



ANCAP
SAFETY



ANCAP Test & Assessment Protocol. Far Side Impact v1.1

JANUARY 2020



PREFACE

During the test preparation, vehicle manufacturers are encouraged to liaise with ANCAP and to observe the way cars are set up for testing. Where a vehicle manufacturer feels that a particular feature should be altered, they should raise this with the ANCAP assessor present at the test, or in writing to the ANCAP Chief Executive Officer if no assessor is present. ANCAP will consider the matter and at their sole discretion and give direction to the test facility.

Vehicle manufacturers warrant not to, whether directly or indirectly, interfere with testing and are forbidden from making changes to any feature that may influence the test, including but not limited to dummy positioning, vehicle setting, laboratory environment etc.

Illustrations in this protocol are reproduced from Euro NCAP publications, and therefore show Euro NCAP markings on left-hand-drive vehicles. Where relevant, the layouts depicted should be adapted to right-hand-drive application.

VERSION	PUBLISHED	DETAILS
1.1	February 2019	First ANCAP version of protocol

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DISCLAIMER.

ANCAP has taken all reasonable care to ensure that the information published in this protocol is accurate and reflects the current technical decisions taken by the organisation. In the event this protocol contains an error or inaccuracy, ANCAP reserves the right to make corrections and determine the assessment and subsequent result of the affected requirement(s).

AUSTRALASIAN NEW CAR ASSESSMENT PROGRAM (ANCAP)

TESTING AND ASSESSMENT PROTOCOL – Far Side Impact

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Where text is contained within square brackets this denotes that the procedure being discussed is currently being trialled by ANCAP. Its incorporation in the Testing and Assessment Protocol will be reviewed at a later date.

1 INTRODUCTION

- 1.1 This protocol details the assessments to be performed in far side occupant protection that contribute to the side impact part of the adult occupant protection rating.
- 1.2 The far side occupant test data will be supplied to ANCAP by the vehicle manufacturer.
- 1.3 [NOT USED]
- 1.4 [NOT USED]
- 1.5 [NOT USED]
- 1.6 Far side test data will only be accepted in the form of physical sled tests; full scale tests and CAE data will not be accepted.

2 PREREQUISITES

- 2.1 In both the MDB and pole impacts, the structural performance of the door, its attachments to the body, the roof/cant rail and sill must be structurally 'stable' to provide confidence in the position intrusion lines. Full or partial detachment of door latches/hinges, fully opened doors or structural failures of the roof/cant rail and sill will preclude the acceptance of far side assessment data.
- 2.2 Any of the following post test conditions will disqualify the vehicle from any rewards in far side occupant protection.
 - 2.2.1 Where the total score of the MDB and pole impacts is below 10.0 points (out of 12).
 - 2.2.2 Restraint system failures in either the MDB or pole impacts that are intended for far side occupant protection. For example, incorrect deployment of centre (occupant to occupant) airbags.

3 HARDWARE SETUP

- 3.1 General
 - 3.1.1 An acceleration based sled rig is to be used along with a 'body in white' (BIW) of the car model being assessed.
 - 3.1.2 Deceleration sleds will be permitted provided that clear evidence showing that the dummy remains in the initial position is given.
 - 3.1.3 The BIW shall be mounted with the centreline at $75^{\circ} \pm 3^{\circ}$ towards the direction of travel.
 - 3.1.4 A BIW that is of a pre-production state will be accepted provided that it is shown to be representative of series production and that any differences have no influence on the far side assessment.
 - 3.1.5 All features which may influence occupant kinematics and protection

must be installed in the BIW.

- 3.1.6 The BIW may be from either a right or left hand drive vehicle.
- 3.1.7 For the purpose of this assessment, the 'far side occupant' is on the driver's side of the vehicle which is also the non struck side. The struck side is the passenger's side of the vehicle.
- 3.1.8 One WorldSID 50th male dummy will be seated on the far side of the vehicle.
- 3.1.9 The assessment shall be performed on the specification of equipment fitted to the best selling variant. This includes, but is not limited to, the transmission, front seats, restraints and interior trim/centre console.
- 3.1.10 The seats of the best selling variant (as per MDB and pole impacts) will be used in the BIW.

3.2 Body preparation

- 3.2.1 The bodyshell shall be mounted on the sled such that there will be no permanent deformation of the body or its mounts during the tests.
- 3.2.2 Struck side intrusion will not be replicated on the BIW.
- 3.2.3 Driver and/or passenger doors will not be required.
- 3.2.4 Structures forwards of the A-pillar and windscreen cowl and rearward of the B-pillar may be removed from the BIW as long as the stability is not compromised
- 3.2.5 Reinforcement of the BIW is recommended but not required provided the BIW is sufficiently stable. The following areas are suggested:

- Pillars and cross members
- Seatbelt mountings (D-loop & Retractor)
- Driver's seat plinth
- Roof

- 3.2.6 To ensure a clear view on dummy kinematics, vehicles with removable roofs, panels or movable sunshine roofs shall be tested without the roof or with them in the open position. The windscreen shall be removed and sufficient reinforcement around the frame/periphery is provided.

Where there is a fixed roof above the front row seats, it shall be cut away between the cant rails and rearwards of the windscreen surround. Reinforcement should subsequently be applied laterally across the BIW.

- 3.2.7 Sufficient spacers shall be fitted in the gaps between the struck side (B-pillar or other structure) and passenger seat, the passenger seat and centre console to stabilize the front passenger seat. This represents the behaviour of the struck side seat and centre console due to crash induced intrusion and deformation. The spacer shall support the full height of the centre console but does not need to be made from one single piece of foam. An example how this can be done is shown in the picture below.

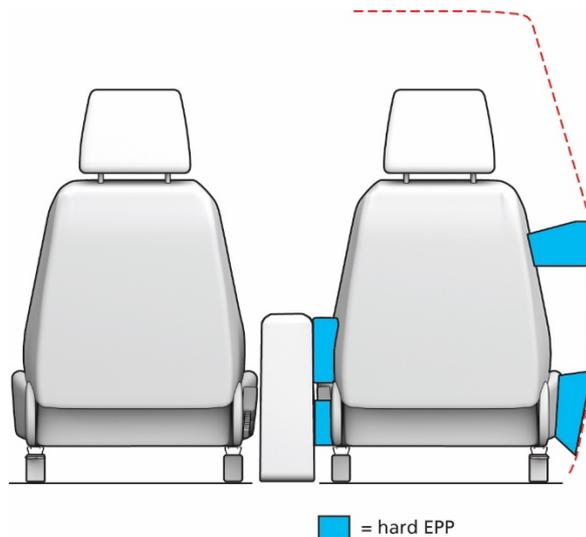


Figure 1: Seat spacers

3.2.8 The spacers shall have the stiffness characteristics from expanded polypropylene (EPP60) or stiffer with compression properties of about 340KPa for 25% of compression (determined according to ISO 844).

