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Test report

12.TR.034/DJ

F120901
20° - 100 km/h Sign post test according to EN 12767:2007

Date	14 March 2012
Author	D. Jansen
Client	Impact Recovery Systems, Inc. 4955 Stout Drive San Antonio Texas, 78219 USA
Approved by Senior testleader	H. Tavenier
Also seen by General manager	K.K. Pahnke
Test date	27 February 2012
Number of pages Number of appendices	12 6

The quality system of TTAI conforms to ISO 17025

Abstract

A 20° - 100 km/h frontal sign post impact test was carried out on a Impact Recovery Systems sign post type Metro Bollard with a Suzuki Swift, according to the EN 12767:2007 test protocol.

The length of the sign post was 0.965 m. The base of the column was mounted on a levelled surface of concrete. The foundation was rigid.
The vehicle was equipped with a Hybrid III 50 percentile ballast dummy, positioned in the driver seat. This dummy was restrained by a 3-point safety belt.

The test took place on 27 February 2012 at TÜV Rheinland TNO Automotive International B.V. in Helmond and was carried out by the technical services of this lab.

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1 Introduction

1.1 Test item

A 20° - 100 km/h frontal sign post impact test according to the EN 12767:2007 test protocol.

1.2 Test object

See Table 1 for a description of the test object.

Table 1: Test object

Object	Metro Bollard
Manufacturer	Impact Recovery Systems
Sign post receive date at TTAI	20 February 2012
Sign post type	Metro Bollard
Height above ground level	0.965 m
Width of sign post	350 mm
Depth of sign post	82 mm
Metro bollard base (L x W)	203 x 203 mm
Sign post	4.3 kg
Sign post centre of gravity	370 mm above ground level
Foundation type	Rigid (Concrete)
Dimension concrete (L x W x H)	2000 x 2000 x 140 mm
Concrete weight	1300 kg

See Appendix C for a design drawing of the sign post.

1.3 Objective of the test

The objective of the test was to evaluate the behaviour of the sign post type: Metro Bollard , manufactured by Impact Recovery Systems, during a 20° frontal impact with a test vehicle.

1.4 Date and place of the test

The test took place on 27 February 2012 at TÜV Rheinland TNO Automotive International B.V. in Helmond and was carried out by the technical services of TÜV Rheinland TNO Automotive International B.V.
The test was witnessed by Mr. G. Wolters of Panache b.v.b.a.

2 Test set-up

2.1 Specifications

At the crash facility, the sign post was installed outside and mounted on a levelled surface of concrete. The backfill type was rigid, type R conform Annex A of EN 12767:2007.

The vehicle was inspected and the preparation was completed by:
- removing spare wheel, tools and carpet from the boot;
- mounting a transducer bracket in front of and behind the gear shift on the tunnel;
- mounting a holding device for the measurement system in the boot;
- installing sensors at the centre of gravity and measurement equipment;
- weighing and ballasting of the vehicle.

See Table 2 for the vehicle test weight and Table 3 for the vehicle centre of gravity location.

Table 2: Vehicle weight

Test number		As delivered weight, measured	Inertial weight, (without dummy)	Test weight, measured	Test weight, required
	Total	692.0 kg	822.0 kg	904.0 kg	(900 ± 40 kg)
F120901	Front axle	429.5 kg	487.5 kg	531.0 kg	-
100 km/h	Rear axle	262.5 kg	334.5 kg	373.0 kg	-

See figure 1 for ballast, positions and mass.
To achieve the requested inertial weight of 825 kg ± 40 kg. The ballast of lead plates were fixed on the following locations:
- Location 1, 0 kg;
- Location 2, 10 kg;
- Location 3, 70 kg;
- Location 4, 10 kg.

