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Transition Assessment Procedure

DN-REQ-03081
September 2017

Withdrawn

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Transport Infrastructure Ireland (TII) is responsible for managing and improving the country's national road and light rail networks.

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TII Publications



Activity:	Design (DN)
Stream:	Road Equipment (REQ)
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**Updates to TII Publications resulting in changes to
Transition Assessment Procedure DN-REQ-03081**

Date: September 2017

Amendment Details:

This Standard supersedes DN-REQ-03081 dated April 2017. The principle changes from the previous standard are:

- a) Section 2.2 Application Procedure for Virtual Impact Tests has been updated to clarify “For each of the connected barriers a simulation of the full scale impact test of the heavier vehicle that barrier has been tested with shall be carried out”.
- b) Appendix B has been revised to include an updated Transition Assessment Application Checklist for Simulation Assessed Systems.
- c) A new Appendix D titled Transition Assessment Scoring Chart for Virtual Tests has been added.
- d) The Transition Assessment Summary is now Appendix E as a result of the introduction of the new Appendix D as outlined in c) above.

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1. Introduction

1.1 General

Transitions are an essential part of Vehicle Restraint System (VRS) installations where two systems of differing cross section or lateral stiffness are connected together. Collision records have shown that barrier connections without a proper transition pose potential risks such as vehicle pocketing, failure of connections, vehicle impalement, high impact severity or failure to contain the impacting vehicle; all of which have the potential to cause serious or fatal injuries to vehicle occupants. It is therefore essential to provide suitable transitions which are designed to eliminate these risks.

Standardised full-scale impact testing is a robust way of assessing the level of safety provided by VRS, including transitions. There are many possible combinations of connections between different types of barriers and parapets; most of which would require a unique transition arrangement. The length of installation for a transition is often much less than the standard installation length of a barrier. This can make it impractical for VRS manufacturers to undertake full scale impact testing for every possible transition. With the improvement of computing technologies and the experience gained over time, computational mechanics has shown to be a valuable, cost and time efficient alternative to full scale impact testing. Where virtual testing is used to simulate full scale crash testing, it is imperative that the virtual test is as close a representation as practical of the physical impact test.

There is currently no harmonised European Standard for the testing and approval of transitions and therefore transitions are not CE marked products. To ensure that a standardised approach is applied to the evaluation of transitions proposed for use on the Irish national road network, TII has established the Transition Assessment Procedure outlined in this Standard with the ultimate objective of ensuring an improved level of safety in this area. This procedure will ensure that an in depth quality assessment is undertaken of every physical or virtual impact test carried out on a transition using the standardised assessment criteria outlined in this Standard.

Transitions deemed suitable for use on Irish national roads following assessment under this Standard will be added to the Compliant Transitions 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 transitions proposed for use on the Irish national road network.

The safety performance and testing requirements for transitions are based upon the principles contained in EN 1317-1:2010, EN 1317-2:2010 and ENV 1317-4:2002 and are outlined in DN-REQ-03034. Further guidance and clarification is contained in this Standard.

The assessments are not intended to provide an “approval” or “refusal” of the system. They are carried out to check compliance against requirements within DN-REQ-03034.

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

Compliance with the requirements of this Standard shall not indemnify the supplier against any claims in law. TII reserves the right to withdraw the system from the Compliant Transition 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) **Critical Impact Point:** An impact point identified to reasonably represent the worst case for testing.
- b) **Pocketing:** The effect where an errant vehicle pockets or snags at the connection point between VRS of different cross section or lateral stiffness due to the difference in dynamic deflection or stiffness between the two elements.
- c) **TII Compliant Transitions:** A transition assessed as having undergone appropriate physical and/or virtual testing using the procedure outlined in this Standard which is approved for use on Irish national roads.
- d) **Transition:** A connection of two VRS of different designs and/or performances.

2. Application Procedure for Physical Impact Tests

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 of the connected barriers:

- Certificate of constancy of performance; and
- Technical drawings.

The following documents and media shall be submitted as a minimum for each impact test carried out with the transition:

- Full test report in accordance with EN 1317 Parts 1, 2 and ENV 1317 Part 4;
- High speed and real time videos of test coverage as specified in relevant part of EN 1317;
- Still photographs of complete installation before and after impact;
- Still photographs of vehicle before and after impact;
- Technical drawings of test item; and
- Confirmation letter from test house which states that the test complies with the relevant requirements of EN 1317.