3.2.9 Interior components required for testing will include, but are not limited to:

- Driver and passenger front seats.
- Full tunnel/centre console components consisting of the full tunnel trim, hand brake assembly, storage compartments.
- Full facia assembly consisting of the facia, steering column and steering wheel. Infotainment systems may be omitted if appropriate.
- Seat belt/pretensioner and anchorage attachments.
- Struck side internal door trim assembly (if doors installed).

3.2.10 If fitted, the struck side door trim shall be painted white (or similar) to contrast with the passenger's seat.

3.3 Active restraints

3.3.1 Active restraint systems shall be standard equipment and identical to those used in the ANCAP impact tests.

3.3.2 Pretensioners must be triggered if the firing strategy is such that they are triggered in the side and pole impact tests.

3.3.3 Triggering of pretensioners will be accepted on the sled if the difference in deployment time from the official tests is no greater than +/-2ms.

3.3.4 Where the difference is greater than 2ms, data must be supplied showing that this did not affect the result.

3.3.5 Triggering of other active restraints, such as the side curtain and seat mounted airbags, will not be permitted unless it can be shown that these

systems have been designed as a countermeasure intended to lower the risk of far side occupant injury. For example, a head curtain airbag that extends beneath the door level, or a seat mounted airbag that can remain sufficiently inflated for the required length of time to limit occupant excursion.

3.4 Vehicle markings

3.4.1 A chequered or similar grid measuring 50x50mm shall be rigidly mounted to the BIW directly behind, but not attached to the front seats in a way that does not result in interference during the test.

3.4.2 All markings must be extended onto the chequered grid board positioned behind the front seats.

3.4.3 Three vertical and parallel excursion lines will be marked in the BIW for both sled test scenarios

- **Maximum intrusion line (red)**

This line is marking the maximum post test intruding point of the interior door panel from AE-MDB (60km/h) and 75° pole impacts respectively. The method to determine the maximum deformation is detailed in Appendix I.

Peak intrusion values will be compared to those observed in the official tests, a suitable tolerance is required and will be established using data observed in the monitoring phase.

- **Head excursion performance limit (yellow)**

Struck side seat centreline

- **Occupant interaction limit (green)**

250mm inboard from the struck side seat centreline

3.4.4 In addition to the three excursion lines, the vehicle centreline will be marked in blue.

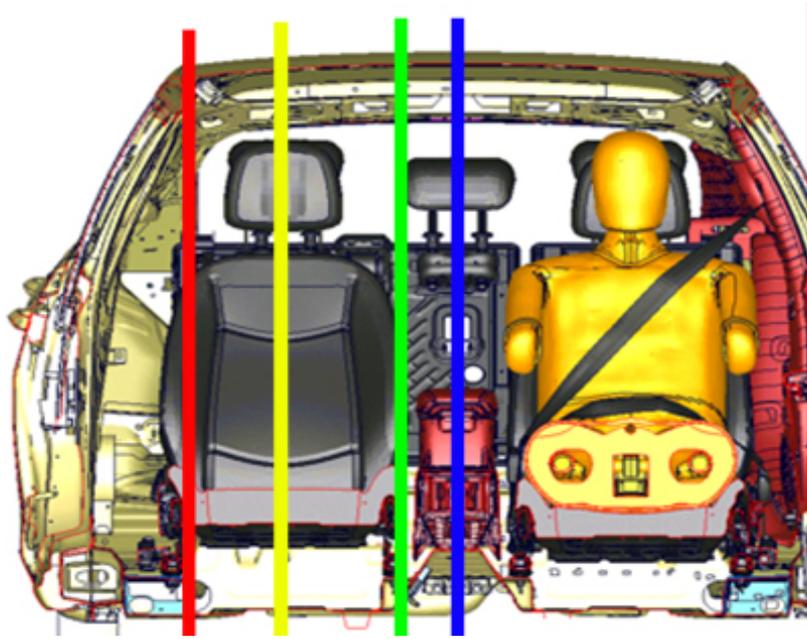


Figure 2: Vehicle markings

4 TEST PROGRAMME

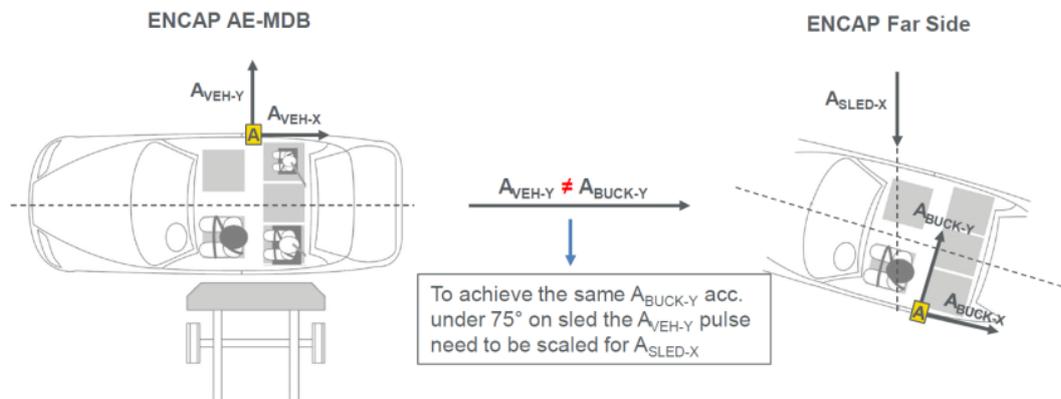
4.1 Sled Acceleration Pulses

4.1.1 Two sled tests are required for far side occupant evaluation.

4.1.2 One test shall be performed using a representative 60km/h MDB to car non struck side B-pillar pulse. The sled pulse shall be a scaled B-pillar pulse as measured in the MDB test and pole test due to the angled test sled set-up. To ensure a similar B-pillar pulse in the sled test the following scaling is applied:

$$A_{X,SLED} = A_{Y,VEHICLE(AE-MDB)} \times 1.035$$

$$A_{X,SLED} = A_{Y,VEHICLE(POLE)} \times 1.035$$



4.1.3 One test shall be performed using a representative 32km/h 75° pole test non struck side B-pillar pulse.

4.1.4 [NOT USED]

4.1.5 All pulses shall be from the non-struck side, B-pillar base and filtered at CFC60.

4.1.6 In house test vehicle variants may differ slightly from the official model tested by ANCAP e.g. engine etc. This is so that testing can be performed in advance of the official ANCAP tests.

4.1.7 The suitability of the correlation between the vehicle and sled pulses will be checked according to the method detailed in Appendix II.

4.2 Dummy and instrumentation

4.2.1 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.

4.2.2 The WorldSID dummy shall be equipped with the half arm assembly on both sides.

4.2.3 The dummy shall be clothed in a sleeveless suit or a modified version of the sleeved suit with sleeves removed.

4.2.4 The dummy shall have a stabilised temperature in the range of 20.6°C to 22.2°C. A copy of the temperature readings is to be supplied as part of the standard output of the test.

