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Transport Infrastructure Ireland

TII Publications

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Terminal Assessment Procedure

DN-REQ-03080

April 2017

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TII Publications



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1. Introduction

1.1 General

Terminals are an important and integral part of a Vehicle Restraint System (VRS) installation. Collision records from around the world have shown that improper terminal installation can have a significant impact on road user safety. Standardised full-scale impact testing is a robust method for assessing the level of safety provided by all VRS, including terminals. It is not practical to test every single scenario observed on the road therefore full-scale tests are used to evaluate the worst case scenario.

There is currently no harmonised European Standard for the testing and approval of terminals for use with VRS and therefore terminals are not a CE marked product. Transport Infrastructure Ireland (TII) has therefore implemented the testing requirements contained in the Draft standard prEN 1317-7:2014 Test methods for the terminals of safety barriers within DN-REQ-03034 Safety Barriers. To ensure that a standardised approach is applied to the evaluation of terminal arrangements proposed for use on the Irish national road network, TII has also established the Terminal Assessment Procedure outlined in this Standard. The assessment criteria presented in this Standard will ensure that a standardised and detailed quality assessment will be undertaken for each impact test carried out on a proposed terminal with the ultimate objective of improving the safety of road users.

Terminal systems deemed suitable for use on Irish national roads following assessment under this Standard will be added to the Compliant Terminal Systems list accessible through the Downloads section of the TII Publications website <http://tiipublications.ie/downloads/>.

1.2 Scope

The scope of this Standard covers all terminals of performance class T110 (P4) proposed for use on the Irish national road network.

The safety performance and testing requirements for terminals are based upon the principles contained in prEN 1317-7:2014 and are outlined in DN-REQ-03034. Further guidance and clarification is contained in this Standard. The assessment procedure is not intended to provide an “approval” or “refusal” of a proposed system. Assessments are carried out to check compliance against the requirements within DN-REQ-03034.

The assessment shall consist of an independent professional review of the test documentation provided by the supplier as per the requirements contained within this document. The supplier shall ensure that all documents provided are accurate and genuine.

Compliance with the requirements of this Standard shall not automatically approve a terminal for use with any type of barrier. Requirements regarding the use of a terminal with particular barrier systems are set out in DN-REQ-03034 and in Section 4.2 of this document. A terminal assessed in isolation may be unsuitable for use with certain types of barrier systems and approval for use with different system shall be sought from TII.

Terminals intended for use on two directional undivided roads will require the terminal to be tested to ‘Test Approach 6’ as detailed in prEN 1317-7:2014. The terminal system shall in this case be deemed to include the transition to the adjacent connecting barrier. The outcome of the assessment under this procedure, and the subsequent inclusion on the TII Compliant Terminal Systems list will be for the terminal system including the transition. The terminal and transition may be connected to barrier types other than that it was tested with subject to the requirements of Section 4.2. Where the terminal is to be used in conjunction with a different transition than that it was tested with, approval for use shall be sought from TII as per Section 4.2 of this Standard.

Compliance with the requirements of this Standard shall not indemnify the supplier against any claims in law. TII reserves the right to withdraw a system from the Compliant Terminal Systems list if there is evidence that the system performs in a different way from that shown in the Initial Type Test or for any other reason for which it sees fit.

1.3 Definitions

For the purpose of this Standard, the following terms defined in IS EN 1317-1 apply:

- a) Vehicle restraint system
- b) Safety barrier

The following terms defined in DN-REQ-03034 also apply:

- a) Hazard
- b) Dynamic Deflection

Particular terms used in this Standard are defined as follows:

- a) **Bi-directional terminal:** A terminal designed and tested to perform at both the approach and departure ends of a barrier.
- b) **Critical Impact Point:** An impact point identified to reasonably represent the worst case for testing.
- c) **Pocketing:** The effect where an errant vehicle pockets or snags at the connection point between a safety barrier and an end terminal due to the difference in dynamic deflection or stiffness between the two elements.
- d) **TII Compliant Terminal Systems:** A terminal system assessed as having undergone appropriate testing using the procedure outlined in this Standard which is approved for use on Irish national roads.
- e) **Terminal:** A 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. A terminal may include a length of connecting barrier if it is required as part of the working mechanisms of the terminal.
- f) **Transition:** A connection of two VRS of different designs and/or performances, may include the connection between a safety barrier and an end terminal.
- g) **Uni-directional approach terminal:** A terminal designed and tested to perform at the approach end of a safety barrier only.