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

No assessment will be carried out until all documentation listed in the Transition Assessment Application Checklist is submitted to TII.

2.2 Application Procedure for Virtual Impact Tests

The following documents and media shall be submitted as a minimum for each of the connected barriers:

- Certificate of constancy of performance;
- Technical drawings;
- Full test reports in accordance with EN 1317 Parts 1 and 2;
- High speed and real time videos of all physical impact test coverage connected barriers as specified in relevant part of EN 1317;
- Still photographs of complete installation before and after impact for each test; and
- Still photographs of vehicle before and after impact for each test.

For each of the connected barriers a simulation of the full scale impact test of the heavier vehicle that barrier has been tested with shall be carried out. These simulations shall provide accurate representations of the full scale impact tests and the resulting measurements shall be comparable. With particular reference to the simulations carried out, a formal technical report shall be submitted. This report shall include:

- Details of the model construction, barrier joint condition details at fixings;
- Close up views of the mesh density plus size details in the heavily loaded areas;
- Videos showing global performance and local deformation characteristics;
- Recorded bolt forces and comparison to installation data;
- Failure mechanism or localised buckling review and comparison;
- Energy balance showing Total, Kinetic, Sliding Interface, Internal and Hourglass Energies;
- Barrier material model data source and model implementation;
- Element types and integration points;
- Statement on the validation of the vehicles used for impact;
- Comparison measurements at key deformation points;
- Acceleration Severity Index (ASI), Theoretical Head Impact Velocity (THIV) and Exit box overlay and proof of validity; and
- Statement of rigid and deformable elements within the barrier and vehicle.

The following documents and media shall be submitted as a minimum for each virtual impact test carried out with the transition:

- Formal technical report detailing the model construction, transition joint condition details at fixings;
- Close up views of the mesh details around the impacted point;
- Videos showing global performance and local deformation characteristics;
- Recorded bolt forces and comparison to installation data;
- Energy balance showing Total, Kinetic, Sliding Interface, Internal and Hourglass Energies;
- Transition material model data source and model implementation;
- Element types and integration points; and
- Statement of rigid and deformable elements within the barrier and vehicle.

The applicant shall also complete and submit the Transition Assessment Checklist and Barrier Correlation Assessment Checklist for Virtual Impact Tests provided in Appendix B to this document which are available for download through the Downloads section of the TII Publications website <http://tiipublications.ie/downloads/>.

Assessments shall not be carried out until all documentation listed in the assessment application checklists contained in Appendix B has been submitted to TII.

2.3 Application Costs

There is no application charge to a supplier proposing a transition for an initial assessment under this procedure. Any subsequent applications for re-assessment of a transition 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.

2.4 Application Enquiries

Any enquiries regarding an application submitted under the TII Transition 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 a transition to assess the transitions conformity with the safety performance and testing requirements set out in DN-REQ-03034.

The Individual Transition Physical Test Assessment Form, as shown in Appendix C, shall be used as a standard template of review and a checklist for the minimum requirements of each individual physical impact test. The virtual tests will be assessed according to the minimum requirements identified in Section 2 of this Standard and a Virtual Test Assessment Report will be prepared to summarise the findings of the assessment. The scoring system used in the independent professional review has been included in Appendix D for clarity. 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 Transition Assessment Summary, as shown in Appendix E to this document.

The decision to include or not to include a proposed transition on the Compliant Transitions list shall be taken by TII based upon the findings of the independent review as outlined in the Transition Assessment Summary and Individual Transition Physical Test Assessment Forms or the Virtual Test Assessment Report. The supplier of the transition being assessed shall be informed of the assessment findings through a letter issued by TII.

Suppliers of transition 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 Transitions

The testing and performance requirements for transitions shall be as described in DN-REQ-03034, with reference to EN1317-1:2010, EN 1317-2:2010 and ENV 1317-4:2002, with additional clarifications provided in this section.

4.1 Impact Point

The Selection of the impact point should generally be carried out in accordance with the guidance provided in ENV 1317-4. Further clarification is presented below to ensure the impact points are selected so as to achieve the objectives of the required tests.

The impact point shall be taken as the point of intersection of a straight line parallel to the vehicle centreline, at the maximum width of the vehicle, with the traffic side of the transition, or the safety barrier, as shown in Figure 4.1. It shall not be taken as a projection of the centreline of the vehicle.