4.2.6 Data processing shall be in accordance with Euro NCAP Technical Bulletin 021.

4.2.7 The WorldSID dummy shall be instrumented to record the channels listed below. Additional channels may be recorded. In-dummy data acquisition system is recommended and in case of 45 or more channels it is required.

Location	Parameter	Minimum amplitude	Channel count
Head	Linear acceleration, Ax, Ay, Az	250g	3
	Angular velocity, ω_x , ω_y , ω_z	4000deg/sec	3
Upper neck	Forces and moments Fx, Fy, Fz, Mx, My, Mz	5kN, 300Nm	6
Shoulder – Joint	Forces, Fx, Fy, Fz	8kN	3
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	Temperature	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
	Forces Fx, Fy, Fz,	5kN	3
	Moments, Mx, My, Mz	300Nm	3
Pelvis	Acceleration, Ax, Ay, Az	200g	3
	Pubic force	5kN	1
Total Channels			41

4.3 Sled Instrumentation

Location	Parameter	Minimum Amplitude	No of channels
B-Post non-struck side (BIW coordinates)	Accelerations, A_x , A_y	150g	2
Sled	Accelerations, A_x	150g	1
Driver Seatbelt Shoulder Section	Force, $F_{diagonal}$	16kN	1
Digital contact switch between thorax and centre console	Time, ms	NA	1
Total vehicle channels			5

4.4 Passenger compartment adjustments

4.4.1 Passenger compartment adjustments used in the BIW will be as per the relevant passenger compartment adjustments detailed in the AE-MDB side impact test protocol (where relevant).

4.4.2 The driver and passenger seat fore/aft and seat back angles will be positioned identically. Where a vehicle has different seat travel between the driver and passenger side, the passenger seat travel will be positioned as close as possible to that of the driver and the seat back angle will also be the same as that of the driver.

4.4.3 Arm rests

4.4.3.1 Any arm-rests or centre console compartments shall be positioned to limit interaction with the dummy and maximise lateral excursion. See Appendix III.

4.4.3.2 Vehicles equipped with adjustable arm-rests on the seat back will have them positioned in the 'not in use' 'up-folded' position aligned with the seat back.

4.4.3.3 Vehicles equipped with adjustable arm rests as part of the centre console will have them positioned fully down and fully retracted.

4.4.3.4 The lid of any arm rest/storage compartment shall be closed.

4.4.3.5 Parts that can be removed from the centre console assembly must be present for the test provided they are equipped on the specification of vehicle tested by Euro NCAP.

4.4.4 The parking brake shall be in the disengaged position and the gear lever in D or in a gear position.

4.5 Driver dummy positioning

4.5.1 The dummy shall be installed on the driver's seat (non struck side) in accordance with the H-point manikin and dummy positioning procedures detailed in the MDB Side Impact test protocol.

4.6 Dummy painting & Markings

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

Tape Sizes:

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



Figure 3: Dummy painting

4.6.2 The dummy shall have two markers at the front of the dummy head for video analysis. They will be positioned on the head front mould split line at:

- Centre of Gravity
- 100mm below Centre of Gravity

4.7 Pre-test measurements

4.7.1 To ensure repeatability of dummy seating & positioning - take detailed static 3D measurements of dummy and vehicle interior after the dummy settling and positioning procedures have been carried out.

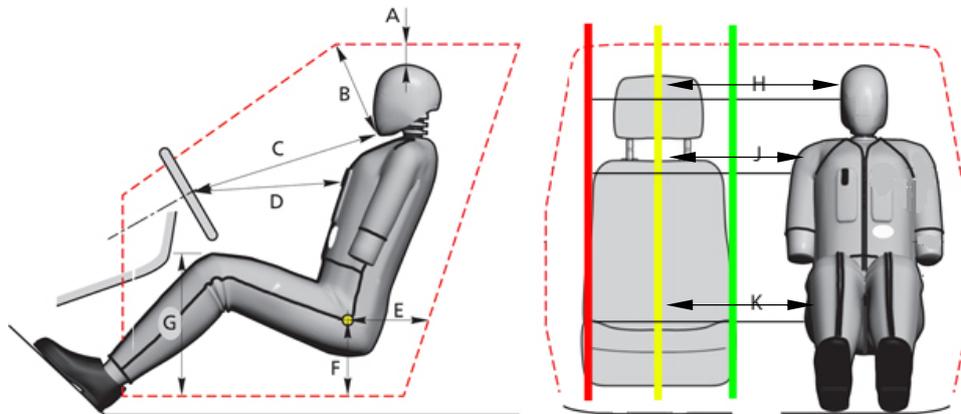


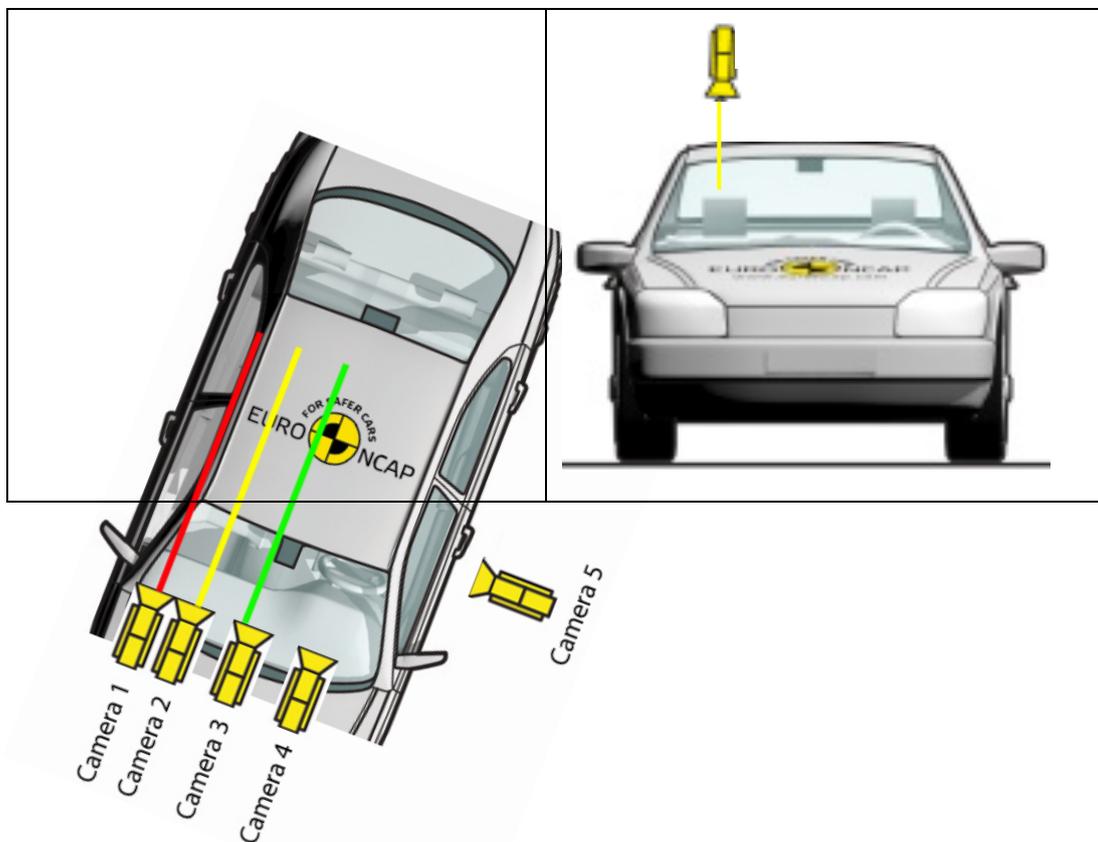
Figure 4: Pre test measurements

Driver measurements	
A	Not required
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), manikin and dummy
F	Hip-joint point/inside opening of the door (vertical), manikin and dummy
G	Knee/floor covering (vertical)
H	Head to seat centreline
J	Shoulder to seat centreline
K	Hip-joint point to seat centreline

