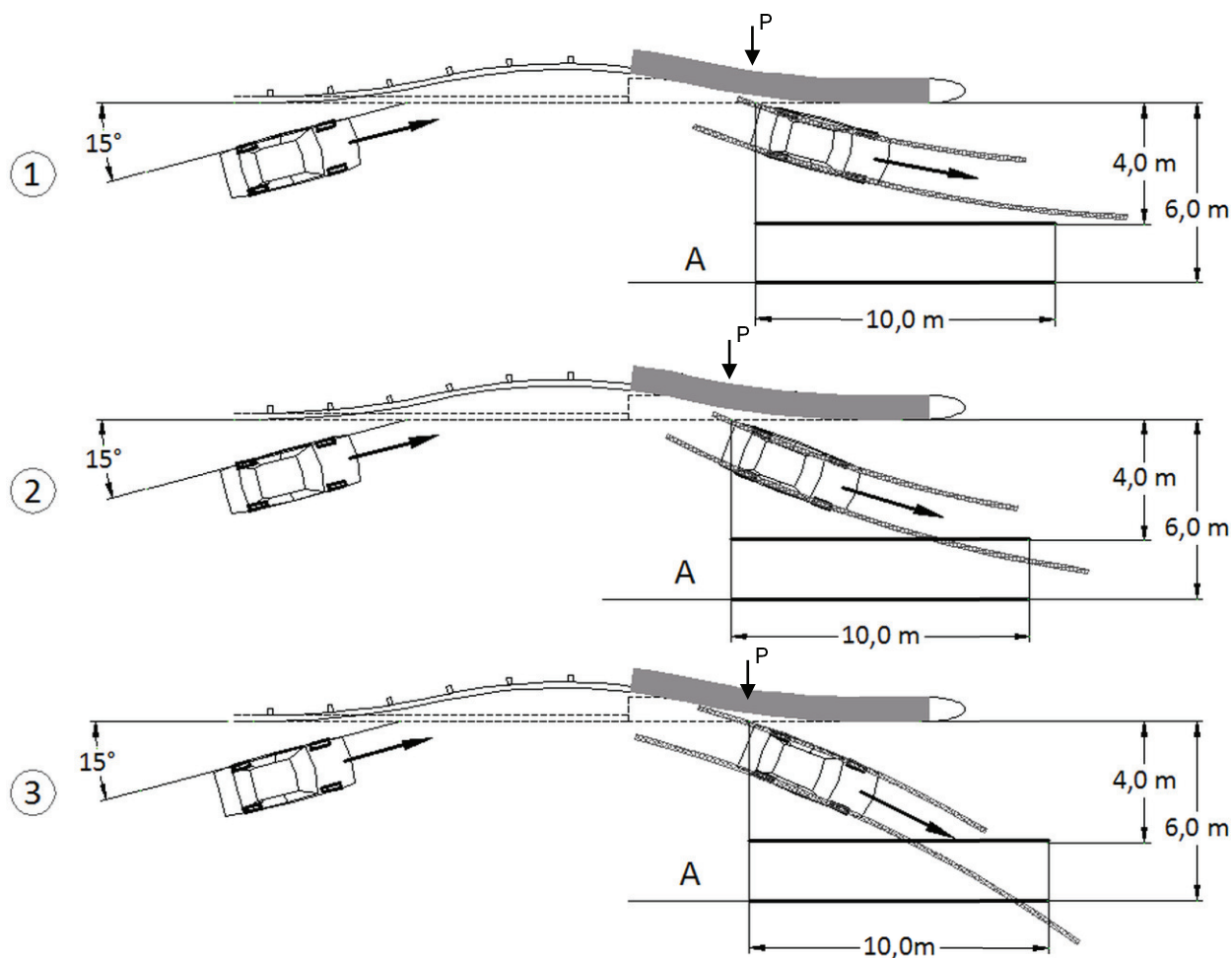
a) Classes of Z for Approach 4

Figure 6 — Classes of Z (1/3)



b) Classes of Z for Approach 5

Figure 7 — Classes of Z (2/3)



c) Classes of Z for Approach 6

**Key**

- 1 pass (Z1, Z3)
- 2 pass (Z2, Z4)
- 3 fail

Figure 8 — Classes of Z (3/3)

**5.4.4 Test vehicle deformation**

The deformation of the interior of the vehicle shall be evaluated and recorded in the form of VCDI (Vehicle Cockpit Deformation Index) in all tests as described in EN 1317-1.

**5.4.5 Severity index**

ASI and THIV shall be computed using at least the minimum amount of vehicle instrumentation as specified in 6.6. These values should be quoted in the test report (see Annex A).

**6 Test methods****6.1 Test site**

The test site shall comply with the requirements of EN 1317-1.

## **6.2 Test vehicles**

The test vehicles shall comply with the requirements of EN 1317-1.

## **6.3 Test item**

### **6.3.1 General**

Detailed descriptions and design specifications of the terminal shall be included in the test report (see EN 1317-1), to enable verification of conformity of the installed system to be tested. This shall include the details of all anchorages installed as part of the test installation. A template is enclosed under Annex A.

### **6.3.2 Installation**

The terminal shall conform to the structural design details and with the installation details as given by the manufacturer.

The structural length of the terminal ( $L_s$ ) shall be determined by the test house, before the other tests, after test Approach 1.

The length and specific barrier type declared by the manufacturer to be necessary to resist the forces to be applied to the terminal shall be provided for the test, and the length ( $L_b$ ) recorded in the test report and the installation Drawings associated with the test.

The dynamic deflection of the connected safety barrier system (from the TB32 test of the system) shall also be reported within the test report. In such cases where this test has not been carried out due to the performance class of the barrier system, the dynamic deflection of the associated TB11 or TB21 (for low angle containment systems) test shall be reported.