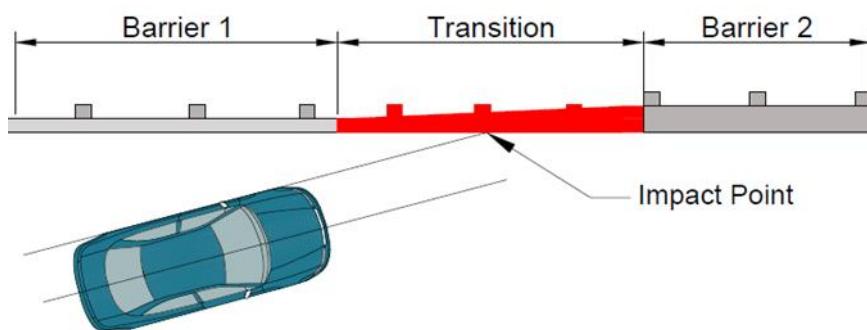


Figure 4.1 – Impact Point

4.1.1 Light Vehicle Test (TB11)

- i) The aim of this test is to evaluate the impact severity of the transition. It is important that the impact point chosen shall provide an acceptable representation of the highest possible severity which can occur during an impact.
- ii) This is generally located at or close to the connection with the stiffer barrier for most transitions. Based on this, the impact point should generally be at a distance of not less than $\frac{3}{4}$ of the length of the transition ($\frac{3}{4} L$) downstream of the start point of the transition and no more than 2m upstream from the end of the transition.
- iii) In the case of longer transitions, the $\frac{3}{4} L$ impact point may be too far away from the stiffest point of the transition, as demonstrated in Figure 4.2. In such circumstances, the main objective of the impact test is not fulfilled and it may not be deemed acceptable when assessed under the procedure outlined in this Standard.

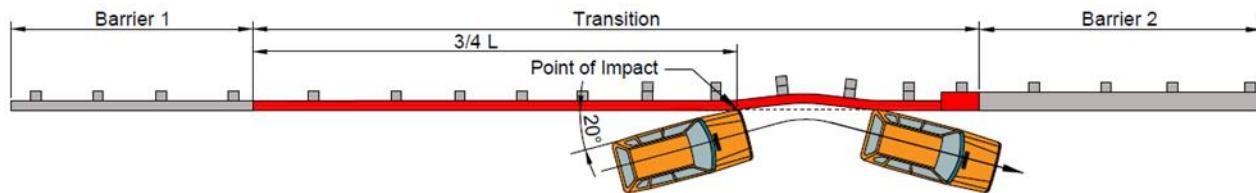


Figure 4.2 – Example of a TB11 test on a longer transition, where 3/4L Impact point is too far away from the stiffer barrier to show highest severity

- iv) In some cases a transition may be required between barriers of similar stiffness, due to difference in cross-section. This transition may be in the form of a short connection between two barriers. In such a scenario, the TB11 impact point should be on the connection piece, as demonstrated in Figure 4.3.