* Horizontal distance from steering wheel centre

5 PHOTOGRAPHIC RECORD

- 5.1 Insufficient high speed or still photography could result in the data not being accepted by the ANCAP Secretariat.
- 5.2 It is essential that the onboard cameras are attached to the sled in a way that minimises relative motion during the test.
- 5.3 Sufficient lighting must also be provided to ensure that the maximum head excursion can be clearly seen on the high speed film.
- 5.4 High speed film
- 5.4.1 High speed film, 1000fps minimum, is required for both tests. The following specification shall be used:
- x Format: MP4 or AVI.
 - x Codec: H.264, Data/Bit rate: 2 Mbps.
 - x Resolution: Native camera resolutions.
 - x Frame rate: 1000 fps.
 - x Must include burnt in timers
- 5.4.2 Sled mounted high speed cameras shall be used to record the whole of the relevant scene.
- 5.4.3 Care should be taken to ensure that camera placement for cameras 1,2, 3 and 4 is directly in line with the corresponding performance line and also parallel to the vehicle centre line. Where the camera positions are overlapping, the highest priority should be given to camera 1.



	<p><u>Onboard camera views:</u></p> <ol style="list-style-type: none"> 1. Front, red line 2. Front, yellow line 3. Front, green line. 4. Front, driver pre-test 5. Side, driver pre-test pelvis to head 6. Plan, yellow line <p><u>Offboard camera views:</u></p> <ol style="list-style-type: none"> 7. Front, parallel to vehicle CL 8. Front, perpendicular to direction of travel
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	<p>Camera: 1</p>
	<p>Description:</p> <p>Front view centred to intrusion limit, as low as possible capturing max head excursion.</p> <p>Parallel to vehicle centreline.</p>

	<p>Camera: 2</p>
	<p>Description:</p> <p>Front view centred to higher performance excursion limit (seat centreline), as low as possible.</p> <p>Parallel to vehicle centreline.</p>



Camera: 3

Description:

Front view centred to occupant interaction limit, as low as possible.

Parallel to vehicle centreline.



Camera: 4

Description:

Front view centred to driver seat centreline.

Parallel to vehicle centreline.

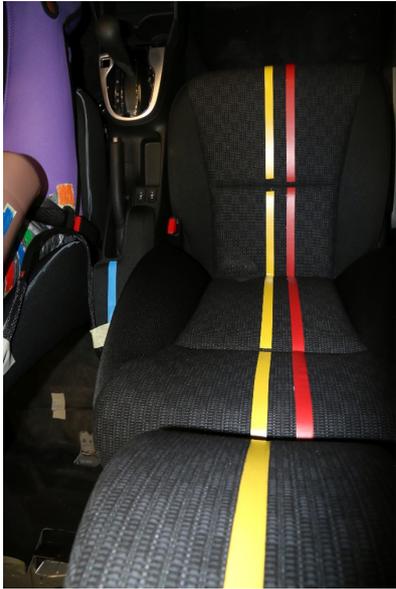


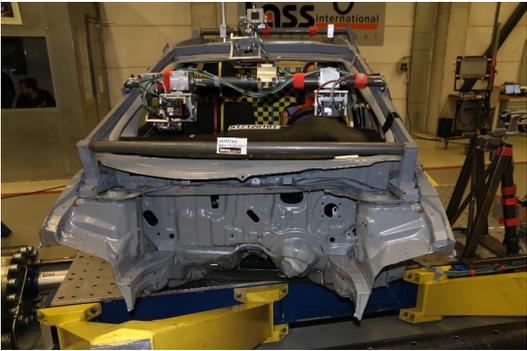
Camera: 5

Description:

side view of driver centred to middle of door aperture, door waist height.

Perpendicular to vehicle centreline.

	<p>Camera: 6</p>
	<p>Description:</p> <p>plan view for X/Y excursion centred on seat centreline.</p> <p>In vertical Z plane.</p>

	<p>Camera: 7</p>
	<p>Description:</p> <p>Front, parallel to vehicle centreline.</p>

	<p>Camera: 8</p>
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Description:

Front, perpendicular to
direction of travel

5.5 Still photography

5.5.1 Pre and post test still photography is required to clearly show the sled set-up and BIW construction. Still photographs should show the fixings of the body in white to the sled, in particular the steering column, facia/tunnel mounting and the appropriate body reinforcements before and after the series of tests.

No.	Pre	Post	View
1.	•	•	Top view of full BIW
2.	•	•	Front view of full BIW
3.	•	•	Rear view of full BIW
4.	•	•	Side view of full BIW
5.	•	•	Driver's side view of BIW at 45 ° to front
6.	•	•	Passenger's side view of BIW at 45 ° to front
7.	•	•	Side view of driver from outside
8.	•	•	Side view of driver from inside (including paint)
9.	•	•	Front view of driver
10.	•	•	Rear view of spacers in position
After dummy removal:			
11.		•	Paint transfer to centre console
12.		•	Paint transfer to passenger's side door/airbags (if applicable)

6 DATA PROCESSING AND REPORTING

6.1 Data processing

Data processing and assessment criteria calculation shall be supplied to ANCAP in ISO-MME format in accordance with Euro NCAP Technical Bulletin 021.

6.2 Reporting

6.2.1 The key deliverables will be as follows:

- Reference pulse data in ISO MME format, as detailed in Section 4.1.
- BIW & test set-up data, as detailed in Section 4.
- All sensor outputs in ISO MME format.
- All sensor curves plotted in a single PDF file (sled and ATD).
- High speed film (min. 1000fps) Section 5.4.
- Photos, as detailed in Section 5.5

7 FAR SIDE OCCUPANT ASSESSMENTS

7.1 Criteria and limit values

The basic assessment criteria used for both impact scenarios, with the upper and lower performance limits for each parameter, are summarised below. The assessments are divided into four individual body regions, the head, neck, chest & abdomen and pelvis & lumbar spine. A maximum of four points are available for the head, neck, chest & abdomen. Where multiple criteria exist for an individual body region, the lowest scoring parameter is used to determine the performance of that region. A maximum of 12 points will be available for each impact scenario.