In Approach 1 only, the manufacturer can decide to install the terminal without following barrier, in order to demonstrate that it does not load the barrier when impacted. It is considered not to load the barrier if the longitudinal dynamic deformation in this test, does not exceed 0,05 m measured from the point where the terminal connects to the barrier. The level of severity is not considered to be affected by less than 0,05 m of displacement.

### **6.3.3 Position of the impact point**

The approach and impact point for the tests shall generally be in accordance with Figures 2 and 3. More specifically, the critical impact points shall be chosen by the test house and shall demonstrate the worst-case testing conditions of the terminal, and shall include any sensitive feature of the design. If the test house chooses an impact point other than that defined by Figures 2 and 3, in order to ensure worst-case conditions, then this choice shall be justified in the test report. Reference can be made to the guideline showed in Annex C.

The impact points on a terminal shall be determined considering only its structural parts.

## **6.4 Accuracies and limit deviations of impact speeds and approach angle**

### **6.4.1 Vehicle impact speed**

Vehicle impact speed shall be measured along the vehicle approach path no further than 6 m before the impact point. The overall accuracy of speed measurement shall be within  $\pm 1$  % of the target impact speed.

The impact speed limit deviation shall be: + 6 % / - 0 %.

### 6.4.2 Vehicle approach angle

Vehicle approach angle shall be measured along the vehicle approach path no further than 6 m before the impact point by a suitable method. The overall accuracy shall be within  $\pm 0,5^\circ$ .

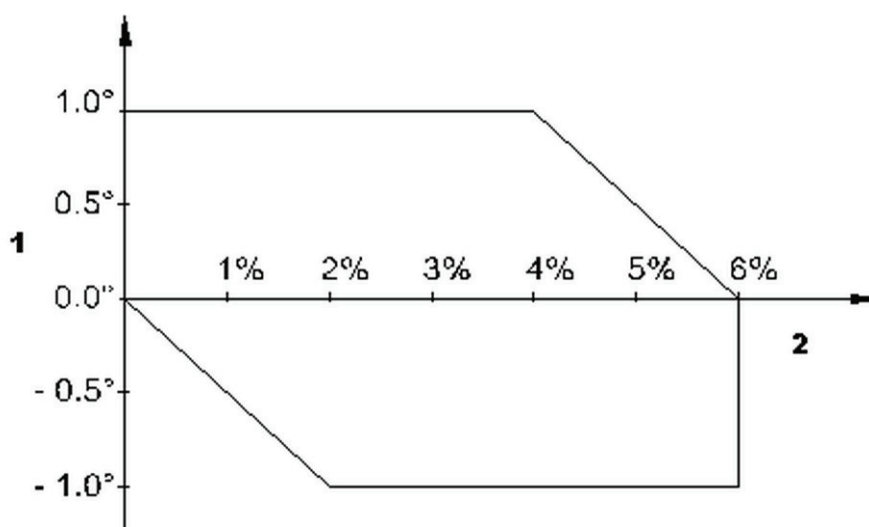
The impact angle limit deviation shall be:  $- 1,0^\circ / + 1,0^\circ$ .

### 6.4.3 Combined limit deviation of speed and angle

To avoid large differences of impact energy, the maximum limit deviation for speed and angle shall not be combined.

At the upper angle tolerance of  $+ 1,0^\circ$  the upper speed limit deviation is reduced to  $+ 4\%$ , and at the angle limit deviation of  $- 1,0^\circ$  the lower speed limit deviation is increased to  $+ 2\%$ .

The complete combined tolerance envelope is shown in Figure 9.



#### Key

- 1 Angle [°]
- 2 Speed [%]

Figure 9 — Envelope of combined tolerances

### 6.5 Vehicle impact point

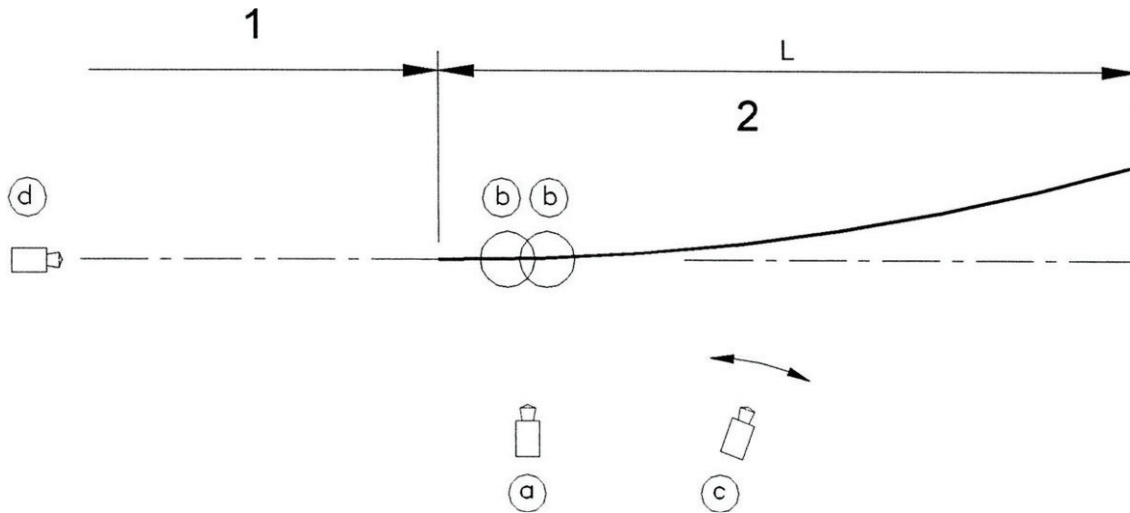
The lateral displacement of the vehicle approach path shall be measured with an accuracy of  $\pm 0,05$  m by a suitable method. The permitted tolerance for the lateral displacement of the vehicle path from its true direction shall be less than  $\pm 0,10$  m at the moment of contact.

