EURO NCAP

#FORSAFERCARS

Version 1.0
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Crash Protection
Frontal Impact

Protocol

Implementation 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

SCORING

Crash Protection – Frontal Impact	Total points 40
Offset test	**20**
Driver – THOR 50th	5
Front passenger – HIII 5th	5
Rear passenger – Q6	5
Rear passenger – Q10	5
Full width test	**10**
Driver – HIII 5th	5
Front passenger – THOR 50th	2.5
Rear passenger – HIII 5th	2.5
Sled & virtual testing	**10**
Driver	5
50km/h – HIII 50th	
56km/h – HIII 95th	
35km/h – HIII 50th	
35km/h – HIII 5th	
56km/h – HIII 5th	
Front passenger	5
50km/h – HIII 95th	
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56km/h – HIII 95th	

Definitions used in this protocol can be found in Euro NCAP Technical Bulletin CP 001.

1 MEASURING EQUIPMENT

1.1 Reference system

The sign convention used for configuring the transducers is stated in SAE J211 (2022).

1.2 Dummies

All Anthropometric Test Devices (ATD) shall conform to the specifications detailed in the respective Technical Bulletins below:

Test	ATD
MPDB & FWDB	THOR 50th percentile - CP 106 Hybrid III 5th percentile - CP 103 Q6 and Q10 child - CP 009
Virtual testing	Hybrid III 5th percentile - CP 103 Hybrid III 50th percentile - CP 104 Hybrid III 95th percentile - CP 105

1.3 Collision partners

1.3.1 MPDB

The Mobile Progressive Deformable Barrier (MPDB) includes both a barrier face and a trolley. The MPDB shall conform to the specifications of Technical Bulletin CP 101.

1.3.2 Full width test

The wall shall be fitted with the Full Width Deformable Barrier Face (FWDB) conforming to the specifications of Technical Bulletin CP 102.

The barrier shall consist of a block of reinforced concrete not less than 3m wide in front and not less than 1.5m high. The barrier shall be of such thickness that it weighs at least 70 metric tons. The front face shall be flat, vertical and perpendicular to the axis of the run-up track. It may be covered with plywood boards 20mm ± 2mm thick to prevent damage to the mounting face. When used, the plywood shall be in good condition.

The barrier face shall be mounted with the lower edge of the honeycomb 80mm above ground level. It is important to ensure that all vehicle structures impact the barrier face and not the surrounding wall.

1.4 Measurements and variables

1.4.1 Instrumentation general

All instrumentation used in the test shall be (re-)calibrated within at least one year before each test and should be re-calibrated if it reaches its Channel Amplitude Class (CAC) during any test.

The measurement data shall be recorded according to ISO 6487 or SAE J211/1 (2022) at a minimum sample frequency of 20kHz. For sled and virtual testing, data shall be provided to Euro NCAP with a sample frequency of 10kHz.

1.4.2 VUT instrumentation

Location	Parameter	CAC
B-Pillar - LHS & RHS	Acceleration, A_x	150g
Driver's seatbelt shoulder section	Force, $F_{diagonal}$	16kN
Row 1 passenger's seatbelt shoulder section	Force, $F_{diagonal}$	16kN
Row 2 passenger's seatbelt shoulder section	Force, $F_{diagonal}$	16kN
Q10 seatbelt shoulder section	Force, $F_{diagonal}$	16kN
Q6 seatbelt shoulder section	Force, $F_{diagonal}$	16kN
Low voltage battery - including secondary batteries	Supply voltage, V_{low}	60V
High voltage battery	Propulsion voltage, V_{high}	1000V

B-pillar accelerometers are to be fitted to a tolerance of ±1 degree and parallel to the X-axis of the vehicle.

Seatbelt loadcells shall weigh <100g and be calibrated in accordance with the procedure in ISO/TS 7242:2014.
Where the fitment of the shoulder belt loadcell significantly influences the natural position of the belt, the loadcell may be supported from above with the use of a weak non-metallic wire or thread. Where loadcells are to be placed on any seatbelts equipped with pretensioners, ensure that the loadcell is placed far enough away from the D-loop to ensure there is no interaction as the pretensioner fires. Where any CRS does not allow the loadcell to be placed a sufficient distance from the D-loop do not attach the loadcell.

1.4.3 MPDB trolley instrumentation

Location	Parameter	CAC
Trolley C of G	Acceleration, A_x A_y A_z	150g
Trolley C of G, backup sensor	Acceleration, A_x A_y A_z	150g

1.4.4 Sled instrumentation

Location	Parameter	CAC
Sled	Acceleration, A_x	150g
Driver seatbelt shoulder and lap* sections	Force, $F_{diagonal}$, F_{lap}	16kN

* Care must be taken to position the lap belt transducer outboard of the dummy so that it does not interfere with the dummy/interior during the impact.

2 TEST CONDITIONS

2.1 VUT preparation

In advance of test preparation, the OEM shall provide Euro NCAP and the test laboratory with the information detailed in Technical Bulletin CP 002. Prepare the vehicle as defined in Technical Bulletin CP 004 and perform pretest intrusion measurements.

2.2 Occupant compartment adjustments

Position the seats as detailed below. Adjustments not listed will be set to mid positions or the nearest position rearward, lowest or outboard. Adjustments are to be made following the order in each table.

Where specific settings are NOT indicated for either the driver or passenger, the same MDP and setting must be used for all occupants. For seat movement definitions, see CP 001.

2.2.1 5th percentile occupants

Adjustment	Required setting – Hybrid III
Fore/aft	**Driver** - MDP permissible between fully forward and 25% of travel, measured in lowest position otherwise fully forwards **Front passenger** - Mid position between fully forward and 95th otherwise first notch rearwards, measured in lowest position
Front seat cushion tilt	MDP permissible up to mid, otherwise mid.
Front seat height	MDP permissible between fully upward and 75% travel downwards, when in 5th percentile fore/aft position, otherwise mid.
Front seat torso angle	MDP otherwise 25° torso angle
Front seat lumbar support	Fully retracted
Front seat cushion length	Fully retracted
Front head restraint	**Fore/aft or tilt -** MDP, otherwise mid position. **Height -** Lowest position.
Front seat belt anchorage	Lowest

2.2.2 50th percentile occupants

Adjustment	Required setting – THOR and Hybrid III
Fore/aft	Mid position between fully forward and 95th otherwise first notch rearwards, measured in lowest position.
Front seat cushion tilt	MDP permissible up to mid, otherwise mid
Front seat height	Lowest position
Front seat torso angle	MDP otherwise 25° torso angle
Front seat lumbar support	Fully retracted
Front seat cushion length	Fully retracted
Front head restraint	**Height:** Mid position **Fore/aft or tilt:** Mid position
Front seat belt anchorage	MDP otherwise mid

2.2.3 95th percentile occupants

Adjustment	Required setting – Hybrid III
Fore/aft	95th position, measured in lowest position
Front seat cushion tilt	MDP permissible up to mid, otherwise mid.
Front seat height	Lowest position
Front seat torso angle	MDP otherwise 25° torso angle
Front seat lumbar support	Fully retracted
Front seat cushion length	Fully retracted
Front head restraint	**Fore/aft or tilt** - MDP, otherwise mid position **Height -** Highest position
Front seat belt anchorage	Highest

2.2.4 Rear seats

The rear seat settings must be the same for MPDB, FWDB and AE-MDB.