2. Application Procedure

2.1 General

Applications for assessment shall be submitted to TII through the Departures from Standards website which can be accessed through the TII Publications website home page.

The following documents and media shall be submitted as a minimum for each impact test:

- Full test report in accordance with EN1317 Parts 1 and 4 or 7 as appropriate;
- High speed and real time videos of test coverage as specified in the relevant part of EN1317;
- Still photographs of complete installation before and after impact;
- Still photographs of vehicle before and after impact;
- Technical drawings of the test item and connected barrier including transition details;
- Confirmation letter from the test house which states that the test complies with the relevant requirements of EN1317;
- CE Certificate and declaration of performance to EN 1317-5 for the connected barrier; and
- Evidence of a suitable quality control system (Factory Production Control) equivalent to EN ISO 9001 and addresses the requirements of EN 1317-5 for the manufacture of the terminal.

The applicant shall complete and submit the Terminal Assessment Application Checklist provided in Appendix A of this document which is available for download through the Downloads section of the TII Publications website <http://tiipublications.ie/downloads/>.

No assessment will be undertaken until all documentation listed in the Terminal Assessment Application Checklist is submitted to TII.

2.2 Application Costs

There is no application charge to a supplier proposing a terminal system for an initial assessment under this procedure. Any subsequent applications for re-assessment of a terminal due to the system initially being deemed to not having undergone appropriate testing shall be subject to a cost at a rate to be set by TII.

2.3 Application Enquiries

Any enquiries regarding an application submitted under the TII Terminal Assessment Procedure with regard to a specific product shall be submitted to barriers@tii.ie.

3. Assessment Procedure

3.1 General

The assessment procedure shall commence once all required documents and media have been received by TII.

An independent professional review shall be undertaken of the documents submitted for each test completed on the terminal to assess the terminal's conformity with the safety performance and testing requirements set out in DN-REQ-03034.

The Individual Terminal Test Assessment Form, as shown in Appendix B, shall be used as a standard template of review and as a checklist for the minimum requirements of each individual impact test. Additional checks may be completed if it is felt necessary. TII may request further information from the applicant to support any further checks deemed necessary to complete the assessment.

3.2 Assessment Results

The findings of the independent review for each impact test shall be summarised in the "Terminal Assessment Summary", as shown in Appendix C of this document. The decision to include or not to include a proposed system on the Compliant Terminal Systems list shall be taken by TII based upon the findings of the independent review. The supplier of the system being assessed shall be informed of the assessment findings through a letter issued by TII.

Suppliers of terminal systems that are deemed to have not undergone appropriate testing based on the assessment of the test results and hence are not acceptable for use on the Irish national road network shall be informed of this with reasoning through a letter issued by TII. Any appeals made to TII on the findings of an assessment shall be treated as a new application for assessment and shall be priced and charged as such. This excludes minor changes and minor reviews where additional clarification material is provided by the applicant.

4. Testing & Performance Requirements for Terminals

The testing and performance requirements for terminals shall be as described in DN-REQ-03034, with reference to EN1317-1:2010, prEN 1317-7:2014 and ENV 1317-4:2002, with additional clarifications provided in this Section.

4.1 Test Installation

To achieve a direction class all impact tests shall be carried out on the same barrier installation type excluding frontal impact tests where a barrier may not be needed. This is especially important for side impact tests with Test Approaches 4 and 6 as outlined in prEN 1317-7:2014. The objective of these tests is to demonstrate the potential for pocketing; a direct result of a sudden change in stiffness at the connection between a terminal and connecting barrier.

4.2 Use with Other Barriers

Once a terminal is assessed as being compliant by TII it will be added to the TII Compliant Terminal Systems list, including details of the connecting barrier and associated transition. If the same terminal is proposed to be connected to barriers other than that which it was tested with i.e. a new transition and barrier, TII must be notified of the proposed new transition and connecting barrier details by email to barriers@tii.ie. Dependant on the details of the proposed transition and connecting barrier, TII will either add the new barrier connection to the TII Compliant Terminal System list or may request further information. A simulated crash test may be required using data from the initial type testing of the terminal and data obtained for the connecting safety barrier. A written report by a qualified designer setting out the evidence and/or methods used including the product specification, calculations and simulated test results compared to original values may be requested. Factors that may affect whether or not additional testing or simulations will be required when connecting to other barriers may include:

- a) the cross-section and material of the proposed transition and connecting barrier;
- b) the difference in dynamic deflection between the proposed transition and connecting barrier and those that were used in the initial type testing; or
- c) whether or not the terminal is proposed for use as a uni-directional approach terminal, a uni-directional departure terminal or a bi-directional terminal.