### 6.6 Vehicle instrumentation

The vehicle instrumentation shall be in accordance with EN 1317-1:2010, Clause 6.

### 6.7 Photographic coverage

For Approaches 1, 2 and 3, the photographic coverage to describe the terminal behaviour and the vehicle motion during and after impact, shall be as described in Figure 10.



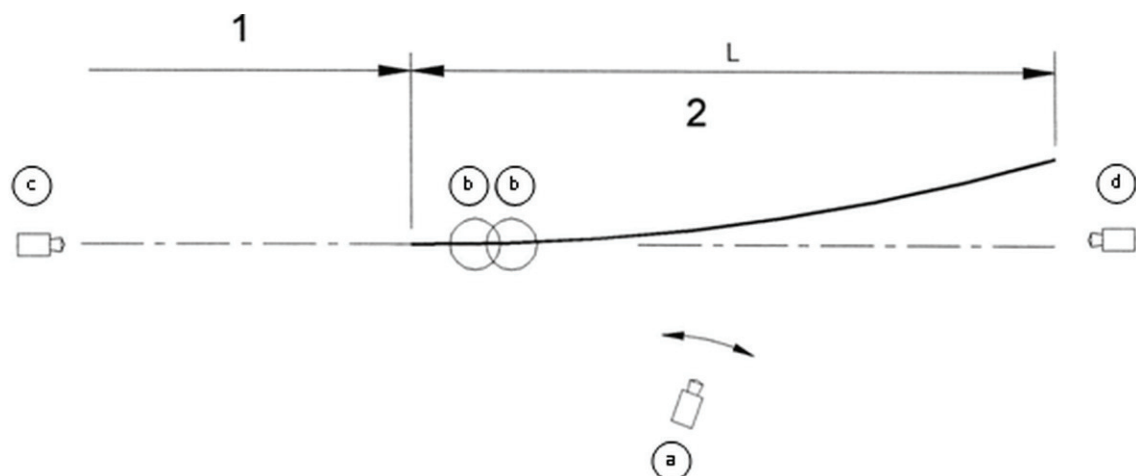
**Key**

- 1 barrier
- 2 terminal
- (a) one high speed camera looking normal to the terminal centre line
- (b) one or two overhead high-speed cameras, located in a way to cover the vehicle motion from at least 6 m before the impact point to a distance to record the performance of the terminal
- (c) one optional panned camera at normal speed sited at right angles to the path of the vehicle
- (d) (Optional) one high speed camera looking from a position behind the impact pointing order to record the vehicle roll, vertical lift, penetration and sequence of action as the terminal is struck

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

**Figure 10 — Layout of cameras for recording tests – Approaches 1, 2 and 3**

For Approaches 4, 5, and 6 the photographic coverage to describe the terminal behaviour and the vehicle motion during and after impact, shall be, at the minimum, as described in Figure 11.



### Key

- 1 barrier
  - 2 terminal
  - (a) one optional panned camera at normal speed to cover the path of the vehicle
  - (b) one or two overhead high-speed cameras, located in a way to cover the vehicle motion from at least 6 m before the impact point to a distance to record the performance of the safety barrier including parapet
  - (c) one high speed camera looking over the safety barrier including parapet from a point behind impact in order to record the vehicle roll, vertical lift, penetration and sequence of action as the system is struck
  - (d) one high speed camera looking along the system from the opposite end to the camera in item (c)
- The need for additional cameras should be considered to cover areas of special interest.

**Figure 11 — Layout of cameras for recording tests – Approaches 4, 5 and 6**

A known scale shall be visible in overhead camera view(s) to assist measurement from the photographic coverage following the test.

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.

### 6.8 Test report

The test report may comply with the format given in Annex A.

The manufacturer shall measure loads to the barrier or give evidence of calculations done with Computational Mechanics, if he intends to use the terminal with different barriers, with reference to prEN 1317-5:\_, Annex A, unless the terminal does not transfer any load to the connecting barrier.



## **Annex A** (informative)

### **Detailed test report template**

The test report shall include the following information as a minimum, in the order given:

#### **Test Report Cover:**

- Name of test laboratory
- Date of report
- Name of client
- Name of test item
- Date of test
- Test number and/or test report number (version number if applicable)
- Test type and reference to standard
- Number of pages including annexes
- Official test report language

#### **Table of Contents**

- 1 Test laboratory
- 2 Client
- 3 Test Item
- 4 Test procedure
  - 4.1 Test type
  - 4.2 Test area
  - 4.3 Installation and description of test item
  - 4.4 Description of test vehicle
- 5 Results
  - 5.1 Test condition
  - 5.2 Test item
  - 5.3 Test vehicle
  - 5.4 Assessment of the impact severity
- 6 General statements
- 7 Approval of report
- 8 Annexes
  - A. General test item arrangement drawings (overview drawing) of the complete item tested and all component drawings, both including dimensions and tolerances. All drawings to be authorised by the client in writing.
  - B. Installation manual including dimensions and tolerances.
  - C. Photographs (with a minimum print size in height and width of 8 cm)
  - D. Ground condition description.