Adjustment	Required setting
Rear seat facing	Forwards
Rear seat lateral position	Most outboard
Rear seat fore/aft	Rearmost
Rear seat cushion tilt	MDP up to mid position, otherwise mid
Rear seat height	MDP up to mid position, otherwise lowest
Rear seat back angle	MDP, otherwise 25° torso angle
Rear seat lumbar support	Fully retracted
Rear seat cushion length	Fully retracted
Rear head restraint	**Fore/aft or tilt -** MDP, otherwise mid **Height** - Lowest in use Remove if the vehicle handbook allows for CRS use.
Rear seat belt anchorage	MDP per stature, otherwise mid

2.2.5 Other settings

Other settings	Required setting
Steering wheel	**5th percentile** – MDP otherwise mid vertical and horizontal with a minimum horizontal distance to the dummy of 250mm measured from the centre of the steering wheel. **50th percentile** - mid vertical and horizontal **95th percentile** – MDP otherwise mid vertical and horizontal
Arm-rests – front and rear seats	Adjustable arm-rests on the seat back will have them positioned in the 'not in use' position. This position is to avoid interference with view of the pelvis. The arm rest may be fixed to avoid movement during the test. Adjustable arm rests as part of the centre console will have them positioned fully down and fully retracted. The lid of any arm rest/storage compartment shall be closed.
Side window glazing	**Front** – lowered. **Rear** - lowered or removed
Gear change lever	In the neutral position
Parking brake	Disengaged
Pedals	Normal position of rest or MDP for adjustable pedals

Other settings	Required setting
Doors	Closed. Rear child locks disengaged. See Post Crash protocol for ADL requirements.
Roof	Lowered / stowed
Sunroof	Open or removed
Sun visors	Stowed
Rear view mirror	Normal position of use
Front passenger airbag	Enabled – Vehicles equipped with automatic restraint system (e.g. airbag/pretensioner) disabling and default OFF may require specific actions enable the airbag.

2.3 Adult dummy positioning

It is the intention that the dummy is not 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 position is checked no more than one hour prior to test.

Measure the location of the H-point manikin for the relevant size occupant, 5th, 50th, and 95th percentile occupants using the procedure defined in Addendum 6 of M.R.1.

Once a dummy has been correctly positioned record the measurements defined in the relevant dummy stature Technical Bulletin.

2.3.1 Dummy Placement

If, after dummy positioning, the vehicle is moved or a test run is aborted ensure that the dummy has not moved from the intended pretest position. If there are difficulties with positioning of any dummy, the H-point location shall be the priority followed by the pelvic angle and then the torso angle.

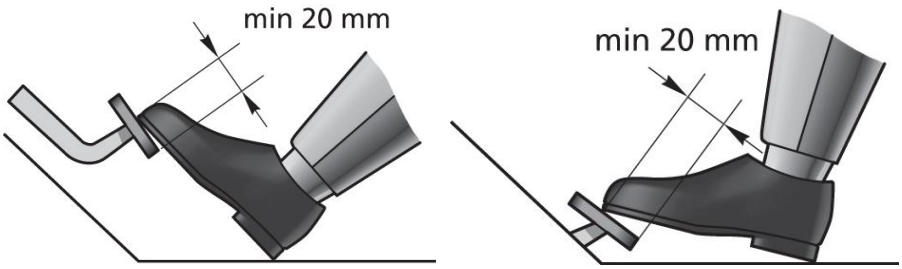
The seat settings shall not be adjusted for dummy positioning unless specifically permitted in the dummy's positioning procedure. If the dummy cannot be positioned within the specified tolerances after three attempts, then it is to be placed as close to the tolerance limits as possible. Record all settings detailed in the table below and those which were not within tolerance.

Where interaction occurs between the rear passenger and the front passenger's seat before test, the full width test shall be performed with the rear passenger seated behind the driver.

2.3.2 HIII 5th percentile

Dummy part	Required setting
H-point	Within a square of ±13mm in X and Z of the manikin H-point of the 5th percentile, with a point 6 mm below the position of the H-point determined using the procedure described in Addendum 6 of M.R.1.
Pelvic angle	20° ±2.5° from the horizontal. **Rear passenger -** If a 20° ±2.5° pelvic angle cannot be achieved, use the design torso angle as a reference value.
Torso angle	Dummy's back in contact with the seat back and the dummy centreline aligned with that of the seatback.
Head	The transverse instrumentation platform horizontal to within ±2.5°. Levelling of the head shall be carried out in this order: – Adjust the H-point within the limits – Adjust the pelvic angle within the limits – Adjust the neck bracket the minimum to ensure that the transverse instrumentation platform is level within limits. If there is contact between the head restraint and head that does not result in forwards movement of the CoG, do not adjust head restraint. If the head is pushed forwards by the head restraint, firstly move the head restraint rearwards in X, then in Z if required. If there is still interference and no further adjustment of the head restraint is possible continue with the test.
Upper arms	**Driver -** Adjacent to the torso as far as is possible **Passenger front & rear -** Positioned in contact with the seatback.
Hands	**Driver** - Palms placed against the steering wheel at a position of a quarter to three. The thumbs should be lightly taped to the steering wheel, where applicable, for the test. **Passenger front -** Palms in contact with the outside of the legs and the little finger in contact with the seat cushion. **Passenger rear -** The forearms and the hands shall be positioned as close as possible to the outer sides of the thighs while the little fingers are lightly in contact with the seat cushion. If there is interference by trim or other interior parts, the interfered upper limb shall be placed on the armrest of the same side to avoid any interference.
Legs	Femurs shall be in contact with the seat cushion as far as possible. The distance between the knees of the dummy shall be 210mm ± 5mm when measured at the outside metal surface of the knees. The femur and tibia for each leg shall be as close as possible to a vertical plane. **Driver -** When the left foot is placed on a footrest or the right foot is positioned onto the accelerator pedal as described below, the distance between the knees may be altered. **Rear Passenger -** The legs shall be positioned as far as possible from the front end of the rear seat cushion while the thighs are kept in contact with the seat cushion. Each leg shall be lowered until the foot comes into contact with the floor while the foot and tibia are kept in a right angle to one another, the thigh inclination angle

Dummy part	Required setting
	shall remain constant.
Feet	**Driver** - One foot shall be placed on the undepressed accelerator pedal with the heel on the floor overlapping the accelerator pedal by at least 20mm.



