



**EUROPEAN NEW CAR ASSESSMENT PROGRAMME
(Euro NCAP)**



**SIDE IMPACT MOBILE DEFORMABLE BARRIER
TESTING PROTOCOL**

For 2020 Implementation

Version 8.1
June 2019

Copyright ©Euro NCAP 2019 - This work is the intellectual property of Euro NCAP. Permission is granted for this material to be shared for non-commercial, educational purposes, provided that this copyright statement appears on the reproduced materials and notice is given that the copying is by permission of Euro NCAP. To disseminate otherwise or to republish requires written permission from Euro NCAP.

Preface

- Where text is contained within square brackets this denotes that the procedure being discussed is currently being trialled in Euro NCAP. Its incorporation in the Test Protocol will be reviewed at a later date.
- 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

Page No.

Side Impact

1	VEHICLE PREPARATION	4
1.1	Unladen Kerb Mass	4
1.2	Reference Loads	4
1.3	'R' Point	5
1.4	Vehicle Preparation	5
2	DUMMY PREPARATION AND CERTIFICATION	7
2.1	General	7
2.2	Certification	7
2.3	Additions and Modifications to the WorldSID Dummy	7
2.4	Dummy Clothing and Footwear	7
2.5	WorldSID Dummy Test Condition	7
2.6	WorldSID Dummy painting and marking	8
2.7	Post Test Dummy Inspection	8
3	INSTRUMENTATION	9
3.1	Dummy Instrumentation	9
3.2	Vehicle Instrumentation	10
3.3	Trolley and Barrier Instrumentation	10
4	PASSENGER COMPARTMENT ADJUSTMENT	11
4.1	Overview of Settings	11
4.2	Seat adjustments	12
4.5	Setting the Steering Wheel	13
4.6	Setting the rear seat (if adjustable)	13
5	DUMMY POSITIONING AND MEASUREMENTS	14
5.1	Determine the H-point of the driver's seat	14
5.2	Dummy Placement	15
5.3	Child Restraint System (CRS) Installation and Child Dummy Placement	17
5.4	Dummy Positioning Measurements	18
6	BARRIER AND TROLLEY	19
6.1	Trolley Preparation	19
7	TEST PARAMETERS	20
7.1	Impact Speed	20
7.2	Post-Impact Braking	20
7.3	Alignment	20
7.4	After Test	20
7.5	Dummy Removal	21
8	Dual Occupancy Test	22
8.1	Vehicle Preparation	22
8.2	Passenger Dummy	22
8.3	Overview of Settings for dual occupancy test	23
8.4	Impact Alignment	24

1 VEHICLE PREPARATION

1.1 Unladen Kerb Mass

- 1.1.1 The capacity of the fuel tank will be specified in the manufacturer's booklet. This volume will be referred to throughout as the "fuel tank capacity".
- 1.1.2 Syphon most of the fuel from the tank and then run the car until it has run out of fuel.
- 1.1.3 Calculate the mass of the fuel tank capacity using a density for petrol of 0.745g/ml or 0.840g/ml for diesel. Record this figure in the test details.
- 1.1.4 Refill the tank with fuel, water or other ballast to a weight equivalent to 90% of its fuel tank capacity of fuel.
- 1.1.5 Check the oil level and top up to its maximum level if necessary. Similarly, top up the levels of all other fluids to their maximum levels if necessary.
- 1.1.6 Ensure that the vehicle has its spare wheel on board along with any tools supplied with the vehicle. Nothing else should be in the car.
- 1.1.7 Ensure that all tyres are inflated according to the manufacturer's instructions for half load.
- 1.1.8 Measure the front and rear axle weights and determine the total weight of the vehicle. The total weight is the 'unladen kerb mass' of the vehicle. Record this mass in the test details.
- 1.1.9 Measure and record the ride heights of the vehicle at all four wheels.

1.2 Reference Loads

- 1.2.1 Place both front seats in their mid-positions, this may not be the same as the final test position. If there is no notch at this position, set the seat in the nearest notch rearward (this will be done more completely in Section 5).
- 1.2.2 Place weights equivalent to WorldSID 50th male test dummy (75kg) in the front driver's seating position. Where a dual occupancy test is to be performed replace Section 1.2.2 with Section 8.1.1.
- 1.2.3 Place weights in the luggage compartment of the vehicle until the total vehicle mass (sum of front and rear axle masses) is 100kg more than the unladen kerb mass (from Section 1.1.8). The normal luggage compartment should be used i.e. rear seats should not be folded to increase the luggage capacity. Spread the weights 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.
- 1.2.4 In the child restraints to be used for testing, place masses equivalent to Q10 and Q6 child dummies on the second-row driver's seat and passenger's seats respectively (23kg and 36kg). If the child restraints are not available at this time then default masses of 7kg and 2kg should be added to the dummy masses.
- 1.2.5 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.
- 1.2.6 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.
- 1.2.7 Record the axle reference loads and reference mass in the test details.
- 1.2.8 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.
- 1.2.9 Remove the weights from the luggage compartment and from the front and rear seats.

1.3 'R' Point

To measure vehicle dimensions and to apply markers, a pointer used to measure co-ordinates in three dimensions will be used.

- 1.3.1 The location of the R point relative to some part of the vehicle structure will have been provided by the manufacturer. Determine the position of this point.
- 1.3.2 Mark a point on the driver's side of the car which has X (longitudinal) co-ordinate not more than 1mm different to the theoretical R point location.
- 1.3.3 Mark a point on the driver's side of the car which is 250mm rearward of the R point location. This is the target impact point.
- 1.3.4 Draw a vertical line through the target impact point.
- 1.3.5 Mark points along the side of the vehicle which have the same X co-ordinates as the impact point. Continue these points onto the roof of the vehicle. The points should all lie in the same vertical transverse plane as the impact point.
- 1.3.6 Using a piece of sticky tape in a colour to contrast with the body-colour, join the points with one edge of the tape. Mark clearly on the tape which of its edges aligns with the impact point. This edge may be used to assess the alignment of the barrier with the impact point.

1.4 Vehicle Preparation

Care should be taken during vehicle preparation that the ignition is not switched on with the battery or airbag disconnected. This will result in an airbag warning light coming on and the airbag system will need to be reset.