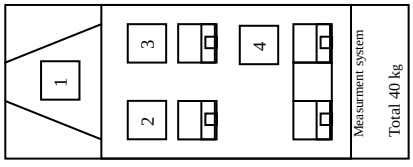


Figure 1: Ballast, positions and mass

Table 3:Vehicle centre of gravity location

Test number	Location	Measured without dummy	Required
	COG longitudinal behind front axle	0.92 m	0.90 ± 0.09 m
F120901	COG lateral from centre line	0.03 m	0.00 ± 0.07 m
100 km/h	COG vertical from ground level	0.53 m	0.49 ± 0.05 m

2.2 Test vehicle

A Suzuki Swift was used in the test. See Table 4 for the test vehicle specifications. The vehicle type was tested according to the calibration described in paragraph 6.2.2 of the EN 12767:2007 and found to be usable for frontal crash tests on support structures. See Appendix B for the vehicle type calibration.

Table 4: Test vehicle

Manufacturer	Suzuki
Vehicle type	Swift
Year of production	1992
Vin number	JSAEAA35S00152156
TTAI test number	F120901
Engine	4 cylinder petrol
Transmission	Manual, 5 gear
Steering	LH drive
Width	1590 mm
Track width (frontal)	1365 mm
Length	3710 mm
Height	1350 mm
Frontal overhang	756 mm
Wheel base	2265 mm
Rear overhang	677 mm
Restraint system	Driver: 3-point safety belt
Remarks	None

See the summary of test-conditions in Appendix A and the photographs on the data pack.

2.3 Vehicle equipment

A Hybrid III 50 percentile ballast dummy was placed in the driver position. This dummy was restrained by a 3-point safety belt.

2.4 Electronic measurements

The data acquisition techniques applied are in accordance with ISO 6487:2000 and SAE J211/1 July 2007. More transducer information is presented on the data pack.

2.5 Vehicle instrumentation

Tri-axial accelerometers were mounted on the following locations:
- In front of the centre of gravity on the tunnel;
- Behind the centre of gravity on the tunnel.

In addition a tri-axial gyro sensor was mounted at the centre of gravity on the tunnel.

2.6 Test set-up

The alignment of the vehicle and the sign post was such that the longitudinal vertical median plane of the sign post and the vehicle coincide with each other. The slow down distance beyond the impact point is approximately 45 m of which the first 16 m is a hardened and levelled surface. The last 29 m consists of a gravelled path to slow down the vehicle.

2.7 Video and photo documentation

A total of 3 high speed video cameras, running at a speed of 250 frames per second and 1 high speed video camera, running at a speed of 1000 frames per second, were positioned to provide the following views:
- LHS; side view perpendicular on vehicle trajectory from about 3 m before to 5 m after impact point;
- LHS; side view perpendicular on vehicle trajectory from about 2 m before to 13 m after impact point;
- LHS; one camera at 12 m after the impact point, to measure the exit speed of the vehicle;
- LHS; one camera tracking the vehicle during it’s motion.

The camera data and positions are presented on the data pack.

Before and after the test, various still-photos were made. The results are presented on the data pack.

3 Test results

3.1 Ambient conditions

Ambient temperature : 6.2 °C outdoors, at impact point.
Relative humidity : 83.1 % outdoors, at impact point.

3.2 Vehicle velocity

Required impact speed	: 100 ± 5	km/h
Measured impact speed	: 97.9	km/h
Measured exit speed		
12 m beyond impact point	: 96.8	km/h (measured from the high speed video)
Adjusted exit speed	: 98.9	km/h

3.3 Deviation of impact alignment

Lateral: : 70 mm left from target. (more to co-driver side)

The tolerance defined in the EN 12767:2007 protocol is ± 100 mm.

3.4 General description of test sequence

The vehicle crashed into the sign post. The sign post pivoted just above the base. The base sheared and detached from the levelled concrete. The sign post with base got stuck under the test vehicle and was dragged until 26 m beyond the impact point. The vehicle slowed down after 43 meter beyond the impact point.

3.5 General performances

General performance of the 100 km/h frontal sign post impact test:

- To measure the impact velocity of the vehicle, a speed measurement system was placed 1.5 meter before impact point.
- The front bumper of the vehicle was slightly deformed by the sign post. For further information about roof deformations see appendix D. The films and photographs are presented on the data pack.
- The distance from the impact point to the vehicle end position was after the test approximately 43 m beyond the impact location.