When this is not the case and the seat is not in the foremost fore/aft position, move the seat forward until sufficient contact between right foot and accelerator pedal can be achieved.

When it is not possible to achieve sufficient contact, follow the FMVSS 208 small female seating positioning procedure, where a support block is used to ensure contact with the pedal and floor. There must be no movement of the support block.

If the right knee has been moved in order to place the right foot on the accelerator pedal, move the left knee and foot an equal distance so that the legs are symmetrical.

The left foot should be placed as flat as possible on the toe-board parallel to the centre line of the vehicle. If any part of the left foot is in contact with a footrest or wheel arch when in this position then place the foot fully on this rest providing a normal seating position can still be achieved. Keep the legs in the same vertical longitudinal plane. The knee gap requirement may be ignored in this case.

Passenger - Placed with the heel as far forwards as possible and then the feet as flat as possible. Both feet shall be parallel to the centreline of the vehicle.

Rear Passenger - When each heel is in contact with the floor, the foot shall be rotated so that the toe comes as much in contact as possible with the floor.

If it is not possible to have each foot in contact with the floor, the foot shall be lowered until the calf comes in contact with the front end of the seat cushion or the back of the foot comes in contact with the vehicle interior. The foot shall be kept as parallel as possible to the floor.

In case of interference by front seat anchorages or by a vehicle body protrusion, the foot shall be rotated as minimally as possible around the tibia. In case interference remains, the femur shall be rotated to resolve or minimize the interference. The foot shall be moved inward or outward while the separation distance between the knees is kept constant.

In case of significant interference by the front seat in its test position or by a vehicle body protrusion, the leg shall be moved toward the occupant side by lifting and keeping the thigh as much in contact as possible with the rear seat cushion.

Finalisation of torso position and readjustment of foot position (if any)

After manipulation of the lower limbs, the dummy position has to be reconfirmed in accordance with the H-point tolerances, pelvic angle and head angle. Any foot displacement during the final positioning of the torso should be undone.

2.3.3 50th THOR dummy positioning

Dummy part	Required setting
H-point	Within a square of ±13mm in X and Z of a point 20mm upward and 20mm forwards of the manikin H-point of the 50th percentile using the procedure described in Addendum 6 of M.R.1.
Pelvic angle	Tilt sensor shall read 0°±1° (X) and 33° ±2.5° (Y).
Torso angle	T1 neck tilt sensor 0°±1° (X) and ±1° (Y) with respect to the manufacturers neck T1 design angle. The THOR torso angle might be different to the H-point manikin design angle. The dummy's back shall be in contact with the seat back and the centre line of the dummy shall be lined up with the centre line of the seats. Push the shoulders fully rearward by hand.
Head	Head CoG tilt sensor 0°±1° (X) If there is contact between the head restraint and head that does not result in forwards movement of the CoG, do not adjust head restraint. If the head is pushed forwards by the head restraint, firstly move the head restraint rearwards in X, then in Z if required. If there is still interference and no further adjustment of the head restraint is possible continue with the test.
Upper arms	**Driver** - Adjacent to the torso as far as is possible. **Passenger** - Adjacent to the torso and against the seat back.
Hands	**Driver** - Palms placed against the steering wheel at a position of a quarter to three. The thumbs should be lightly taped to the steering wheel, where applicable, for the test. **Passenger** - Palms in contact with the outside of the legs and the little finger in contact with the seat cushion.
Legs	If the knees are in contact with the facia or the gap is less than 30mm, move the dummy and seat rearwards until a gap of 30mm is achieved, or to the nearest notch rearwards. It must be possible to pass a sphere of 30mm diameter between the knee clevis flesh and facia (the tibia flesh shall be ignored). Record the new H-point location within the test details. The femurs shall be in contact with the seat cushion as far as possible. Set the initial distance apart of the outboard metal surfaces of the knee clevis flanges of each dummy to 270mm ± 10mm. When the left foot is placed on a footrest or the right foot is positioned onto the accelerator pedal as described below, the initial distance between the knees may be ignored. The femur and tibia for each leg shall be as close as possible to a vertical plane.

Dummy part	Required setting
Feet	**Driver** - The right foot shall rest on the undepressed accelerator pedal with the heel on the floor. To keep the upper and lower legs in the same vertical plane, move the upper leg accordingly. If the foot cannot be placed on the pedal then it should be placed as far forwards as possible with the foot perpendicular to the lower tibia, in line with the centre line of the pedal. If a dedicated footrest is present, place the left foot fully on this rest providing a normal seating position can still be achieved. Keep the legs in the same vertical plane. The knee gap requirement of 270mm ± 10mm may be ignored in this case. Where there is no footrest, position the left foot at an equal distance from centre line of seat as the right leg is from centreline. The left foot should be placed as flat as possible on the toe-board parallel to the centreline of the vehicle. Note the knee gap in the test details. **Passenger** - The feet shall be placed with the heel as far forwards as possible with the feet as flat on the floor as possible. Both feet shall be parallel to the centreline of the vehicle.

2.3.4 HIII 50th percentile

Dummy part	Required setting
H-point	Within a square of ±13mm in X and Z of a point 6mm below the manikin H-point of the 50th percentile using the procedure described in Addendum 6 of M.R.1.
Pelvic angle	22.5° ±2.5° from the horizontal.
Torso angle	Dummy's back in contact with the seat back and the dummy centreline aligned with that of the seatback.
Head	The transverse instrumentation platform horizontal to within ±2.5°. Levelling of the head shall be carried out in this order: – Adjust the H-point within the limits – Adjust the pelvic angle within the limits – Adjust the neck bracket the minimum to ensure that the transverse instrumentation platform is level within limits. If there is contact between the head restraint and head that does not result in forwards movement of the CoG, do not adjust head restraint. If the head is pushed forwards by the head restraint, firstly move the head restraint rearwards in X, then in Z if required. If there is still interference and no further adjustment of the head restraint is possible continue with the test.
Upper arms	Adjacent to the torso as far as is possible.
Hands	Palms placed against the steering wheel at a position of a quarter to three. The thumbs should be lightly taped to the steering wheel, where applicable, for the test.