- 1.4.1 Remove the carpeting, spare wheel and any tools or jack from the luggage area. The spare wheel should only be removed if it will not affect the crash performance of the vehicle.
- 1.4.2 Ensure that the vehicle's battery is connected, if possible in its standard position. Check that the dashboard light for the airbag circuit functions as normal.
- 1.4.3 Fit the on-board data acquisition equipment in the boot of the car. Also fit any associated cables, cabling boxes and power sources.
- 1.4.4 Place weights equivalent to a WorldSID 50th dummy (75kg) in the front driver's seat of the car (with the front seats in their mid-positions).
- 1.4.5 In the child restraints to be used for testing, place masses equivalent to Q6 and Q10 child dummies on the second-row driver's side seat and passenger's seats respectively (23kg and 36kg). If the child restraints are not available at this time then default masses of 7kg and 2kg should be added to the dummy masses.
- 1.4.6 Weigh the front and rear axle weights of the vehicle. Compare these weights with the reference weight determined in Section 1.2.6.
- 1.4.7 The total vehicle mass shall be within 1% of the reference mass. Each axle load shall be within the smaller of 5% or 20kg of its respective axle reference load. If the vehicle differs from the requirements given in this paragraph, items may be removed or added to the vehicle which has no influence on its structural crash performance. The levels of ballast in the fuel tank (equivalent in mass to 90% capacity of fuel) may also be adjusted to help achieve the desired axle weights. Any items added to increase the vehicle weight should be securely attached to the car.
- 1.4.8 Repeat Sections 1.4.6 and 1.4.7 until the front and rear axle weights and the total vehicle weight are within the limits set in 1.4.7.
- 1.4.9 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.

1.4.10 Record the final axle weights in the test details.

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

2 DUMMY PREPARATION AND CERTIFICATION

2.1 General

- 2.1.1 A WorldSID 50th percentile male test dummy shall be used in the front driver's position. It shall conform to the specification detailed in ISO 15830, parts 1-5.
- 2.1.2 Details of the child dummy preparation and certification are contained in the Euro NCAP Child Occupant Protection Testing Protocol.

2.2 Certification

Full details of the WorldSID certification requirements are available in the documents mentioned in Section 2.1.1 above. No manufacturer shall have access to any pre-test information regarding any of the test equipment to be used by Euro NCAP, or be permitted to influence its selection in any way.

- 2.2.1 The WorldSID shall be re-certified after every FOUR impact tests.
- 2.2.2 Details of the IR Tracc length calculation procedure are described in Technical Bulletin TB017.
- 2.2.3 If an injury criterion reaches or exceeds its normally accepted limit (eg HIC of 700) then that part should be re-certified.
- 2.2.4 If any part of a dummy is broken in a test then the part shall be replaced with a fully certified component.
- 2.2.5 Copies of the dummy certification certificates will be provided as part of the full report for a test.

2.3 Additions and Modifications to the WorldSID Dummy

- 2.3.1 The WorldSID dummy shall be equipped with the half arm assembly on both sides.
- 2.3.2 It is acceptable for the dummy to be equipped with build level E ankle joins.

2.4 Dummy Clothing and Footwear

- 2.4.1 WorldSID
 - 2.4.1.1 The dumm(ies) shall be clothed in a sleeveless suit or a modified version of the sleeved suit with sleeves removed.

2.5 WorldSID Dummy Test Condition

- 2.5.1 Dummy Temperature
 - 2.5.1.1 The dummy shall have a stabilised temperature in the range of 20.6°C to 22.2°C.
 - 2.5.1.2 A stabilised temperature shall be obtained by soaking the dummy in temperatures that are within the range specified above for at least 1 hour prior to the test.
 - 2.5.1.3 Measure the temperature of the driver dummy for at least 5 hours before test at intervals not exceeding 10 minutes and not exceeding 5 minutes before test.
 - 2.5.1.4 The temperature shall be measured using an onboard sensor located on the blue band of the first thoracic non struck side rib as far from the spine box as possible.
 - 2.5.1.5 A copy of the temperature readings is to be supplied as part of the standard output of the test.
- 2.5.2 Dummy Joints
 - 2.5.2.1 Stabilise the dummy temperature by soaking in the required temperature range for at least 5 hours.
 - 2.5.2.2 Set the torque on the shoulder screws to obtain a 1-2g holding force of the arm on its pivot.
 - 2.5.2.3 For adjustable joints in the legs, the tensioning screw or bolt which acts on the constant friction surfaces should be adjusted to obtain a 1-2g holding force.

- 2.5.2.4 The dummy joint stiffnesses should be set as close as possible to the time of the test and, in any case, not more than 24 hours before the test.
- 2.5.2.5 Maintain the dummy temperature within the permissible temperature range between the time of setting the limbs and up to a maximum of 5 minutes before the time of the test.

2.6 WorldSID Dummy painting and marking

- 2.6.1 The dummies shall have masking tape placed on the areas to be painted using the sizes detailed below. The tape should be completely covered with the following coloured paints. The paint should be applied close to the time of the test to ensure that the paint will still be wet on impact.

Driver

Head (Paint tape outline)	Red
Head CoG (circle Ø40mm)	Yellow
Head top along mid sagittal plane	Green
Shoulder/Arm	Blue
2 nd Thorax Rib	Green
3 rd Thorax Rib	Red
1 st Abdomen Rib	Blue
2 nd Abdomen Rib	Green
Pelvis	Orange

NOTE: The tape should be completely covered with the coloured paints specified, with the exception of the driver head which should have only the outer edge of the tape painted. Adhesive target markers should be attached to the top/rear of the child dummy’s head in order to aid the assessment of the child head containment.

Tape Sizes:

Driver

Head	= 100mm square, centreline of head with lower edge at C of G.
Head	= 200mm x 20mm strip, center located at head C of G
Arm	= 25mm x 150mm, starting at bottom edge of shoulder fixing hole.
Ribs	= 25mm x 150mm strip, starting at the rearmost accessible point at seat back.
Pelvis	= 50mm x 100mm, centred on hip joint point.

