Version 1.0
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Vehicle Under Test
Pre & Post Test Actions

Crash Protection

Technical Bulletin CP 004

Implementation 1st January 2026

PREFACE

During the test preparation, vehicle manufacturers are encouraged to liaise with the laboratory and to check that they are satisfied with the way cars are set up for testing. Where a manufacturer feels that a particular item should be altered, they should ask the laboratory staff to make any necessary changes. Manufacturers are forbidden from making changes to any parameter that will influence the test, such as dummy positioning, vehicle setting, laboratory environment etc.

It is the responsibility of the test laboratory to ensure that any requested changes satisfy the requirements of Euro NCAP. Where a disagreement exists between the laboratory and manufacturer, the Euro NCAP secretariat should be informed immediately to pass final judgment. Where the laboratory staff suspect that a manufacturer has interfered with any of the set up, the manufacturer's representative should be warned that they are not allowed to do so themselves. They should also be informed that if another incident occurs, they will be asked to leave the test site.

Where there is a recurrence of the problem, the manufacturer’s representative will be told to leave the test site and the Secretary General should be immediately informed. Any such incident may be reported by the Secretary General to the manufacturer and the person concerned may not be allowed to attend further Euro NCAP tests.

DISCLAIMER: Euro NCAP has taken all reasonable care to ensure that the information published in this protocol is accurate and reflects the technical decisions taken by the organisation. In the unlikely event that this protocol contains a typographical error or any other inaccuracy, Euro NCAP reserves the right to make corrections and determine the assessment and subsequent result of the affected requirement(s).

CONTENTS

1 TEST VEHICLE PREPARATION

1.1 Unladen kerb mass

The unladen kerb mass is the nominal mass of a complete vehicle with bodywork and all factory fitted equipment, electrical and auxiliary equipment for normal operation of the vehicle, including liquids, tools, fire extinguisher, standard spare parts, chocks and spare wheel, if fitted.

The fuel tank shall be filled to 90% of the manufacturer rated capacity and the other liquid containing systems (except those for used water) to 100% of the capacity specified by the manufacturer.

Measure and record the front and rear axle and total weights. Ensure that the front seat track positions are in mid and that the vehicle has its spare wheel onboard along with any other equipment supplied with the vehicle as defined by the unladen kerb mass. Nothing else shall be in the car.

Inflate all tyres to the manufacturer's instructions for half load. Record the ride heights of the vehicle at all four wheels.

1.2 Reference mass

Place both front seats in their middle, seat-track positions. If there is no notch at this position, set the seat in the nearest notch rearward.

Place the following masses on the front seats representing the vehicle occupants and luggage:

Test	Driver	Passenger	Rear	Rear	Luggage
MPDB	80kg	57kg	25kg*	38kg*	75kg
FWT	57kg	80kg	-	57kg	75kg
AE-MDB	75kg	-	38kg*	25kg*	75kg
Pole	75kg	-	-	-	75kg
Pole O2O	75kg	75kg	-	-	75kg
VRU	75kg	75kg	-	-	-

Add the mass of the CRS to be used in the tests to the child dummy masses. If CRS are not available, add default masses of 7kg and 2kg.

For the luggage mass, the normal luggage compartment shall be used, i.e. rear seats must not be folded to increase the luggage capacity. Spread the weight as evenly as possible over the base of the luggage compartment. If the weights cannot be evenly distributed, concentrate weights towards the centre of the compartment.

For two seater vehicles only, the mass of child dummies and child seats shall not be included in the reference load. For vehicles with limited rear space, child seats and dummies shall be included in the reference load.

Roll the vehicle back and forth to ‘settle’ the tyres and suspension with the extra weight on board. Weigh the front and rear axle weights of the vehicle. These loads are the ‘axle reference loads’ and the total weight is the ‘reference mass’ of the vehicle.

Record the axle reference loads and reference mass in the test details.

Measure and record the ride heights of the vehicle at the point on the wheel arch in the same transverse plane as the wheel centres. Do this for all four wheels.

1.3 Vehicle width and overlap – MPDB & FWT

Determine the widest point of the vehicle ignoring the rearview mirrors, side marker lamps, tyre pressure indicators, direction indicator lamps, position lamps, flexible mudguards and the deflected part of the tyre sidewalls immediately above the point of contact with the ground. Record this width in test details.

Determine the centreline of the vehicle, y=0, and mark a line on the bonnet and bumper on the centreline of the car.

1.4 R Point – AE-MDB

Mark a point on the driver’s side of the vehicle which has X (longitudinal) co-ordinate not more than 1mm different to the theoretical R point location provided by the OEM.

Mark a vertical line on the driver’s side of the car and roof which is 250mm rearward of the R point location. This is the target impact point for the AE-MDB test. Mark clearly on the tape which of its edges aligns with the impact point.

1.5 Vehicle preparation

Ensure that the vehicle’s battery is connected to the vehicle’s electrical circuit in its standard position. Check that the dashboard light for the airbag circuit functions as normal. Alternatively, the vehicle battery acid may be drained, or an additional live battery may be placed in the luggage compartment of the vehicle. If the supply from the drained battery is not supported by an additional battery, the test must be conducted within fifteen minutes after draining the battery. Where any additional battery is used it must be connected directly to the original battery so that the vehicle’s original electrical system, cable routing and connections remain unaltered. The power cables connecting both batteries must be positioned on the non-struck side of the car in such a way to minimise the risk of the cable being cut during the impact. The cable used to connect both batteries must have a minimum cross section of $5mm^2$ to ensure a minimum voltage drop. The current supplied to the vehicle must be monitored throughout the impact across the original battery. Where an additional battery is to be used the vehicle manufacturer will be required to indicate the minimum voltage/current needed during the test for all systems to operate as intended. The manufacturer will be asked to confirm that the laboratory modifications are suitable for use in the vehicle being tested and will not influence any of the vehicle systems.

If the engine fluids are to be drained then drain the coolant, oil, air-conditioning (air conditioning refrigerant should be drained without venting it to the atmosphere) and Power Assisted Steering (PAS) fluids.

If the fluids are drained then measure the weights of each of these fluids, excluding the air conditioning fluid, and replace with an equivalent weight of water or other ballast.

Remove the luggage area carpeting, spare wheel and any tools or jack from the car. The spare wheel should only be removed if it will not affect the crash performance of the vehicle.

An emergency abort braking system may be fitted to the vehicle. This is optional; the test facility may elect to test without an abort system. Where such a system is fitted its inclusion shall not influence the operation or function of any of the foot controls, in particular the brake pedal. The position and the resistance to movement of the pedals shall be the same as prior to fitment of the system. Remove as little as possible of the interior trim; any mass compensation will be made when all equipment has been fitted.

Fit the on-board data acquisition equipment in the boot of the car. Also fit any associated cables, cabling boxes and power sources.

Place weights on the vehicle seating positions to represent the occupants, CRS and luggage in the table above.

Weigh the front and rear axle weights of the vehicle and make sure the following conditions are met:

Individual axle weights shall be within 5% and 20kg of the reference mass.

The total vehicle mass shall be within 1% and 20kg of the reference mass.

If the weights differ by more than the specified tolerances, add or remove items which do not influence the structural crash performance of the vehicle. The ballast in the fuel tank (equivalent in mass to 90% capacity of fuel) may also be adjusted to help achieve the desired weights. Any additional mass that is added to the vehicle should be securely and rigidly attached. Record the final vehicle mass and axle weights in the test details.

For fully electric vehicles, if a total vehicle mass within 25kg of the reference mass cannot be achieved, it is acceptable for the total mass to be within 2% of the reference mass. A heavier test mass may be used with the agreement of the OEM, the test mass must not be below the minimum value of the specified tolerances.

The vehicle manufacturer is required to inform Euro NCAP and the test laboratory of the presence of any pre-crash systems that must be disabled prior to impact. Disabling information shall be provided to the laboratory prior to impact. It is the responsibility of the vehicle manufacturer to ensure that the disconnection of the system does not influence the performance of any systems that are intended to function during the impact.

1.6 Vehicle markings

1.6.1 MPDB

If applicable, position the rear seats in accordance with the passenger compartment adjustments. Install the H-point machine on the Q6 position following the procedure detailed for a 5th female occupant and mark the H-point location on the vehicle.