Dummy part	Required setting
Legs	Femurs shall be in contact with the seat cushion as far as possible. Set the initial distance apart of the outboard metal surfaces of the knee clevis flanges of each dummy to 270mm ± 10mm. When the left foot is placed on a footrest or the right foot is positioned onto the accelerator pedal as described below, the initial distance between the knees may be ignored. The femur and tibia for each leg shall be as close as possible to a vertical plane.
Feet	The right foot shall rest on the undepressed accelerator pedal with the heel on the floor. To keep the upper and lower legs in the same vertical plane, move the upper leg accordingly. If the foot cannot be placed on the pedal then it should be placed as far forwards as possible with the foot perpendicular to the lower tibia, in line with the centre line of the pedal. If a dedicated footrest is present, place the left foot fully on this rest providing a normal seating position can still be achieved. Keep the legs in the same vertical plane. The knee gap requirement of 270mm ± 10mm may be ignored in this case. Where there is no footrest, position the left foot at an equal distance from centre line of seat as the right leg is from centreline. The left foot should be placed as flat as possible on the toe-board parallel to the centreline of the vehicle. Note the knee gap in the test details.

2.3.5 HIII 95th percentile

Dummy part	Required setting
H-point	Within a square of ±13mm in X and Z of a point [6mm] below the manikin H-point of the 95th percentile using the procedure described in Addendum 6 of M.R.1.
Pelvic angle	22.5° ±2.5° from the horizontal.
Torso angle	Dummy's back in contact with the seat back and the dummy centreline aligned with that of the seatback.
Head	The transverse instrumentation platform horizontal to within ±2.5°. Levelling of the head shall be carried out in this order: – Adjust the H-point within the limits – Adjust the pelvic angle within the limits – Adjust the neck bracket the minimum to ensure that the transverse instrumentation platform is level within limits. If there is contact between the head restraint and head that does not result in forwards movement of the CoG, do not adjust head restraint. If the head is pushed forwards by the head restraint, firstly move the head restraint rearwards in X, then in Z if required. If there is still interference and no further adjustment of the head restraint is possible continue with the test.
Upper arms	**Driver -** Adjacent to the torso as far as is possible. **Passenger -** Positioned in contact with the seatback.

Dummy part	Required setting
Hands	**Driver** - Palms placed against the steering wheel at a position of a quarter to three. The thumbs should be lightly taped to the steering wheel, where applicable, for the test. **Passenger front -** Palms in contact with the outside of the legs and the little finger in contact with the seat cushion.
Legs	Femurs shall be in contact with the seat cushion as far as possible. Set the initial distance apart of the outboard metal surfaces of the knee clevis flanges of each dummy to 270mm ± 10mm. The femur and tibia for each leg shall be as close as possible to a vertical plane. **Driver –** When the left foot is placed on a footrest or the right foot is positioned onto the accelerator pedal as described below, the distance between the knees may be altered.
Feet	**Driver** - The right foot shall rest on the undepressed accelerator pedal with the heel on the floor. To keep the upper and lower legs in the same vertical plane, move the upper leg accordingly. If the foot cannot be placed on the pedal then it should be placed as far forwards as possible with the foot perpendicular to the lower tibia, in line with the centre line of the pedal. If a dedicated footrest is present, place the left foot fully on this rest providing a normal seating position can still be achieved. Keep the legs in the same vertical plane. The knee gap requirement of 270mm ± 10mm may be ignored in this case. Where there is no footrest, position the left foot at an equal distance from centre line of seat as the right leg is from centreline. The left foot should be placed as flat as possible on the toe-board parallel to the centreline of the vehicle. Note the knee gap in the test details. **Passenger** - The feet shall be placed with the heel as far forwards as possible with the feet as flat on the floor as possible. Both feet shall be parallel to the centreline of the vehicle.

2.3.6 Seat belt – all dummies

Adjust the seatbelt D-loop for the relevant occupant as detailed in the tables above, carefully place the seat belt across the dummy and lock as normal. It will be necessary to re-position the hands as described above.

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

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.

After following the above steps, the seatbelt should lie in a natural position across the dummy sternum assembly and shoulder clavicle. Where this is not the case, and the D-loop is adjustable, the anchorage shall be adjusted and steps above repeated. For example, an unnatural position would be where the belt is in contact with the neck, neck shield, vehicle seat or above the shoulder rotation adjustment screw (Hybrid III series only).

The upper anchorage should be adjusted by a sufficient amount to ensure a natural belt position, this may require multiple attempts. Where the belt position requires adjustment, pictures must be taken showing the pre and post adjustment position.

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.

Where the fitment of the shoulder belt or lap belt loadcell significantly influences the natural position of the belt, the loadcell may be supported from above with the use of a weak non-metallic wire or thread.

2.4 CRS installation and child dummy placement

The use of additional belt guides, clips or other components that are not an integral part of the CRS is prohibited. Belt guides that are fitted to the vehicle must be permanently attached and information on their use must be contained in the vehicle handbook, where this is not the case they MUST NOT be used for testing.

2.4.1 Q10 dummy installation

Attach a foam pad of 125mm x 90mm with a thickness of 20mm ±2mm to the rear of the dummy pelvis, outside the suit, using tape to hold it in place. The pad shall be centred on the midsagittal plane with the upper edge at the same height as the top of the pelvis flesh. This pad shall remain on the dummy for the test unless it can be removed without the need to move the dummy. The foam pad shall have the following properties:

Density of 152-200kg/m^3

Compression deflection 25% of 89-118kPa

CRS/Dummy	Required setting
Booster cushion	Place the booster cushion on the relevant seating position and mark the fore/aft position on the side of the CRS and vehicle. Align the CRS with the vehicle seat centreline and check that there is no interaction between the CRS and side door when it is closed. If there is interaction, the CRS may be moved inboard by up to 50mm. If an ISOFIX CRS is used no markings are needed, the CRS shall be aligned with the anchorages and engaged with the vehicle.
Q10 placement	Place the dummy on the CRS with both aligned to the seat centreline. Ensure that the suit has not moved in the gap between femur and hip by pulling the suit towards the knees. Buckle the seatbelt. If the buckle is not accessible because of interaction with the CRS, move the CRS and dummy outboards as little as possible (max 50mm) to get free access to the buckle. Remove the slack from the webbing but do not tighten the webbing. Realign the CRS with the marks on the vehicle seat. If the CRS cannot easily be aligned with the original marks due to the shape of the vehicle seat or position of the seat belt buckle, then re-mark the new lateral position of CRS relative to vehicle seat.