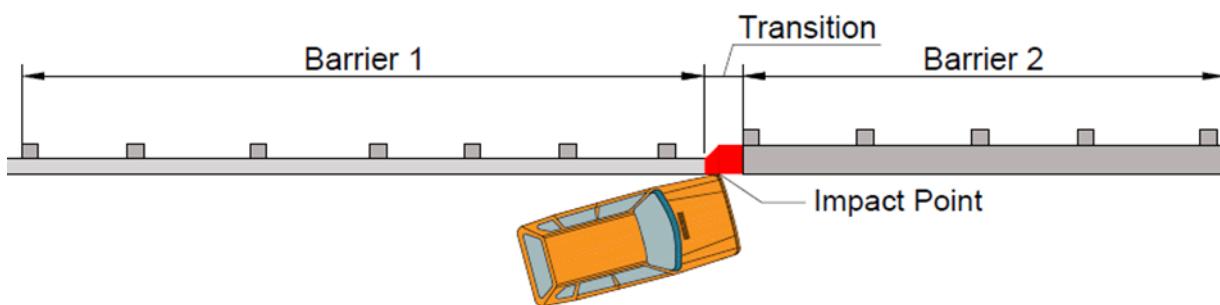


Figure 4.3 – Example of a TB11 test on a short transition

4.1.2 Containment Test (TB32 or higher)

- i) The aim of the test is to provide the highest impact momentum among tests specified and therefore evaluate the containment level of the transition and to identify any potential for pocketing. It is important to choose an impact point which gives the highest potential for pocketing.
- ii) Generally, an impact point of $\frac{1}{2}$ of the length of transition ($\frac{1}{2} L$) is recommended. However, as the transition gets longer, the mid-point gets further away from the end. In the case of a very long transition, a vehicle impacting the $\frac{1}{2} L$ point may be redirected before interacting with the area of highest concern in terms of pocketing. This is demonstrated in Figure 4.4. In such circumstances, the main objective of the impact test is not fulfilled and it may not be deemed acceptable when assessed under the procedure outlined in this Standard. In such cases the impact point should be positioned closer to the end of the transition. An acceptable impact point is generally 2 to 5 metres upstream from the end of transition for semi-rigid systems dependant on the VRS specific details.

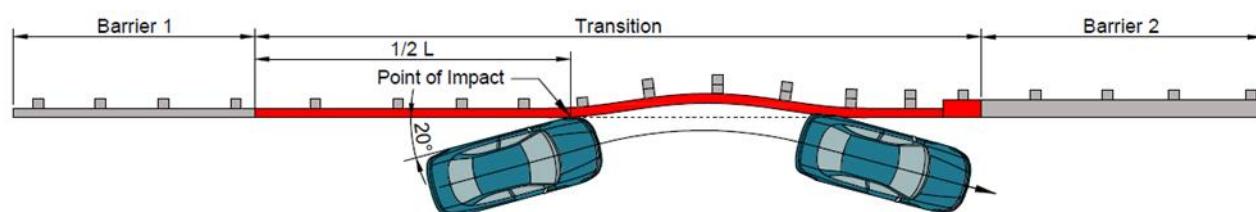


Figure 4.4 – Example of a TB32 test on a long transition, where half way impact point is too far away from the stiffer barrier to show potential pocketing

- iii) In some cases a transition may be required between barriers of similar stiffness, due to difference in cross-section. This transition may be in the form of a short connection between two barriers. This connection is likely to present the stiffest point in the system. In such a scenario, the containment test impact point should be positioned upstream of the connection as demonstrated in Figure 4.5. The objective of this impact position is to evaluate the potential for pocketing around the stiffer connection piece, as well as to evaluate the strength of the connection. An acceptable impact point is generally between 2 to 5 metres from the end of transition for semi-rigid systems dependent on the VRS specific details.

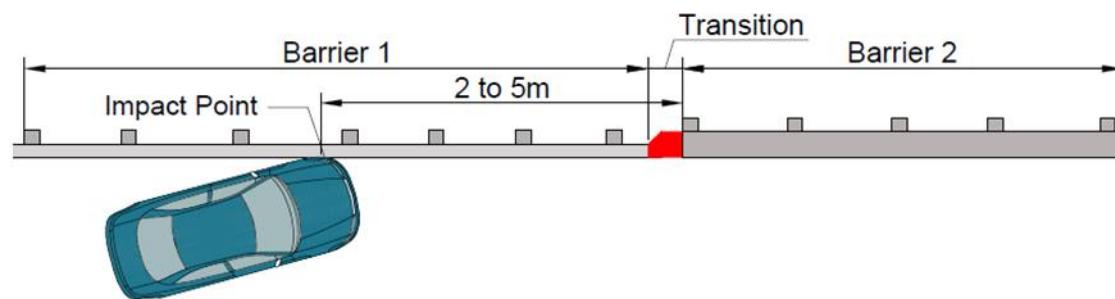


Figure 4.5 – Example of a TB32 test on a short transition

Appendix A:

Transition Assessment Application
Checklist for Physical Impact
Tests

TRANSITION ASSESSMENT CHECKLIST (FOR FULL SCALE TESTED SYSTEMS)			
Submission Date:	Click here to enter a date.		Contact Details:
Manufacturer:			
Product Name:			
Transition Between	Barrier 1		
	Barrier 2		

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, 2 & 4	Choose an item.
2	High speed & real time videos	Of test coverage as specified in relevant part of EN1317	Choose an item.
3	Still photographs	Of complete installation before and after impact	Choose an item.
4	Still photographs	Of Vehicle before and after impact	Choose an item.
5	Technical drawings	Of test item connected barrier	Choose an item.
6	Confirmation from test house	That the test complies with the relevant requirements of EN1317	Choose an item.
7	Certificate of constancy of performance for connected barriers	Showing performance parameters such as containment level, dynamic deflection, working width, impact severity level	Choose an item.