Mark head excursion lines at 400mm-600mm forward of the H-point location of the 5th female occupant in 50mm increments. The 450mm and 550mm excursion lines shall be clearly distinguished from the other markings in some way, for example using a different colour.

The excursion lines shall be marked on both sides of the vehicle, as well as on the interior and exterior. These lines shall be marked in such a way that they are clearly visible to the onboard and offboard cameras. Alternatively, it is acceptable for the lines across the vehicle to be superimposed during post film processing.

With the Gabarit positioned as specified in ECE Regulation No. 173, the positions of the back and bottom planes of the device will be defined using the 3D Measuring arm, targets will be applied to the top and side surfaces of the Gabarit to help in this process. The intersection of these planes will define the Cr-point for the seating position in question.

1.6.2 FWT

Mark 5th female rear passenger head excursion markings at:

- 450mm forward of the rear dummy H-point $X_{AF05,dummy}$.
- 550mm forward of the rear dummy H-point $X_{AF05,dummy}$.

The excursion lines shall be marked on both sides of the vehicle, as well as on the interior and exterior. These lines shall be marked in such a way that they are clearly visible to the onboard and offboard cameras.

None of the rear occupant's head excursion lines shall be more forward than the most rearward point on the seatback of the front passenger seat, when in the 5th female position. In this case the head excursion line(s) aligns with the most rearward point on the seatback of the front passenger seat, when in the 5th female position.

1.6.3 AE-MDB & Pole

Mark the centreline of the vehicle on the facia and centre console so that it can be seen from the offboard camera views.

Mark the centreline of both rear outboard seating positions (including head restraint centreline if necessary) and on the CRS used for test. Markings placed on hard parts of the CRS, rather than seat fabric, are preferable. If an ISOFIX CRS is used no markings are needed.

2 INTRUSION MEASUREMENTS

2.1 General

For vehicle deformation and intrusion measurements a 3D measuring system which is capable of recording three dimensional co-ordinates of a point in space shall be used. A tolerance of +/- 1mm is applicable to such a system.

The vehicle shall be supported during measuring of all points.

2.1.1 Pretest – MPDB & FWT

Remove the carpet, trim and spare wheel from the luggage compartment. The plastic trim or rubber seals that might influence the latching mechanism should be re-fitted once the intrusion measurements have been recorded.

Apply the manufacturer's co-ordinate system onto the vehicle so that three defined locations are established. Alternatively, locate the vehicle axis reference frame centrally to the rear of the vehicle, see Figure 1. Level the reference frame and measure the stud heights of the reference frame. Set up the vehicle co-ordinate axes in the 3D arm or similar device. Measure the position of at least 5 datum points on the rear of the vehicle. These points should be on structures which are not expected to be deformed in the test and should be positioned such that they have wide spaced locations in three dimensions and can all be reached with the 3D measuring system in one position.

Figure 1 Setting up axis reference frame

Measure the pretest positions of the following points:

Mark	
Pedal centres	In test position Clutch, brake, accelerator, foot operated parking brake - undepressed
Steering wheel centre	In pretest position, airbag removed
A-pillar, driver's side B-pillar, driver's side	100mm above the sill 100mm beneath the lowest level of the side window aperture. All points shall be as close as possible to the rubber seal around the door aperture

B-pillar, passenger's side	100mm above the sill 100mm beneath the lowest level of the side window aperture. All points shall be as close as possible to the rubber seal around the door aperture

2.1.2 Posttest MPDB & FWT

Use any 3 of the 5 datum points at the rear of the vehicle, and their pretest measurements, to redefine the measurement axes.

If the axes cannot be redefined from any three of the datum points relocate the axis reference frame in the pretest position. Set the studs of the frame to the same heights as in pretest, see Figure 2. Set up the measurement axes from the frame.

Record the positions of the B-pillar points on the passenger's side of the vehicle. Compare the vertical co-ordinates of the B-pillar sill points pre and posttest.

For the B-pillar sill point, find the angle θ that best satisfies the following equation:

$$z = -x'\sin\theta + z'\cos\theta$$

where z = pretest vertical measurement

x', z' = posttest longitudinal and vertical measurement

Figure 2 Re-setting axis reference frame

Measure the posttest positions of the following points.

Mark	
Pedal centres	In posttest position. Clutch, brake, accelerator, foot operated parking brake – undepressed Clutch, brake, accelerator, foot operated parking brake – with 200N to produce the maximum moment about the pedal pivot, brake fluid must be drained prior to measurement

Steering wheel centre	In posttest position, airbag removed If disconnected posttest, reposition so that it is in contact with whatever structure(s) last constrained it from further movement
A-pillar, driver's side B-pillar, driver's side	100mm above the sill 100mm beneath the lowest level of the side window aperture.
B-pillar, passenger's side	100mm above the sill. 100mm beneath the lowest level of the side window aperture.

Transform the posttest longitudinal and vertical measurements (x′,z′) using the following equations.

$$\begin{bmatrix} X' \\ Z' \end{bmatrix} = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix} \begin{bmatrix} x' \\ z' \end{bmatrix}$$

X and Z should now be in the same frame of reference as the pre-impact measurements, assuming that the point on the passenger's side B-pillar sill is not displaced vertically or laterally during the impact.

From the pre and posttest measurements determine:

Mark	
Pedal centres	Longitudinal and vertical movement of all of foot operated pedals.
Steering wheel centre	Longitudinal, lateral and vertical movement of the centre of the top of the steering column.
A-pillar waist, driver	Rearward movement
Door aperture	reduction in width at waist and sill levels.

2.1.3 Posttest AE-MDB & pole

Posttest intrusion measurements to be taken using the intrusion area limited by the following lines:

Line	Description
A	Vertical line at x-position 700mm forward of the R-point
B	Horizontal line at z-position of R-point (sagittal plane)
C	Vertical line at x-position at the back of headrest stems
D	Horizontal line at door waist (sagittal plane)

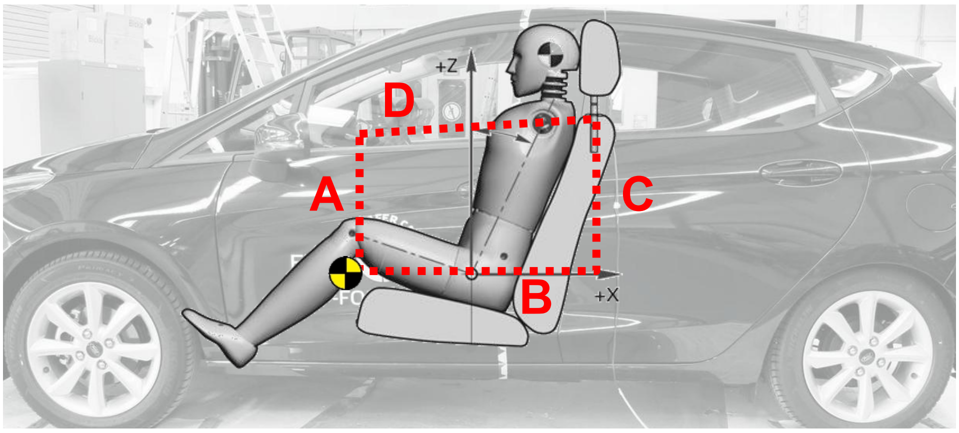


Figure 3: Intrusion area

The maximum inboard intrusion point is determined within the intrusion area, the method to find this point is described as follows. There is no compulsory procedure how to measure the maximum inboard point. It is acceptable to use 3D scan, 3D arm or a tape measure.

In most cases the armrest will be the most inboard part. Therefore, the measurement will be taken from the most inboard surface of the armrest.

At waistline level, if this is the most inboard area, the inner door trim/cover shall be measured for reference. The intrusion point is defined as the most inboard part of the metal door structure +50mm inboard (see example below).

Figure 4: Intrusion measurement

3 TESTING OF ELECTRIC VEHICLES

For vehicles that are not solely powered by ICE, additional preparations and precautions are required to ensure safety before, during and after crash-testing for all persons involved. This bulletin now includes requirements on:

a) Information that OEM needs to provide to the test laboratory.
b) Checks the test laboratory needs to perform on the vehicle pre, during and post test.

