ASEAN NCAP
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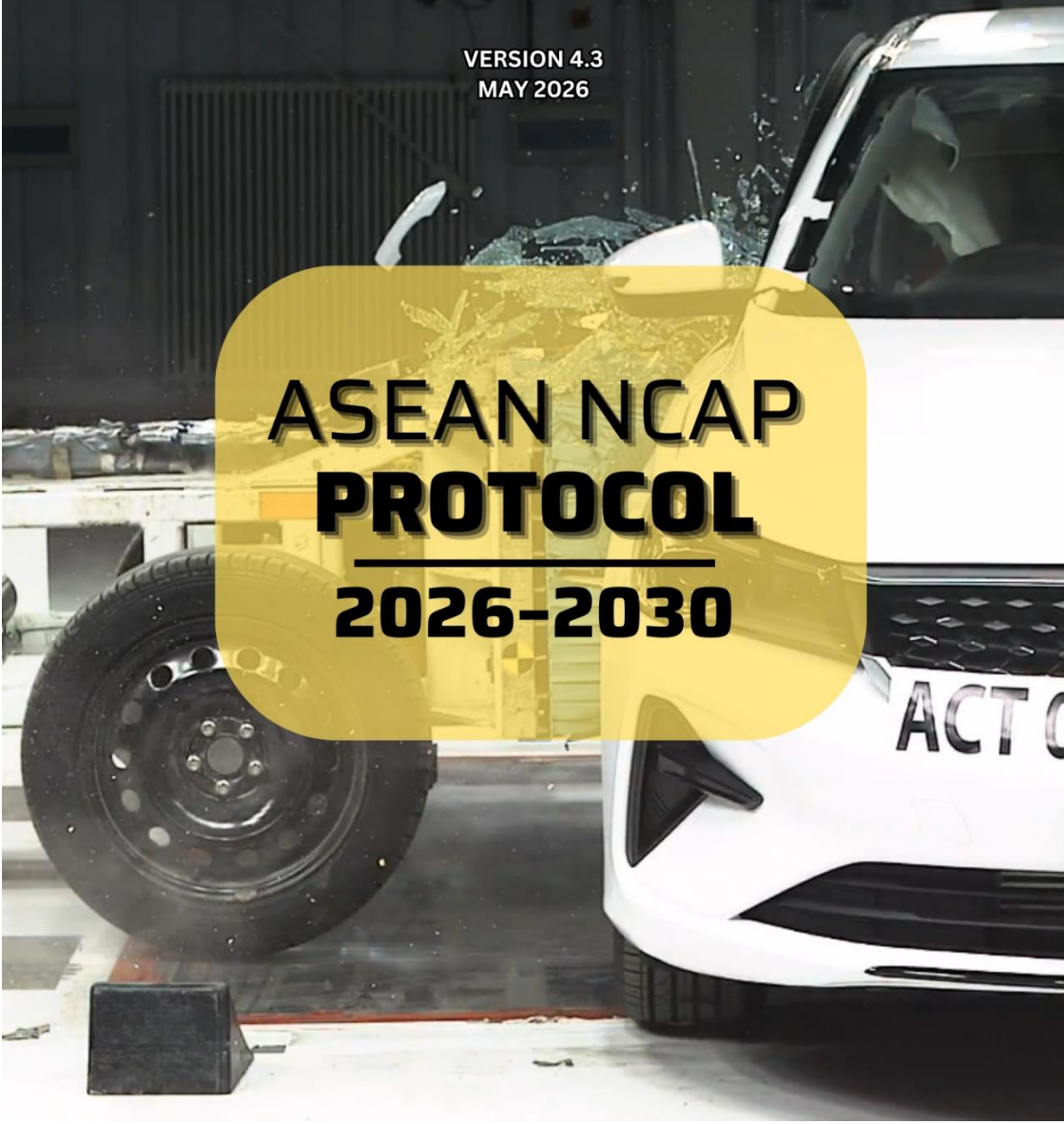
TEST PROTOCOL – FRONTAL IMPACT

VERSION 4.3
MAY 2026



ASEAN NCAP PROTOCOL 2026-2030

Preface

Where text is contained within square brackets this denotes that the procedure being discussed is currently being trialled in ASEAN 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 ASEAN NCAP. Where a disagreement exists between the laboratory and manufacturer, the ASEAN NCAP secretariat should be informed immediately to pass final judgement. Where the laboratory staff suspect that a manufacturer has interfered with any of the setup, the manufacturer's representatives 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 representatives will be told to leave the test site and the Secretariat

should be immediately informed. Any such incident may be reported by the Secretariat to the manufacturer and the persons concerned may not be allowed to attend further ASEAN NCAP tests.

DISCLAIMER: ASEAN 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, ASEAN NCAP reserves the right to make corrections and determine the assessment and subsequent result of the affected requirement(s).

In addition to the settings specified in this protocol, the following information will be required from the manufacturer of the car being tested in order to facilitate the vehicle preparation. A vehicle handbook should be provided to the test laboratory prior to the assessment.

TEST PROTOCOL – OFFSET FRONTAL IMPACT

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NEW CAR ASSESSMENT PROGRAM FOR SOUTHEAST ASIAN COUNTRIES (ASEAN NCAP)

TEST PROTOCOL – OFFSET FRONTAL IMPACT (OFI)

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 0.745 g/ml or 0.840 g/ml for diesel. Record this figure in the test details.

1.1.4 Put water, or other ballast, to this mass in the fuel tank.

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 Calculate 10 percent of the fuel tank capacity mass as determined in 1.1.3.

1.2.2 Remove this mass of ballast from the fuel tank, leaving 90 percent of the mass in the tank.

1.2.3 Place both front seats in their mid-positions. If there is no notch at this position, set the seat in the nearest notch rearward (this will be done more completely in Section 6).

1.2.4 Place a mass of equivalent to a Hybrid-III dummy (88 kg with instrumentation and cables) on each of the front seats.

1.2.5 Place 36 kg in the luggage compartment of the vehicle. 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.

1.2.6 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 side seat respectively (23 kg and 36 kg). If the child restraints are not available at this time then default masses of 7 kg each should be added to the dummy masses.

1.2.7 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.

1.2.8 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.

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

1.2.10 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.

1.2.11 Remove the weights from the luggage compartment and the front and rear seats.

1.3 Vehicle Width and Overlap

1.3.1 Determine the widest point of the vehicle ignoring the rear-view mirrors, side marker lamps, tyre pressure indicators, direction indicator lamps, position lamps, flexible mudguards and the deflected part of the tyre side-walls immediately above the point of contact with the ground.

1.3.2 Record this width in test details.

1.3.3 Determine the centre-line of the vehicle. Calculate 10% of the vehicle width (Section 9.3) and mark a line on the bonnet and bumper which is this distance from the centre line on the steering-wheel side of the car. The distance from this line to the widest point on the steering wheel side of the car will be the overlap with the deformable barrier.

Take the pre-impact vehicle intrusion measurements at this point. See Section 2 for a full description of how to do this.

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. The manufacturer will need to be contacted if this occurs.

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

Where an additional battery is to be used the vehicle manufacturer will be required to indicate the minimum voltage/current needed during the test for all systems to operate as intended. The manufacturer will be asked to confirm that the laboratory modifications are suitable for use in the vehicle being tested and will not influence any of the vehicle systems.

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

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

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

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

mass compensation will be made when all equipment has been fitted.

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

1.4.7 Place weights equivalent to a Hybrid-III dummy (88 kg) in each of the front seats of the car (with the seats in their mid-positions).

1.4.8 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 side seat respectively (23 kg and 36 kg). If the child restraints are not available at this time, then default masses of 7 kg each should be added to the dummy masses.

1.4.9 Weigh the front and rear axle weights of the vehicle. Compare these weights with those determined in Section 1.2.9.