**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 test item
- 3.2 Date of installation
- 3.3 Date of test
- 3.4 Laboratory's test reference number
- 3.5 Additional information

**4 Test procedure****4.1 Test type (according to Table 1)**

- 4.1.1 Test code (for example, TT5.1.100)

**4.2 Test area**

- 4.2.1 Description of type and condition of test area
- 4.2.2 Sketch of vehicle approach to indicate impact point
- 4.2.4 Type of underground
- 4.2.5 Class/condition of underground
- 4.2.6 Additional Information

**4.3 Installation and detailed description of test item**

- 4.3.1 Conformity between test item drawings and item tested (Yes/No) – if no, define the details of non-conformity (e.g. material thicknesses, material properties)
- 4.3.2 Conformity between installation manual and item installed (Yes/No) – if no, define the details of non-conformity (e.g. tolerances for post spacing, test item height, fastening torques, tensioning)

- 4.3.3 Description of the terminal tested which shall include, as a minimum:
  - 4.3.3.1 Ground fixing details
  - 4.3.3.2 Structural length of the terminal (Ls) in metres
  - 4.3.3.3 Description of the type of safety barrier attached to the terminal and details of their connection (if appropriate)
  - 4.3.3.4 Length of the barrier attached to the terminal (Lb) in metres
  - 4.3.3.5 Height of the test item in the impact area
  - 4.3.3.6 Post spacing and/or unit length (in metres)
  - 4.3.3.7 Where the connecting barrier is pretensioned, the value(s) of the tension(s) have to be indicated
  - 4.3.3.8 Location of impact point selected (with justification)
  - 4.3.3.9 Details of all anchorages used within the test installation
  - 4.3.3.10 Any additional information to describe the terminal sufficiently

#### 4.4 Description of test vehicle

- 4.4.1 Vehicle make and model
- 4.4.2 Model year and/or initial registration
- 4.4.3 Vehicle identification number (VIN)
- 4.4.4 Vehicle mass according to EN 1317-1:2010, Table 1
- 4.4.5 Location of the centre of gravity of the vehicle in the test condition according to EN 1317-1:2010, Table 1
  - NOTE For tests with cars, the centre of gravity shall be measured without the ATD in the vehicle.
- 4.4.6 Position of vehicle instrumentation and measured displacement from vehicle centre of gravity
- 4.4.7 Added ballast
  - 4.4.7.1 Ballast type/description
  - 4.4.7.2 General ballast position
  - 4.4.7.3 Total ballast mass
- 4.4.8 ATD (if fitted):
  - 4.4.8.1 ATD type
  - 4.4.8.2 ATD mass
  - 4.4.8.3 ATD position in vehicle
- 4.4.9 Total test mass in kilogramme
- 4.4.10 Dimensions and characteristics of vehicle, which shall include as a minimum:
  - 4.4.10.1 Total vehicle length
  - 4.4.10.2 Total vehicle width (excluding side mirrors)
  - 4.4.10.3 Wheel track
  - 4.4.10.4 Number of axles
- 4.4.11 Vehicle roadworthiness assessment (including date of assessment)
- 4.4.12 Any additional information

## 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 Location of actual impact point
- 5.1.6 Displacement of actual impact point from designated impact point
- 5.1.7 General description of test sequence
- 5.1.8 Air temperature
- 5.1.9 Any additional information

### 5.2 Test item

#### General

- 5.2.1 Permanent lateral displacement of the terminal in front of the original traffic face of the terminal in metres
- 5.2.2 Permanent lateral displacement of the terminal behind the original traffic face of the terminal in metres
- 5.2.5 Length of terminal deformation (Ld), including the length of any connecting safety barrier
- 5.2.6 Permanent lateral displacement of the barrier and the permanent longitudinal and vertical displacement of both the terminal and the barrier.

#### Impact test acceptance criteria

- 5.2.7 Details of test item parts over 2,0 kg totally detached:
  - 5.2.7.1 Identification
  - 5.2.7.2 Weight (kg)
  - 5.2.7.3 Final location measured perpendicular to the original traffic face of the terminal
  - 5.2.7.4 Final location measured along the line of the original traffic face of the barrier starting from the detachment point
- 5.2.8 Elements of the terminal penetrated the passenger compartment of the vehicle (Yes/No) – if yes, description of penetration is required.
- 5.2.9 Deformations of and/or intrusions into the passenger compartment (Yes/No) – if yes, description of deformations and/or intrusions are required.

### 5.3 Test vehicle

#### General

- 5.3.1 General description of vehicle trajectory
- 5.3.2 Vehicle cockpit deformation index VCDI
- 5.3.3 Description of the damage and deformation to the test vehicle (including penetration of the terminal into the vehicle passenger compartment)
- 5.3.4 Speed of vehicle's centre of gravity when crossing exit box control line F, in kilometres per hour (if applicable)
- 5.3.5 Speed of vehicle's centre of gravity when crossing exit box control line A, in kilometres per hour (if applicable)
- 5.3.6 Speed of vehicle's centre of gravity when crossing exit box control line D, in kilometres per hour (if applicable)

- 5.3.7 Speed of vehicle's centre of gravity when crossing exit box control line R, in kilometres per hour (if applicable)
- 5.3.8 Maximum distance of vehicle in front of the traffic face of the barrier, in metres, measured from the front centreline of the undeformed terminal
- 5.3.9 Maximum distance of vehicle behind the traffic face of the barrier, in metres, measured from the front centreline of the undeformed terminal

**Impact test acceptance criteria**

- 5.3.10 Actual impact speed and angle within tolerance limits? (Yes/No)
- 5.3.11 Actual impact speed and angle combination within the tolerance envelope in Figure 9 (Yes/No)
- 5.3.12 Vehicle rolls over during the test (Yes/No)

**For Approaches 1, 2 and 3:**

- 5.3.13 Vehicle crosses exit box control line F (Yes/No)
- 5.3.14 Vehicle crosses exit box control line A (Yes/No)
- 5.3.15 Vehicle crosses exit box control line D (Yes/No)
- 5.3.16 Vehicle crosses exit box control line R (Yes/No)

**For Approaches 4, 5 and 6:**

- 5.3.17 Vehicle crosses the exit box line defined in 5.5.3.3

**5.4 Assessment of the impact severity**

All severity indices shall be rounded to the nearest whole number, unless stated otherwise. Filtering frequency applied to the raw data shall also be stated.