For dummy injury criteria, a sliding scale system of points scoring has been used to calculate points for each measured criterion. This involves two limits for each parameter, a more demanding limit (higher performance), below which a maximum score is obtained and a less demanding limit (lower performance), beyond which no points are scored. Where a value falls between the two limits, the score is calculated by linear interpolation. A sliding scale is NOT applicable to head excursion.

For both impact scenarios, capping is applied to the head, chest and abdomen.

	Criteria	Performance limits			Points
		Higher	Lower	Capping g	
Head	HIC ₁₅ (with hard contact)	500	700	700	4 points
	Resultant 3ms acceleration	72g	80g	80g	
	Excursion	yellow line		red line	
	SUFEHM	monitoring			
Neck	Tension Fz		3.74kN		4 points
	Lateral flexion MxOC		50Nm		
	Extension negative MyOC		50Nm		
Chest & Abdomen	Chest lateral compression	28mm	50mm	50mm	4 points
	Abdomen lateral compression	47mm	65mm	65mm	
TOTAL					12 points

A hard contact is assumed if the peak resultant head acceleration exceeds 80g or if there is other evidence of hard contact.

7.1.1 Modifiers

	Criteria	Performance limits	
Pelvis & Lumbar	Pubic symphysis	2.8kN	-4 points
	Lumbar Fy	2.0kN	
	Lumbar Fz	2.84kN	
	Lumbar Mx	100Nm	

7.1.2 Occupant to occupant interaction limit

Where the head exceeds the occupant interaction limit (green line), the score of the test in which this occurred will be reduced by 50%. [This score reduction can be avoided in case the OEM provides compelling data that demonstrates that in both loadcases the countermeasure implemented avoids occupant-to-occupant interaction without jeopardising the protection of other body regions.]

The data provided to ANCAP should contain, but is not limited to:

- Evidence showing triggering strategy and trigger times
- Physical test data including dummy numbers, for both driver and passenger, from a full scale and/or sled test confirming the system functionality
- Supporting CAE data demonstrating robustness of the system

7.2 Scoring

The far side score is the sum of the scores from both impact scenarios. The final score from the far side occupant assessments will be scaled down to a maximum of 4 points in the AOP total.

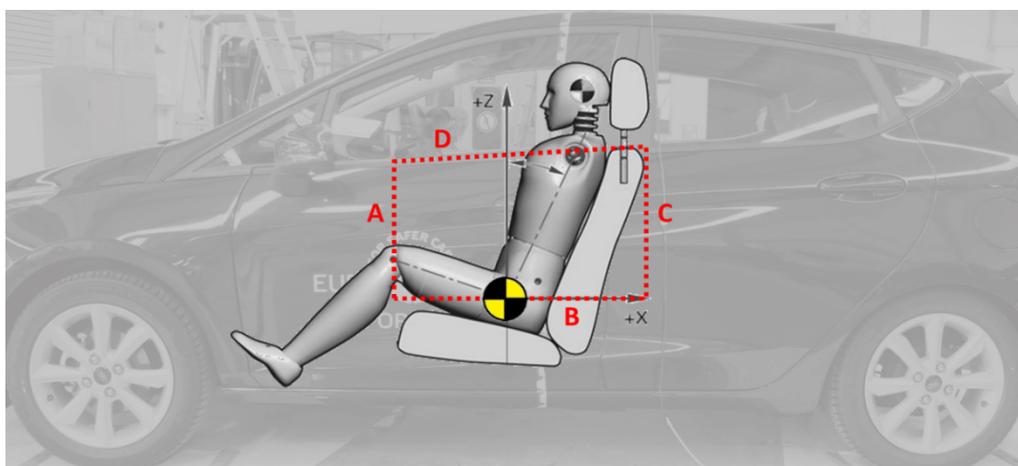
Appendix I

To determine the excursion lines the following method is to be followed. In this method the following definitions are used:

Intrusion area

The intrusion area is the external area limited by the following lines:

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



Maximum inboard intrusion

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

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

At waistline level, the inner door trim/cover is ignored. The point is defined as the most inboard metal part of the door structure +50mm inboard (see example below)



Appendix II

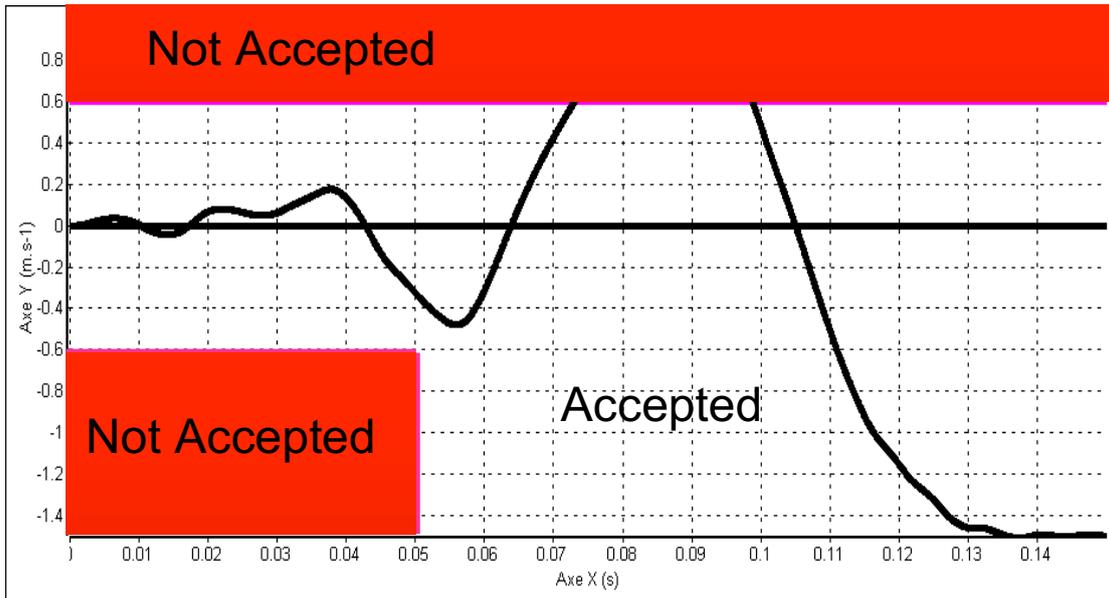
The pulse performed on the sled facility should be close to or more severe than the full scale test pulse. To validate this point, the following process should be used:

- Change the orientation to have sled pulse and vehicle pulse in globally positive values
- Calculate by integration the Delta V from vehicle pulse $DV1(t)$, setting the initial velocity to 0
- Calculate by integration the Delta V from sled test $DV2(t)$, setting the initial velocity to 0
- Calculate the difference $DV = DV1 - DV2$
- Calculate by integration of $DV1$ the X displacement from vehicle pulse $DX1(t)$, setting the initial value to 0
- Calculate by integration of $DV2$ the X displacement from sled test $DX2(t)$, setting the initial value to 0
- Calculate the difference $DX(t) = DX1(t) - DX2(t)$
- Calculate DX at 120 ms