3.1 OEM Pre-test information

In order to achieve the safe and timely testing of vehicles the following items and information should be provided (at the latest upon vehicle delivery to the lab) by the OEM completing the HV vehicle questionnaire in CP 002 covering the following:

a) The location of the service plug (if applicable).
b) Diagram/drawing/photos and guidelines to show the location of HV connection*.
c) The minimum State of Charge (SoC) of the Rechargeable Electrical Energy Storage System (REESS) to any state which allows the normal operation of the powertrain.
d) Instructions on how to put the vehicle in the correct state to be tested (restraint system deploys as normal as it would on the road, ADL, eCall etc functioning “as normal”).
e) Pre & Post test: Instructions on how to move the vehicle in order not to damage the HV system (for Pre) and not to create additional risk (for Post).

*If possible, break-out leads from HV and relevant adaptor to DAU may be fitted by OEM personnel at test lab during the vehicle crash preparation phase (ideally one week in advance from the crash test date).

If the OEM does not provide the completed questionnaire with the relevant information, the penalty of the ‘EV and hybrid vehicle compliance with ECE regulations regarding electrical vehicle safety’ assessment (Post Crash Protocol) will be applied automatically, irrespective of the post-crash compliance checks.

The HV questionnaire must be supplied to the test laboratory at the same time as the Emergency Response Guide (ERG). These documents must be delivered to the lab at least 2 weeks before the first crash test.

3.2 High voltage vehicle testing

Euro NCAP requires laboratories to measure the voltage of the HV battery during the full-scale crash test. UN regulation No. 94, 95, 135 and 137 have requirements which cover protection against electrical shock. Four test options are allowed to verify the protection against electrical shock:

a) Absence of high voltage
b) Low electrical energy
c) Physical protection
d) Isolation resistance

The laboratories are required to record and complete the post-test HV assessment of protection against electrical shock, see APPENDIX A for assessment table in accordance with the flow chart process.

3.2.1 HV Status

Euro NCAP tests can be carried out with a minimum state of charge (SoC) as per the HV questionnaire.

3.2.1.1 Pre-test

To indicate the risk of >30v AC/60v DC post-test, an exterior LED indicator light should be mounted to show the status. The OEM is asked to provide guidance for mounting the LED lights.

3.2.1.2 Post-test

After the crash test, extreme care needs to be taken to ensure that there is no exposure to high voltage before any person touches the vehicle. After all the verifications with an active HV system have been done the HV system must be deactivated following the OEM instructions supplied within the HV questionnaire.

In the case of non-compliance of protection of electrical shock post-test, all post-test activities will be halted, the laboratory must activate their relevant Emergency Plan and the OEM shall be contacted immediately to instruct on the safe isolation of the HV system.

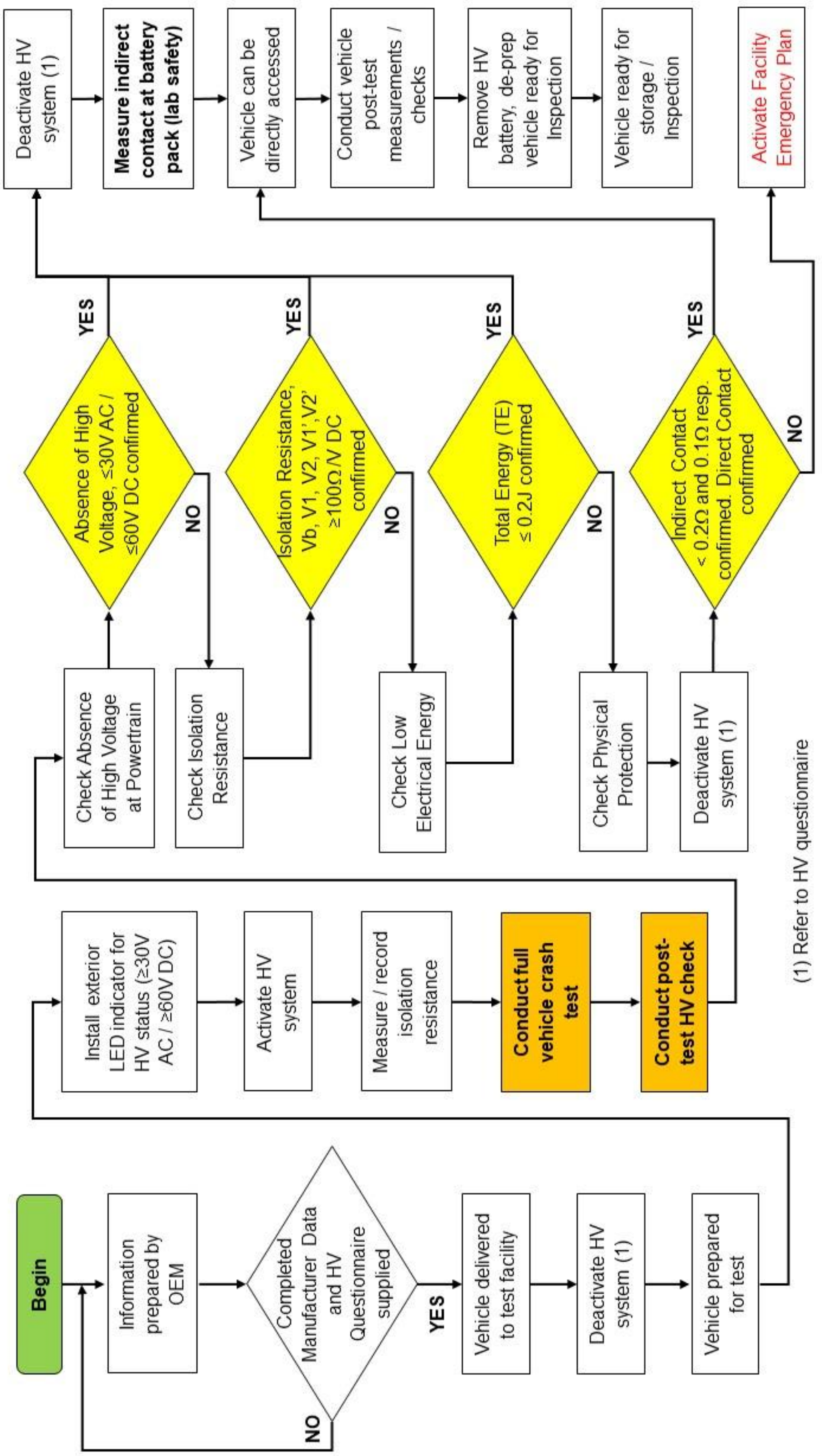
For storage, inspection and viewing the OEM or Laboratory should remove the battery pack post test.

3.2.2 Thermal Event

3.2.2.1 Post-crash

The HV battery temperature and battery temperature rise rate should be monitored. The method of monitoring the battery temperature (e.g. thermocouple, CAN data) is at the discretion of the test laboratory. Any and all audio and visual warnings provided by the vehicle of a potential thermal event will be noted. In the case of a thermal event occurring and no warning being provided by the vehicle this will also be noted with Euro NCAP Secretariat being informed.

In order to aid the test laboratories when checking a high voltage vehicle the following process flow chart indicates the preparation and assessment process:


Begin
Information prepared by OEM
Completed Manufacturer Data and HV Questionnaire supplied
NO
YES
Vehicle delivered to test facility
Deactivate HV system (1)
Vehicle prepared for test
Install exterior LED indicator for HV status (≥30V AC / ≥60V DC)
Activate HV system
Measure / record isolation resistance
Conduct full vehicle crash test
Conduct post-test HV check
Check Absence of High Voltage at Powertrain
Absence of High Voltage, ≤30V AC / ≤60V DC confirmed
Check Isolation Resistance
Isolation Resistance, Vb, V1, V2, V1', V2' ≥100Ω/V DC confirmed
Check Low Electrical Energy
Total Energy (TE) ≤ 0.2J confirmed
Check Physical Protection
Deactivate HV system (1)
Indirect Contact < 0.2Ω and 0.1Ω resp. confirmed. Direct Contact confirmed
YES
NO
Deactivate HV system (1)
Measure indirect contact at battery pack (lab safety)
Vehicle can be directly accessed
Conduct vehicle post-test measurements / checks
Remove HV battery, de-prep vehicle ready for Inspection
Vehicle ready for storage / Inspection
Activate Facility Emergency Plan
(1) Refer to HV questionnaire

4 ENERGY EQUIVALENT SPEED

From the start, Euro NCAP test protocols have included requirements for intrusion measurements. For the EES setup (Energy Equivalent Speed) it is important to accurately measure the deformation of the impact zones to generate the corresponding EES values for each impact scenario. In the end, this is needed to fulfil the calculation requirements of the EES model.