**General**

- 5.4.1 Graphs of linear accelerations and angular velocities

**Impact test acceptance criteria**

- 5.4.2 Acceleration severity index, ASI (rounded to 1 decimal place)
- 5.4.3 Theoretical head impact velocity, THIV
  - 5.4.3.1 Time of flight of the theoretical head in milliseconds
  - 5.4.3.2 THIV in kilometres per hours

**6 General statements**

- 6.1 The test results in this report relate only to the system 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 House
- 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, both including dimensions and tolerances.
- B. Installation manual including dimensions and tolerances.
- C. Photographs

D. Ground condition description.

## **Annex B** (informative)

### **Objective of each of the impact tests and guidelines for determination of impact points and exit box**

Impact test matrix as shown in Table 1 has the purpose to determine the suitability of the terminals in the different classes of velocity considering a number of possible impacts which conventionally assess it when evaluating the behaviour of the device, the vehicle and the occupants.

A "structural centreline" shall be determined for the terminal. This shall correspond with the axis to be loaded in Approach 1 in order to achieve maximal deformation of the terminal taking into account all major structural elements of the terminal.

**Approach 1**, frontal impact, is meant to achieve maximum longitudinal deformation of the terminal and to evaluate

- the containment capacity of the terminal and therefore is performed with the heavier passenger vehicle,
- if any longitudinal element of the terminal penetrates into the passenger compartment,
- the exit speed,
- if the terminal causes too high severity indices.

**Approach 2**, offset frontal impact, is meant to evaluate

- the effect of striking the terminal frontally, but offset to evaluate the yaw of the light vehicle,
- if any longitudinal element of the terminal penetrates into the passenger compartment,
- the exit speed,
- if the terminal causes too high severity indices.

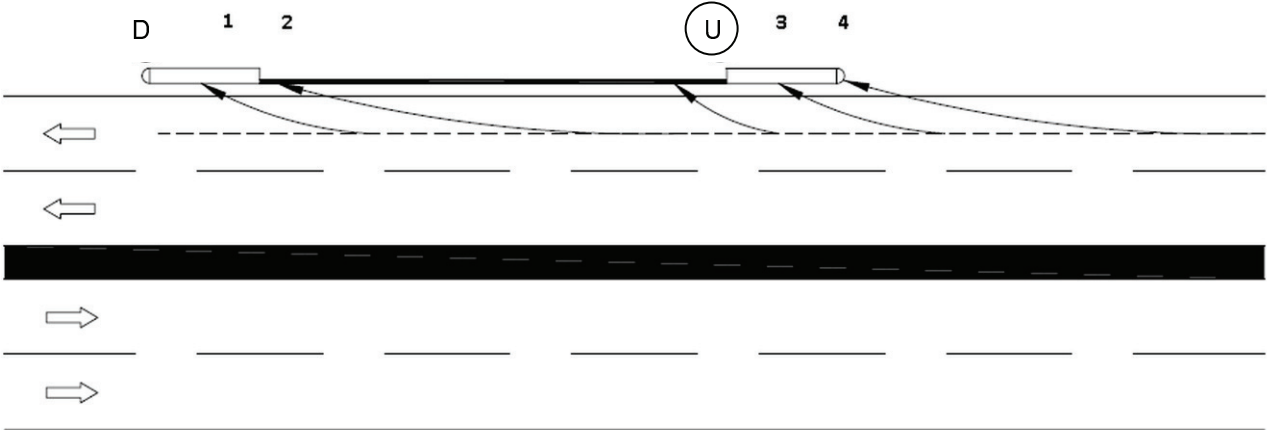
**Approach 3**, frontal angulated impact, represents the most probable impact angle and is performed with the heavier passenger vehicle.

It is also used to evaluate if the car loses contact to ground surface and what happens then.

**Approach 4**, side impact, is testing the side impact behaviour and is performed with the heavier passenger vehicle in the performance class to evaluate the possible danger of pocketing in the case of a stiff barrier and a weak terminal end.

**Approach 5**, inverse side impact, is testing the side impact behaviour in the reverse direction, taking account of possible lateral impacts on two ways roads. It is performed with the light passenger vehicle.

**Approach 6**, inverse side impact on the connected barrier, at the critical impact point located before the end part of the terminal (line R), is performed to evaluate possible danger of pocketing in case of weak barrier and stiff terminal end. It is performed with the heavier passenger vehicle in the performance class.