1.4.10 If the axle weights differ from those measured in Section 1.2.9 by more than 5% (of the axle reference loads) or by more than 20 kg, remove or add items which do not influence the structural crash performance of the vehicle. Similarly, if the total vehicle mass differs by more than 25 kg from the reference mass, non-structural items may be removed or added. 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 additional mass that is added to the vehicle should be securely and rigidly attached.

1.4.11 Repeat Sections 1.4.9 and 1.4.10 until the front and rear axle weights and the total vehicle weight are within the limits set in 1.4.10. Record the final axle weights in the test details.

1.4.12 For fully electric vehicles, if a total vehicle mass within 25 kg of the reference mass cannot be achieved, it is acceptable for the total mass to be within 2% of the reference mass.

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

1.5 Vehicle Markings

1.5.1 ASEAN NCAP, MIROS and GLOBAL NCAP markings will be attached to the exterior of the vehicle in the following locations: upper half of driver's door, upper half of front

passenger's door and on the front half of the roof of the vehicle. Refer to Figure 1.1 below.

1.5.2 Test house logos may be added to the vehicle provided that they do not detract attention from the ASEAN NCAP markings. Suitable locations for such markings would be the lower half of the rear doors and on the bonnet at the base of the windscreen.

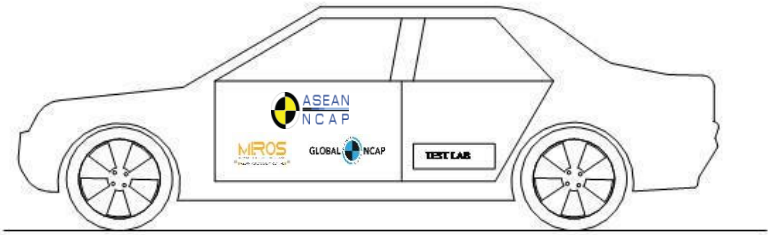


Figure 1.1 Vehicle marking

2 INTRUSION MEASUREMENTS

For vehicle deformation and intrusion measurements, a 3D measuring system which is capable of recording 3-dimensional co-ordinates of a point in space can be used. A tolerance of +/- 1mm is applicable to such a system. The system requires an axis system to be set up relative to the object to be measured, typically the transverse, longitudinal and vertical directions of a vehicle. An origin is first needed, followed by a point on the positive x-

axis and then a point in the positive x-y plane. Since the front of the vehicle is highly deformed after the impact, it is simplest to use some structure at the rear of the vehicle as a reference for measurement; this obviates the need to level the car after testing, the accuracy of which is limited. Most of the procedure which follows relates to the setting up of these axes.

2.1 Before Test

2.1.1 Determine and mark the centre of the clutch, brake and accelerator pedals.

2.1.2 Set the steering wheel to its mid-position, if it is adjustable for either rake or reach (for full description of how to do this, see Section 6).

2.1.3 Remove the centre of the steering wheel or, if fitted, the airbag assembly to expose the end of the steering column. When doing this, carefully note the connections to the airbag which will need to be remade on re-assembly. Follow the manufacturer's instructions when removing the airbag and/or steering wheel assemblies.

2.1.4 Determine and mark the centre of the top of the steering column.

2.1.5 Remove the carpet, trim and spare wheel from the luggage compartment. The plastic trim or rubber seals that might influence the latching mechanism should be re-fitted once the intrusion measurements have been recorded. This is to ensure that any opening of the rear door during the impact is not caused by the omission of some part of the trim around the latching mechanism.

2.1.6 Locate the vehicle axis reference frame (see Figure 2.1) centrally to the rear of the vehicle.

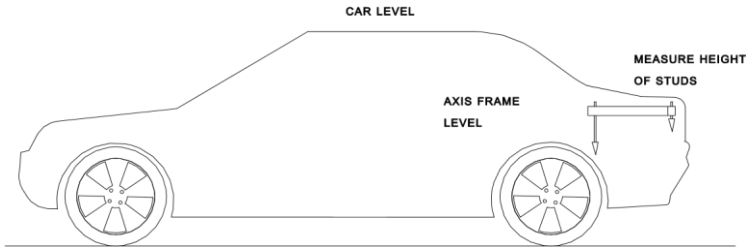


Figure 2.1 Setting up axis reference frame

2.1.7 Level the reference frame.

2.1.8 Measure and record the stud heights of the reference frame. These will be used after the test to help reset the reference frame, if required.

2.1.9 If it is necessary to lean on the vehicle to reach the following points, the vehicle should be supported to maintain the ride heights during measuring.

2.1.10 Set up the vehicle co-ordinate axes in the 3D arm or similar device.

2.1.11 Mark and record the position of at least 5 datum points on the rear of the vehicle. These points should be on structures which are not expected to be deformed in the test and should be positioned such that they have wide spaced locations in three dimensions and can all be reached with the 3D measuring system in one position.

2.1.12 Working on the passenger side of the vehicle determine and mark the positions on the B-post which are:

i. at a distance of 100 mm above the sill.
ii. at a distance of 100 mm beneath the lowest level of the side window aperture.

All points should be as close as possible to the rubber sealing strip around the door aperture.

2.1.13 Measure and record the pre-impact positions of the two door aperture points.

2.1.14 Working on the driver's side of the vehicle determine and mark the positions on the A and B posts which are:

i. at a distance of 100 mm above the sill.
ii. at a distance of 100 mm beneath the lowest level of the side window aperture.
All points should be as close as possible to the rubber sealing strip around the door aperture.

2.1.15 Use the arm to measure the pre-impact positions of the centre of the top of the steering-column and the four door aperture points.

2.1.16 Record the position of the centre of the un-depressed clutch, brake and accelerator pedals and where applicable foot operated parking brake. If the pedal is adjustable, set it to the mid position or a reasonable variation from this in accordance with the manufacturer's recommendations for the 50th percentile position.

2.1.17 Replace the steering wheel and airbag assembly. Check that all bolts are securely fastened. Ensure that all connections to the airbag are replaced and check the dashboard light to confirm the circuit is functional.

2.2 After Test

2.2.1 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, according to Section 9.6, 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.

2.2.2 Remove the dummies according to Section 9.6 and remove the data acquisition and emergency abort equipment (if fitted) from the luggage compartment.

2.2.3 Remove the centre of the steering wheel or airbag assembly.

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

2.2.5 If the axes cannot be redefined from any 3 of the datum points relocate the axis reference frame in the same position as in Section 2.1.8. Set the studs of the frame to the same heights as in Section 2.1.11 (Figure 2.2). The frame should now be in the same position relative to the car as it was before impact. Set up the measurement axes from the frame.

2.2.6 Record the post-impact positions of the B-post points on the unstruck passenger's side of the vehicle.

2.2.7 Compare the vertical co-ordinate of the B-post sill point before (Section 2.1.12) and after (Section 2.2.5) the test.

2.2.8 Find the angle θ that best satisfies the following equation: $z = -x'\sin\theta + z'\cos\theta$ for the B-post sill point (where z = pre impact vertical measurement and x', z' = post-impact longitudinal and vertical).

2.2.9 Working on the struck side of the vehicle, record the post-impact co-ordinates of the centre of the steering column, the centre of the clutch, brake and accelerator pedals, and where applicable a foot operated parking brake, with no load applied to them and in the blocked position (loaded with 200N to produce the maximum moment about the pedal pivot), the door aperture points. Prior to the 'blocked' pedal measurement, i.e. with the 200N applied, the brake fluid shall be removed to avoid the build-up of hydraulic pressure. If the steering column has become detached during impact due to the operation of the shear capsules, the column should be repositioned before measurement in the upward and lateral directions so that it is in contact with whatever structure(s) last constrained it from further movement. If any of the foot pedals become detached do not take a measurement of that pedal.