Euro NCAP involves several laboratories that each may have their own internal procedures, quality standards and equipment. In order to improve the consistency of material supplied by the laboratories, all measurement requirements previously specified by Euro NCAP have been brought together, reviewed and updated. This document summarises the most recent specifications that are compulsory for all official Euro NCAP tests at the accredited Euro NCAP test laboratories.

4.1 General Requirements

4.1.1 Measurement Equipment

4.1.1.1 For measuring the deformation of the MPDB (ODB), Full Width and Side MDB Impact a 3D measuring system shall be used (e.g. 3D measurement arm with attachable scan module). This system must be capable of recording three dimensional co-ordinates of single points, as well as clouds of points (scanner). A tolerance of +/- 1mm is applicable to such a system.

4.1.1.2 For measuring the deformation of the Side Pole Impact three 3m rulers shall be used. A tolerance of +/- 1cm is applicable to this measurement method.

4.1.1.3 In addition to the standard accelerometers, a triaxial gyro sensor has to be mounted on a rigid surface in the vehicle trunk. The sensor shall have a range of at least 900°/second.

4.1.1.4 Overview of required measurements:

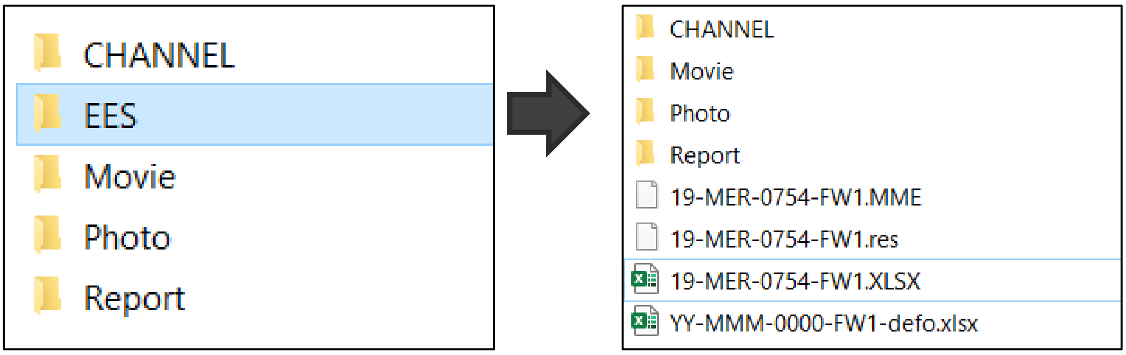
	Dynamic		Static	
	Accelerometer	**Angular velocity**	**3D scan**	**Simple measurement**
	Standard EN sensor			
MPDB/ODB	**X**	**X**	**(X)**	**X**
AE-MDB	**X**	**X**	**X**	
Pole Side Impact	**X**		**(X)**	**X**
Full Width	**X**		**(X)**	**X**
Pedestrian				**X**

X Mandatory

(X) Optional: It is acceptable to extract the required measurement points from a 3D scan

4.1.2 Upload Files/Digital Data Format

4.1.2.1 Measurement Data shall be stored in the common folder structure as illustrated in the following figures:

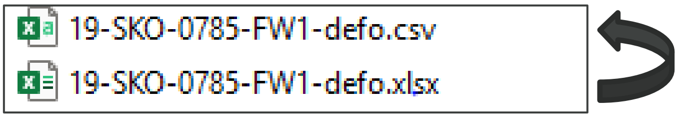


a) Crash Test Data (MME-Files)

For calculation of the measurement data of each crash test impact scenario use macros provided by X-Crash. The filename consists of the test number. The macro creates two files in following formats: .mme and .res.

b) Deformation Measurement (CSV-File)

To determine the intrusion in each crash test please follow the measurement instruction as shown in Sections 4.2 to 4.5.

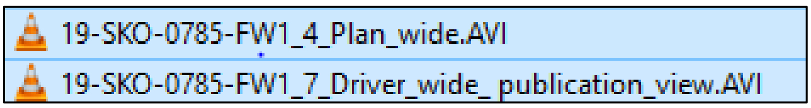


Save .xlsx template as .csv file!

4.1.2.2 Media Files

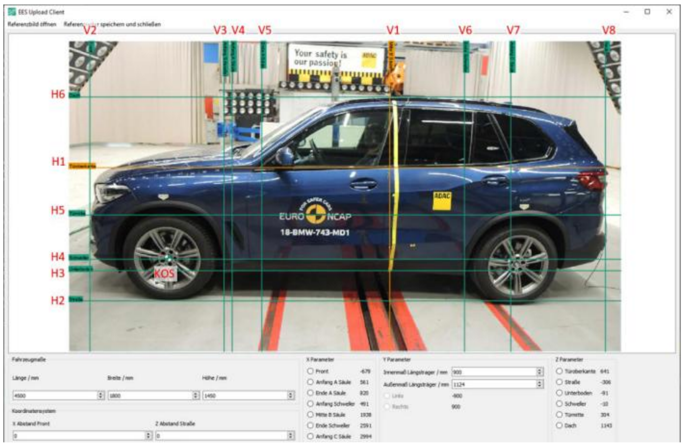
a) Videos

Video Data will be automatically integrated in the EES tool by uploading the MME-File (please consider the correct filenames according to Euro NCAP Film and Photo Protocol). For evaluation reasons two videos are needed:



b) Photos

To set up the reference grid in the EES Upload Client a side view of the vehicle under testing from before (!) the crash test is necessary. Therefore, please use a photo with an orthogonal view of the left side of the vehicle (in driving direction, independently of driver position).



Additionally, for evaluation reasons please provide at least three photos of the deformation zone at different angles after crash.

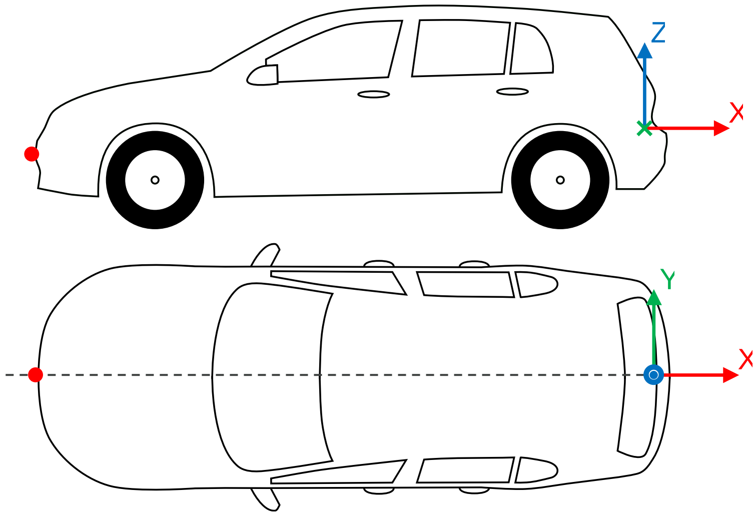


4.2 Frontal MPDB Impact

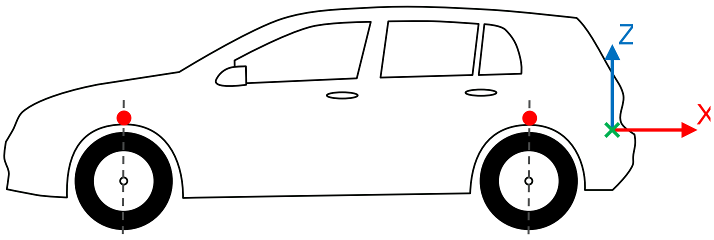
4.2.1 Before Test

4.2.1.1 This measurement shall be performed together with the intrusion measurements according to the MPDB frontal impact testing protocol (Section 2.1), using the same axis system.