**Key**

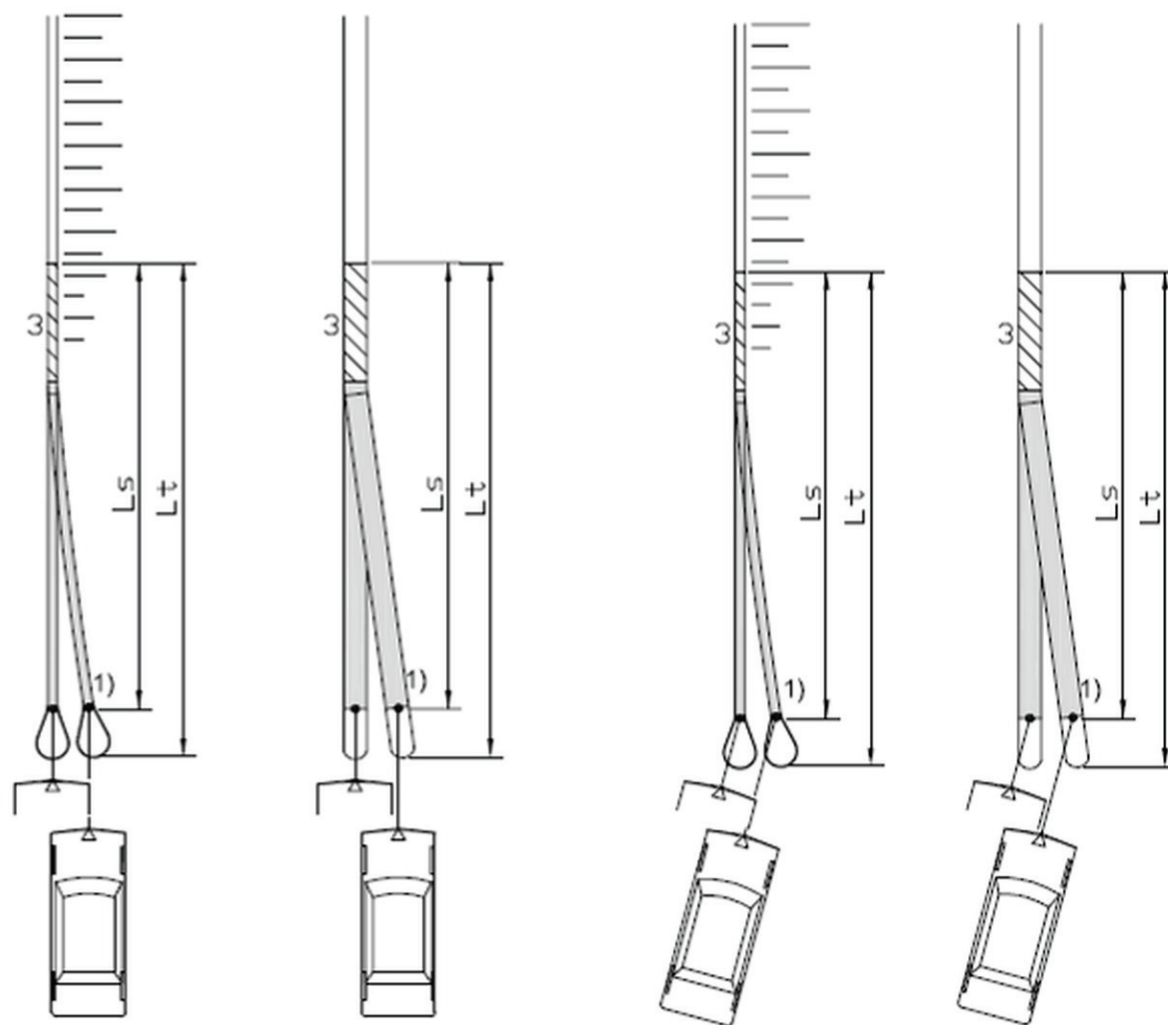
- 1 Approach 5
- 2 Approach 6
- 3 Approach 4
- 4 Approach 3

**Figure B.1 — Possible in-service approach directions**

The impact points for the different tests, as described in Table 1 and Figures 2 and 3 are dependent on the shape of the terminal.

In Figures B.2 to B.6, there are indications for different shapes and installation positions for all approaches.





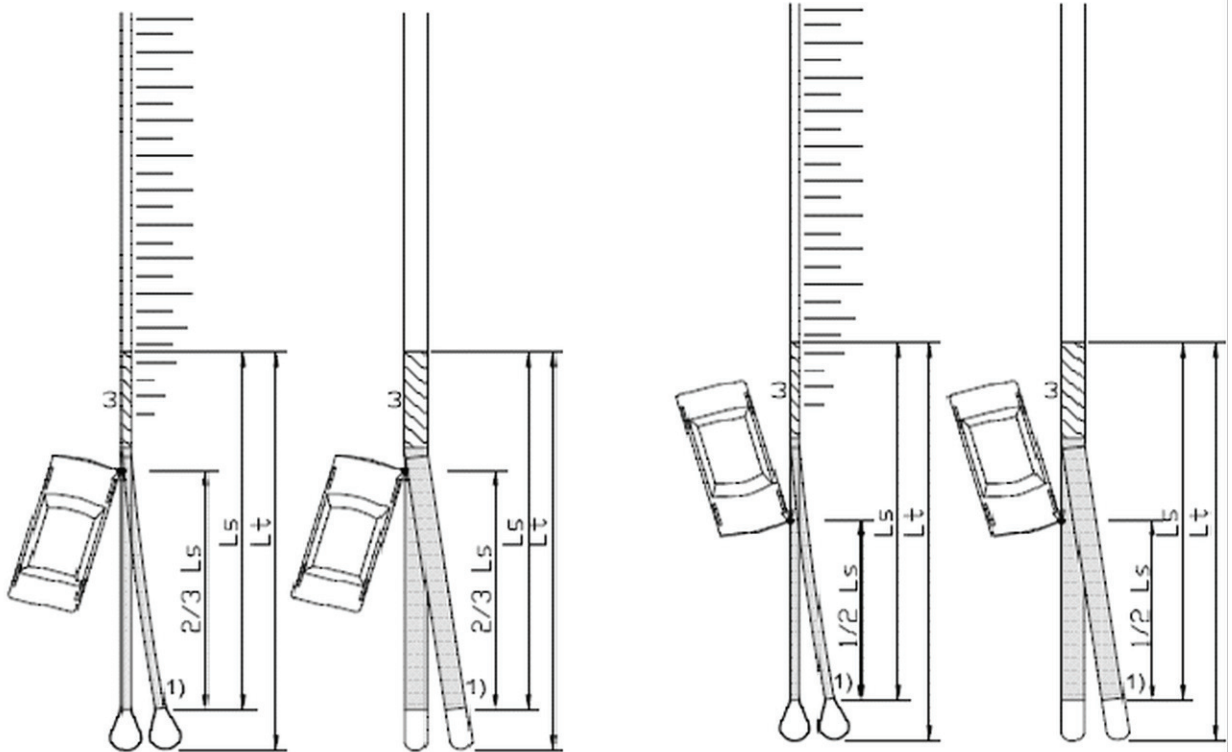
**a) Approach 1**  
with two alternative shapes