The predicted behaviour of the sign post by de manufacturer was:
“The vehicle catch on the bollard, it is expected to shear safely at either the base or pivoting spring assembly.”

3.6 Occupant risk

Acceleration severity index, ASI :**0.1**
Theoretical Head Impact velocity, THIV :**0 km/h**
Time of flight :**0 ms**
The ASI and THIV graphs are presented in Appendix E.

3.7 Basic requirements

§ 5.2.1: The test item **did** behave in a manner predicted by the manufacturer. (see high speed video on the data pack)

§ 5.2.2.1: The test item or detached elements **did not** penetrate the occupant compartment. The windscreen **was not** fractured and **not** penetrated. (See Appendix F and the data pack for the locations of the detached test elements after the test)

§ 5.2.2.2: The vehicle **did** remain upright for not less than 12 meters beyond the impact point with a roll and pitch angle of less than 45°.

3.8 Additional requirements

Not Applicable.

3.9 Additional restriction

Not Applicable.

3.10 Static deformation results

The results of the roof deformation measurements are presented in Appendix D.

3.11 High speed video results

The results of the high speed video recordings are presented on the data pack.
Concerning these results:

- no remarks

3.12 Electronic measurement results

The results of the electronic measurements are presented on the data pack.
Concerning these results:

- no remarks

4 General statements

The test results in this report relate only to the items as tested. Other impact conditions may give different results. Restrictions to the installation may be given in paragraph 3.8 and 3.9 of this report.

5 Approval of report

Date : 14 March 2012

Name : D. Jansen

Signature : 