CRS/Dummy	Required setting
	Ensure that the rear of the CRS is in contact with the seat back by pressing the CRS backwards against the seat and making sure that the fore/aft markings are still aligned. Where applicable, place the hip shields on the Q10 dummy. Ensure that the distance between the hip shields is no less than 154mm. If needed, a large gap should be used to establish the best fit.
Torso	Ensure that the dummy's lower back is in contact with the vehicle seat back by bending the dummy's back into an upright position and then rocking the dummy sideways while at the same time pushing the pelvis backwards. Ensure that the booster cushion is aligned with the new reference marks and that the dummy is on the centreline of the CRS and not rotated about the vertical axis. Push the dummy's shoulders toward the seat back until either the shoulders contact the seat back or the head is in contact with the head restraint. Ensure that the dummy is sitting in an upright position and is aligned with the centreline marks on the head restraint (if applicable) or is parallel to the marks of the centreline. Ensure that the CRS position did not change relative to the marked position
Head	If the head is pushed forwards by the head restraint, firstly move the head restraint rearwards in X, then in Z if required. If there is still interference and no further adjustment of the head restraint is possible continue with the test.
Arms	The upper arm shall be positioned parallel to the chest. The measurements shall be taken on the neoprene suit along the front surface of the arm (bicep) and between the two IR-TRACCs on the chest. Position the lower arms parallel to the upper legs resting on the booster cushion or armrest as close as possible to the side of the femur. The elbows shall be kept as close as possible to the torso. Where possible, the tip of fingers should be in line with the screws of the knee joint in the x-direction.
Legs	Position the femurs straight forward with a distance of 130mm ±5mm between the centres of the knees. If the CRS prevents this gap from being achieved, position the knees as close to the target values as possible. Where possible, allow the lower legs to rest naturally. The tibias shall be parallel to the vehicle centreline and the feet shall be separated by the same distance as the knees.
Seatbelt	Follow the CRS installation instructions when routing the seat belt and ensure that the belt is routed correctly through any necessary belt guides. Remove the slack of the lap belt by pulling on the diagonal belt near the buckle with a force of 150N. Ensure that the belt is not twisted in the guidance of the booster cushion. The belt shall initially be positioned over the IR-TRACC (upper for Q10) if possible, a load of 50N shall be applied to the diagonal section of the belt in towards the D-loop to achieve a natural and flat position across the chest. The belt may have moved away from the initial position, there is no need for further adjustment. The use of any non-permanent belt guides or clips on either the vehicle or CRS is prohibited. There must be no tape or stickers applied to the diagonal section of the adult belt.

Once the Q10 dummy has been correctly positioned, the two IR-TRACC holes shall be clearly marked on the suit of the dummy. Measure the Q10 dummy position as detailed in CP 009.

See Section 2.5 for details on establishing if the vehicle qualifies as limited rear space.

2.4.2 Q6 dummy installation

CRS/Dummy	Required setting
Booster seat	Follow the procedure for Q10 detailed above.
Q6 placement	Follow the procedure for Q10 detailed above. Where the rear head restraints interfere with the CRS, they should be repositioned as necessary to avoid this. They may only be removed if instructed to do so in the vehicle handbook.
Torso	Ensure that the dummy's upper back is in contact with the vehicle seat back if seated on a booster cushion or the back of the CRS if seated in a booster seat. This is done by bending the dummy's back into an upright position and then rocking the dummy sideways while at the same time pushing the pelvis backwards. Ensure that the CRS is aligned with the new reference marks and that the dummy is on the centreline of the CRS and not rotated about the vertical axis. Push the dummy's shoulders toward the seat back or CRS until either the shoulders contact the seat back or the booster seat back. Ensure that the dummy is sitting in an upright position and is aligned with the centreline marks on the head restraint (if applicable) or is parallel to the marks of the centreline. Ensure that the CRS position did not change relative to the marked position.
Arms	The upper arm shall be positioned parallel to the chest. The measurements shall be taken on the neoprene suit along the front surface of the arm (bicep) and along the IR-TRACC on the chest. Position the lower arms parallel to the upper legs resting on the booster or armrest as close as possible to the side of the femur. The elbows shall be kept as close as possible to the torso.
Legs	Position the femurs straight forward with a distance of 150mm ±5mm between the centres of the knees. If the CRS prevents this gap from being achieved, position the knees as close to the target values as possible. Where possible, allow the lower legs to rest naturally. The tibias shall be parallel to the vehicle centreline and the feet shall be separated by the same distance as the knees.
Seatbelt	Ensure that the lap belt is routed through the belt guidance of the booster seat. Remove the slack of the lap belt by pulling on the diagonal belt near the buckle with a force of 150N. Route the diagonal belt through the belt guidance of the booster for boosters with high back. Ensure that the belt is not twisted in the guidance of the booster. The belt shall lie naturally across the chest and be allowed to sit as it falls. A load of 50N shall be applied to the diagonal section of the belt towards the D-loop to achieve a natural and flat belt position across the chest.

CRS/Dummy	Required setting
	The use of any non-permanent belt guides or clips on either the vehicle or CRS is prohibited. There shall be no tape or stickers applied to the diagonal section of the adult belt.

No dummy positioning measurements are taken for the Q6.

2.5 Determining limited rear space for child occupants

In advance of test preparation, the OEM shall inform Euro NCAP and the test laboratory if they anticipate the vehicle qualifying for limited rear space assessment, CP 002. Where a vehicle is deemed as limited rear space, by following the procedure below, the assessment shall be conducted as detailed in CP 008-1.

Reposition the front seat track 30mm forward of its test position. If there is no notch at this position, set the seat in the nearest notch forwards of 30mm. During repositioning, check for interaction between the Q dummy lower legs, feet and the front seat.

If there is no contact between the front of the dummy toes and the front seat when it is 30mm forward, reposition the front seats in their test positions. Interaction between the Q dummy lower legs, feet and the front seat is acceptable in this case. It is also acceptable for the top of the foot/toes to contact the underside of the front seat when it is 30mm forward. Record the pelvic angle.

If there is contact between the dummy and the front seats when they are 30mm forward of their test position, follow the steps below to limit contact between dummy and front seat. This is not relevant if there is only contact between the top of the foot/toes and the underside of the front seat.

Try to reposition the feet and tibias by pushing them beneath the front seat or rotating the tibias about the Z axis. If this is not sufficient then move the pelvis of the dummy forwards while keeping the CRS in place until there is no contact with the seat in front. It is permitted to change the pelvic angle up to 5 degrees relative to the initial pelvic angle. This should be done in incremental steps until the contact between the toes and front seat is removed. It is acceptable for the top of the foot/toes to contact the underside of the front seat. Record the final pelvic angle.

When the dummy toes remain in contact with the front seat after repositioning the dummy as mentioned above, the vehicle will be treated as limited rear space for that particular test. It is acceptable for the top of the foot to contact the underside of the front seat.