2.7 Post Test Dummy Inspection

- 2.7.1 All dummies shall be visually inspected immediately after the test.
- 2.7.2 Any lacerations of the skin or breakages should be noted in the test details, a dummy may have to be re-certified in this case. Refer to Section 2.2.
- 2.7.3 Any screws that have become loose or detached shall be re-tightened to the required torque or replaced as necessary.

3 INSTRUMENTATION

All instrumentation shall be calibrated before the test programme. The Channel Amplitude Class (CAC) for each transducer shall be chosen to cover the Minimum Amplitude listed in the table. In order to retain sensitivity, CACs which are orders of magnitude greater than the Minimum Amplitude should not be used. A transducer shall be re-calibrated if it reaches its CAC during any test. All instrumentation shall be re-calibrated after one year, regardless of the number of tests for which it has been used. A list of instrumentation along with calibration dates should be supplied as part of the standard results of the test. The transducers are mounted according to procedures laid out in SAE J211. The sign convention used for configuring the transducers is stated in SAE J211 (2007).

3.1 Dummy Instrumentation

3.1.1 The WorldSID dummy shall be instrumented to record the channels listed below. Additional channels may be recorded.

3.1.2 Where the number of channels in the WorldSID dummy is 45 or more, only in-dummy data acquisition systems may be used. Where there are less than 45 channels, the use of umbilical cables is at the laboratories discretion. Details of the child dummy instrumentation is contained in the Euro NCAP Child Occupant Protection Testing Protocol.

Location	Parameter	Minimum amplitude	Channel count
Head	Linear acceleration, Ax, Ay, Az	250g	3
Upper neck	Forces and moments Fx, Fy, Fz, Mx, My, Mz	5kN, 300Nm	6
Shoulder(s) ¹ – Joint	Forces, Fx, Fy, Fz	8kN	3 (6)
Shoulder – Rib	Displacement & rotation	100mm	2
Thorax - Upper rib	Displacement & rotation	100mm	2
Thorax - Mid rib	Displacement & rotation	100mm	2
Thorax - Lower rib	Displacement & rotation	100mm	2
Thoracic temperature ²	Temperature, see 2.5.1.3	30°C	1
Abdomen - Upper rib	Displacement & rotation	100mm	2
Abdomen - Lower rib	Displacement & rotation	100mm	2
Spine - T12	Acceleration, Ax, Ay, Az	200g	3
Pelvis	Acceleration, Ax, Ay, Az	200g	3
Pelvis – Pubic	Force	5kN	1
Femoral neck – struck side only	Force, Fx, Fy, Fz	5kN	3
	Total Channels		35 (38)

1 In a dual occupancy test, both driver shoulder shall be instrumented.

2 It is not necessary for this channel to be recorded through the dummy onboard DAU.

3.2 Vehicle Instrumentation

- 3.2.1 The vehicle is to be fitted with an accelerometer on the unstruck B-pillar. The accelerometer is to be fitted in the lateral direction (A_y).
- 3.2.2 Remove carpet and the necessary interior trim to gain access to the sill directly below the B-pillar.
- 3.2.3 Securely attach a mounting plate for the accelerometer horizontally on to the sill.
- 3.2.4 Fix the accelerometer to the mounting plate. Ensure the accelerometer is horizontal to a tolerance of ± 5 degrees.

VEHICLE

Location	Parameter	Minimum Amplitude	No of channels
B-Post (unstruck)	Acceleration, A_y	150g	1
Battery (including any secondary batteries)	Supply voltage, V	15V	1
Total Channels per Vehicle			2

3.3 Trolley and Barrier Instrumentation

- 3.3.1 The trolley is to be fitted with an accelerometer at its Centre of Gravity. The accelerometer is to be fitted in the fore/aft direction (A_x).

TROLLEY

Location	Parameter	Minimum Amplitude	No of channels
Trolley C of G	Acceleration, A_x	150g	1
Total Channels per Trolley			1

TOTAL CHANNELS

1x Driver	35 (38)
1x Q10	30
1x Q6	13
1x Vehicle	2
1x Trolley	1
TOTAL	81 (84)

4 PASSENGER COMPARTMENT ADJUSTMENT

4.1 Overview of Settings

Adjustment	Required Setting	Notes	Methods
Seat fore/aft	As defined in 4.4		
Seat base tilt	As defined in 4.4		
Seat height	As defined in 4.4		
Torso angle	Manufacturer's design position	Otherwise 23° to Vertical	See Section 5.1
Seat lumbar support	Fully retracted		See Section 4.2
Front head restraint height & tilt	Mid locking position	As whiplash test position. If there is any interference with the rear of the dummy head, move the HR to the most rearward position.	See Section 6.2 Whiplash testing protocol.
Front seat belt anchorage (where adjustable)	Initially, manufacturer's 50th percentile design position	If no design position then set to mid position, or nearest notch upwards	See Section 5.2.7
Steering wheel	Highest position and most outward		See Section 4.5
Rear seat fore/aft (where adjustable)	Manufacturer's design position	Where no details are provided in the handbook, set to mid	See Section 4.6
Rear seat back angle (where adjustable)	Manufacturer's design position	Otherwise 25° to Vertical	See Section 4.6
Rear seat facing	Forwards		
Rear head restraint height & tilt	As recommended in vehicle handbook.	Where no details are provided in the handbook, set to mid or next lowest position for height and mid locking position for tilt. Must not interfere with child/CRS installation	See Section 6.2 Whiplash testing protocol.
Rear seat belt anchorage (where adjustable)	As recommended in vehicle handbook for CRS installation.	If no recommendation then set to mid-position, or nearest notch upwards. MUST be same as ODB	
Arm-rests (Front seats)	Lowered / in use position	May be left up if dummy positioning does not allow lowering. Where adjustable place in horizontal position. Single occupancy test only.	
Arm-rests (Rear seats)	Stowed position		
Side window glazing	All raised		
Gear change lever	In the neutral position		
Parking brake	Engaged		
Pedals	Normal position of rest	Adjustable pedals fully forward	See Section 4.2
Doors	Closed, not locked	For automatic door locks, refer to the Rescue and Extrication protocol.	
Roof / sunroof	Raised / fully closed	Where applicable	
Sun visors	Stowed position		
Rear view mirror	Normal position of use		

Adjustments not listed will be set to mid-positions or nearest positions rearward, lower or outboard.