4.2.1.2 Determine and measure the reference point. This is the most forward point on the bumper in the centreline of the vehicle.



4.2.1.3 Measure the point on the wheel arch in the same transverse plane as the wheel centres. Do this for all four wheels.



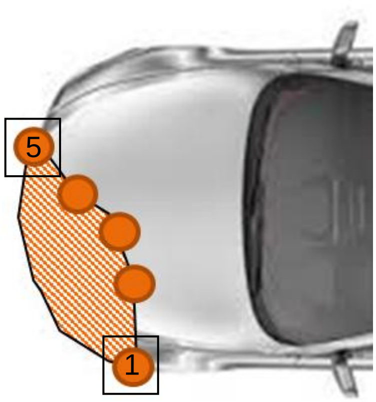
4.2.1.4 The points measured in 4.2.1.2 and 4.2.1.3 are references ("most forward point" and "ride height" of the vehicle) required for aligning the measurements of MPDB frontal, Full width frontal and AE-MDB side impact to the original vehicle geometry. If the same origin is used for all tests, the points in 4.2.1.2 and 4.2.1.3 only have to be measured on one single vehicle.

4.2.2 After Test

4.2.2.1 Measure the beginning and the end of the deformation in x-direction, here the height should be approximately in the middle of the chassis beam.

4.2.2.2 Measure the deepest deformation at the outer body skin of the vehicle (beginning of deformation, mark 1 at the front left tyre) in x-direction and the ‘end’ of deformation in y-direction (mark 5 in x-direction ↔ smallest deformation should usually end in front of the longitudinal beam).

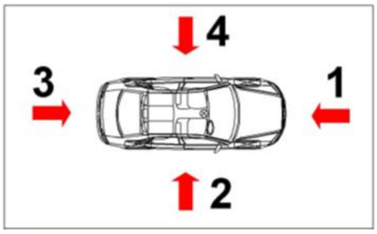
4.2.2.3 Measure three freely selectable deformation points (striking points like kinks or bumps) in almost equal distances in between mark 1 and 5. Please consider as well compressed bumper parts as expected in a real accident scenario.



4.2.2.4 The measured values should be exported to the assessment file (.csv-format). Please note, that there is one additional column in the template to set limits for the calculation model (mark 6: x6 = 0 mm and y6 = y5 + 100mm).

1	0	185	550	780	1200	1300
500	700	500	425	380	160	0

deformation endpoint



VDI2 position of impact zone

Column coordinates (grid position)

Row coordinates (grid position)

Impact values for equivalent position

Content of CSV-file:

1;0;520;780;1050;1400;

460;610;580;650;330;0;

4.2.2.5 Please see also the HV questionnaire for special cases of deformation, e.g. broken cross member, lost front tyre, cutting of longitudinal beam after removing barrier, etc.

4.3 Frontal Full Width Impact

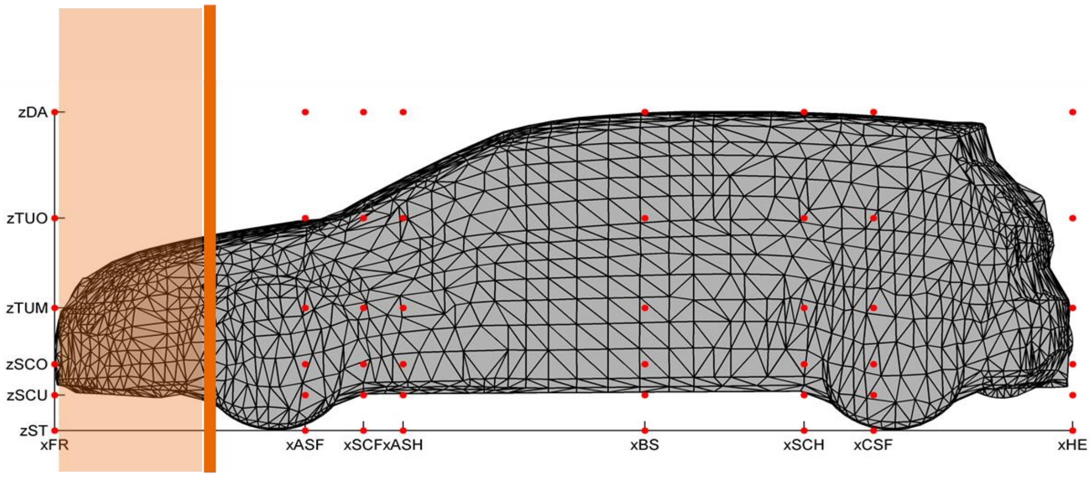
4.3.1 Before Test

4.3.1.1 Please refer to Section 4.2.1 and if necessary, repeat steps 4.2.1.1 to 4.2.1.3.

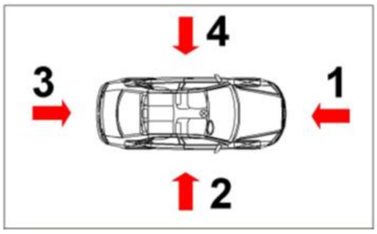
4.3.2 After Test

4.3.2.1 Measure the beginning and the end of the deformation in x-direction, here the height is negligible.

4.3.2.2 Measure the deepest deformation at one single point of the outer body skin of the car. Please consider as well compressed bumper parts as expected in a real accident scenario.



4.3.2.3 Finally, the measured value should be exported to the assessment file (.csv-format).



VDI2 position of impact zone

Column coordinates (grid position)

Row coordinates (grid position)

Impact values for equivalent position

Content of CSV-file:

1;0;

0;545;

4.4 Side AE-MDB Impact

The following procedure describes the standard measurements for the MDB side impact. For laboratories that are able to perform the advanced measurement procedure can be performed instead, see APPENDIX B.

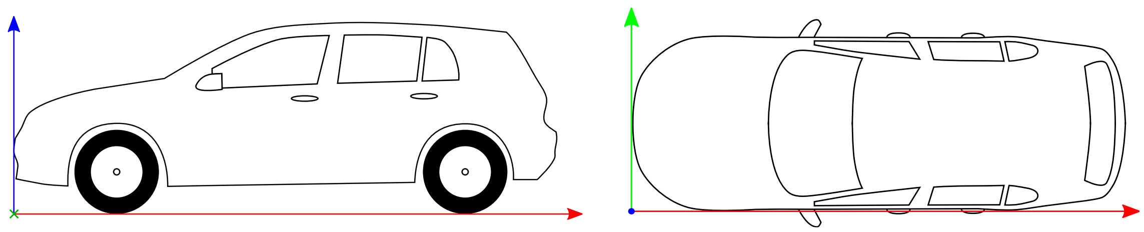
4.4.1 Before Test

4.4.1.1 For the pre- and post-crash measurements of the side MDB vehicle, the following coordinate system shall be used:

X = 0 in the most forward point of the car (measured pre-crash in the MPDB measurement)

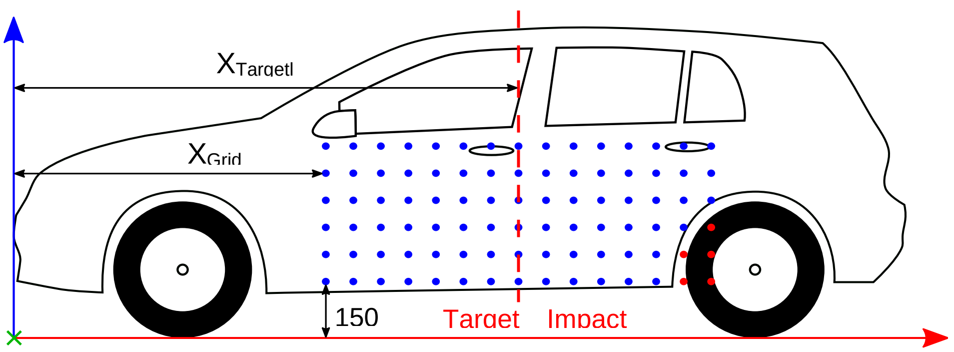
Y-axis is the lateral axis of the vehicle

X-Y-plain is the ground, considering the design ride heights. It may be necessary to calculate the correct ground level, using the design ride heights from the pedestrian tests and the wheel arch points measured in 4.2.1.3.