The front seat must be returned to the test position.

3 TEST PROCEDURES

3.1 MPDB

Front Occupants	Head & Neck	Chest & Abdomen	Knee, Femur & Pelvis	Lower leg, Foot & Ankle	Total points
Driver	1.25	1.25	1.25	1.25	**5.0**
Front passenger	1.25	1.25	1.25	1.25	**5.0**

Rear Occupants	Head	Neck	Chest	Total points
Q6 (behind driver)	2.5	1.25	1.25	**5.0**
Q10 (behind front passenger)	2.5	1.25	1.25	**5.0**

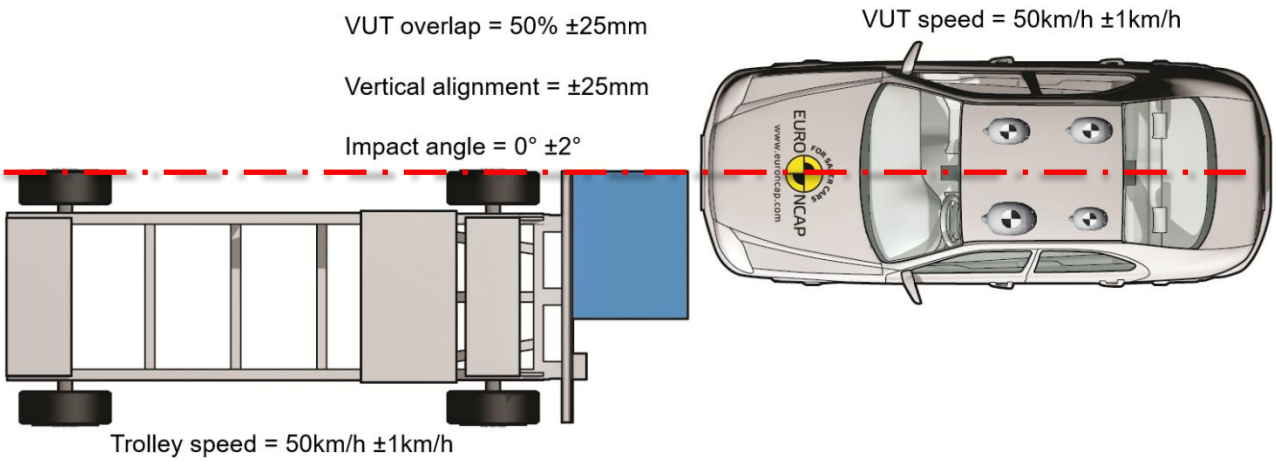


Figure 1 MPDB test

The laboratory shall include on the vehicle or MPDB face a physical means of identifying the overlap between the MPDB face and vehicle at T0.

A method may be employed to prevent secondary impacts between the vehicle and trolley. This may be an emergency braking system on the vehicle and trolley or another method. There must be no braking at T0. Braking must NOT begin until 100ms after the vehicle velocity has reached zero or 100ms after T0 where the vehicle continues to move forward.

Measure the speed of both the test vehicle and the trolley as near as possible to the point of impact. Record the actual test speeds in the test report.

If the impact alignment cannot be established, film analysis will be used to try to assess the alignment. Both the horizontal and vertical alignments shall be noted in the test report along with the impact angle of both the test vehicle and the trolley as near as possible to the point of impact.

3.2 FWDB

Occupant	Head & Neck	Chest & Abdomen	Knee, Femur & Pelvis	Lower leg, Foot & Ankle	Total points
Driver	1.25	1.25	1.25	1.25	**5.0**
Front passenger	0.625	0.625	0.625	0.625	**2.5**
Rear passenger	0.625	1.25	0.625	-	**2.5**

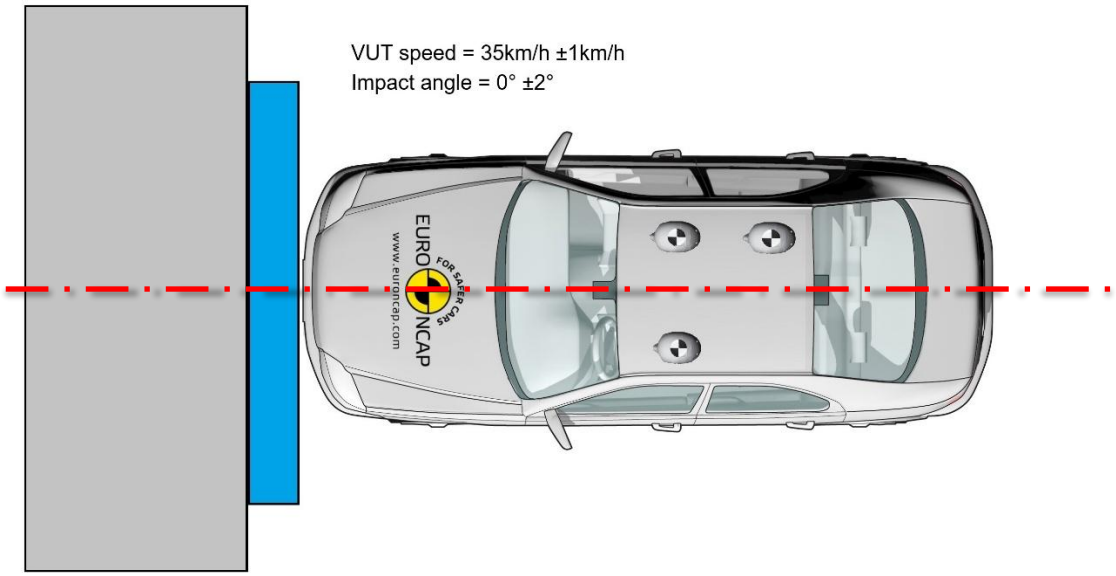


Figure 2 Full width test

The sagittal plane of the vehicle and barrier face shall be coincident.
Measure the speed of the vehicle as near as possible to the point of impact.

3.3 Sled and Virtual testing

Loadcase	Occupant	Head & neck	Chest & abdomen	Knee, femur & pelvis	Lower leg, foot & ankle	Total points
Sled	Driver	0.625 / 2	0.625 / 2	0.625 / 2	0.625 / 2	**2.5**
	Front passenger	0.625 / 2	0.625 / 2	0.625 / 2	0.625 / 2	**2.5**
Virtual	Driver	0.625 / 3	0.625 / 3	0.625 / 3	[0.625 / 3]*	**2.5**
	Front passenger	0.625 / 3	0.625 / 3	0.625 / 3	[0.625 / 3]*	**2.5**

*Points awarded by default unless in any physical test (including full-scale) any dummy exceeds the LPL for Tibia index or Tibia force

[To be implemented once lower leg certification procedure is adopted and virtual models qualify]

Sled and Virtual testing will be assessed based on the combination of physical sled test data and virtual test data provided by the OEM. When the virtual test data is not provided or does not meet the VTC validation criteria and Technical Bulletins CP 500 & 520, only the sled loadcases can be scored based on physical sled test data provided by the OEM.