4.2 Seat adjustments

- 4.2.1 Position the seat's adjustable lumbar supports so that the lumbar supports are in the lowest, retracted or deflated adjustment positions.
- 4.2.2 Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position.
- 4.2.3 Position an adjustable seat cushion length to the retracted position.
- 4.2.4 Position an adjustable leg support system in its rearmost position.
- 4.2.5 Place adjustable pedals in the full forward position (towards the front of the vehicle.)

4.3 Seat markings

- 4.3.1 Identify and mark one seat reference point (SRP₁) at the rear side of the seat cushion, SRP₁.
- 4.3.2 Where the seat cushion pitch is adjustable, identify and mark a second reference point, SRP₂, that is at least 300mm forward of the rear reference point (SRP₁) and draw a line through the two reference points.
- 4.3.3 Locate and mark the longitudinal centreline of the seat cushion. The intersection of the vertical longitudinal plane that passes through the SRP₁ and the seat cushion upper surface determines the longitudinal centreline of a bucket seat cushion.
- 4.3.4 Where the front seats are bench seats, locate and mark the longitudinal line on the seat cushion that marks the intersection of the vertical longitudinal plane through the centreline of the steering wheel and the seat cushion upper surface.

4.4 Positioning the seat

- 4.4.1 Use the seat control that primarily moves the seat vertically to adjust the rearmost seat reference point, SRP₁, defined in 4.3.1 to the upper most vertical location.
- 4.4.2 Use the seat control that primarily moves the seat fore-aft to adjust the rearmost seat reference point, SRP₁, defined in 4.3.1 to the rearmost location.
- 4.4.3 Determine and record the range of angles of the seat cushion pitch and using only the control(s) that primarily adjust(s) the cushion pitch, set cushion pitch to the mid-angle
- 4.4.4 Use the seat control that primarily moves the seat vertically to adjust the rearmost seat reference point defined in 4.3.1, SRP₁, to the lowest vertical location. Verify that you are still at the rearmost seat track location. Record the X position of SRP₁.
- 4.4.5 Use the seat control that primarily moves the seat fore-aft to adjust the rearmost seat reference point, SRP₁, to the rearmost location. Record the X position of SRP₁.
- 4.4.6 Use the seat control that primarily moves the seat fore-aft to adjust the rearmost seat reference point, SRP₁, to the forward most location; Record the X position of SRP₁.
- 4.4.7 Measure and mark an X position 20mm rearward of the midpoint (MP +20mm).
- 4.4.8 Use the seat control that primarily moves the seat fore-aft to adjust the rearmost seat reference point, SRP₁, to the X position marked in 4.4.7 or, if this is not possible, to the first X possible position rearward the marked position in 4.4.7. If the seat cannot be placed at exactly 20mm rearward of the midpoint select the next closest available rearward setting.
- 4.4.9 For some vehicles this final step may change the cushion pitch as established in 4.4.8, this is acceptable.
- 4.4.10 Record test seat position using the seat reference point, SRP₁.

The settings for the passenger seat should be as near as possible to being the same as that of the driver's seat.

4.5 Setting the Steering Wheel

- 4.5.1 Set the steering wheel at the geometric highest driving position considering the full range of telescopic and tilt adjustment possibilities, in order to provide clearance for the legs and thorax.

4.6 Setting the rear seat (if adjustable)

- 4.6.1 If the vehicle rear seat position is adjustable put it in the same fore/aft position as that used in the frontal impact ODB test with the same seat back angle.

5 DUMMY POSITIONING AND MEASUREMENTS

5.1 Determine the H-point of the driver's seat

The device to be used is the H-point machine as described in SAE J826.

If the seat is new and has never been sat upon, a person of mass $75 \pm 10\text{kg}$ should sit on the seat for 1 minute twice to flex the cushions. The seat shall have been at room temperature and not been loaded for at least 1 hour previous to any installation of the machine.

- 5.1.1 Set the seat back so that the torso of the H-point manikin is as close as possible to the manufacturer's recommendations for normal use. In absence of such recommendations, an angle of 23 degrees $\pm 1^\circ$ towards the rear from vertical will be used.
- 5.1.2 The driver and passenger seatback angle and seat base shall be set to the same position.
- 5.1.3 Place a piece of muslin cloth on the seat. Tuck the edge of the cloth into the seat pan/back join, but allow plenty of slack.
- 5.1.4 Place the seat and back assembly of the H-point machine on the seat at the centre line of the seat.
- 5.1.5 The length of the lower leg and thigh segments of the H-point manikin shall be adjusted to the 50th percentile (418mm) and 10th percentile (408mm) positions respectively.
- 5.1.6 Attach lower legs to machine ensuring that the transverse member of the T-bar is parallel to the ground.
- 5.1.7 Place the right foot on the undepressed accelerator pedal, with the heel as far forwards as allowable. The distance from the centre line of the machine should be noted.
- 5.1.8 Place left foot at equal distance from centre line of machine as the right leg is from centre line. Place the foot flat on the footwell.
- 5.1.9 Apply lower leg and thigh weights.
- 5.1.10 Tilt the back pan forwards to the end stop and draw the machine away from the seatback.
- 5.1.11 Allow the machine to slide back until it is stopped by contacting the seat back.
- 5.1.12 Apply a 10kg load twice to the back and pan assembly positioned at the intersection of the hip angle intersection to a point just above the thigh bar housing.
- 5.1.13 Return the machine back to the seat back.
- 5.1.14 Install the right and left buttock weights.
- 5.1.15 Apply the torso weights alternately left and right.
- 5.1.16 Tilt the machine back forwards to a vertical position and, while holding the T-bar, rock the pan by 5 degrees either side of the vertical. The feet are NOT to be restrained during the rocking. Holding the T-bar to prevent the H-Point machine from sliding forward on the seat cushion, return the machine back to the seat back.
- 5.1.17 Reposition the feet by lifting the leg and then lowering the leg so that the heel contacts the floor and the sole lies on the undepressed accelerator.
- 5.1.18 Check the lateral spirit level and if necessary apply a lateral force to the top of the machine back, sufficient to level the seat pan of the machine.
- 5.1.19 Adjust the seat back angle to the angle determined in 5.1.1, measured using the spirit level and torso angle gauge of the H-point machine. Ensure that the torso remains in contact with the seat back at all times. Ensure that the machine pan remains level at all times.
- 5.1.20 If the measured angle is not within $\pm 1^\circ$ of the target, the chest and buttocks weights shall be removed, the seat back readjusted, and the steps to position the H-point manikin shall be repeated, beginning with tilting the back pan forward as in 5.1.10.
- 5.1.21 Measure and record in the test details the position of the H-point relative to some easily identifiable part of the vehicle structure.