2.2.10 Transform the post impact longitudinal and vertical measurements (x', z') using the following equations.

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

2.2.11 Where θ is the angle determined in Section 2.2.8. X and Z should now be in the same frame of reference as the pre-impact measurements. [1]

2.2.12 From the pre-impact and adjusted post-impact data collected, determine

i) the longitudinal, lateral and vertical movement of the centre of the top of the steering column
ii) the longitudinal and vertical movement of all of the foot operated pedals
iii) the rearward movement of the A-post at waist level
iv) the reduction in width of the door aperture at waist and sill levels.

2.2.13 Record these intrusion measurements in the test details.

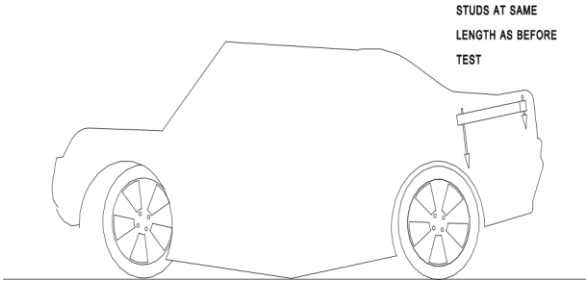


Figure 2.2 Re-setting axis reference frame after test

[1] This assumes that the point on the unstruck B-post sill is not displaced vertically or laterally during the impact.

3 DUMMY PREPARATION AND CERTIFICATION

3.1 General

3.1.1 Hybrid III test dummies should be used for the front seat driver and passenger positions. They should conform to U.S. Department of transportation, Code of Federal Regulations Part 572 Subpart E and ECE Regulation No. 94, except for modifications and additions stated later - See Section 3.3.

3.1.2 A Q6 child dummy, in a high-back booster seat, in the rear driver side seating position.. This will be either the high-back booster seat recommended by the vehicle manufacturer, or if there is no recommendation, a suitable CRS from the CRS Reference List in ASEAN NCAP Technical Bulletin (ATB) 002.

3.1.3 A Q10 child dummy, in a high-back booster seat, in the rear front passenger side seating position. If there is no recommendation for a high back booster seat, one will be chosen by ASEAN NCAP from the CRS Reference List in ATB 002.

3.1.4 Where a vehicle is equipped with an integrated CRS covering the Q6 and/or Q10 on the rear outboard 2nd row test positions, the integrated CRS will be used in the dynamic tests. Integrated CRS will be used even if it is optional equipment. Where a vehicle is equipped with only one integrated CRS on

either outboard position covering both or only one of two child ages, the integrated CRS will be used only where applicable.

3.2 Dummy Certification

Full details of the certification procedure for the Hybrid-III dummy are available elsewhere (see Part 572 Subpart E of US Department of Transportation Code of Federal Regulations), SAE J2856 and Annex 10 of ECE Regulation No. 94). Details of the certification procedure of the Q6 and Q10 child dummies are available in the user documentation. No manufacturer shall have access to any pre-test information regarding any of the test equipment to be used by ASEAN NCAP or be permitted to influence its selection in any way.

3.2.1 The Hybrid-III dummies shall be re-certified after every THREE impact tests.

3.2.2 If an injury criterion reaches or exceeds its normally accepted limit (e.g. HIC of 700) then that part of the dummy shall be re-certified.

3.2.3 If any part of a dummy is broken in a test, then the part shall be replaced with a fully certified component.

3.2.4 Copies of the dummy certification certificates will be provided as part of the full report for a test.

3.2.5 Child dummy certification

a) The Q6 and Q10 child dummies shall be re-certified after every TWENTY impact tests (e.g. 10 frontal and 10 side impacts, or any combination of the two test types). Hip shields shall be replaced after every dummy certification, hip liners shall be replaced after every twenty impact tests.
b) The Q10 dummy shoulder lateral impact certification test is to be performed with the side impact shoulder kit only.
c) If an injury criterion reaches or exceeds its normally accepted limit (eg HIC of 700) then that part should be re-certified.
d) If any part of a dummy is broken in a test then the part shall be replaced with a fully certified component.
e) Copies of the dummy certification certificates shall be provided by the laboratory as part of the full report for a test.

3.3 Additions and Modifications to the Hybrid III Dummies

3.3.1 The additions and modifications which will change the dynamic behaviour of the test dummies from Part 572E specification dummies are:

3.3.2 Roller ball-bearing knees shall be fitted.

3.3.3 Extra instrumentation is also fitted such as enhanced instrumented lower legs and a 6-axis neck. See Section 4 for a full instrumentation list.

3.3.4 Foam neck shields (Part 93051-1-DN or equivalent) must be fitted to the driver and passenger if a frontal protection airbag is present.

3.4 Additions and Modifications to The Child Dummies

3.4.1 The Q6 dummy shall be standard build level A, and the Q10 standard build level C. See the relevant user manual for each dummy.

3.4.2 The Q10 dummy is used with the full arms for frontal impact testing.

3.5 Dummy Clothing and Footwear

3.5.1 Hybrid-III dummies

3.5.1.1 Each dummy will be clothed with formfitting cotton stretch garments with short sleeves and pants which should not cover the dummy's knees.

3.5.1.2 Each dummy shall be fitted with shoes equivalent to those specified in MIL-S13192 rev P. (size XW).

3.6 Dummy Test Condition

3.6.1 Dummy Temperature

3.6.1.1 The dummy shall have a stabilised temperature in the range of 19ºC to 22ºC.

3.6.1.2 A stabilised temperature shall be obtained by soaking the dummy in temperatures that are within the range specified above for at least 5 hours prior to the test.

3.6.1.3 Measure the temperature of the dummy using a recording electronic thermometer placed inside the dummy's flesh. The temperature should be recorded at intervals not exceeding 10 minutes.

3.6.1.4 A printout of the temperature readings is to be supplied as part of the standard output of the test.

3.6.2 Dummy Joints
All constant friction joints should have their 'stiffness' set by the following method.

3.6.2.1 Stabilise the dummy temperature by soaking in the required temperature range for at least 5 hours.

3.6.2.2 The tensioning screw or bolt which acts on the constant friction surfaces should be adjusted until the joint can just hold the adjoining limb in the horizontal. When a small downward force is applied and then removed, the limb should continue to fall.

3.6.2.3 The dummy joint stiffness 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.

3.6.2.4 Maintain the dummy temperature within the range 19° to 22°C between the time of setting the limbs and up to a maximum of 10 minutes before the time of the test.

3.6.3 Dummy face painting

3.6.3.1 With the exception of the Hybrid-III face, the dummies should have masking tape placed on the areas to be painted using the size table 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.

Hybrid-IIIs

Eyebrows (left and right)	Red
Nose	Green
Chin	Yellow

Left Knee	Red
Right Knee	Green
Left Tibia (top to bottom)	Blue, Green, Red, Yellow
Right Tibia (top to bottom)	Yellow, Red, Green, Blue

Child dummies

Top of Head	Blue
Head-band (left to right)	Red, Yellow, Green

NOTE: The tape should be completely covered with the coloured paints specified.
Paint Area Sizes:

Hybrid-IIIs

Eyebrows	= 25 x 50 mm rectangle, 2 units
Nose	= 25 x 40 mm strip, down nose centre line
Chin	= 25 x 25 mm square, centre line of chin

Knees = 50 x 50 mm square, knee centre line with bottom edge level with top of tibia flesh
Tibias = 25 mm x 50 mm, 4 adjacent areas down leg centre line with top edge level with top of tibia flesh

Child Dummies
Top of Head = 75 x 75 mm square
Headbands = 25mm wide, widest circumference remaining at eyebrow level at front, extending to the head C of G at each side.

3.7 Post Test Dummy Inspection

3.7.1 The dummies should be visually inspected immediately after the test. Any lacerations of the skin or breakages of a dummy should be noted in the test specification. A dummy may have to be re-certified in this case. Refer to Section 3.2.