Tests Submitted				
#	Test Type	Test House	Test No	Comments
1				
2				
3				

Submitted By:

Signature:

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

Appendix B:

Transition Assessment Application
Checklists for Virtual Impact Tests

TRANSITION ASSESSMENT CHECKLIST FOR VIRTUAL IMPACT TESTS (FOR SIMULATION ASSESSED SYSTEMS)		
Submission Date:	Click here to enter a date.	
Manufacturer:		
Product Name:		
	Barrier 1:	
	Barrier 2:	

Documents and Multimedia to be Provided for Each Virtual Test*			
#	Item	Comment	Item Submitted (Y/N)
1.	Format Technical Report**	Report is to contain the following a) to e)	
a)	Evidence of Vehicle Model Quality		
i)	Vehicle model mesh	Images of vehicle mesh density local to contact areas	
ii)	TR 16303 vehicle-in-idle test	Stability of model under gravity load (CofG disp vs time or energy balance)	
iii)	TR 16303 vehicle suspension tests	Symmetric, asymmetric and single load tests to validate suspension kinematics	
iv)	TR 16303 vehicle steering tests	Linear and circular track test to verify steering behaviour	
v)	TR 16303 vehicle curb or step tests	Curb or step test to further demonstrate suspension and steering stability	
vi)	TR 16303 vehicle full scale tests	Rigid wall and deformable barrier vehicle tests for confirmation of model stability	
b)	Evidence of Vehicle Model Accuracy		
i)	Vehicle model mass, centre of gravity in X,Y,Z and wheel tracks	Comparison to EN1317 tolerance (and test vehicle if correlating to test data)	
c)	Evidence of Barrier AND Transition Model Accuracy		
i)	Energy balance plot	Plot must show added mass and total, internal, kinetic, hourglass and sliding interface energies	
ii)	Element Formulation	Element formulation (ELFORM) used for the shell and solid elements	
iii)	Number of Integration Points	Number of integration points (NIPs) used for the shell elements	
iv)	Boundary conditions	An overview of how the vehicle restraint system has been constrained	
v)	Mesh density	Images of barrier/transition mesh density and the element edge length range.	
vi)	Material Data	A summary of the material model and properties used for the deformable components.	
vii)	Impact speed and angle	Confirmation of the impact speed and angle used for each virtual test (and correlated to test where available)	

Documents and Multimedia to be Provided for Each Virtual Test*			
#	Item	Comment	Item Submitted (Y/N)
viii)	Software Version	Specify the version of the software used to simulate the virtual tests	
d)	Evidence of Barrier Model Accuracy		
i)	EN1317 standard result data	Table of the key VRS metrics recorded in simulation and their equivalent physical test values where available (e.g. working width, dynamic deflection, intrusion, THIV, ASI). Exit box overlay.	
ii)	Still image comparison	Side by side comparison of the virtual test stills versus the physical test (with accompanying time stamps, clearly showing point of separation between transition and vehicle).	
e)	Evidence of Transition Performance		
	Plastic strain plots	Plastic strain contour plot still images of areas of interest with reference to the specific failure strain for the respective material.	
	Bolt force data	Tensile and shear bolt force data with either bolt failure being modelled (and locations of failure being recorded with accompanying images) or calculated in post-processing e.g. effective stress. <u>The failure criteria used must be specified.</u>	
2.	Videos showing global performance and local deformation characteristics	Various view angles such as Front, Side, Rear, Top and ISO for review.	

Simulations Submitted				
#	Simulation Date	Supplier (if not Manufacturer)	Unique ID	Comments
1	Click here to enter a date.			
2	Click here to enter a date.			
3	Click here to enter a date.			