5.2 Dummy Placement

- 5.2.1 It is the intention that the dummy should not be left to sit directly on the seat for more than 2 hours prior to the test. It is acceptable for the dummy to be left in the vehicle for a longer period, provided that the dummy is checked no more than one hour prior to test. It is not acceptable for the dummy to be left in the vehicle overnight or for a similarly lengthy period.
- 5.2.2 If the vehicle has only two side doors, it may be necessary to fit the child restraint systems and child dummies (Section 5.3) before setting up the driver dummy in the front seat.

5.2.3 *H-point*

Note that the H-point of the WorldSID dummy is situated 20mm forward of that of the H-point determined by the H-point manikin.

- 5.2.3.1 Using only the controls that move the seat fore-aft, move the test seat to the rearmost position to facilitate placement of the dummy.
- 5.2.3.2 Position the dummy in the seat such that the mid-sagittal plane is coincident with the centreline markings and the upper torso resting against the seat back.
- 5.2.3.3 Apply a fore-aft and lateral rocking motion to settle the pelvis rearward in the seat.
- 5.2.3.4 To ensure a repeatable and stable pelvis position, ensure that the pelvis is in contact with the seat cushion over the whole length.
- 5.2.3.5 To ensure a repeatable placement of the lower abdominal rib, make sure it is inside the pelvis flesh and not on top of it.
- 5.2.3.6 Move the seat together with the dummy to the test seat position defined in 4.4.9. If it is not possible to reach the seat test position due to knee contact, shift the targeted test seat position rearwards in the stepwise increments to the closest position where the knee clearance is at least 5mm. Modify the target H-point accordingly.
- 5.2.3.7 Verify that the H-point is reasonably close ($\pm 10\text{mm}$) to the target H-point 5.1.21 or as defined in 5.2.3.6 if the target H-point has been modified. If not, repeat step 5.2.3.3. If it is still not possible, record the rearmost seat cushion reference point and the dummy H-point and proceed to the next step.
- 5.2.3.8 Extend the right leg without displacing the thigh from the seat cushion. Allow the sole of the foot to settle on the accelerator pedal; the heel of the shoe should be in contact with the floor pan. Where a lack of ankle articulation prevents the foot from sitting flat on the accelerator pedal, keep the foot at a 90 degree angle to the tibia and ensure that the heel is in contact with the floor.
- 5.2.3.9 Extend the left leg without lifting the thigh from the seat cushion and allow the sole of the foot to settle on the footrest or floor if no footrest is present. The heel of the shoe should be in contact with the floor. In case of tibia contact, slide the foot rearward toward the seat until a 5mm clearance is obtained. Where a lack of ankle articulation prevents the foot from sitting flat on the floor, keep the foot at a 90 degree angle to the tibia and ensure that the heel is in contact with the floor.
- 5.2.3.10 Position the H-point of the dummy to match the WorldSID H-point coordinates recorded following Section 5.1 to within $\pm 10\text{mm}$. Prioritise the X coordinate.
- 5.2.4 Head and torso
- 5.2.4.1 Adjust the dummy until the thorax tilt sensor coincides with the angle specified by the manufacturer.
- 5.2.4.2 If the rib angle is not specified by the manufacturer and the seat back is $23^\circ \pm 1^\circ$, adjust the dummy until the thorax tilt sensor reads -2° (2° downwards) $\pm 1^\circ$.
- 5.2.4.3 If no rib angle is specified and the seat back angle is not $23^\circ \pm 1^\circ$, no further adjustment

of rib angle is required.

5.2.4.4 Adjust the dummy neck bracket to level the head at the closest position to $0^\circ \pm 1^\circ$.

5.2.5 Legs and feet

5.2.5.1 Proceed to the final foot and leg positioning by repeating Section 5.1.7 and 5.1.8. Where a lack of ankle articulation prevents the foot from sitting flat on the accelerator pedal/floor, keep the foot at a 90 degree angle to the tibia and ensure that the heel is as far forward as possible and in contact with the floor.

5.2.5.2 No distance is specified for the knee spacing. However, priority should be given to ensure the following:

5.2.5.3 There is 5 mm clearance between the knees/legs and the steering shroud and centre console.

5.2.5.4 There is a stable foot and ankle position.

5.2.5.5 The legs are as parallel as possible to the sagittal plane.

5.2.6 Arms

5.2.6.1 Place both arms at the first detent downward of the most upward detent that corresponds to a differential angle of 32° between rib angle sensor and the arm angle.

5.2.7 Seat belt

5.2.7.1 Where possible, initially position the upper seat belt anchorage in the manufacturers 50th percentile design position. If no design position is provided, set the adjustable upper seat belt anchorage to the mid-position or nearest notch upward.

5.2.7.2 Carefully place the seat belt across the dummy and lock as normal.

5.2.7.3 Remove the slack from the lap section of the webbing until it is resting gently around the pelvis of the dummy. Only minimal force should be applied to the webbing when removing the slack. The route of the lap belt should be as natural as possible.

5.2.7.4 Place one finger behind the diagonal section of the webbing at the height of the dummy sternum. Pull the webbing away from the chest horizontally forward and allow it to retract in the direction of the D-loop using only the force provided by the retractor mechanism. Repeat this step three times, only.