Requirement #1:

- If all the DV values up to 120 ms are in the zone as shown below, requirement #1 is OK – check requirement #2
- If some DV values up to 120 ms are outside the zone, requirement #1 is not OK
 - **sled test is less severe than the test pulse and cannot be accepted**

$$DV = DV(\text{Vehicle Pulse}) - DV(\text{buck}) \text{ test}$$

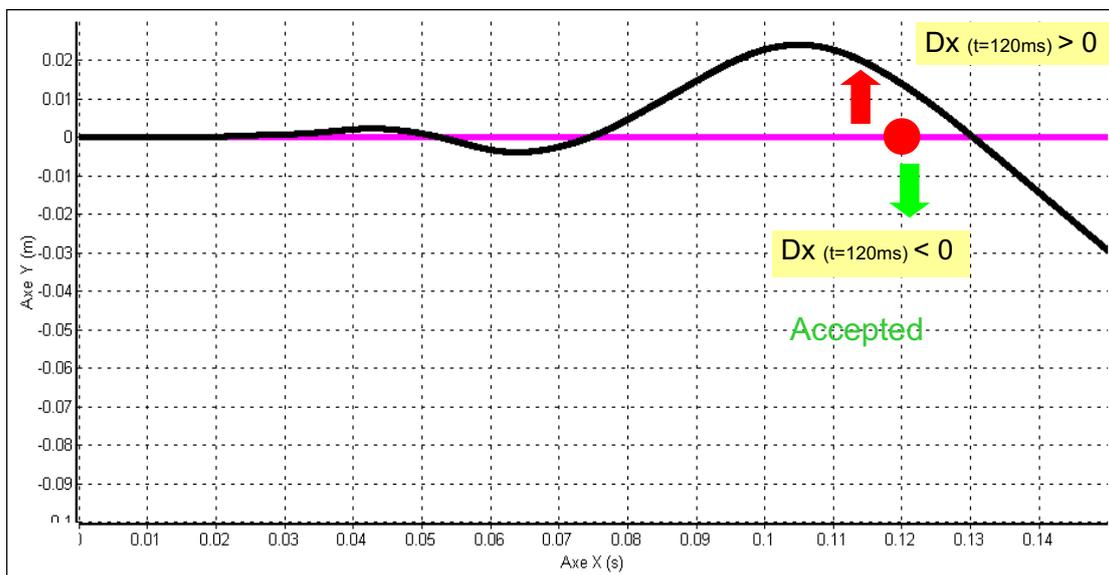


Sample pulse showing a sled test that cannot be accepted as parts of DV are outside the acceptable zone

Requirement #2:

- If DX value at 120 ms is negative, requirement #2 is OK
 - **sled test is accepted**
- If DX value at 120 ms is positive, requirement #2 is not OK
 - **sled test cannot be accepted**

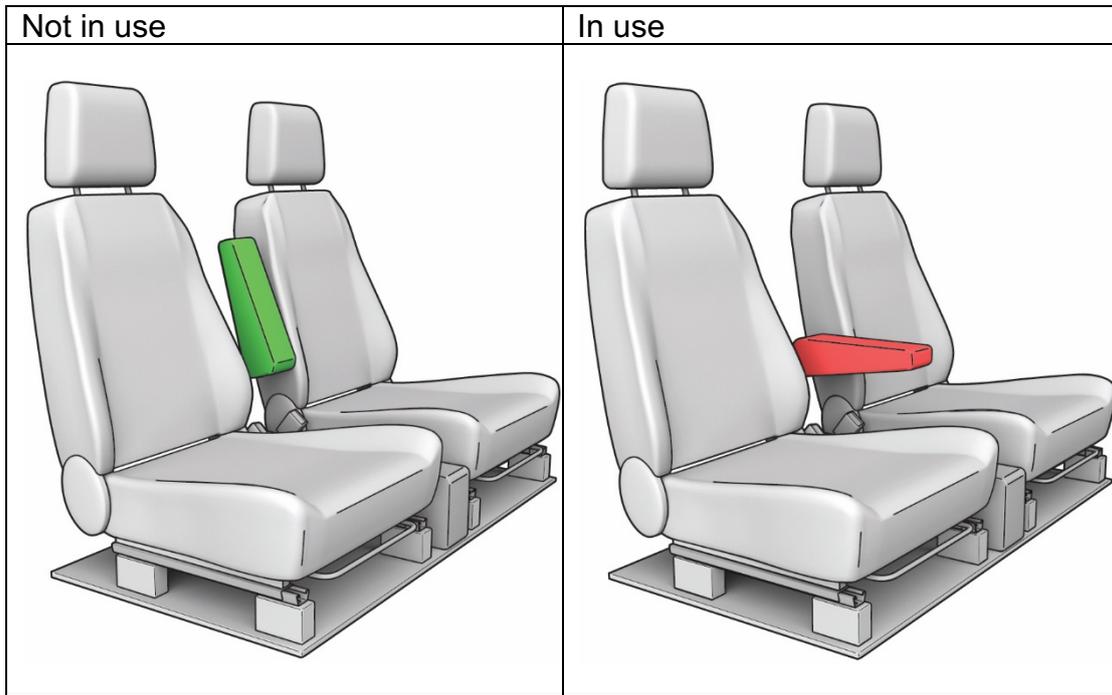
$$DX = \text{Integration}(DV(\text{Vehicle Pulse}) - DV(\text{buck}))dt$$



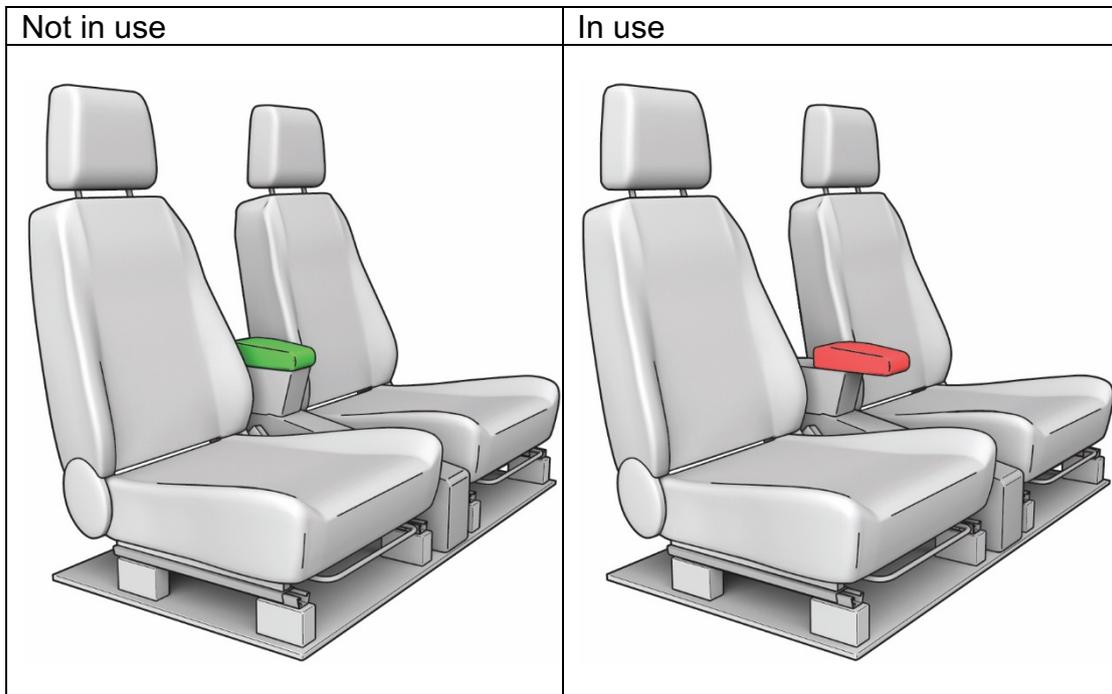
Sample picture shows a sled test that cannot be accepted as DX is positive
@ 120ms