4 INSTRUMENTATIONS

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. 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 (1995). The sign convention used for configuring the transducers is stated in SAE J211.

4.1 Dummy Instrumentation

The dummies to be used shall be instrumented to record the channels listed below.

Hybrid-III

Location	Parameter		Minimum Amplitude	Driver No of channels	Passenger No of channels
Head	Accelerations, A_x A_y A_z		250 g	3	3
Neck	Forces	F_x F_y	9 kN	2	2
		F_z	14 kN	1	1
	Moments, M_x M_y M_z		290 Nm	3	3
Chest	Accelerations, A_x A_y A_z		150 g	3	3
	Deflection, D_{chest}		100 mm	1	1
Pelvis	Accelerations, A_x A_y A_z		150 g	3	3
Femurs (L & R)	Forces, F_z		20 kN	2	2
Knees (L & R)	Displacements, D_{knee}		19 mm	2	2
Upper Tibia (L & R)	Forces, F_x F_z		12 kN	4	4
	Moments, M_x M_y		400 Nm	4	4

Lower Tibia[2] (L & R)	Forces, F_x F_z (F_y)	12 kN	4	4
	Moments, M_x M_y	400 Nm	4	4
	Total Channels per Dummy		36	36
	Total Channels		72	

[2] Note that for both dummies the measurement of F_y is at the laboratory's discretion.

Q6

Location	**Parameter**		**Minimum Amplitude**	**No of Channels**
Head	Accelerations, A_x A_y A_z		200 g	3
Upper Neck (OC)	Forces	F_x F_y	5.0 kN 5.0 kN	2
		F_z	6.0 kN	1
	Moments	M_x M_y	90 Nm	2
		M_z	45 Nm	1
Chest	Accelerations, A_x A_y A_z		200 g	3
	Thorax - 1d IR-TRACC		90 mm	1
	Total Channels			**13**

Q10

Location	Parameter		Minimum Amplitude	No of Channels
Head	Accelerations, A_x A_y A_z		200 g	3
Head Tilt sensor (static)	Angle		NA	NA
Upper Neck (OC)	Forces	F_x F_y	8.0 kN	2
		F_z	10.0 kN	1
	Moments	M_x M_y	90 Nm	2
		M_z	45 Nm	1
Chest (T4)	Accelerations, A_x A_y A_z		200 g	3
	Displacement & rotation		90 mm 40 deg	4
	Total Channels			16

4.2 Vehicle Instrumentation

4.2.1 The vehicle is to be fitted with an accelerometer on each B-post. The accelerometers are to be fitted in the fore/aft direction (A_x).

4.2.2 Remove carpet and the necessary interior trim to gain access to the sill directly below the B-post.

4.2.3 Securely attach a mounting plate for the accelerometer horizontally on to the sill, without adversely affecting seat belt retractors and/or pretensioners.

4.2.4 Fix the accelerometer to the mounting plate. Ensure the accelerometer is horizontal to a tolerance of ±1 degree and parallel to the X-axis of the vehicle.

4.2.5 Attach lightweight (<100 g) seatbelt loadcells to the shoulder section of the driver and passenger seatbelts.

4.2.6 Attached accelerometer (A_x, A_y, A_z) behind the seat installed with Q6 and Q10 dummy.

4.2.7 Securely attached at the vehicle body and remove any necessary interior trim to gain access directly behind the seat.

VEHICLE

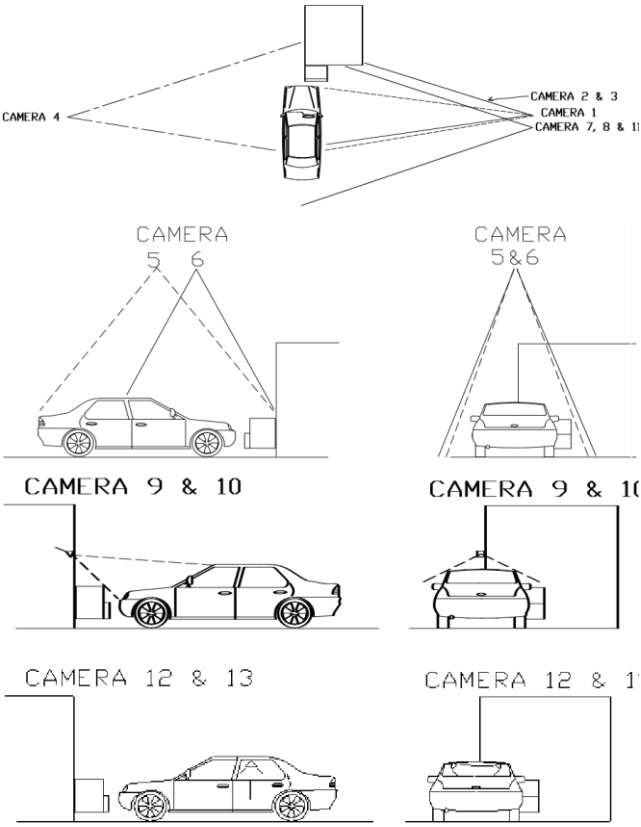
Location	Parameter	Minimum Amplitude	No of channels
B-Post LHS	Accelerations, A_x	150 g	1
B-Post RHS	Accelerations, A_x	150 g	1
Driver Seatbelt Shoulder Section	Force, $F_{diagonal}$	16 kN	1
Passenger Seatbelt Shoulder Section	Force, $F_{diagonal}$	16 kN	1
Q6 Floor G	Accelerations, A_x A_y A_z	150 g	3
Q10 Floor G	Accelerations, A_x A_y A_z	150 g	3
	Total Channels per Vehicle		10

TOTAL CHANNELS

1X Driver Hybrid-III	36
1X Passenger Hybrid-III	36
1X Q6	13
1X Q10	20
1X Vehicle	10
Total Channels per Test	115

5 CAMERA LOCATIONS

Set up high speed film cameras according to the following diagrams.



Camera No.	Camera Type	Shot Content
1	>/= 500 fps high speed	Driver (tight)
2	>/= 500 fps high speed	Driver (wide)
3	>/= 500 fps high speed	Backup for 2 (optional)
4	>/= 500 fps high speed	Passenger (wide)
5	>/= 500 fps high speed	Plan view (wide) (optional)
6	>/= 500 fps high speed	Plan view (tight) (optional)
7	>/= 500 fps stills camera	Driver (wide)
8	>/= 500 fps stills camera	Backup for 7 (optional)
9	>/= 500 fps high speed	Front view driver & passenger
10	>/= 500 fps high speed	Backup for 9 (optional)
11	>/= 500 fps high speed	Driver (wide) (optional)
12	>/= 500 fps high speed	Child dummy max head excursion/head protection Onboard
13	>/= 500 fps high speed	Child dummy max head excursion/head protection Onboard
14	Live camera (go pro)	Frontal - on coming vehicle and driver side

5.1 Lens sizes should be chosen appropriately in order to achieve the required shot content/intention. In order to prevent view distortion, a minimum lens size of 9mm is applicable.

5.2 Cameras 2, 7 and 9 are considered an essential requirement for all tests for media coverage.

5.3 For forward facing CRS, cameras 12 and 13 shall be fitted on the 550 mm excursion line and point across the vehicle to capture head excursion. For rearward facing CRS, the camera should capture the head protection/containment, there is no need to position the camera on the excursion line.

5.4 When attaching onboard cameras, the vehicle manufacturer should be consulted to ensure that no damage is caused to the vehicle that would influence the impact performance. Additionally, the test laboratory should be informed if the side curtain airbags are expected to deploy during the impact. Where additional equipment is added, the mass shall be offset when achieving the final test weight.

5.5 If the test vehicle is equipped with curtain airbag, internal lighting needs to be added if the onboard camera is not able to record sufficient images for the assessment.