5.2.7.5 After following the above steps, the seatbelt should lie in a natural position across the dummy sternum and shoulder clavicle. Where this is not the case, for example the belt is close to or in contact with the neck or the belt is above the shoulder rotation adjustment screw, and the upper belt anchorage is adjustable the anchorage should be lowered and steps 5.2.7.3 and 5.2.7.4 repeated.

5.2.7.6 The upper anchorage should be lowered by a sufficient amount to ensure a natural belt position following the repetition of steps 5.2.7.3 and 5.2.7.4. This may require multiple attempts.

5.2.7.7 Once the belt is positioned the location of the belt should be marked across the dummy chest to ensure that no further adjustments are made. Mark also the belt at the level of the D-loop to be sure that the initial tension is maintained during test preparation.

5.2.7.8 Measure the vertical distance between the dummy nose and the diagonal webbing.

5.2.7.9 Measure the horizontal distance between the diagonal webbing and the door/window.

5.2.8 After positioning the dummy measure and record the dummy position according to Section 5.4 and determine the impact location as described in Section 1.4.

5.3 Child Restraint System (CRS) Installation and Child Dummy Placement

The child dummy and CRS installation procedures are detailed in the Euro NCAP Child Occupant Protection Testing protocol.

5.4 Dummy Positioning Measurements

The following measurements are to be recorded prior to the test after the dummy settling and positioning procedures have been carried out.

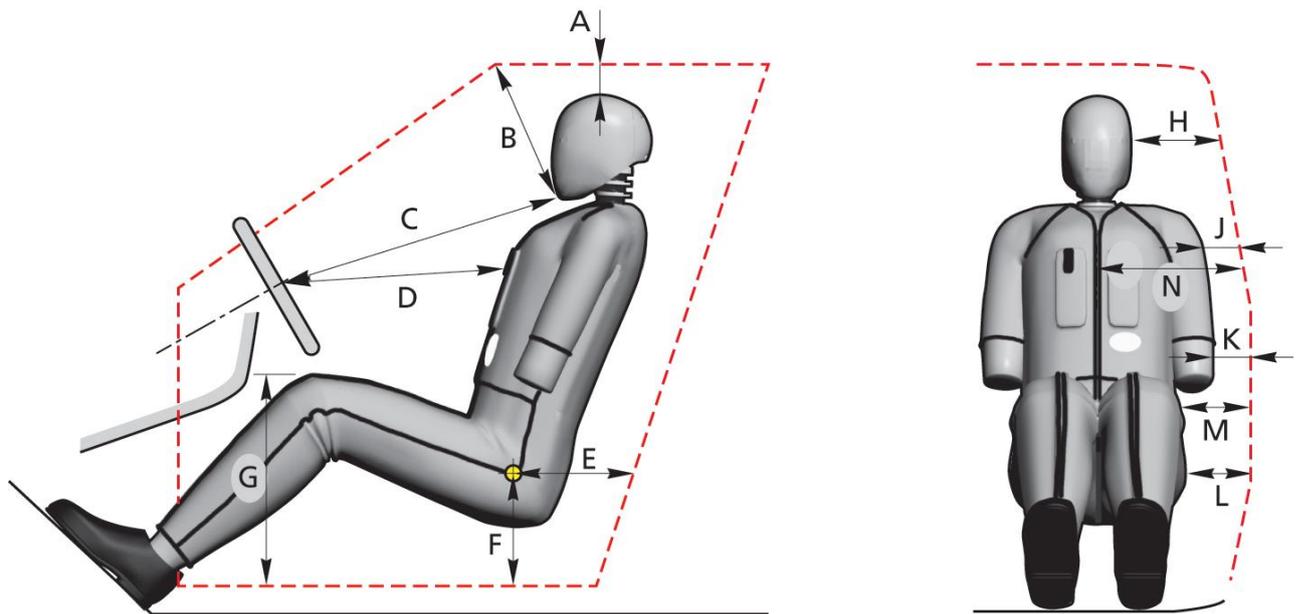


Figure 1: Driver dummy measurements

Driver measurements	
A	Head/roof panel
B	Chin/windscreen joint
C	Chin/centre of the steering
D*	Thorax strap/centre of the steering wheel
E	Hip-joint point/inside opening of the door (horizontal)
F	Hip-joint point/inside opening of the door (vertical)
G	Knee/floor covering (vertical)
H	Head/side window pane (or padding)
J	Shoulder/window pane (or padding)
K	Elbow/door (or padding)
L	Pelvis/door (or padding)
M	Knee/door (or padding)
N	Belt webbing to door (horizontally)

* Horizontal distance from steering wheel centre

6 BARRIER AND TROLLEY

The trolley will be fitted with the Advanced European Mobile Deformable Barrier face (AE-MDB) and ventilation frame conforming to the specifications of Technical Bulletin 014.

6.1 Trolley Preparation

- 6.1.1 The mobile deformable barrier (MDB) includes both an impactor and a trolley.
- 6.1.2 The total mass shall be $1400 \pm 20\text{kg}$.
- 6.1.3 The centre of gravity shall be situated in the longitudinal median vertical plane within 10mm, $1000 \pm 30\text{mm}$ behind the front axle and $500 \pm 30\text{mm}$ above the ground.
- 6.1.4 The distance between the front face of the impactor and the centre of gravity of the barrier shall be $2000 \pm 30\text{mm}$.
- 6.1.5 The height of the barrier shall be such that the uppermost part of the front face of the beam element (the intersection between the upper and lower row of blocks) is $550\text{mm} \pm 5\text{mm}$ above ground level measured statically prior to impact.
- 6.1.6 The front and rear track width of the trolley shall be $1500 \pm 10\text{mm}$.
- 6.1.7 The wheelbase of the trolley shall be $3000 \pm 10\text{mm}$.
- 6.1.8 The trolley may be fitted with an emergency abort system. This is optional, the test facility may elect to test without an abort system.
- 6.1.9 Inflate all tyres of the trolley to the same pressure.
- 6.1.10 Mark a line along the vertical centreline of the barrier which may be used to check the alignment of the barrier with the impact location of the test vehicle.
- 6.1.11 Measure the wheelbase of the trolley, left and right.
- 6.1.12 Determine the average wheelbase from Section 6.1.11 and record in the test details.
- 6.1.13 Record in the test details the track of the trolley at the front and at the rear.
- 6.1.14 Ensure that the weight distribution is as even as possible left to right.
- 6.1.15 Record in the test details the final weights measured at each of the wheels.