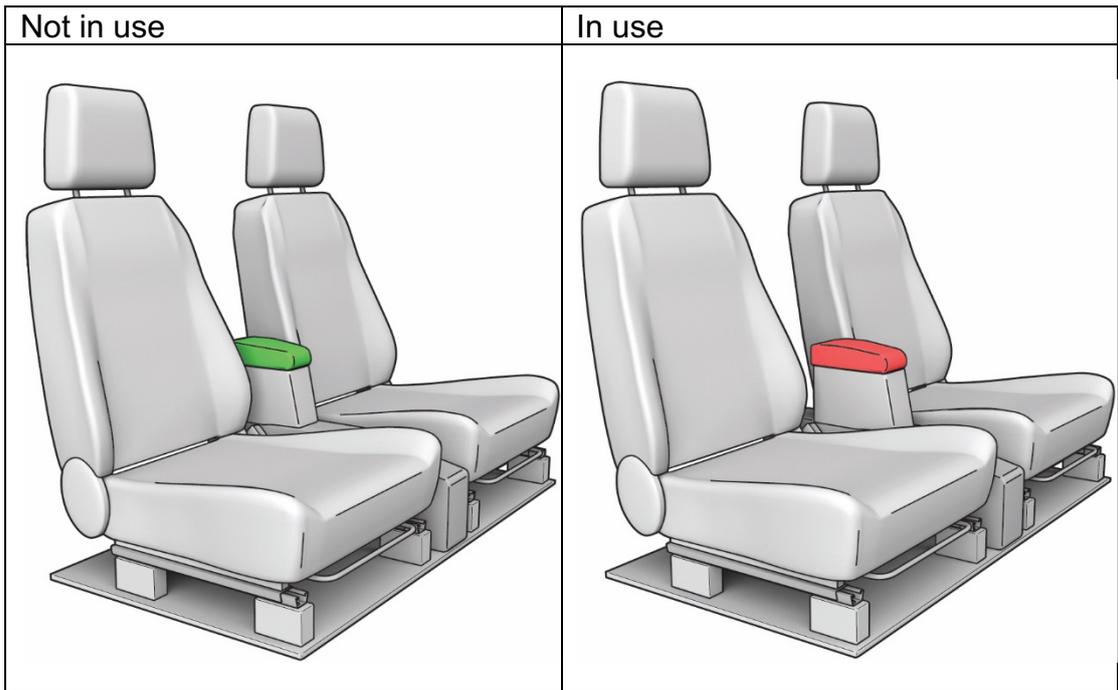
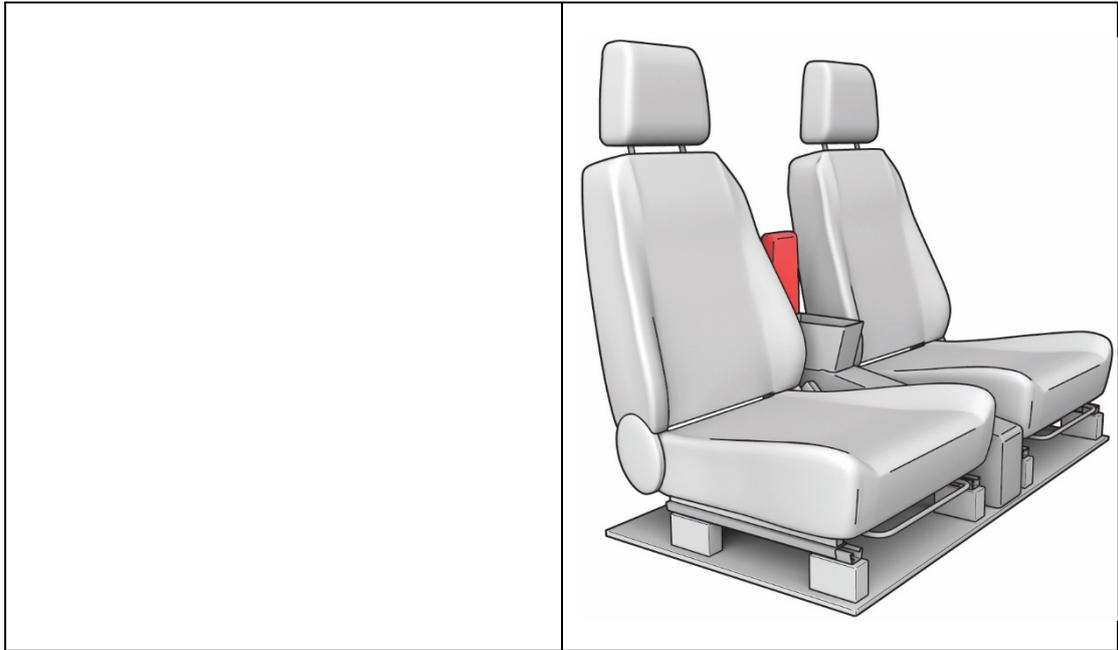
Appendix III