Submitted By:

Signature:

*The reader is referred to the simulation and modelling guidelines presented in TR 16303:2011

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

BARRIER CORRELATION ASSESSMENT CHECKLIST (FOR SIMULATION ASSESSED SYSTEMS)			
Submission Date:	Click here to enter a date.		Contact Details:
Manufacturer:			
Product Name:			
	Barrier 1:		
	Barrier 2:		

Documents and Multimedia to be Provided for Each Simulation*			
#	Item	Comment	Item Submitted for both barriers (Y/N)
1	Formal technical report	Including model construction details, vehicle positioning and close-up views of the mesh details	Choose an item.
2	Videos showing global performance and local deformation characteristics	Various view angles such as Front, Side, Rear, Top and ISO	Choose an item.
3	Recorded bolt forces and comparison to installation data	Time history files and effective stress calculation	Choose an item.
4	Failure mechanism or localised buckling review and comparison	Photos from Test and Still Images from Simulation	Choose an item.
5	Energy balance	Total, Kinetic, Sliding Interface, Internal and Hourglass Energies	Choose an item.
6	Barrier material model data source and model implementation	Curves of stress-vs-strain and conversion to model input	Choose an item.
7	Element types and integration points	With reference to the software version	Choose an item.
8	Statement on the validation of the vehicles used for simulation	Data showing correlation achieved to vehicle only test, other barrier test or assumptions made on performance.	Choose an item.
9	Comparison measurements at key deformation points	Matching points on Test and Simulation using the same measurement method.	Choose an item.
10	ASI, THIV and Exit box overlay and proof of validity	Still Image comparison.	Choose an item.
11	Statement of rigid and deformable elements within the barrier and vehicle	Visual layout	Choose an item.

Simulations Submitted				
#	Simulation Date	Supplier (if not Manufacturer)	Unique ID	Comments
1	Click here to enter a date.			
2	Click here to enter a date.			
3	Click here to enter a date.			

Submitted By:

Signature:

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

Appendix C:

Individual Transition Physical Test Assessment Form

Individual Transition Full Scale Impact Test Assessment Form
Submitted for Compliance with EN1317-1, 2 & 4

1) General Information		Contact Details:
Assessment Date:		
Manufacturer:		
Product Name:		
Between Barrier 1		
and Barrier 2		
Impact Test Type:		
Test Standard:		
Test House:		
Test Date:		Test No:
Photo of Product from Impact Test		

2) Properties of Barrier 1	
Manufacturer:	
Product Name:	
Containment Level:	
Normalised Working Width:	
Normalised Dynamic Deflection:	
Impact Severity Level:	
Vehicle Intrusion:	

3) Properties of Barrier 2	
Manufacturer:	
Product Name:	
Containment Level:	
Normalised Working Width:	
Normalised Dynamic Deflection:	
Impact Severity Level:	
Vehicle Intrusion:	

4) Installation	
Transition installed with sufficient length of barrier to demonstrate performance? (Y/N)	Choose an item.
Does installation match technical drawings provided? (Y/N)	Choose an item.

5) Test Site	
Is test lab accredited for EN1317? (Y/N)	Choose an item.
Is test area flat with gradient not exceeding 2.5%? (Y/N)	Choose an item.
Is test area clear of standing water, ice or snow? (Y/N)	Choose an item.
Enough space provided for demonstration of exit box characteristics? (Y/N)	Choose an item.

6) Impact Direction (ID)	
Impact Direction: from Barrier #:	to Barrier #:
Is ID as described in standard; i.e. from softer to stiffer barrier? (Y/N)	Choose an item.
Is justification provided if other ID is chosen? (Y/N/NA)	Choose an item.
Is ID representative of worst case scenario? (Y/N)	Choose an item.

7) Impact Point (IP)	
Impact Point Location:	Mid Point of Approach
Is IP as described in standard? (Y/N)	Choose an item.
Is justification provided if other IP is chosen? (Y/N/NA)	Choose an item.
Is IP representative of worst case scenario (based on TII requirements) Y/N?	Choose an item.
Is IP identified in the report match the actual achieved in the test? (Y/N)	Choose an item.

8) Test Vehicle	
Is the test vehicle representative of current traffic in Europe? (Y/N)	Choose an item.
Are tyres inflated to manufacturers Specification? (Y/N)	Choose an item.
Is the test vehicle road worthy? (Y/N)	Choose an item.

	Target Value	Tolerance	Actual	Compliant? (Y/N)
Total Mass (kg):				Choose an item.
Test Inertial Mass (kg):				Choose an item.
Maximum Ballast (kg):				Choose an item.
ATD Mass (kg):				Choose an item.
Wheel Track (kg):				Choose an item.
CGX (m):				Choose an item.
CGY (m):				Choose an item.
CGZ _ Vehicle Mass (m):				Choose an item.