4.4.1.2 Ensure that the vehicle is loaded, so that the ride heights are the same as under test conditions.

4.4.1.3 Create a grid of points (2100x750mm) with an equal distance of 150mm on the impact zone, where the centre of the grid equals the midpoint of the impact zone (referring to the target centreline of the barrier). This will be a number of 90 points in total. Only points that meet vehicle structure must be marked. The marking shall be robust enough to withstand the impact.



$$X_{Grid} = X_{Targetline} - 1.050 \text{ mm}$$

76 $X=X_{Grid}+0$ Z=900	**77** $X=X_{Grid}+150$ Z=900	**78** $X=X_{Grid}+300$ Z=900	**…** … …	**90** $X=X_{Grid}+2.100$ Z=900
… … …	**…** … …	**…** … …	**…** … …	**…** … …
16 $X=X_{Grid}+0$ Z=300	**17** $X=X_{Grid}+150$ Z=300	**18** $X=X_{Grid}+300$ Z=300	**…** … …	**30** $X=X_{Grid}+2.100$ Z=300
1 $X=X_{Grid}+0$ Z=150	**2** $X=X_{Grid}+150$ Z=150	**3** $X=X_{Grid}+300$ Z=150	**…** … …	**15** $X=X_{Grid}+2.100$ Z=150

4.4.1.4 Measure all marked points on the vehicle surface. Points that don't exist (see red points in picture above) must be added manually to complete the grid. These points have to include the calculated X- and Z-position; Y shall be set to "0".

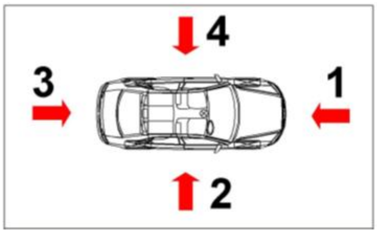
4.4.2 After Test

4.4.2.1 Measure all marked points on the vehicle surface. Points that don't exist have to be added manually to complete the grid. These points have to include the calculated X- and Z-position; Y shall be set to "0".

4.4.2.2 Most points will vary in X and Z Test, compared to the pre-test measurement. This can be ignored.

4.4.2.3 Calculate ΔY (Yundeformed – Ydeformed) for each grid point.

4.4.2.4 Finally, the coordinates of the grid points with the related ΔY values should be exported to the assessment file (.csv-format).



VDI2 position of impact zone

Column coordinates (grid position)

Row coordinates (grid position)

Impact values for equivalent position

Content of CSV-file:

4;X_{Grid}+0;X_{Grid}+150;X_{Grid}+300;X_{Grid}+450;……..…; X_{Grid}+2100;

150;13;62;88;52;……..…;128;

300;44;64;96;131;……..…;78;

450;38;67;120;138;……..…;124;

…;…;…;…;…;……..…;…;

900;111;97;131;147;……..…;117;

4.5 Side Oblique Pole Impact

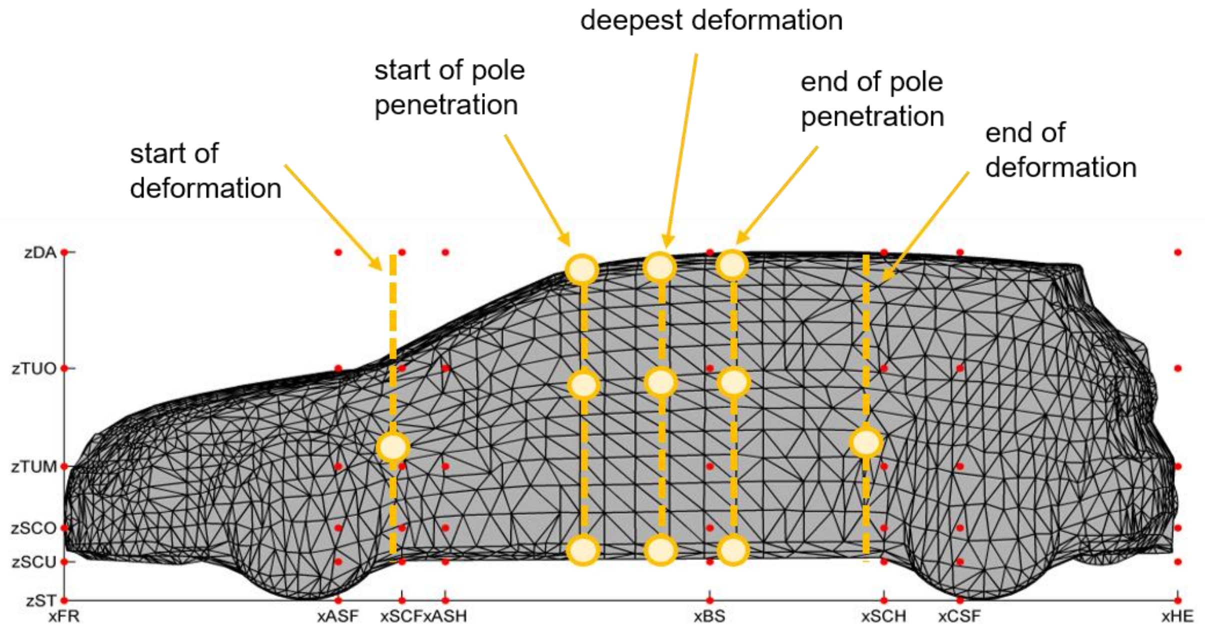
4.5.1 Before Test

4.5.1.1 Pre-crash measurement not required

4.5.2 After Test

4.5.2.1 Measure the beginning and the end of the deformation in x-direction, here the height is negligible.

4.5.2.2 Measure the deepest deformation, the start and the end of the penetration through the pole in x-direction at the following three heights: sill, transition door window, roof frame.

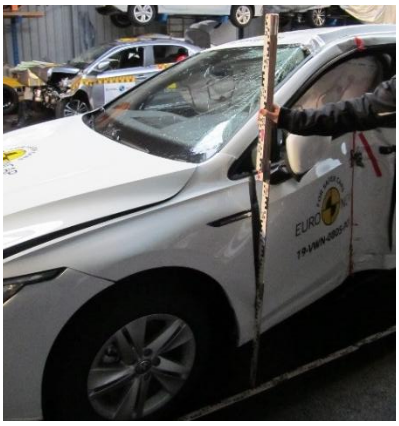
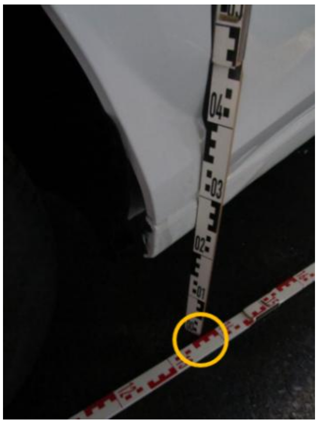
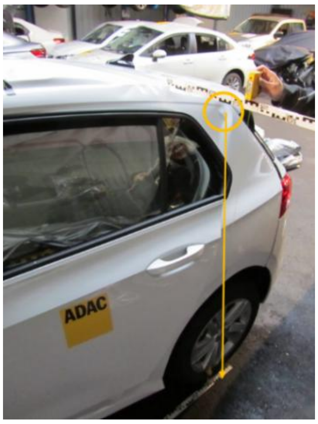


You can carry out these measurements manually using a ruler.