6 PASSENGER COMPARTMENT ADJUSTMENTS

Adjustment	Required Setting	Notes	Methods
Seat Fore/Aft	Mid position as defined in Section 6.1	May be set to first notch rearwards of mid position if not lockable at mid position	See Section 6.1
Seat Base Tilt	Manufacturer 's design position	Permissible up to Mid Position	See Section 6.1.11
Seat Height	Lowest position		
Seat Back Angle (as defined by torso angle)	Manufacturer 's design position	Otherwise, 25° to vertical as defined by Torso angle	See Section 7.1.1
Front Head Restraints	Highest position		
Head Restraint Tilt	Manufacturer's design position	Otherwise mid position	
Seat Lumbar Support	Manufacturer 's design position	Otherwise fully retracted	See Section 6.1.12

Adjustment	Required Setting	Notes	Methods
Steering wheel - vertical	Mid position		See Section 6.3
Steering wheel - horizontal	Mid position		See Section 6.2
Rear Head Restraints	Remove or Lowest	Unless instructed otherwise by the manufacturer	
Rear Seat Fore/Aft	Mid position	Vehicle manufacturer to supply details of seat position contained in handbook when no handbook is available at the time of test.	See Section 6.4.1
Rear Seat Facing	Forwards		See Section 6.4.1

Adjustment	Required Setting	Notes	Methods
Arm-rests (Front seats)	Lowered position	May be left up if dummy positioning does not allow lowering	
Arm-rests (Rear seats)	Stowed position		
Glazing	Front - Lowered Rear - Lowered or Removed	This applies to opening windows only	
Gear change lever	In the neutral position		
Pedals	Normal position of rest		
Doors	Closed, not locked		
Roof	Lowered	Where applicable	
Sun Visors	Stowed position		

Adjustment	Required Setting	Notes	Methods
Rear view mirror	Normal position of use		
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	

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

6.1 Determination of and Setting the Fore/aft, Tilt and Lumbar Settings of the Seat.

6.1.1 The manufacturers seat fore/aft position which corresponds to the 95th percentile male seating position will have been provided.

6.1.2 Place a mark on the moving part of seat runner close to the unmoving seat guide.

6.1.3 Move the seat to its most forward position of travel.

6.1.4 Mark the unmoving seat guide in line with the mark on the seat runner. This corresponds to the seat in its most forward position.

6.1.5 Move the seat to the position of its travel provided for the 95th percentile male.

6.1.6 Mark the unmoving seat guide in line with the mark on the seat runner. This corresponds to the 95th percentile male's seating position.

6.1.7 Measure the distance between the forwards and rearwards marks. Place a third mark on the seat guide mid-way between the forwards and rearwards marks.

6.1.8 Move the seat so that the mark on the seat runner aligns with the mark on the seat guide.

6.1.9 Lock the seat at this position. Ensure that the seat is fully latched in its runners on both sides of the seat. The seat is now defined as being at its 'mid seating position'. The vehicle will be tested with the seat in this position.

6.1.10 If the seat will not lock in this position, move the seat to the first locking position that is rear of the mid seating position. The vehicle will be tested with the seat in this position.

6.1.11 If the seat base is adjustable for tilt it may be set to any angle from the flattest up to its mid position according to the manufacturer's preference. The same seat tilt setting must be used for frontal and side impact.

6.1.12 If the seat back is adjustable for lumbar support it should be set to the fully retracted position, unless the manufacturer specifies otherwise or the dummy prevents this.

6.2 Setting the Steering Wheel Horizontal Adjustment

6.2.1 Choose a part of the facia that is adjacent to the steering column and can be used as a reference.

6.2.2 Move the steering wheel to the most forward position of its travel.

6.2.3 Mark the steering column in line with an unmoving part of the facia. This corresponds to the most forward travel of the steering wheel.

6.2.4 Move the steering wheel to the most rearwards position of its travel.

6.2.5 Mark the steering column in line with an unmoving part of the facia. This corresponds to the most rearwards travel of the steering wheel.

6.2.6 Measure the distance between the forwards and rearwards marks on the steering column. Place a third mark on the steering column mid-way between the forwards and rearwards marks. This corresponds to the centre of travel of the steering wheel.

6.2.7 Move the steering wheel so that the mark on the steering column aligns with the facia.

6.2.8 Lock the steering column at this position. The steering wheel is now in its mid-position of travel. The vehicle will be tested with the steering wheel in this position.

6.3 Setting the Steering Wheel Vertical Adjustment

A method that is in principle the same as Section 6.2 should be used to determine and set the steering wheel vertical adjustment to the mid position.

It is unlikely that the same part of the facia used during the setting procedures for the horizontal adjustments could be used for the vertical adjustment.

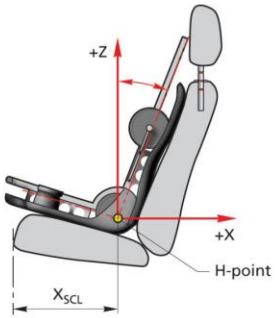
Care should be taken to avoid unintentional adjustment of the horizontal setting during the vertical adjustment procedure.

6.4 Marking Q10 & Q6 Child Dummy Head Excursion Line

6.4.1 If applicable, position the rear seats in accordance with the adjustments detailed in Section 6.

6.4.2 Install the H-point machine in accordance with the procedure detailed in Section 7 and determine the rear passenger seat H-point.

6.4.3 Determine the H-point coordinates for the Hybrid III 5th Percentile Female Dummy (HIII-05F) using the following equations:



$$X_{AF05,dummy} = X_{AM50,H-point\ manikin} + (93\ mm - 0.323 \times X_{SCL})$$

$$Z_{AF05,dummy} = Z_{AM50,H-point\ manikin} - 6\ mm$$

where X_{SCL} is defined as the horizontal distance between the H-point and the most forward point on the seat cushion.

6.4.4 The HIII-05F H-point coordinates determined in Section 6.4.3 shall be used as the reference point for the head excursion assessment.

6.4.5 The vehicle shall be clearly marked on both sides to define scales at:

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

The markings shall be applied in 50 mm increments and shall be clearly visible on the high-speed film. Markings shall be applied to:

- the exterior upper door region,
- waist level of the door, and
- interior waist level surfaces.

6.4.6 The 450 mm and 550 mm excursion lines shall be clearly distinguished from the other markings by using a different colour. These lines shall also be marked in locations clearly visible to the onboard cameras. Alternatively, it is acceptable for the lines across the vehicle to be superimposed during post-film processing.

6.4.7 None of the excursion lines shall be positioned more forward than the most rearward point on the seatback of the front passenger seat in the 5th percentile female seating position. In this case, the excursion line(s) shall align with the most rearward point on the seatback of the front passenger seat.

7 DUMMY POSITIONING AND MEASUREMENTS

The following chapter deals with all aspects of seating the dummy in the vehicle to be tested. A general timetable of the complete procedure is set out below:-

Timetable

	When this is done
1. Determine the H-point of the driver's seat	Before test day
2. Determine the H-point of the passenger's seat	Before test day
3.Dummy installation	Before test day
4. Dummy placement	Test day
5.Dummy positioning	Test day
6. Dummy positioning measurements	Test day - after vehicle has been positioned for test

7.1 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 ± 10 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.

7.1.1 Set the seat back so that the torso of the dummy is as close as possible to the manufacturer's reasonable recommendations for normal use. In absence of such recommendations, an angle of 25 degrees towards the rear from vertical will be used.

7.1.1.1 The driver and passenger seatback angle and seat base shall be set to the same position.

7.1.1.2 Where one seat is height adjustable and the other is fixed, the relative angle between the seat back and the ground should be the same for both seats.

7.1.1.3 Where both seats are adjustable, the manufacturer is asked to supply recommended settings. These should not differ from the nominal settings by more than a reasonable amount. In any of the above situations, the manufacturer may provide convincing information that the seat adjustments should be different from those specified here. If so the fully supported request to vary the set up should be made to the Secretariat.