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

10) Impact Severity		
ASI:	THIV:	Class:

11) Deflection Characteristics				
Normalised Dynamic Deflection (m)	Normalised Working Width (m)	Normalised Working Width Class	Normalised Vehicle Intrusion (m)	Normalised Vehicle Intrusion Class
Does test footage match values shown in the report? (Y/N)				Choose an item.

12) Exit Box	
Exit Box Width (A+16% of veh. Length)	Exit Box Length (B)
Did test vehicle stayed within vehicle exit box ? (Y/N)	Choose an item.

13) Vehicle & Transition Impact Behaviour	
No parts of transition or connected barriers penetrated passenger compartment? (Y/N)	Choose an item.
Deflection of / intrusion into passenger compartment? (Y/N)	Choose an item.
No principal longitudinal element of transition or connected barriers break? (Y/N)	Choose an item.
No more than one of the wheels of vehicle completely passed over or under the transition ? (Y/N)	Choose an item.
Test vehicle did not roll over? (Y/N)	Choose an item.
Test vehicle did not have excessive roll, yaw or pitch? (Y/N)	Choose an item.
If tested with an HGV or Bus, no more than 5% of the mass of ballast became detached or split during the test up to the time when the wheel tracks of the vehicle left the exit box? (Y/N/NA)	Choose an item.

14) Verdict	
Is the test compliant with TII requirements? (Y/N)	Choose an item.
With following Notes to Consider:	
Items of High Importance:	
Items of Medium Importance:	
Items of Low Importance:	

Assessed by:

Signature:

Appendix D:

Transition Assessment Scoring Chart for Virtual Tests

Virtual Test Scoring System				
VEHICLE				
Model Quality				
Test Category	Sub-category	Measurand	(Max Point Score)	Score Awarded
Mesh	Density Level	Evidence of frontal mesh refinement	1	
Vehicle-in-idle	Vehicle-in-idle test	Stability (CofG Z disp vs time or energy balance)	1	
Suspension	Symmetric	Proof of symmetric load kinematics/capability	1	
	Asymmetric	Proof of asymmetric load kinematics/capability	1	
	Single	Proof of single load kinematics/capability	1	
Steering	Linear	Deviation of less than 1% of covered length	1	
	Circular	Rear axle follows front with minimal slippage	1	
Curb	Curb	No undue wheel 'jump' in wheel Z disp plots	1	
Full Scale Test	Full Width Rigid Wall	To EN1317 tolerance and total energy conserved	1	
	Offset Wall or Barrier	To EN1317 tolerance and total energy conserved	1	
SUBTOTAL			/10	0
Model Accuracy				
Test Category	Sub-category	Measurand	(Max Point Score)	Score Awarded
Model Mass	Model Data	To within EN1317 tolerance standard	2	
Model CofG X	Model Data	To within EN1317 tolerance standard	2	
Model CofG Y	Model Data	To within EN1317 tolerance standard	2	
Model CofG Z	Model Data	To within EN1317 tolerance standard	2	
Model Tracks	Model Data	Front and rear within EN1317 tolerance standard	2	
SUBTOTAL			/10	0

BARRIERS			
Model Quality			
Test Category	Sub-category	Measurand	(Max Point Score)
Mesh Density Level	Mesh	Mesh density range 6 - 10 mm	1
Energy Balance		Total energy variation < 10 %	1
		Hourglass energy < 5%	1
		Added mass < 5% of total model mass	1
		No negative sliding interface energy	1
Element Formulation	Shell Elements	If not fully integrated and has hourglass energy	0
		If not fully integrated and no hourglass energy	0.5
		If fully integrated	1
	Solid Elements	If not fully integrated and has hourglass energy	0
		If not fully integrated and no hourglass energy	0.5
		If fully integrated	1
Number of Int Points	Shell Elements	NIP < 3	0
		3 ≤ NIP < 5	0.5
		NIP = 5	1
Impact Speed	Test Setup	To within EN1317 tolerance standard	1
Impact Angle	Test Setup	To within EN1317 tolerance standard	1
SUBTOTAL			/10
			0

Model Accuracy – Barrier 1			
Avg VRS Metric Error Lower Limit	Avg VRS Metric Error Upper Limit	(Max Point Score)	Score Awarded
0%	5%	5	
5%	7.50%	4.5	
7.50%	10%	4	
10%	12.50%	3.5	
12.50%	15%	3	
15%	20%	2.5	
20%	25%	2	
25%	30%	1.5	
30%	40%	1	
40%	50%	0.5	
50%	100%	0	
SUBTOTAL			/5
			0