4.3 Critical Impact Point

The selection of the critical impact point should generally be carried out in accordance with the guidance provided in prEN 1317-7:2014. Further clarification is presented below to ensure the impact points are selected so as to achieve the objectives of the required tests.

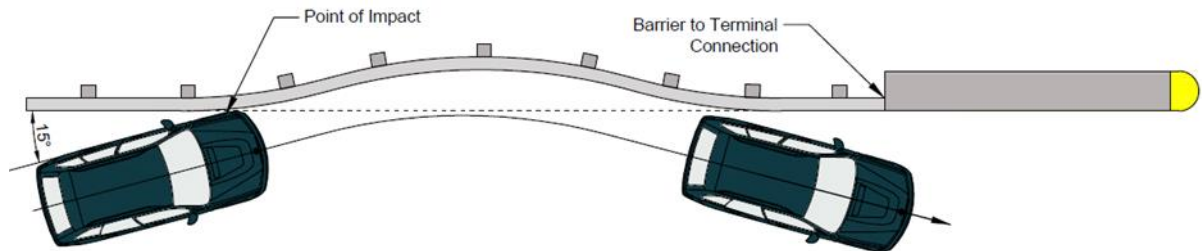
4.3.1 Test Approach 6

The aim of this test is to evaluate the danger of pocketing where there is a sudden change in stiffness between the connecting barrier and the terminal. It is important to choose an impact point which has the highest potential for pocketing. For semi-rigid VRS, this is generally 2 to 5 metres from the end of terminal dependant on the VRS specific details.

If the impact point is too far from the connection to the terminal the test vehicle may be redirected and leave the barrier prior to reaching and interacting with the terminal connection point, which is the area that has the highest potential for pocketing. This is demonstrated in Figure 4.1 where the main

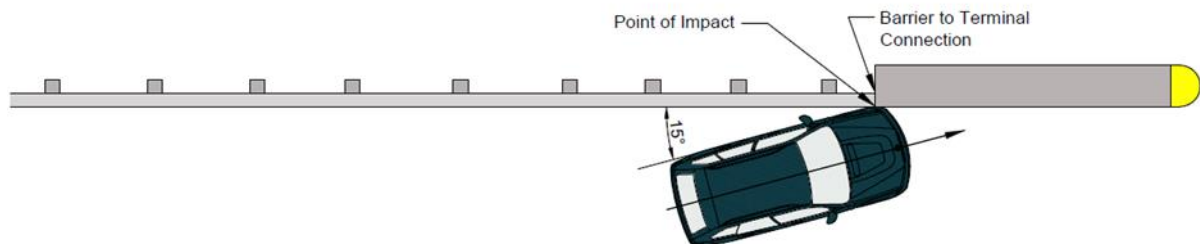
objective of the impact test is not fulfilled and it may not be deemed acceptable when assessed under the Terminal Assessment Procedure outlined in this Standard.

Figure 4.1: Example of test approach 6 with impact point too far away from the end of terminal



If the impact point chosen is too close to, or exactly at the terminal connection point, as illustrated in Figure 4.2, sufficient space may not be provided for the barrier to deflect and therefore potential pocketing to occur. In this scenario the main aim of the impact test is not fulfilled and it may not be deemed acceptable when assessed under the Terminal Assessment Procedure outlined in this Standard.