7.1.2 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.

7.1.3 Place the seat and back assembly of the H-point machine on the seat at the centre line of the seat.

7.1.4 Set the thigh and lower leg segment lengths to 401 and 414 mm respectively.

7.1.5 Attach lower legs to the machine, ensuring that the transverse member of the T-bar is parallel to the ground.

7.1.6 Place right foot on undepressed accelerator pedal, with the heel as far forwards as allowable. The distance from the centre line of the machine should be noted.

7.1.7 Place left foot at equal distance from centre line of the machine as the right leg is from centre line. Place foot flat on footwell.

7.1.8 Apply lower leg and thigh weights.

7.1.9 Tilt the back pan forwards to the end stop and draw the machine away from the seat-back.

7.1.10 Allow the machine to slide back until it is stopped by contacting the seat back.

7.1.11 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.

7.1.12 Return the machine back to the seat back.

7.1.13 Install the right and left buttock weights.

7.1.14 Apply the torso weights alternately left and right.

7.1.15 Tilt the machine back forwards to the end stop and rock the pan by 5 degrees either side of the vertical. The feet are NOT to be restrained during the rocking. After rocking the Tbar should be parallel to the ground.

7.1.16 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 pedal.

7.1.17 Return the machine back to the seat back.

7.1.18 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.

7.1.19 Adjust the seat back angle to the angle determined in 7.1.1, 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.

7.1.20 Measure and record in the test details the position of the H-point relative to some easily identifiable part of the vehicle structure.

7.2 Determine the H-point of the Passenger's Seat

Follow the procedure for the determination of the driver's H-point ensuring that the distance from the centre line to the legs is the same as that used in the determination of the driver's H-point.

For both right and left feet, place the feet flat on the floor.

7.3 Dummy Installation

It is the intention that the dummy should not be left to sit directly on the seat for more than 4 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 not left in overnight or for a similarly lengthy period.

If it is known that the dummy will be in the vehicle for a time longer than 4 hours, then the dummy should be sat on plywood boards placed over the seat. This should eliminate unrealistic compression of the seat.

7.4 Dummy Placement

If the vehicle has only two side doors, it may be necessary to fit the child restraint systems and child dummies (section 7.6) before setting up the Hybrid-III dummies in the front seats.

7.4.1 Ensure that the seat is in the correct position as defined by Section 7.1.

7.4.2 Place the dummy in the seat with the torso against the seat back, the upper arms against the seat back and the lower arms and hands against the outside of the upper leg.

7.5 Dummy Positioning

Dummy positioning should be carried out immediately before the test and the vehicle should not be moved or shaken thereafter until the test has begun. If a test run is aborted and the vehicle brought to a standstill using an emergency braking method, the dummy placement procedure should be repeated. If the dummy, after three attempts cannot be positioned within the tolerances below then it is to be placed as close to the tolerance limits as possible. Record this in the test details.

7.5.1 *H-point*

The dummy's H-point shall be within 13mm in the vertical dimension and 13mm in the horizontal dimension of a point 6mm below the H-point as determined in Section 7.1. Record the position of the dummy H-point in the test details.

7.5.2 *Pelvic Angle*

The pelvic angle measurement gauge should read 22.5° ± 2.5° from the horizontal. Record the measured angle in the test details.

7.5.3 *Head*

The transverse instrumentation platform of the head shall be horizontal to within 2.5°.

Levelling of the head shall be carried out in this order:

- Adjust the H-point within the limit (Section 7.5.1)
- Adjust the pelvic angle within the limits (Section 7.5.2)
- Adjust the neck bracket the minimum to ensure that the transverse instrumentation platform is level within limits
- Record the measured angle in the test details.

7.5.4 *Arms*

The driver's upper arms shall be adjacent to the torso as far as is possible.

The passenger's arms shall be adjacent to the torso and in contact with the seat back.

7.5.5 *Hands*

The driver dummy's hands shall have their palms placed against the steering wheel at a position of a quarter to three. The thumbs should be lightly taped to the wheel.

The passenger's hands should be placed with the palms in contact with the outside of the legs and the little finger in contact with the seat cushion.

7.5.6 *Torso*
The dummies' backs should be in contact with the seat back and the centre line of the dummies should be lined up with the centre line of their respective seats.

7.5.7 *Legs*
The upper legs of both dummies shall be in contact with the seat cushion as far as possible. The distance apart of the outside metal surfaces of the knees of each dummy shall be 270 mm ± 10 mm (except if the left foot is placed on a footrest in Section 7.5.8 below). The legs of the dummies should be in vertical longitudinal planes as far as is possible.

7.5.8 *Feet*
The driver dummy's right foot shall rest on the undepressed accelerator pedal with the heel on the floor. 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. 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 of 270 mm ± 10 mm may be ignored in this case. Note the knee gap in the test details.
The passenger dummy's feet shall be placed with the heel as far forwards as possible and the feet as flat as possible. Both feet shall be parallel to the centre line of the vehicle.

7.5.9 *Seat belt*
7.5.9.1 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.

7.5.9.2 Carefully place the seat belt across the dummy and lock as normal. It will be necessary to re-position the hands as described in Section 7.5.5.

7.5.9.3 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.

7.5.9.4 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.

7.5.9.5 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, for example the belt is close to or in contact with the neck shield or the belt is above the shoulder rotation adjustment screw, and the upper belt anchorage is adjustable the anchorage should be lowered and steps 7.5.9.3 and 7.5.9.4 repeated.

7.5.9.6 The upper anchorage should be lowered by a sufficient amount to ensure a natural belt position following the repetition of steps 7.5.9.3 and 7.5.9.4 repeated. This may require multiple attempts.

7.5.9.7 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.

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

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

7.5.9.10 Where the fitment of the shoulder belt loadcell (Section 4.2.5) 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.

7.6 Child Dummy positioning and measurements

Two high-back booster seats are to be fitted on the rear seat, one suitable for a ten-year-old child, the other for a six-year-old child.

Read the relevant sections of the vehicle handbook and the instructions provided with the child restraint. This is to identify any special features of either the vehicle or the child restraint that are intended to improve performance or may influence installation. Instructions on tightening of the adult seat belt around the child restraint should be noted, but the installation itself should follow the procedure below.

The use of additional belt guides, clips or other components that are not an integral part of the high-back booster seats 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.

7.6.1 General

Before installing the dummies and high-back booster seats, ensure that the passenger compartment adjustments for the rear

seats are performed according to Section 7.1.1.1 for frontal impact.

7.6.2 Marking centrelines

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

The vehicle manufacturer shall confirm whether the centreline of the head restraints aligns with the centreline of the vehicle's rear seat cushion. Where this is not the case the OEM shall supply details of the seat base centreline. Where no information is provided, either the centreline of the head restrains, seat cushion or the ISOFIX anchorages shall be used, whichever is the most appropriate for the high-back booster seats installation.

7.6.3 Q10 Installation

7.6.3.1 Placing the high-back booster seat in the vehicle

a) Place the high-back booster seat on the relevant seating position. Mark the fore–aft position on the side of the high-back booster seat and on the vehicle. Align the high-back booster seat with the markings on the vehicle seat cushion and verify that there is no contact between

the high-back booster seat and the side door when closed. If contact occurs, the high-back booster seat may be moved inboard by up to 50 mm.

b) If an ISOFIX high-back booster seat is used, no markings are required. The high-back booster seat shall be aligned with the ISOFIX anchorages and securely engaged with the vehicle.