Model Accuracy – Barrier 2			
Avg VRS Metric Error Lower Limit	Avg VRS Metric Error Upper Limit	(Max Point Score)	Score Awarded
0%	5%	5	
5%	7.50%	4.5	
7.50%	10%	4	
10%	12.50%	3.5	
12.50%	15%	3	
15%	20%	2.5	
20%	25%	2	
25%	30%	1.5	
30%	40%	1	
40%	50%	0.5	
50%	100%	0	
SUBTOTAL			/5
			0

TRANSITION				
Model Quality				
Test Category	Sub-category	Measurand	(Max Point Score)	Score Awarded
Mesh Density Level	Mesh	Mesh density range 6 - 10 mm	1	
Energy Balance		Total energy variation < 10 %	1	
		Hourglass energy < 5%	1	
		Added mass < 5% of total model mass	1	
		No negative sliding interface energy	1	
Element Formulation	Shell Elements	If not fully integrated and has hourglass energy	0	
		If not fully integrated and no hourglass energy	0.5	
		If fully integrated	1	
	Solid Elements	If not fully integrated and has hourglass energy	0	
		If not fully integrated and no hourglass energy	0.5	
		If fully integrated	1	
Number of Int Points	Shell Elements	NIP > 3	0	
		3 ≤ NIP < 5	0.5	
		NIP = 5	1	
Impact Speed	Test Setup	To within EN1317 tolerance standard	1	
Impact Angle	Test Setup	To within EN1317 tolerance standard	1	
SUBTOTAL			/10	0
Model Accuracy				
Max VRS Metric Error Lower Limit	Max VRS Metric Error Upper Limit	(Max Point Score)	Score Awarded	
NOT APPLICABLE				
TOTAL – (PREDICTIVE CAPABILITY INDICATOR)			/50	0

PERFORMANCE MODIFIERS			
Assessment of failure due to plastic strain in transition or barrier components	Reasoning:	-5	
Assessment of bolt failure (either in model – thus locations recorded, or via post processing calculations)	Reasoning:	-5	
OVERALL TRANSITION PERFORMANCE SCORE		/50	0

Appendix E:

Transition Assessment Summary for Physical Tests

TRANSITION ASSESSMENT SUMMARY FOR PHYSICAL TESTS		
Date:	Click here to enter a date.	Contact Details:
Manufacturer:		
Product Name:		
Transition Between	Barrier 1:	
	Barrier 2:	

Photo(s) of Transition

Testing Programme				
#	Test Code	Test Report Reviewed (Y/N)	Test Compliant (Y/N)	Comments
1		Choose an item.	Choose an item.	
2		Choose an item.	Choose an item.	
3		Choose an item.	Choose an item.	

Properties of Barrier 1	
Manufacturer:	
Product Name:	
Containment Level:	
Normalised Working Width:	
Normalised Dynamic Deflection:	
Impact Severity Level:	
Vehicle Intrusion:	
Is permission received from manufacturer of Barrier 1? (Y/N/NA)	Choose an item.

Properties of Barrier 2	
Manufacturer:	
Product Name:	
Containment Level:	
Normalised Working Width:	
Normalised Dynamic Deflection:	
Impact Severity Level:	
Vehicle Intrusion:	
Is permission received from manufacturer of Barrier 2? (Y/N/NA)	Choose an item.

Containment Level	
Containment Level:	
Is Containment Level of transition higher than or equal to lower Containment Level of connected barriers? (Y/N)	Choose an item.

Permitted Use in TII Network	
Speed of Road (km/h):	

Impact Severity Level				
#	Test Code	ASI	THIV	Impact Severity Class for Test
1				
2				
3				
Impact Severity Class of Transition:				

Deflection Characteristics					
#	Test Code	Normalised Dynamic Deflection (m)	Normalised Working Width (m)	Normalised Working Width Class	Normalised Vehicle Intrusion Class
1					
2					
3					
Transition:					
Is DD of transition smaller than largest DD of Barriers? (Y/N)					Choose an item.

Assessed By: _____ Signature: _____

Summary	
Is the product compliant with TII requirements? (Y/N)	Choose an item.
With following Notes to Consider:	
Items of High Importance:	
Items of Medium Importance:	
Items of Low Importance:	



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