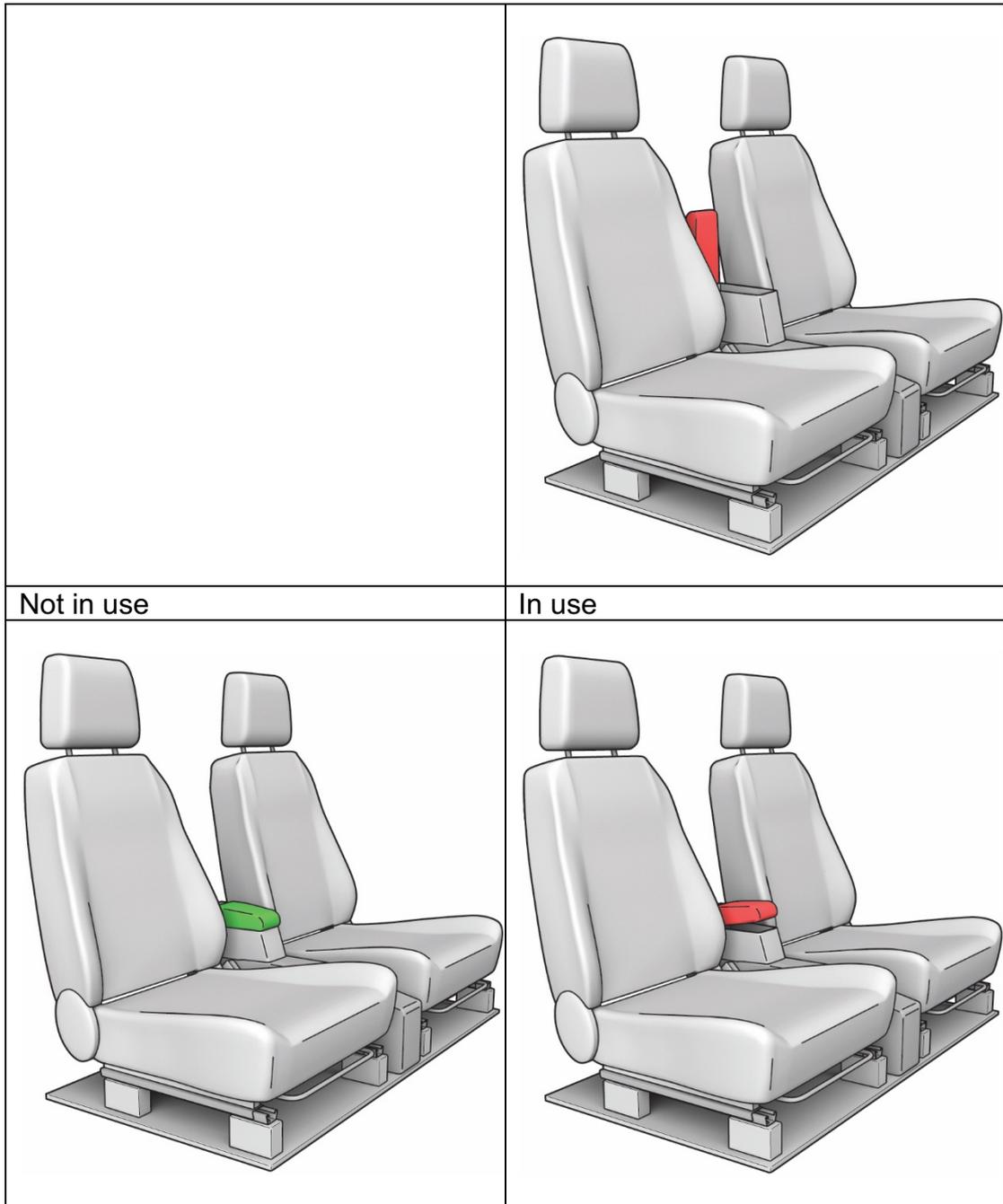
Seat mounted arm rests

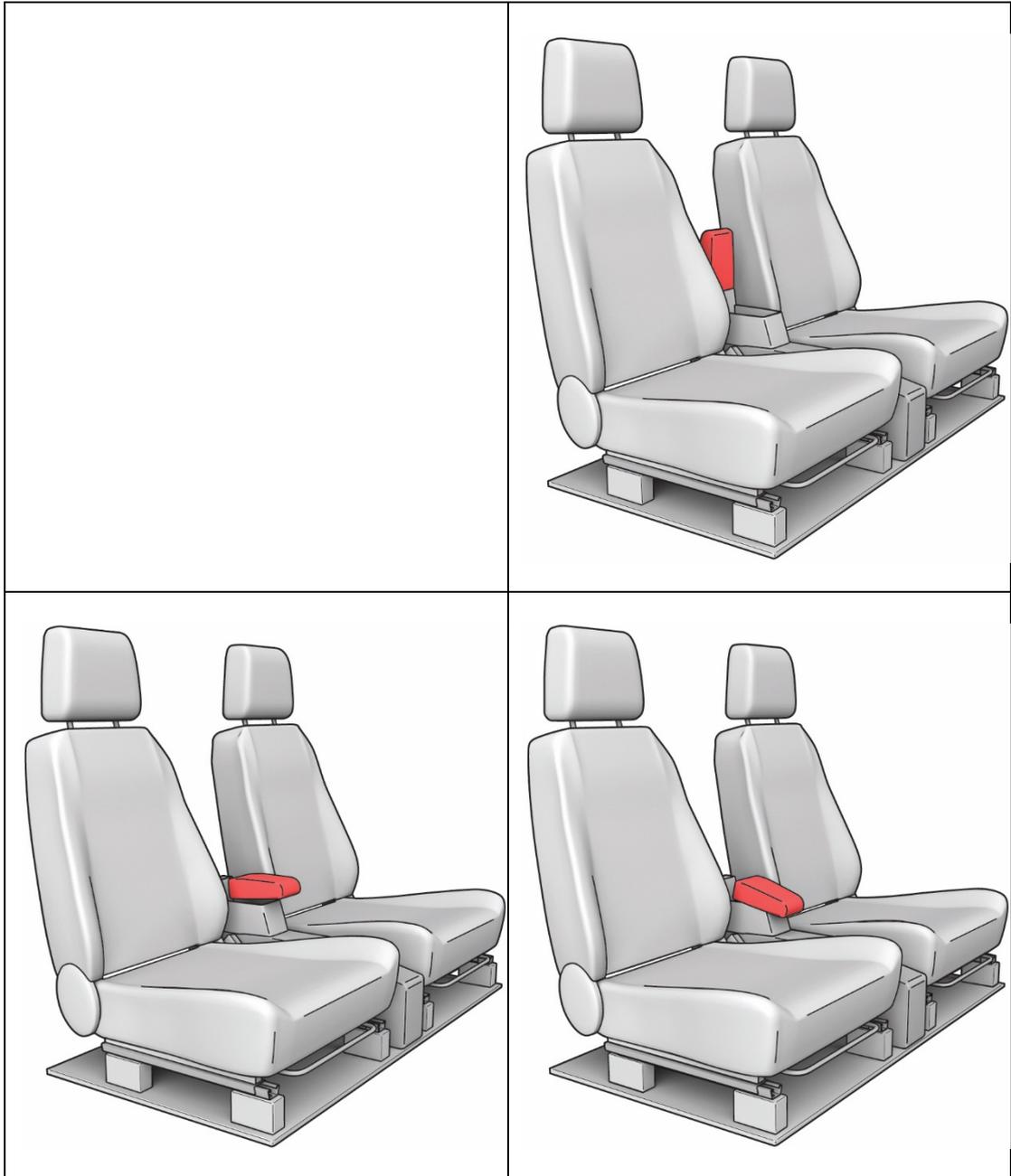


Centre console and tunnel mounted









Not in use	In use
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