7 TEST PARAMETERS

An on-board data acquisition unit will be used. This equipment will be triggered by a contact plate at the point of first contact ($t=0$) and will record digital information at a sample rate of 20kHz (alternatively a sample rate of 10kHz may be used). The equipment conforms to SAE J211 (2007).

BEFORE THE TEST, ENSURE THAT THE LIVE BATTERY IS CONNECTED, A SINGLE KEY IS IN THE IGNITION, THE IGNITION IS ON AND THAT THE AIRBAG LIGHT ON THE DASHBOARD ILLUMINATES AS NORMAL (WHERE FITTED)

If the vehicle is fitted with a suspension system, pedal retraction system or any other system which requires running of the engine just before test execution, the engine should be run for a predetermined time, specified by the manufacturer.

7.1 Impact Speed

7.1.1 Measure the speed of the trolley as near as possible to the point of impact.

7.1.2 Record the actual test speed in the test details.

$$\text{TARGET SPEED} = 60\text{km/h} \pm 1\text{km/h}$$

7.2 Post-Impact Braking

7.2.1 A method must be employed to eliminate secondary impacts between the barrier and the car. This may be an emergency braking system on the trolley or other method but should be activated only after the first impact is complete.

7.2.2 Do NOT start the braking at the point of initial impact or the trolley will be decelerating during the test.

7.3 Alignment

7.3.1 With the vehicle offered up against the barrier, tape a small rivet at the centreline of the deformable barrier as close as possible to the point of first contact.

7.3.2 This pin should align with the vertical impact point line previously marked on the car (Section 1.4).

7.3.3 After the test, if the mark made by the pin is not within the tolerance square detailed below, film analysis will be used to try to assess the alignment. Both the horizontal and vertical alignments shall be noted in the test report.

7.3.4 TARGET ALIGNMENT = CENTRELINE OF BARRIER COINCIDENT WITH PLANE 250mm REARWARD OF 'R' POINT $\pm 25\text{mm}$

7.3.5 TARGET VERTICAL ALIGNMENT = $\pm 25\text{mm}$

7.4 After Test

7.4.1 Door Opening

7.4.1.1 Check that none of the doors, including boot lids and any movable roofs, have opened or partially opened during the test. Where this is the case photographic evidence shall be obtained and provided in the test report.

7.4.1.2 Struck side doors handles shall be immediately covered with tape to prevent inadvertent opening. Reference measurements shall be taken between the door skin and aperture to ensure that the door has not move or been disturbed between the test and inspection.

7.4.1.3 Check that the unstruck side doors are not locked and open the doors by hand (front door followed by rear door).

7.4.1.4 If the doors do not open, record this in the test details.

7.4.2 Refer to the Rescue and Extrication protocol for further details of post-test assessment.

7.5 Dummy Removal

7.5.1 Do not move the driver seat. Try to remove the dummy.

7.5.2 If the dummy cannot be removed with the seats in its original position, recline the seat back and try again.

7.5.3 If the dummy still cannot be removed, try to slide the seat back on its runners or remove the steering wheel.

7.5.4 If the dummy still cannot be removed, the seat can be cut out of the car.

8 Dual Occupancy Test

The dual occupancy AE-MDB test for evaluating occupant to occupant interaction will only be accepted in 2020 and 2021. From 2022 onwards, occupant to occupant protection must be demonstrated with the dual occupancy pole test.

8.1 Vehicle Preparation

8.1.1 Place weights equivalent to two WorldSID 50th dummies (75kg) in both front seats in their mid positions.

8.2 Passenger Dummy

8.2.1 A WorldSID 50th percentile male test dummy shall be used in the front passenger's position. It shall conform to the specification detailed in ISO 15830, parts 1-5.

8.2.2 The dummy shall conform to the specifications detailed in Section 2.

8.2.3 The dummy shall be re-certified after every TEN impact tests.

8.2.4 Dummy painting (sizes specified in Section 2.6)

Driver

Head (100 mm x 100mm tape outline)

Head CoG (circle Ø40mm)

Head top along mid sagittal plane

inboard side of head

Red

Yellow

Green

Passenger

Head (100 mm x 100mm tape outline)

Head CoG (circle Ø40mm)

Head top along mid sagittal plane

Shoulder/Arm

inboard side of head

Blue

Orange

Yellow

Green

8.2.5 Dummy Instrumentation

The WorldSID dummy on the passenger's seat shall be instrumented to record the channels listed below. Additional channels may be recorded.

Location	Parameter	Minimum amplitude	Channel count
Head	Linear acceleration, Ax, Ay, Az	250g	3
Upper neck	Forces and moments Fx, Fy, Fz, Mx, My, Mz	5kN, 300Nm	6
Shoulder – Joint	Forces, Fx, Fy, Fz	8kN	3
Spine - T12	Acceleration, Ax, Ay, Az	200g	3
Pelvis	Acceleration, Ax, Ay, Az	200g	3
Pelvis – Pubic	Force	5kN	1
	Total Channels		19

8.3 Overview of Settings for dual occupancy test

Adjustment	Required Setting	Notes	Methods
Seat Fore/Aft	As defined in 4.4	Driver	
Seat Fore/Aft	Same fore/aft position as driver.	Passenger. The head CoG must be aligned with that of the driver.	See Section 8.3.2
Seat Base Tilt	As defined in 4.4	Driver and Passenger	
Seat Height	As defined in 4.4	Driver and Passenger	
Torso Angle	Manufacturer's design position	Otherwise 23° to Vertical Identical for driver and passenger	See Section 5.1
Seat Lumbar Support	Fully retracted		See Section 4.2
Arm-rests (Front seats)	Raised / not in use position		

Adjustments not listed will be set according to Section 4.1.