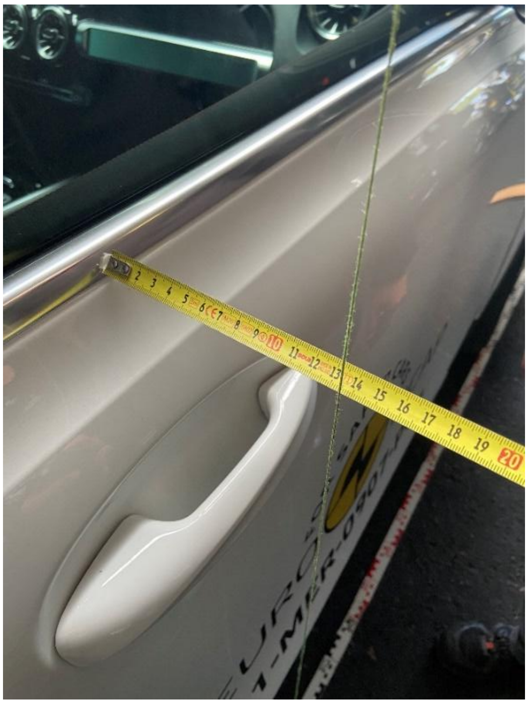
4.5.2.3 Place two rulers on a flat floor so that the zeros of the two rulers meet at the front left corner of the vehicle. The ruler at the front should be perpendicular to the front of the vehicle. The ruler on the vehicle side of the pole should be in curse with both wheel contact points.

4.5.2.4 Measure the distance from the front of the vehicle to the beginning of the deformation in x-direction. The deformation usually begins between the fender and the driver's door.

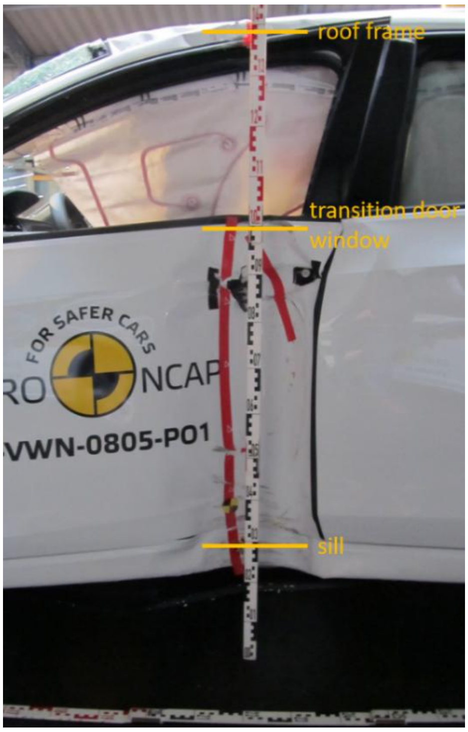
4.5.2.5 Measure the end of the deformation in the same way. The end of the deformation is usually indicated by a dent in the roof frame.

4.5.2.6 Define the vehicle shape of the undeformed side using a plumb. Therefore, measure the distance from the plumb line (on top of the ruler's outer edge) to the outer body skin (striking point) at the heights described in 6.6.2. Note the values for further calculations in the EES assessment file (MS Excel template).


4.5.2.7 Measure the deepest deformation caused by the pole at the common three heights in y and x direction (same procedure as in 6.2.6). Also, the beginning and the end (bend points) of the penetration of the pole into the vehicle structure shall be measured.

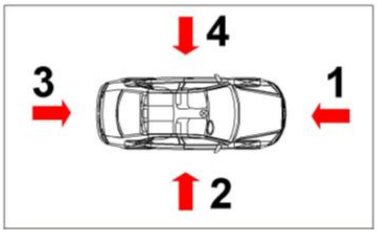


4.5.2.8 Finally, the measured values should be exported to the assessment file (.csv-format).

	1510	2310	2350	2500	3050
1750	0	330	360	300	0
1260	0	320	340	290	0
150	0	300	310	270	0

height

start deformation end



VDI2 position of impact zone

Column coordinates (grid position)

Row coordinates (grid position)

Impact values for equivalent position

Content of CSV-file:

4;1510;2310;2350;2500;3050;

1750;0;330;360;300;0;

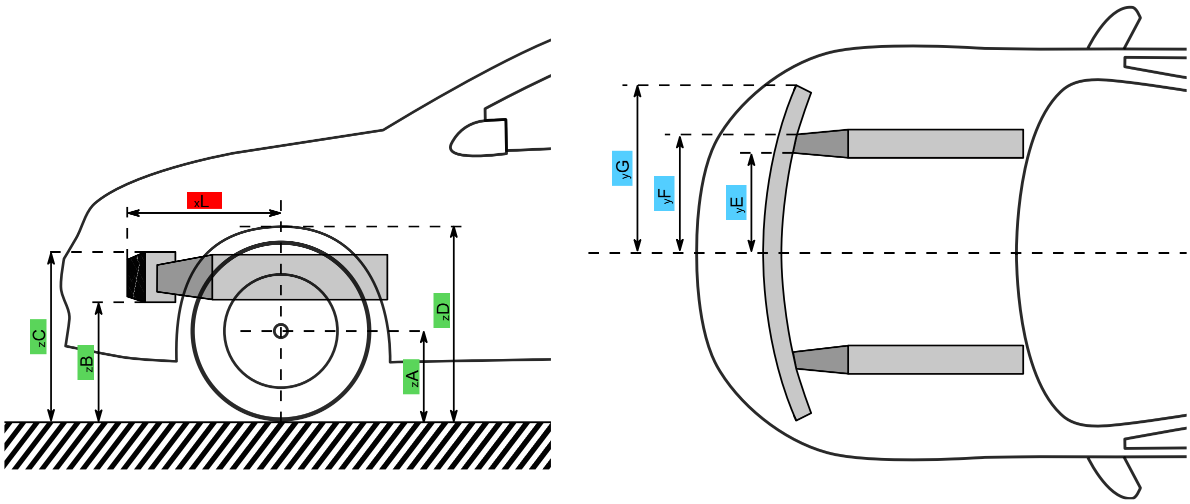
1260;0;320;340;290;0;

150;0;300;310;270;0;

4.6 Pedestrian Protection

4.6.1 Measurement of chassis beams

4.6.1.1 The following measurement shall be performed to evaluate the structure of the EES model, i.e. the position of the chassis beam is needed. Therefore, measure the distances illustrated in the figure below. Please note, that this measurement can only be done for conventional and hybrid electric vehicles (no BEV).



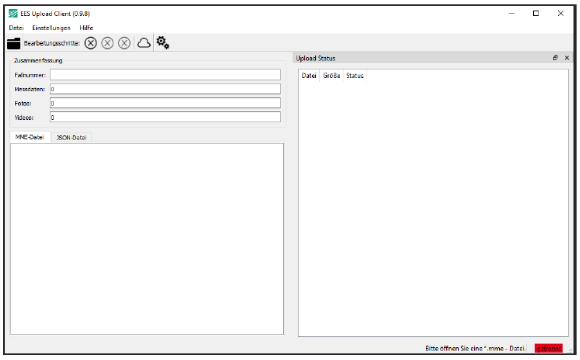
4.7 EES Upload Client

4.7.1 Please follow the quick start instructions which were delivered together with the EES Upload Client by Fraunhofer.

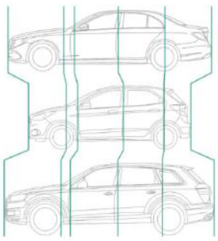
4.7.2 Dimensions from Manufacturers' Request (length, width, height of vehicle) are needed to fulfil all requirements of the Upload Client.

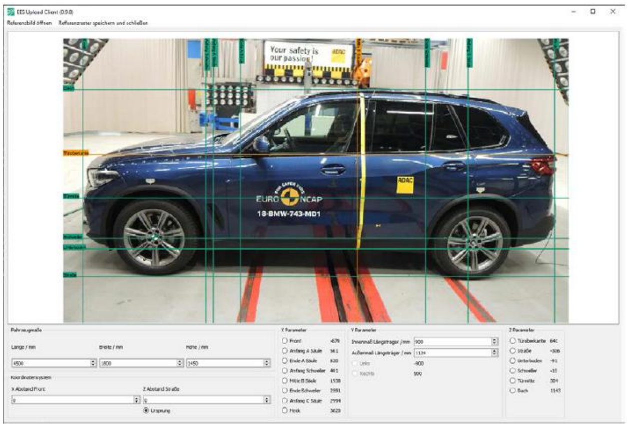
4.7.3 This is a platform to send out the data to the Server of Fraunhofer. The test data (vehicle channels), deformation pictures, 3D measurements and a grid definition need to be uploaded. Upload should take about 5 minutes.