The vehicle manufacturer shall provide Human Body Model (HBM) simulation data to be eligible for the full points for the virtual loadcases. When this data is not provided, the maximum available score for virtual testing is halved.

3.3.1 Loadcase matrix

	Sled & Virtual		Virtual			
Severity	50 km/h	56 km/h	35 km/h	35 km/h	56 km/h	50 km/h
Pulse	R137	OEM	FWDB	FWDB	OEM	R137
Driver	H-III 50th	H-III 95th	H-III 50th	H-III 5th	H-III 5th	HBM 50th
Front Passenger	H-III 95th	H-III 5th	H-III 5th	H-III 50th	H-III 95th	-

3.3.2 Pulse severity

All pulses used for the sled testing and virtual tests can be based on in-house testing or CAE data. However, the reference pulses below will be used to assess the pulse severity of the virtual pulse against these reference pulses and need to meet the requirements of Technical Bulletin CP 500.

Low severity pulse – 35km/h
The 35 km/h pulse shall be the official Euro NCAP FWDB pulse.

Mid severity pulse – 50km/h
The 50 km/h pulse shall be a UN R137 pulse, to be provided by the VM.

High severity pulse – 56km/h
The 56 km/h pulse shall be a 56 km/h Full Width rigid wall test pulse, to be provided by the VM.
Where no vehicle specific 56km/h pulse data is available, a generic high severity pulse must be used as defined by Euro NCAP. Two generic pulses are available and the applicable one for the VUT has to be selected: Pulse 1 – For PHEV and ICE powered vehicles only Pulse 2 – For Battery electric vehicles only The generic pulse is intended to be ‘worst case’ and must be more severe than that observed by Euro NCAP in the 50km/h MPDB test & mid severity pulse. Where this is not the case, all high severity data will receive no reward. The generic pulse is a fallback case only and its use in this procedure will be reconsidered by Euro NCAP in the future.

3.4 Colour band scheme

Adult	Criterion		Green	Yellow	Orange	Brown	Red
Body region	**Limit value points**		< HPL 100%	80%	40%	20%	≥ LPL 0%
Head & Neck	HIC_{15}	-					
	A_{res}-3ms	g					
	$F_{X,shear}$	kN					
	$F_{Z,tension}$	kN					
	$M_{Yextension}$	Nm					
Chest & Abdomen	$D_{chest\ compression}$	mm					
	$V_{viscous\ criterion}$	m/s					
	$D_{abdomen\ compression}$	mm					
Knee, femur and pelvis	$F_{acetabulum}$	kN					
	F_{femur}	kN					
	D_{knee}	mm					
Lower Leg, Foot & Ankle	I_{tibia}	-					
	F_{tibia}	kN					

Q dummy	Criterion		Green	Yellow	Orange	Brown	Red
Body region	**Limit value points**		< HPL 100%	80%	40%	20%	≥ LPL 0%
Head	HIC_{15}	-					
	A_{res}-3ms	g					
Neck	$F_{Z,tension}$	kN					
	$My_{,extension}$						
Chest	A_{res}-3ms	g					
	$D_{chest\ compression\ res}$	mm					

3.4.1 Prediction by OEM

The vehicle manufacturer may provide the Euro NCAP Secretariat with colour predictions detailing the protection offered by the vehicle based on CAE or in-house test data, which may then be used in the vehicle rating. Predictions must be provided to the Euro NCAP Secretariat before any test preparation begins. In order for ANY predicted data to be used in the rating, all of the following requirements must be met:

Prediction is provided for ALL full-scale tests – MPDB, FWDB, AE-MDB, Pole.

Prediction is provided for all dummies and applicable dummy assessment criteria detailed in Section 3.4 & 3.5.

Prediction is provided based on dummy performance without modifiers applied.

The predicted level of protection offered by the vehicle is verified by Euro NCAP with the use of the full scale tests. The difference between the predicted data and that recorded in the official test must be within 25% of the colour band width for each assessment criterion (LPL-HPL)/3.

When a measured dummy parameter performs better or worse than predicted, but within the tolerance, the predicted result is used in the rating. When a measured dummy parameter performs better or worse than predicted and is outside the tolerance, the measured value shall be used in the rating. After the results comparison has been made, any modifiers identified will then be applied to the relevant body regions and test scores.

An example of the prediction and scoring method is detailed in Technical Bulletin CP 006.

Where the OEM provides no predicted data or the data provided does not meet the requirements detailed above in this section, the vehicle rating shall be based on the measured results obtained in the official tests for ALL areas of the assessment.

3.5 Injury criteria and limits

Where multiple criteria exist for an individual body region, the lowest scoring parameter is used to determine the performance of that region. Capping limits will not be applied to sled and virtual test assessments.

3.5.1 Head & neck

Criterion		HIII 5th		HIII 50th		THOR 50th		HIII 95th
		HPL - LPL	Capping	HPL - LPL	Capping	HPL - LPL	Capping	HPL - LPL
HIC_{15}	-	500 - 700	700	500 - 700	700	500 - 700	700	500 - 700
A_{res}-3ms	g	72 - 80	80	72 - 80	80	72 - 80	80	72 - 80
$F_{X,shear}$	kN	1.2 - 2.0	2.7 Driver only	1.9 - 3.1	3.10	1.9 - 3.1	3.1	2.3 - 3.8
$F_{Z,tension}$	kN	1.70 - 2.6	2.9 Driver only	2.7 - 3.3	3.30	2.7 - 3.3	3.3	3.3 - 4.0
$M_{Yextension}$	Nm	36 - 49	57 Driver only	42 - 57	57	42 - 57	57	56 - 76

A hard contact is assumed if the peak resultant head acceleration exceeds 80g or if there is other evidence of hard contact. Only where the peak resultant head acceleration A_{res} exceeds 80g or there is a hard contact, will the limits for HIC_{15} and A_{res}-3ms be applied.