Figure 4.2: Example of approach number 6 test with impact point too close to the end of terminal

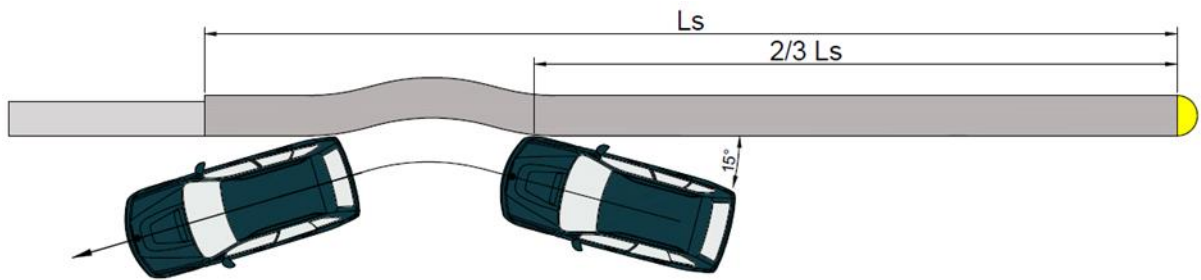


4.3.2 Test Approach 4

The aim of this test is to evaluate the side impact behaviour and possible danger of pocketing in cases where the barrier is stiffer than the terminal to which it is connected.

In rare cases a terminal may be long enough that the standard impact point of $2/3L_s$ (L_s = structural length of the terminal) may be too far away from the end of the barrier, as shown in Figure 4.3. In this scenario, the main aim of the impact test may not be fulfilled and it may not be deemed acceptable when assessed under the Terminal Assessment Procedure outlined in this Standard.

Figure 4.3: Example of approach number 4 with impact point too far away from the terminal



For both Test Approach 4 and Test Approach 6, if the critical impact point chosen is outside the guidance values outlined in this Section, the reasoning for this based on computational mechanics i.e. simulation must be included within the application submitted to TII for assessment.

5. References

5.1 TII Publications

DN-REQ-03034 Safety Barriers

5.2 Irish and European Standards

IS EN 1317-1: 2010 Road restraint systems - Part 1: Terminology and General Criteria for Test Methods

IS ENV 1317-4: 2001 Road Restraint Systems - Part 4: Performance Classes, Impact Test Acceptance Criteria and Test Methods for Terminals and Transitions

prEN 1317-7, Road Restraint Systems - Part 7: Performance Classes, Impact Test Acceptance Criteria and Test Methods for Terminals of Safety Barriers

Appendix A:

Terminal Assessment Application Checklist



TII Terminal Assessment Procedure

TERMINAL ASSESSMENT CHECKLIST			
Submission Date:		Contact Details:	
Manufacturer:			
Product Name:			

Documents and Multimedia to be Provided for Each Test*			
#	Item	Comment	Item Submitted (Y/N)
1	Full test report	In accordance with EN1317 Parts 1 & 4/7	
2	High speed & real time videos	Of test coverage as specified in relevant part of EN1317	
3	Still photographs	Of complete installation before and after impact	
4	Still photographs	Of Vehicle before and after impact	
5	Technical drawings	Of test item, transition and connected barrier	
6	Confirmation from test house	That the test complies with the relevant requirements of EN1317	
7	CE Certificate and declaration of performance for connected barrier	Showing performance parameters such as containment level, dynamic deflection, working width, impact severity level	
8	Evidence of a suitable quality control system	Factory production control system, which complies with EN ISO 9000 and addresses the requirements of EN 1317-5 for the manufacture of the terminal	

Tests Submitted				
#	Test Type	Test House	Test No	Comments
1				
2				
3				
4				
5				
6				

Submitted By:

Signature:

*All documents which are not English will have to be translated.

Appendix B:
Individual Terminal Test
Assessment Form



TII Terminal Assessment Procedure

TII - Individual Terminal Test Assessment Form
Submitted for Compliance with EN1317-1 and ENV1317-4:2001 or prEN1317-7:2014

1) General Information		
Assessment Date:		Contact Details:
Manufacturer:		
Product Name:		
Single or Double Sided:		
Impact TestType:		
Test Standard:		
Test House:		
Test Date:		Test No: <input type="text"/>
Photo of Product from Impact Test		

2) Details of the Barrier Tested With	
Manufacturer:	
Product Name:	
Product Description:	
Containment Level:	
Working Width:	
Dynamic Deflection:	
Impact Severity Level:	

3) Installation	
Terminal installed with sufficient length of barrier to demonstrate performance? (Y/N)	<input type="text"/>
Does installation match technical drawings provided? (Y/N)	<input type="text"/>
Is L ₂ determined? (Y/N) _ Value	<input type="text"/>
Is L ₁ determined? (Y/N) _ Value	<input type="text"/>
Is datum point justified? (Y/N) Value	<input type="text"/>