**b) Approach 3**  
with two alternative shapes

**Key**

- 1 impact point
- 3 connected barrier

**Figure B.2 — Impact point for flared end terminals (Approaches 1 and 3)**



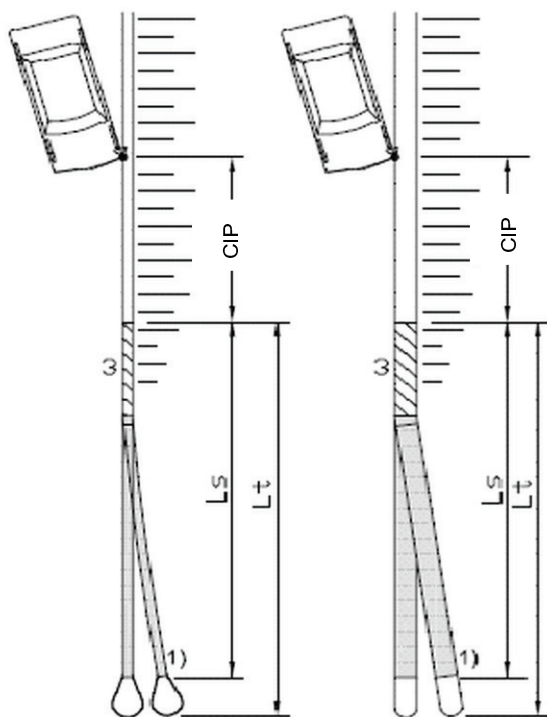
**a) Approach 4**  
with two alternative shapes