Job title : Test Engineer

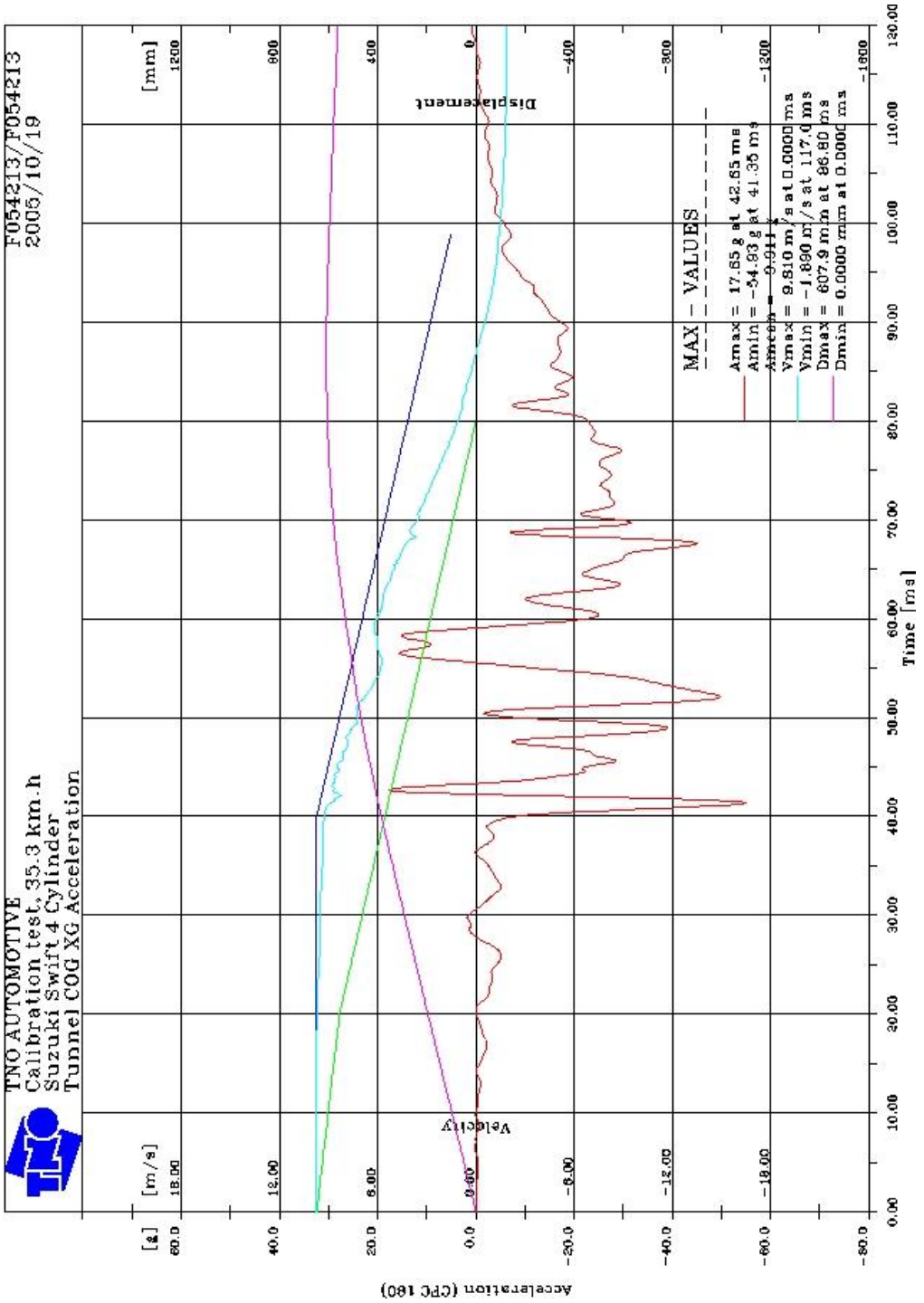
Appendix A Summary of test-conditions

Table A.1: Test information

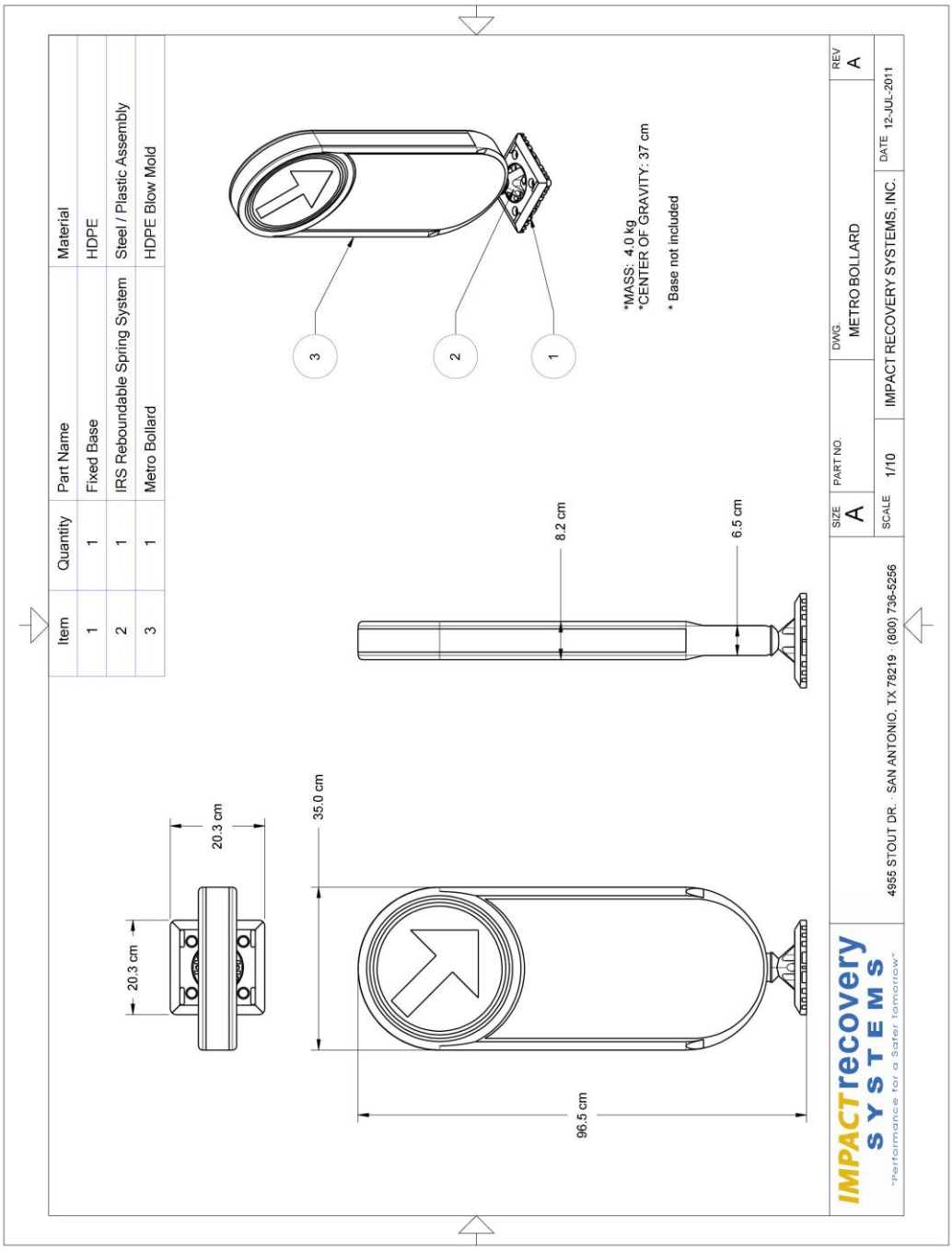
TTAI test number		F120901	
TTAI test engineer		D. Jansen	
Client test engineer		Mr. G. Wolters of Panache b.v.b.a.	
Test date		27 February 2012	
Sign post type		Metro Bollard	
Height above ground level		0.965 m	
Width of sign post		350 mm	
Depth of sign post		82 mm	
Metro Bollard base (L x W)		203 x 203 mm	
Test vehicle		Suzuki Swift	
Steering		LH drive	
Engine		4 cylinder petrol	
Transmission		Manual, 5 gear	
Tyre size		155/70 R13	
Tyre pressure		2.2 bar front, 2.2 bar rear	
Test weight required		900 $\pm$ 40 kg	
Driver dummy identification		Hybrid III 50th percentile ballast dummy	
Restraint system		Driver: 3-point safety belt	
Photographic coverage		4 high speed video cameras	
No. of data channels		9	
Impact speed	required	100 $\pm$ 5	km/h
	measured	97.9	km/h