7.6.3.2 Placing the Q10 dummy in the vehicle

a) Place the Q10 dummy on the high-back booster seat. Ensure that the suit has not moved into the gap between the femur and hip by pulling the suit toward the knees.

b) Align the Q10 dummy and the high-back booster seat with the marked centreline.

c) Buckle the seat belt. If the buckle is not accessible due to interaction with the high-back booster seat, move the high-back booster seat and Q10 dummy outboard by the minimum distance required, up to a maximum of 50 mm, to allow free access to the buckle. Remove slack from the webbing without tightening it.

d) Attempt to realign the high-back booster seat with the markings on the seat cushion. If the high-back booster seat cannot be aligned with the original markings due to the vehicle seat shape or seat belt buckle position, remark the new lateral position relative to the vehicle seat.

e) Ensure that the rear of the high-back booster seat is in contact with the vehicle seat back by pressing it rearward and verifying that the fore–aft markings remain aligned.
f) Where applicable, install the hip shields on the Q10 dummy. Ensure that the distance between the hip shields is not less than 154 mm. If necessary, use the larger gap setting to achieve the best fit.

7.6.3.3 Q10 dummy positioning

a) Ensure that the dummy's lower back is in contact with the high-back booster seat 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.
b) Ensure that the high-back booster seat is aligned with the new reference marks.
c) Ensure that the dummy is sat on the centreline of the high-back booster seat and is not rotated about the vertical axis.
d) Where the rear head restraints interfere with the high-back booster seat, they should be repositioned as necessary to avoid this. They may be removed if instructed to do so in the vehicle handbook.
e) 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.

f) Ensure that the high-back booster seat position did not change relative to the marked position.

7.6.3.4 Legs

a) Position the femurs straight forward with a distance of 130 mm ±5 mm between the centres of the knees. If the high-back booster seat prevents this gap from being achieved, position the knees as close to the target values as possible.
b) 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.
c) Record the pelvic angle using the tilt sensor in the test details.

7.6.3.5 Position of the front seat

a) Reposition the front seat 30 mm forward of its test position. If there is no notch at this position, set the seat in the nearest notch forwards of 30 mm.
b) During repositioning, check for interaction between the Q dummy lower legs, feet and the front seat.
c) With the front seats 30 mm forward, if there is no contact between the front of the dummy toes and the seat in front, it is acceptable for the top of the foot/toes to contact the underside of the front seat, reposition the front seats in their test positions and proceed to belt routing. The

interaction between the Q dummy lower legs, feet and the front seat are acceptable. Record the pelvic angle.

d) If there is contact between the dummy and the front seats when they are 30 mm forward of their test position, follow the steps below to limit contact between dummy and the front seat. Note: this is not relevant if there is only contact between the top of the foot/toes and the underside of the front seat.
    i. 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:
    ii. Move the pelvis of the dummy forwards, while keeping the high-back booster seat in place, until there is no more 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.

e) 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 test see Section 7.7. It is acceptable for the top of the foot to contact the underside of the front seat.

f) The front seat must be returned to the test position.

7.6.3.6 Belt routing

a) Follow the high-back booster seat installation instructions when routing the seat belt and ensure that the belt is routed correctly through any necessary belt guides.
b) Remove the slack of the lap belt by pulling on the diagonal belt near the buckle with a force of 150 N.
c) Ensure that the belt is not twisted in the belt guide.
d) The belt shall initially be positioned over the IRTRACC (upper for Q10) if possible, a load of 50 N 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.
e) The use of any non-permanent belt guides or clips on either the vehicle or the high-back booster seat is prohibited.
f) There shall be no tape or stickers applied to the diagonal section of the adult belt.

7.6.3.7 Arms

a) 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.

7.6.3.8 Dummy marking

a) Once the dummy has been correctly positioned, the two IRTRACC holes shall be clearly marked on the suit of the dummy.

7.6.4 Q6 Installation

7.6.4.1 Placing the high-back booster seat in the vehicle

a) Place the high-back booster seat on the relevant seating position. Mark the fore–aft position on the side of the high-back booster seat and on the vehicle. Align the high-back booster seat with the markings on the vehicle seat cushion and verify that there is no contact with the side door when it is closed. If contact occurs, the high-back booster seat may be moved inboard by up to 50 mm.

b) If an ISOFIX high-back booster seat is used, no markings are required. The high-back booster seat shall be aligned with the ISOFIX anchorages and engaged with the vehicle.

7.6.4.2 Placing the Q6 dummy in the vehicle

a) Place the dummy in the high-back booster seat and ensure that the suit has not moved in the gap between femur and hip by pulling the suit towards the knees.
b) Align the dummy and high-back booster seats with the marked centreline.
c) Buckle the seatbelt. If the buckle is not accessible because of interaction with the high-back booster seats, move the high-back booster seats and dummy outboards by the minimum distance (with a maximum of 50mm) required to get free access to the buckle. Remove the slack from the webbing but do not tighten the webbing.
d) Try to realign the high-back booster seats with the marks on the seat cushion. If the high-back booster seats 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 high-back booster seats relative to the vehicle seat
e) Ensure that the back of the high-back booster seats is in contact with the seat back by pressing the high-back booster seats backwards against the seat and making sure that the fore/aft markings are still aligned.
f) Where the rear head restraints interfere with the high-back booster seats, they should be repositioned as necessary to avoid this. They may be removed if instructed to do so in the vehicle handbook.

7.6.4.3 Q6 dummy positioning

a) Ensure that the dummy's upper back is in contact with the back of the high-back booster seats. 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.
b) Ensure that the high-back booster seats is aligned with the new reference marks.
c) Ensure that the dummy is sat on the centreline of the high-back booster seats and is not rotated about the vertical axis.
d) Push the dummy's shoulders toward the back until the shoulders contact the high back booster seat.
e) 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.
f) Ensure that the high-back booster seats position does not change relative to the marked position.

7.6.4.4 Legs

a) Position the femurs straight forward with 150 mm ±5 mm between the centres of the knees. If the high-back booster seats prevents this gap from being achieved, position the knees as close to the target values as possible.
b) 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.

7.6.4.5 Position of the front seat

Follow the steps detailed in Section 7.6.3.5 to establish whether the vehicle is considered to be of limited rear space for the Q6 see Section 7.7. If this is not the case, proceed with the steps below.

7.6.4.6 Belt routing

a) Ensure that the lap belt is routed through the belt guidance of the booster seat.
b) Remove the slack of the lap belt by pulling on the diagonal belt near the buckle with a force of 150N.
c) Route the diagonal belt through the belt guidance of the booster with high back. Ensure that the belt is not twisted in the guidance of the booster.
d) 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.
e) The use of any non-permanent belt guides or clips on either the vehicle or high-back booster seats is prohibited.
f) There shall be no tape or stickers applied to the diagonal section of the adult belt.

7.6.4.7 Arms

a) 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.
b) 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.

7.7 Vehicles with Limited Rear Space

Vehicles will be considered as having limited rear space when the child dummies cannot be installed with the front seats in the full scale impact test position after adjustment in Section 7.6.3.5. Where this is the case, the test laboratory will confirm that child dummy cannot be installed without interference from the vehicle. Where a manufacturer wishes to avoid being awarded zero points for the CRS dynamic assessments, the dynamic performance will be based on manufacturers data from test(s) with modified front seating positions. These tests shall be performed using the appropriate CRS with the front seats positioned to one notch forwards of contact with the dummy.
The dummy pelvis shall be positioned in the last step after adjustment in Section 7.6.3.5.

The tests must be equivalent to the ASEAN NCAP front impact tests and contain an equivalent level of instrumentation. Adult dummies are not required but their mass should be compensated for in the final test mass. It is the responsibility of the vehicle manufacturer to ensure that adequate film coverage of the impact, and specifically child head excursion and head containment, is provided.

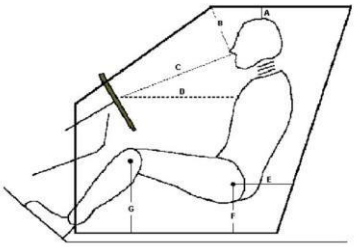
If the laboratory has established that the vehicle is not able to accommodate the Q10 dummy seated on a high back booster seat due to interaction between the dummy foot or the dummy toe with front seat, Q10 dummy is allowed to be seated in booster cushion only.