**b) Approach 5**  
with two alternative shapes

**Key**

- 1 impact point
- 3 connected barrier

**Figure B.3 — Impact point for flared end terminals (Approaches 4 and 5)**

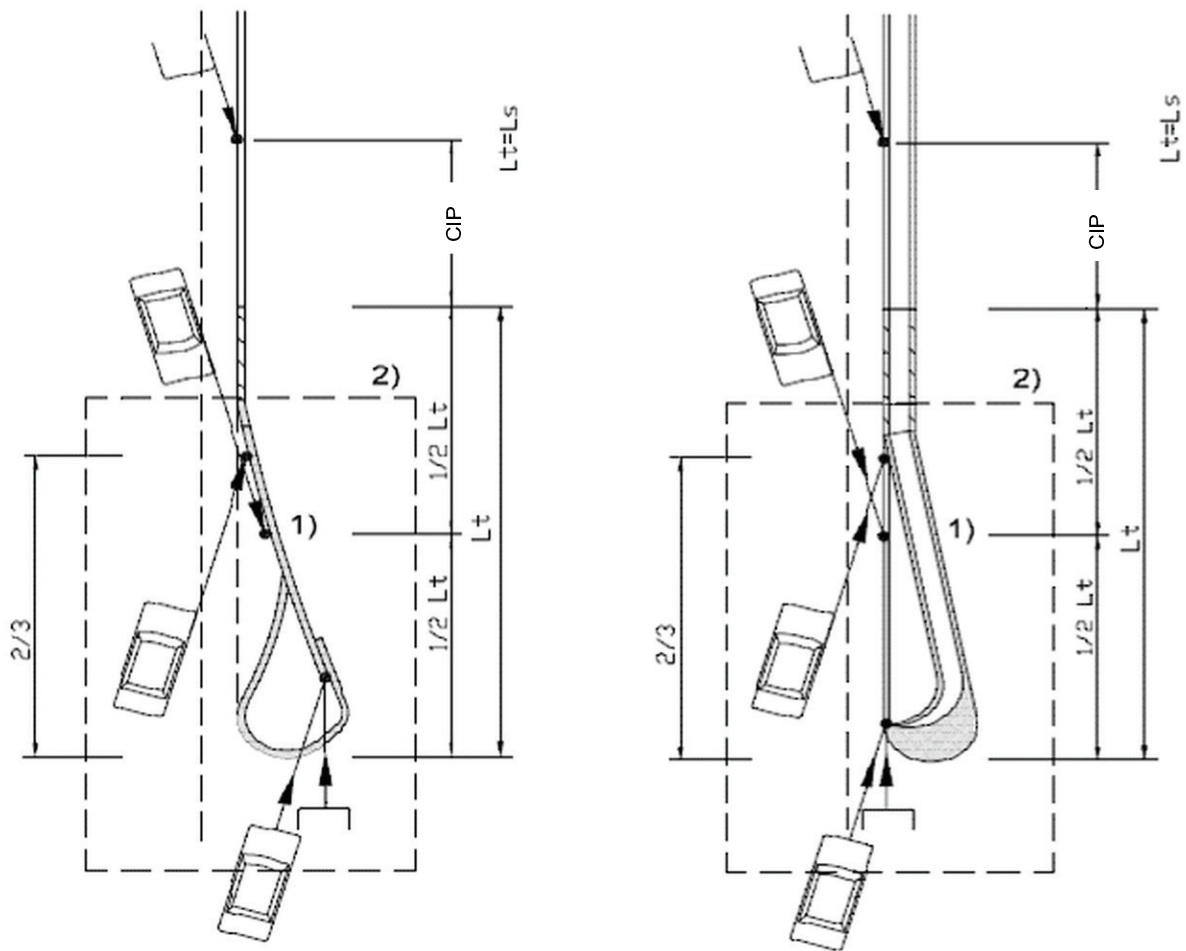


**Approach 6**  
with two alternative shapes

**Key**

- 1 impact point
- 3 connected barrier

**Figure B.4 — Impact point for flared end terminals (Approach 6)**



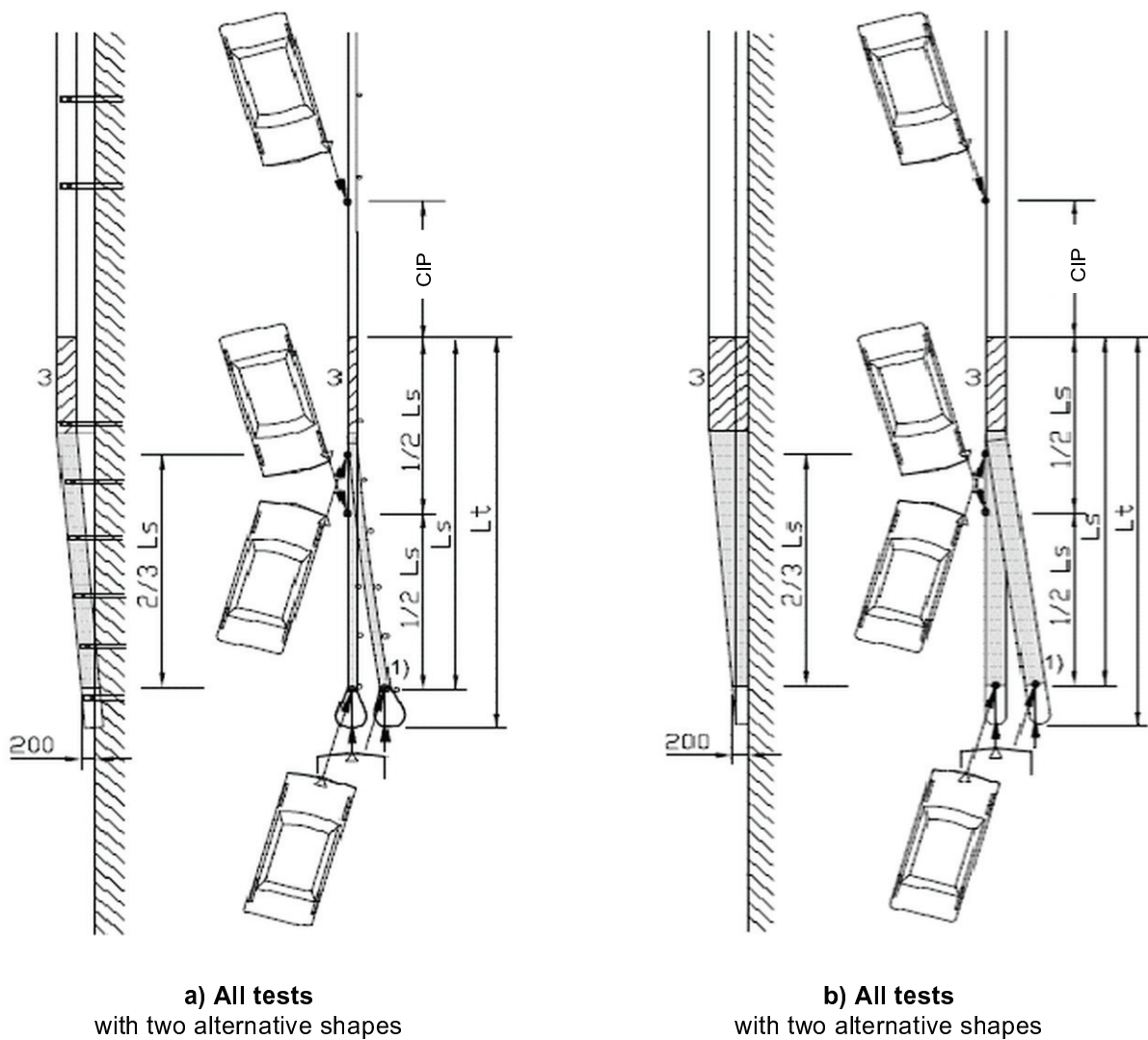
**a) All tests**  
with two alternative shapes

**b) All tests**  
with two alternative shapes

**Key**

- 1 impact point
- 2 connected barrier

**Figure B.5 — Impact point for flared end terminals (all tests)**



- Key**
- 1 impact point
  - 3 connected barrier

**Figure B.6 — Impact point for flared end terminals (all tests)**

## **Annex C**

### **(informative)**

### **Points to consider when selecting the Critical Impact Point for Terminals**

The following general points may be considered when determining the critical impact point. This list is not exhaustive.

- The view of the associated notified certification body.
- The structural, and total length of the terminal, and the location of the datum point.
- The results of computational mechanics completed on the terminal, if available.
- The deflection characteristics of the terminal and, if installed, connecting barrier.
- The influence of the connected systems on each other, with respect to deflection.
- The risk of affecting the:
  - Dynamic deflection and working width
  - Severity indices and vehicle damage (VCDI)
  - Containment capability
  - Product integrity
  - Vehicle exit box characteristics
- The location of any stiff elements and/or anchorages, and the risk of pocketing.
- The location of any weak elements (e.g. connections).
- The need to transmit forces into the terminal.
- Any changes in ground conditions.

## Bibliography

- [1] EN 1317-3<sup>3)</sup> *Road restraint systems – Part 3: Performance classes, impact test acceptance criteria and test methods for crash cushions*
- [2] prEN 1317-4<sup>4)</sup>, *Road restraint systems – Performance classes, impact test acceptance criteria and test methods for transitions*
- [3] prEN 1317-5:<sup>5)</sup>, *Road restraint systems — Part 5: Product requirements, test and assessment methods and acceptance criteria*

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3) An amendment to this EN 1317-3 is currently being elaborated in order to restructure this supporting standard to bring it into line with prEN 1317-5:\_\_

4) To be published.

5) To be published