Appendix B Calibration tests

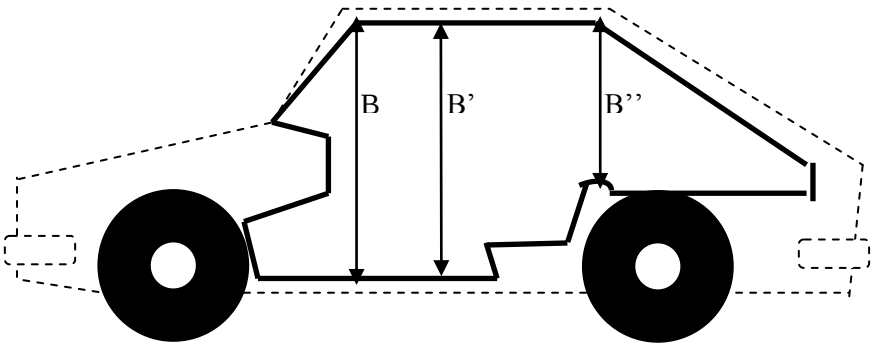
F054213 0° - 35 km/h Calibration Test,
with a Suzuki Swift 4 cylinder engine, year of production 1991.
Calibration test date: 19 October 2005.

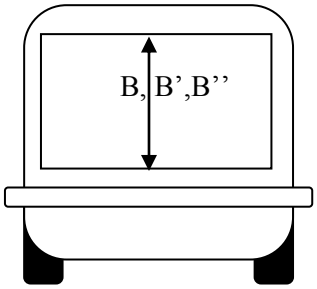


Appendix C Sign post design



Appendix D Roof deformation results

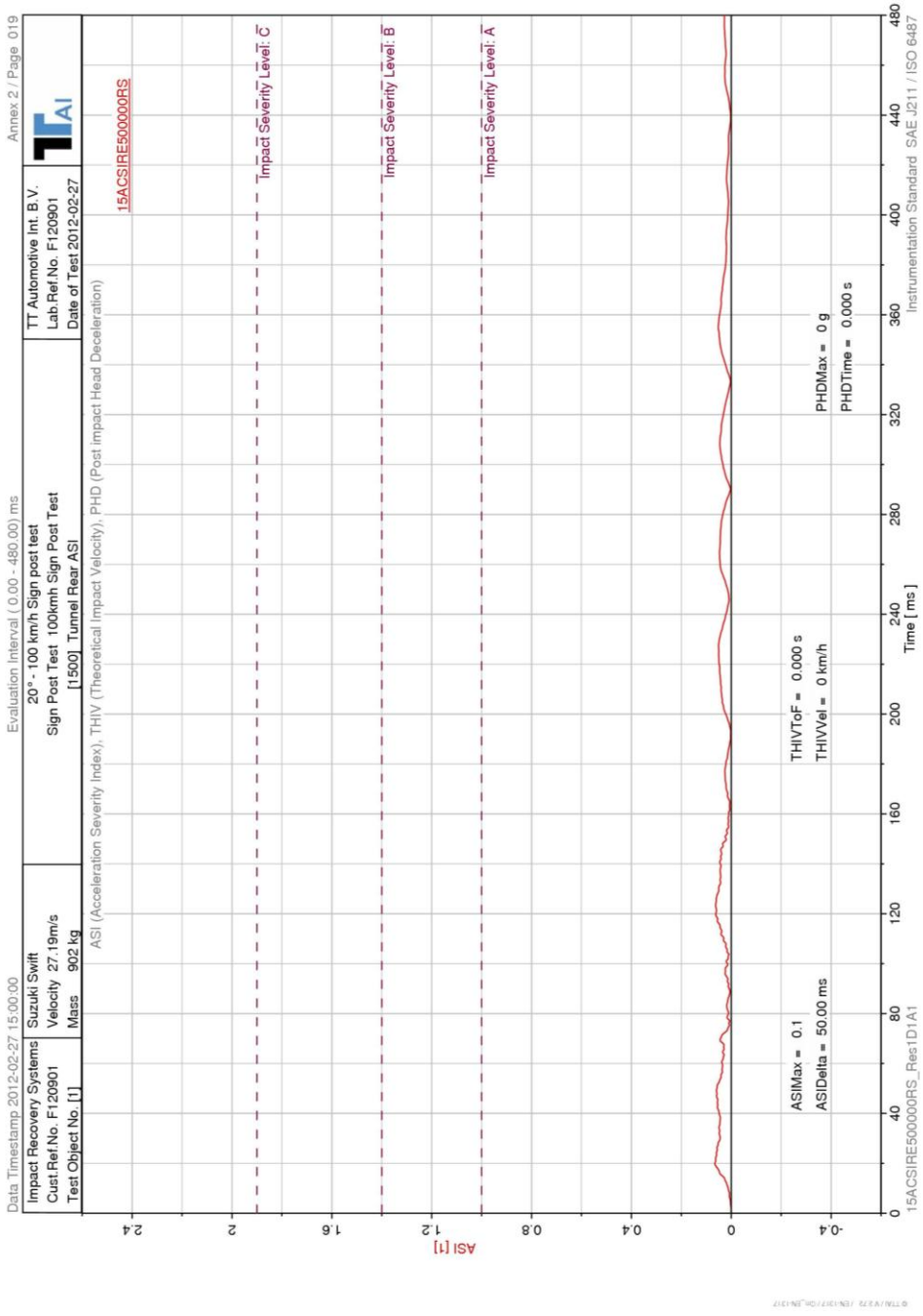




MEASURED on LHS	Before [mm]	After [mm]	Result [mm]
B. Roof behind windscreen close to horizontal – floor	978	979	+1
B’ Roof in line with B-pillar – floor panel	1043	1043	0
B’’ Roof in front of rear window close to hor. – floor	801	800	-1

Appendix E Measurement results

ASI and THIV graphs



Appendix F Detached elements

There were no detached elements.