- 8.3.1 Determine the H-point of the passenger's seat as detailed in Section 5.1.
- 8.3.2 Set the passenger's seat to the same fore/aft position as that of the driver's seat.
- 8.3.3 Install the passenger dummy as detailed in Section 5.2.
- 8.3.4 Ensure that the CoG of the passenger's head is in the same fore/aft position as that of the driver $\pm 10\text{mm}$.
- 8.3.5 Where the passenger seat height is not adjustable, the smallest possible fore/aft distance between driver and passenger head CoG should be achieved without adjustment of the seat back angle.

8.3.6 Dummy Positioning Measurements for passenger side

The following measurements are to be recorded prior to the test after the dummy settling and positioning procedures have been carried out, see Figure 2.

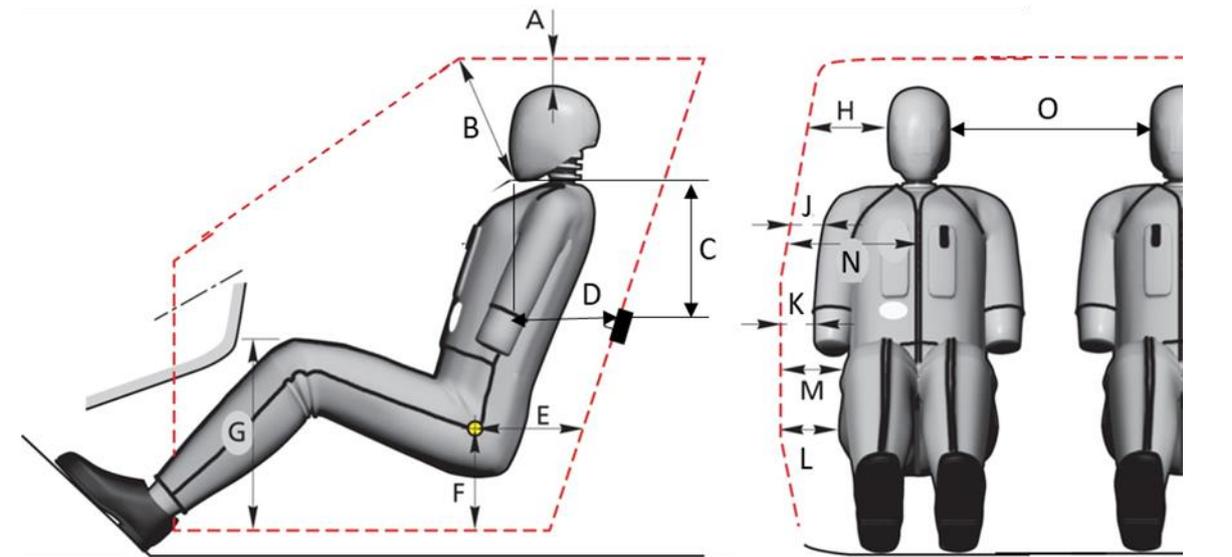


Figure 2: Passenger Dummy Measurements

Driver measurements	
A	Head/roof panel
B	Chin/windscreen joint
C	Chin/door hook plate top screw head (vertical)
D	Chin/door hook plate top screw head (horizontal)
E	Hip-joint point/inside opening of the door (horizontal)
F	Hip-joint point/inside opening of the door (vertical)
G	Knee/floor covering (vertical)
H	Head/side window pane (or padding)
J	Shoulder/window pane (or padding)
K	Elbow/door (or padding)
L	Pelvis/door (or padding)
M	Knee/door (or padding)
N	Belt webbing to door (horizontally)
O	Distance between CoG and impact line (horizontally)

8.4 Impact Alignment

The impact alignment in the dual occupancy test shall also be in accordance with Section 7.3, Figure 3.

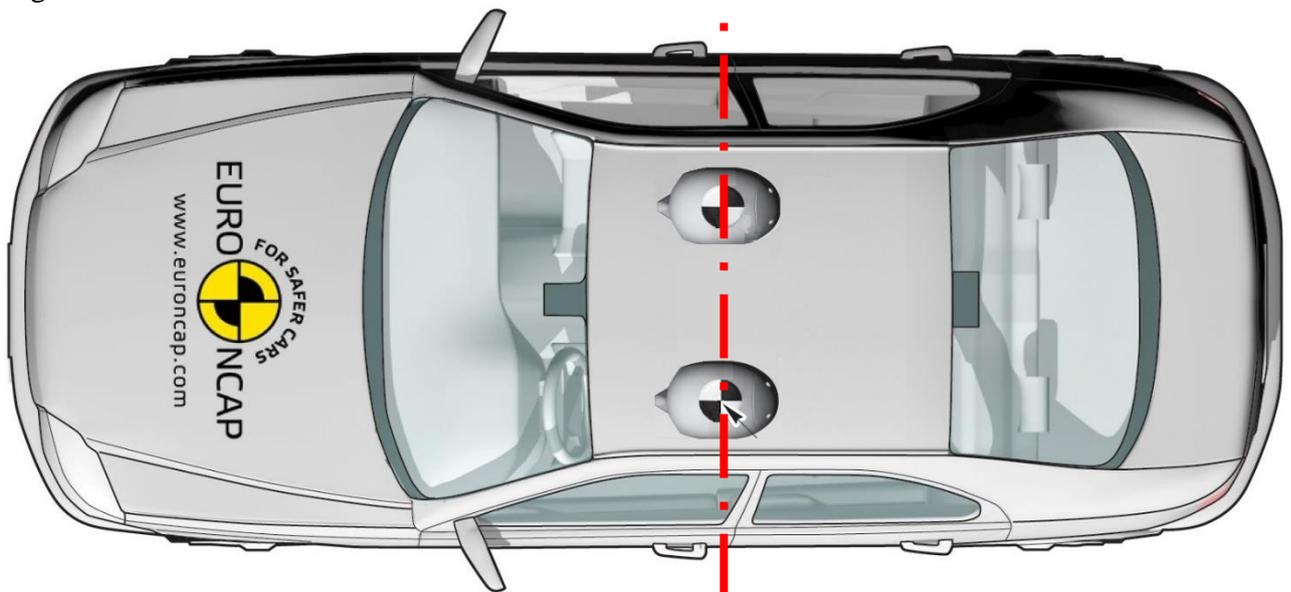


Figure 3: Impact reference line