3.5.2 Chest & abdomen

Criterion		Severity	HIII 5th		HIII 50th		THOR 50th		HIII 95th
			HPL - LPL	Capping	HPL - LPL	Capping	HPL - LPL	Capping	HPL - LPL
$D_{chest\ compression}$	mm	35km/h	18 - 34[3]	34	20- 42[3]	42	29 - 54[3]	54	-
		50km/h	18 - 34[3]	34	20 - 42[3]	42	35 - 60[1]	60	28 - 55[2]
		56km/h	22 - 42[1]	42	-	-	-	-	28 - 55[2]
$V_{viscous\ criterion}$	m/s		0.5 - 1.0	1.0	0.5 - 1.0	1.0	-	-	0.5 - 1.0
$D_{abdomen\ compression}$	mm		-	-	-	-	88	-	-

Biomechanical limits applicable to LPL only - 45 year old[1], 50 year old[2], 65 year old[3]

The THOR chest assessment is based on the maximum compression of all four ribs, R_{max}.

3.5.3 Knee, femur & pelvis

Criterion		HIII 5th HPL - LPL	HIII 50th HPL - LPL	THOR 50th HPL - LPL	HIII 95th HPL - LPL
$F_{acetabulum}$	kN	-	-	3.3 - 4.1	-
F_{femur}	kN	2.6 - 6.2	3.8 - 9.1	3.8 - 9.1	4.8 - 11.5
D_{knee}*	mm	6 - 15	6 - 15	6 - 15	6 - 17

*Not applicable to virtual tests.

3.5.4 Lower leg, foot & ankle

Criterion		HIII 5th LPL	HIII 50th HPL - LPL	THOR 50th HPL - LPL	HIII 95th HPL - LPL
I_{tibia}*	-	1.3	0.4 - 1.3	0.4 - 1.3	[0.4] - 1.3
F_{tibia}*	kN	8.0	2.0 - 8.0	2.0 - 8.0	[4.0] - 10.0

*Not applicable to virtual tests.
Limits in [square brackets] are to be implemented once a lower leg certification procedure is adopted.

3.5.5 Child occupants

Body region	Criteria		Q6 HPL - LPL	Q10 HPL - LPL	Capping
Head	HIC_{15}	-	500 - 700	500 - 700	700
	A_{res}-3ms	g	60 - 80	60-80	80
Neck	$F_{Z,tension}$	kN	1.7 - 2.62	1.7 - 2.62	-
	$M_{Yextension}$	Nm	36	49	-
Chest	$D_{chest\ compression\ res}$	mm	30 - 42	56	56
	A_{res}-3ms	g	-	41 - 55	55

Injury parameter assessments will not be evaluated during the rebound phase of the dummy.

If no hard contact between the head and vehicle is observed on the high speed film, the head assessment is based on the Resultant 3ms acceleration only.

Neck extension My is evaluated where there is a head to interior contact only.

Chest acceleration peaks caused by the firing of seatbelt pretensioners early in the loading event will be ignored.

4 POSTTEST ASSESSMENT & INSPECTION

4.1 After test

Immediately after the test, check that none of the doors and boot lids have opened or partially opened during the test. Where this is the case photographic evidence shall be obtained and provided in the test report.

Refer to the Euro NCAP Post Crash protocol for further details of all post-test assessments and provide all required information in a Post crash report.

4.1.1 Dummy removal

Before dummy removal, refer to the Post Crash protocol for seat belt buckle unlatching.

Before dummy removal, measure the distance between all foot pedals and a fixed point in the footwell, e.g. seat runner, seat mounting bolt. If access cannot be gained remove the dummies taking care not to disturb any pedals and then record the measurement. This measurement should be re-checked before the pedals are measured with the 3D measuring system. If the pedal has moved re-position the pedal using the measurement taken previously.

Do not move the driver or passenger seats, try to remove the dummies. If the dummies cannot be removed with the seats in their original positions, recline the seat back and try again. Note any entrapment of the dummies. If the dummies can still not be removed, try to slide the seats rearwards on their runners. If the dummies can still not be moved, the seats may be cut out of the car.

Record the method used to remove the dummies.

4.2 Post test static measurements

Measure and record the post test vehicle intrusion defined in Technical Bulletin CP 004. Perform the post test barrier face scan as defined in CP 007.

4.3 Inspection

After the test, Euro NCAP will perform a vehicle inspection where scoring modifiers can be applied.

4.3.1 Occupant Modifiers

The modifier penalties mentioned in the table below are defined as a percentage of the maximum body region score for each dummy, in each loadcase and are applied to that body region. Further details regarding the modifiers and how they are applied to the rating can be found in Technical Bulletin CP 007.

Adult Occupants	Modifiers	Criterion	Modifier score
Head & neck	Head bottoming out	Inspection	-20%
	Unstable airbag contact	Inspection	-20%
	Hazardous airbag deployment	Inspection	-20%
	DAMAGE (THOR-50)	0.42 ≤ DAMAGE < 0.47 ≥ 0.47	-20% -40%
	Incorrect airbag deployment	Inspection	-20%
	Excursion (rear seats)	≥ 450mm ≥ 550mm	-50% -100%
Chest	Steering wheel contact	Inspection	-20%
	Shoulder belt load	5^{th} & 50^{th} Percentile ≥ 6.00kN	-40%
	Incorrect airbag deployment	Inspection	-20%
Knee, femur and pelvis	Submarining	Inspection	-100%
	Knee load – Variable	≥ 3.8kN or 6.0mm Inspection	-20%
	Knee load – Concentrated	Inspection	-20%
	Incorrect airbag deployment	Inspection	-20%
Lower leg, foot and ankle	Pedal displacement	Rearward ≥ 100mm Rearward ≥ 200mm Vertical 72mm	-50% -100% -20%
	Pedal blocking	50mm	-20%

Rear child occupants	Modifiers	Criterion	Modifier score
Head	Q6 excursion	550mm	-100%
	Q10 excursion	≥ 450mm ≥ 550mm	-50% -100%
Q dummy score	Full belt slippage	Inspection	-100%
	Partial belt slippage	Inspection	-50%
	Restraint	Inspection	-100%
	Submarining	Inspection	-100%
	Ejection	Inspection	-100%
	CRS to vehicle attachment	Inspection	-100%

4.3.2 Test Modifiers

The modifier penalties mentioned in the table below are defined as a percentage of the maximum adult occupant test score for each loadcase.

Test penalties	Modifiers	Criteria	modifier score
A-pillar	Rearward displacement	100mm	-2.5%
Steering column displacement	Rearward Vertical Lateral	90mm 72mm 90mm	-1.25%
Bodyshell integrity		Inspection	-1.25%
Footwell rupture		Inspection	-1.25%
Compatibility CP 007	OLC	25g-40g	0 to -25%
	Standard deviation	50mm-150mm	
	Bottoming out	Inspection	
Door opening	Per door	Inspection	-2.5%
Door detachment	Structural detachment	Inspection	-50%
Restraint failure		Inspection	-50%