4) Test Site	
Is test lab accredited for EN1317? (Y/N)	<input type="text"/>
Is test area flat with gradient not exceeding 2.5%? (Y/N)	<input type="text"/>
Is test area clear of standing water, ice or snow? (Y/N)	<input type="text"/>
Enough space provided for demonstration of exit box characteristics? (Y/N)	<input type="text"/>



TII Terminal Assessment Procedure

5) Impact Point (IP) Location	
Impact Point Location:	
Is the IP as described in standard? (Y/N)	
Is justification provided if other IP is chosen? (Y/N/NA)	
Is IP representative of worst case scenario? (Y/N)	
Is IP identified in the report match the actual achieved in the test? (Y/N)	

6) Test Vehicle				
Is the test vehicle representative of current traffic in Europe? (Y/N)				
Are tyres inflated to manufacturers Specification? (Y/N)				
Is the test vehicle road worthy? (Y/N)				
	Target Value	Tolerance	Actual	Compliant? (Y/N)
Total Mass (kg):				
Test Inertial Mass (kg):				
Maximum Ballast (kg):				
ATD Mass (kg):				
Wheel Track (kg):				
CGX (m):				
CGY (m):				
CGZ_ Vehicle Mass (m):				

7) Impact Conditions				
	Target Value	Tolerance	Actual	Compliant? (Y/N)
Impact Speed (km/h):				
Impact Angle (°):				
Is combined tolerances within envelope? (Y/N)				
Does test footage match values shown in the report? (Y/N)				

8) Impact Severity		
ASI:	THIV:	Class:

9) Permanent Displacement		
D_a (m)	D_d (m)	PLD Class (x_a/y_a)
Any detached parts of terminal over 2kg included in classification? (Y/N/NA)		
Does test footage match values shown in the report? (Y/N)		

10) Exit Box		
Approach Side Z_a (m)	Departure Side Z_d (m)	Exit Box Class, Z_e
Does test footage match values shown in the report? (Y/N)		

11) Vehicle & Terminal Impact Behaviour	
Any parts of terminal penetrated passenger compartment? (Y/N)	
Deflection of / intrusion into passenger compartment? (Y/N)	
Did any principal longitudinal element of barrier or terminal break? (Y/N)	
Did test vehicle rolled over? (Y/N)	
Did test vehicle have excessive roll, yaw or pitch? (Y/N)	



TII Terminal Assessment Procedure

12) Verdict	
Is the test compliant with TII requirements? (Y/N)	
With following Notes to Consider:	

Assessed by:

Signature:

Appendix C: Technical Assessment Summary



TII Terminal Assessment Procedure

TERMINAL ASSESSMENT SUMMARY	
Date:	Contact Details:
Manufacturer:	
Product Name:	

Testing Programme				
#	Test Code	Test Report Reviewed (Y/N)	Test Compliant (Y/N)	Comments
1				
2				
3				
4				
5				
6				
Are all side impact tests* carried out with same connection with same barrier? (Y/N)				
Do technical drawings match every test installation? (Y/N)				

Performance Class:	
Direction Class:	
Single or Double Sided:	

Permitted Use in TII Network	
Speed of Road	Direction of Installation

Impact Severity Level (ISL)				
#	Test Code	ASI	THIV	Impact Severity Class (ISC) for Test
1				
2				
3				
4				
5				
6				
Impact Severity Class of Product:				

Permanent Lateral Displacement (PLD)				
#	Test Code	D _s (m)	D _d (m)	PLD Class (x _# y _#)
1				
2				
3				
4				
5				
6				
PLD Class of Product:				

* Tests with approach 4, 5 & 6



TII Terminal Assessment Procedure

Exit Box				
#	Test Code	Approach Side Z_a (m)	Departure Side Z_d (m)	Exit Box Class, Z_e
1				
2				
3				
4				
5				
6				
Exit Box Class of Product:				


Properties of Barrier Tested With	
Manufacturer:	
Product Name:	
Product Description:	
Containment Level:	
Working Width:	
Dynamic Deflection:	
Impact Severity Level:	

Photo(s) of Terminal

Assessed By:

Signature:



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