- developed program: "EES Upload Client"
- upload in 3 steps:
  - (1) open a "*.mme"-file
  - (2) create the reference grid of the crashed car
  - (3) load the deformation data ("*.csv")
- upload contains channels, relevant pictures and some videos (for future verification)



- step 2:
  - defines reference grid for the tested car
  - enables us, to scale every car to the voxel model:





APPENDIX A

Post-test HV assessment of protection against electrical shock for each full scale crash test vehicle to be used in combination with the Flow Chart.

Test Facility	
Vehicle Make / Model	
Test / Assessment Date	

Post-Test HV Check*			
Absence of High Voltage	**Recorded values graph**		**Status** **(OK, Not OK, N/A)**
	Vb	**Graph**	
	V1	**Graph**	
	V2	**Graph**	
	Measured values		**Status** **(OK, Not OK, N/A)**
	Vb		
	V1		
	V2		
	V1’		
	V2’		
	Ri/ Nominal voltage		

***** Relevant checks to be completed as per each lab’s internal requirements following the flow chart process.

Post-Test HV Check*			
Isolation Resistance	**Direct measurement with external DC power supply**		**Status** **(OK, Not OK, N/A)**
	Ri+ / Nominal voltage		
	Ri- / Nominal voltage		
	Voltage measurement + calculations		**Status** **(OK, Not OK, N/A)**
	V1 > V2		
	V2 > V1		
	Ri+/Nominal voltage		
	Ri-/Nominal voltage		
Low Electrical Energy	**Measured value or calculated value**		**Status** **(OK, Not OK, N/A)**
	TE		
	TE_1		
	TE_2		
Physical Protection	**Measured value for all exposed conductive parts**		**Status** **(OK, Not OK, N/A)**
	Indirect		
	Direct		

***** Relevant checks to be completed as per each lab's internal requirements following the flow chart process.

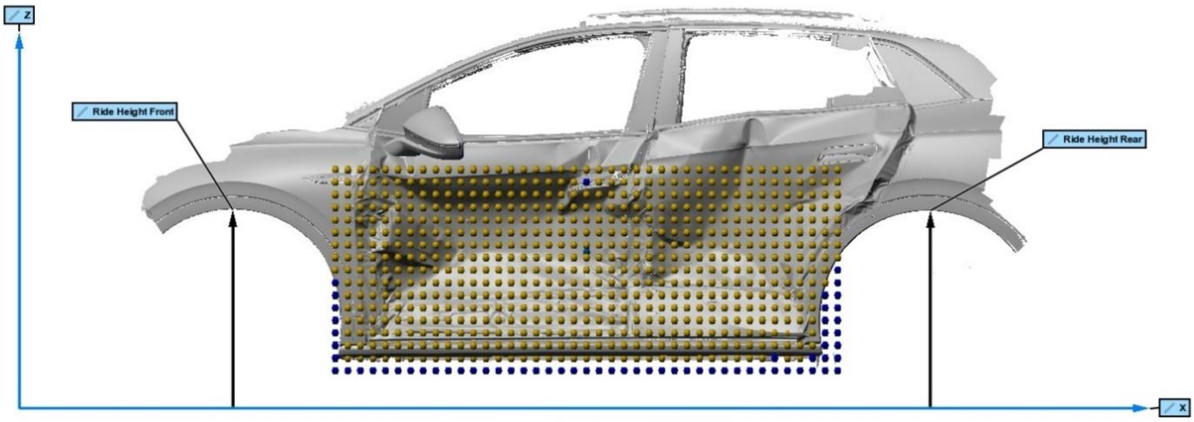
APPENDIX B

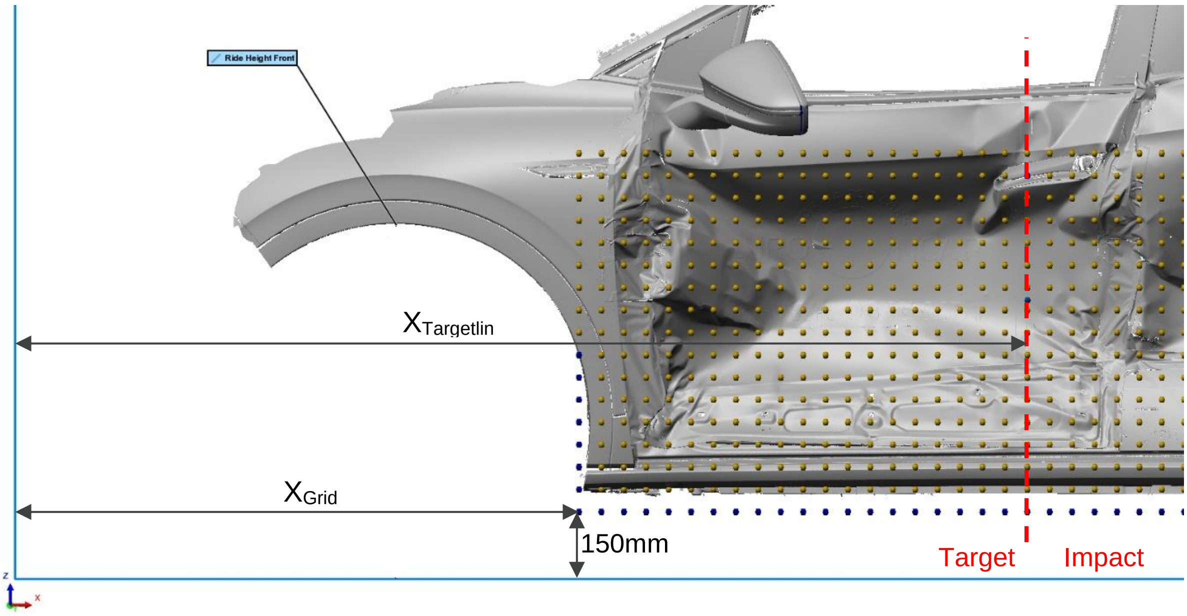
1. Advanced MDB side impact measurement procedure

1.1. Cover gaps on the impact side with masking tape to avoid holes in the following scan process

1.2. Scan the impact side of the vehicle.

1.3. Create a grid of points (2000x800mm) with an equal distance of 50mm on the impact zone, where the centre of the grid equals the mid-point of the impact zone (referring to the hit point of the barrier). This will be a number of 697 points in total.





XGrid = XTargetline – 1.000 mm

657 X=X_{Grid}+0 Y=0 Z=950	**658** X=X_{Grid}+50 Y=0 Z=950	**659** X=X_{Grid}+100 Y=0 Z=950	**…** … … …	**697** X=X_{Grid}+2.000 Y=0 Z=950
… … … …	**…** … … …	**…** … … …	**…** … … …	**…** … … …
83 X=X_{Grid}+0 Y=0 Z=250	**84** X=X_{Grid}+50 Y=0 Z=250	**85** X=X_{Grid}+100 Y=0 Z=250	**…** … … …	**123** X=X_{Grid}+2.000 Y=0 Z=250
42 X=X_{Grid}+0 Y=0 Z=200	**43** X=X_{Grid}+50 Y=0 Z=200	**44** X=X_{Grid}+100 Y=0 Z=200	**…** … … …	**82** X=X_{Grid}+2.000 Y=0 Z=200
1 X=X_{Grid}+0 Y=0 Z=150	**2** X=X_{Grid}+50 Y=0 Z=150	**3** X=X_{Grid}+100 Y=0 Z=150	**…** … … …	**41** X=X_{Grid}+2.000 Y=0 Z=150

1.4. The grid points shall be projected on the mesh of the scanned vehicle surface along the Y axis. Do this for the scan of the undeformed vehicle as well as for the scan of the deformed vehicle.

1.5. It may be that some points do not hit the mesh (e.g. because of holes in the mesh). This can be ignored if the points are outside the vehicle structure. Points on the vehicle structure should be placed as close as possible to the desired position by considering the Y value of the neighbouring grid points or the surrounding mesh surface.

1.6. Calculate ΔY (Yundeformed – Ydeformed) for each grid point.

1.7. Finally, the coordinates of the grid points with the related ΔY values should be exported to the assessment file (.csv-format).