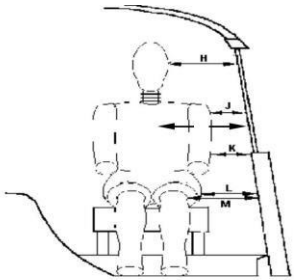
If the laboratory has established that the vehicle is not able to accommodate the Q10 dummy seated on a booster cushion due to interaction between the dummy head and vehicle roof, the Q10 will be seated directly on the rear seat without the use of any booster cushion. If, with the Q10 seated directly on the rear seat, there is still insufficient space between the dummy head and vehicle roof, the vehicle will be assessed in the same way as a two-seater.

7.8 Dummy Measurements

7.8.1 Hybrid III

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



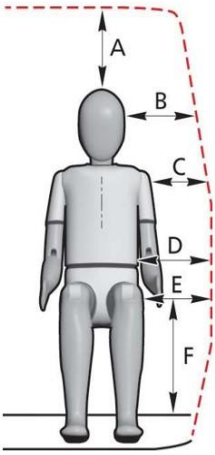


Driver's Side		Passenger's Side	
A	Chin to top of rim	A	Chin to facia
B	Nose to top edge of glass	B	Nose to top edge of glass
C	Stomach to rim	C	Stomach to facia*
D	H-point to top of sill	D	H-point to top of sill
E	Knee bolt to top edge of sill	E	Knee bolt to top edge of sill

F	Knee bolt to top edge of bolster	F	Knee bolt to top edge of bolster*
G	Head to roof surface	G	Head to roof surface
H	Nose to webbing (vertically)	H	Nose to webbing (vertically)
J	Belt webbing to door (horizontally)	J	Belt webbing to door (horizontally)
θ	Neck Angle	θ	Neck Angle
	H-Point Coordinates (to vehicle)		H-Point Coordinates (to vehicle)
α	Seat back angle (as defined by torso angle)	α	Seat back angle (as defined by torso angle)

7.8.2 Child Dummy

7.8.2.1 The following measurements are to be carried out prior to test but after positioning procedures have been carried out.



Q10	
A	Top of head to roof (vertically)
B	Head CoG to door/window (horizontal)
C	Shoulder (pivot point) to door/window (horizontal)
D	Lower rib to door (horizontal)
E	Hip joint (femur mounting hole) to door (horizontal)
F	Hip joint (femur mounting hole) to floor (vertical)
α	Head angle (where fitted)
β	Pelvic angle (tilt sensor, where fitted)

8 STILL PHOTOGRAPHY

The following photographs will be taken pre and post-test unless otherwise indicated. Pre-test photographs will be taken with the dummies in their final positions. Examples of the photographs required are given in Annex 1 (Euro NCAP Frontal Impact Photograph Specification Version 1).

No.	**View**
1	Front view of barrier.
2	Side view of barrier.
3	Side view of barrier at 45 degrees to front.

4 Side view of barrier with vehicle.
5 Car RHS, with camera centred on junction of B-post waist, showing full car.
6 Car RHS, with camera centred on B-post waist, showing rear passenger compartment.
7 Car RHS, with camera aimed at waist height, showing driver's compartment.
8 Car RHS at 45 degrees to front. 9 Front view of car.
10 Car LHS at 45 degrees to front.
11 Car LHS, with camera aimed at waist height, showing front passenger's compartment.
12 Car LHS, with camera centred on B-post waist, showing rear passenger compartment.
13 Car LHS, with camera centred on B-post waist, showing full car.
14 Driver and seat to show driver compartment and position of seat relative to the sill.
15 To show area immediately in front of driver.
16 To show driver's footwell area and location of dummy's feet and pedals.
17 Passenger and seat to show compartment and position of seat relative to sill.
18 To show area immediately in front of passenger.
19 To show passenger footwell area and dummy's feet.
20 To show both child dummies and restraints through LHS rear door.

21	To show both child dummies and restraints through RHS rear door.
22	*Overall view of where the car has come to rest after impact (including barrier).
23	*To show position of all door latches and/or open doors.
24	*To show driver knee contacts with facia (airbag should be lifted if obscuring view).
25	*To show passenger knee contacts with facia (airbag should be lifted if obscuring view).
26	^RHS rear seat belt anchorage with child restraint and Q6 dummy in place.
27	^LHS rear seat belt anchorage with child restraint and Q10 dummy in place.
28	*Q6 dummy and restraint through LHS rear door.
29	*Q10 dummy and restraint through RHS rear door.

* Post-test only, ^ Pre-test only

After Dummy Removal

No.	**View**
30	Passenger compartment from rear window.
31	LHS interior from RHS of car.
32	RHS interior from LHS of car.
33	LHS front door area.
34	RHS front door area.

35 Facia.
36 Passenger footwell.
37 Driver footwell.
38 Steering wheel taken perpendicular to driver's side.
39 Driver right knee impact point.
40 Driver left knee impact point.
41 Passenger knee impact area.

Note: The above photos are for a RHD car, for a LHD car camera location will switch sides.

9 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.

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 brake pedal retraction mechanism which requires a vacuum present in the brake system, the engine

may be ran for a predetermined time, specified by the manufacturer.

9.1 Deformable Barrier

Fix a deformable barrier as specified in UNECE Regulation 94 to the concrete block. The height of this barrier should be 200 mm ±5 mm from the ground.

9.2 Speed

9.2.1 Measure the speed of the vehicle as near as possible to the point of impact.

9.2.2 This speed should be 64 km/h (40 mph) ± 1 km/h. Record the actual test speed in the test details.

TARGET SPEED = 64 km/h ± 1 km/h

9.3 Overlap

9.3.1 With the vehicle offered up against the barrier, tape a small pin as near as possible to that edge of the deformable barrier which is to be struck.

9.3.2 Mark the point on the bumper of the vehicle where the pin should strike if an exact overlap of 40% was achieved.

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

TARGET OVERLAP = 40% ± 20 mm
TARGET VERTICAL ALIGNMENT = ± 25 mm

After Test

9.4 Door Opening Force

The opening of vehicle doors post-test shall be recorded on video.

9.4.1 Check that none of the doors have locked during the test.

9.4.2 Try to open each of the doors (front doors followed by rear doors) using a spring-pull attached to the external handle. The opening force should be applied perpendicular to the door, in a horizontal plane, unless this is not possible. The manufacturer may specify a reasonable variation in the angle of the applied force. Gradually increase the force on the spring-pull, up to a maximum of 500 N, until the door unlatches. If the door does not open record this then try to unlatch the door using the internal handle. Again, attempt to open the door using the spring-pull attached to the external handle. Record the forces required to unlatch the door and to open it to 45^{o} in the test details.

9.4.3 If a door does not open with a force of 500 N then try the adjacent door on the same side of the vehicle. If this door then opens normally, retry the first door.

9.4.4 If the door still does not open, record in the test details whether the door could be opened using extreme hand force or if tools were needed.

Note: In the event that sliding doors are fitted, the force required to open the door sufficiently enough for an adult to escape should be recorded in place of the 45^{o} opening force.

9.5 Video of Dummy Position

9.5.1 The post-impact positions of the dummies will be recorded on video.

9.6 Dummy Removal

9.6.1 Do not move the driver or passenger seats. Try to remove the dummies.

9.6.2 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 dummy.

9.6.3 If the dummies can still not be removed, try to slide the seats back on their runners.

9.6.4 If the dummies can still not be moved, the seats can be cut out of the car.

9.6.5 Record the method used to remove the dummies.

9.7 Intrusion Measurements

Take the vehicle intrusion measurements. See Section 2.2 for a full description of how to do this.

ACKNOWLEDGEMENT

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