EUROPEAN NEW CAR ASSESSMENT PROGRAMME (Euro NCAP)

L7e SIDE IMPACT TESTING PROTOCOL

Version 1.1
June 2014

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Preface

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

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

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

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

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 preparation where available.

Manufacturer-Specified Settings	
Adjustment	**Section Reference**
Frontal Impact	
Fuel Tank Capacity	Manufacturer's Handbook
Unladen Kerb Weight	Manufacturer's Handbook
Tyre Pressures	Manufacturer's Handbook
Seat Back/Torso Angle	
95th Percentile Male Seating Position	Section 6.1
Seat Base Tilt	Section 6.1
Rear seat position (where applicable)	Manufacturer's Handbook Section 6.4
Door Handle Pull Angle	Section 9.4
50th Percentile Seat belt anchorage position	Section 6.0
Seat Lumbar Support Position	
Engine Running	
Driver Airbag Removal Instructions	
Side Impact	
As Front, in addition:	
Height of non-adjustable version of front seat	Section 5.2
R-Point	Section 1.4

Contents

1 VEHICLE PREPARATION

1.1 Unladen Kerb Mass

Note: EC directive 96/27/EC defines the Unladen Mass of the vehicle as the mass with 90% fuel but all other fluids at maximum capacity.

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 Refill the tank with fuel, water or other ballast to a weight equivalent to 90% of its fuel tank capacity of fuel.

1.1.4 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.

1.1.5 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.

1.1.6 Ensure that all tyres are inflated according to the manufacturer's instructions for half load.

1.1.7 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.

1.1.8 Measure and record the ride heights of the vehicle at all four wheels

1.2 Reference Loads

1.2.1 Place both front seats in their mid-positions, this may not be the same as the final test position. If there is no notch at this position, set the seat in the nearest notch rearward (this will be done more completely in Section 5).

1.2.2 Place weights equivalent to an ES-2 test dummy (80kg) in the front driver's seating position.

1.2.3 Place weights in the luggage compartment of the vehicle until the total vehicle mass (sum of front and rear axle masses) is 100kg more than the unladen kerb mass (from Section 1.1.7). 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 Roll the vehicle back and forth to 'settle' the tyres and suspension with the extra weight on board. Weigh the front and rear axle weights of the vehicle. These loads are the "axle reference loads" and the total weight is the "reference mass" of the vehicle.

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

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

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

1.3 'R' Point

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

1.3.1 The location of the R point relative to some part of the vehicle structure will have been provided by the manufacturer. Determine the position of this point.

1.3.2 Mark a point on the driver's side of the car which has X (longitudinal) co-ordinate not more than 1mm different to the theoretical R point location.

1.3.3 Draw a vertical line through the R-Point and mark it clearly 'R'.

1.3.4 Mark points along the side of the vehicle which have the same X co-ordinates as the 'R' point. Continue these points onto the roof of the vehicle. The points should all lie in the same vertical transverse plane as the 'R' point.

1.3.5 Using a piece of sticky tape in a colour to contrast with the body-colour, join the points with one edge of the tape. Mark clearly on the tape which of its edges aligns with the 'R' point. This edge may be used to assess the alignment of the barrier with the 'R' point.

1.4 Vehicle Preparation

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

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

1.4.2 Ensure that the vehicle's battery is connected, if possible in its standard position. Check that the dashboard light for the airbag circuit functions as normal.

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

1.4.4 Place weights equivalent to a ES-2 dummy (80kg) in the front driver's seat of the car (with the front seats in their mid-positions).

1.4.6 Weigh the front and rear axle weights of the vehicle. Compare these weights with those determined in Section 1.2.5

1.4.7 The total vehicle mass shall be within 1% of the reference mass (Section 1.2.5). Each axle load shall be within the smaller of 5% or 20kg of its respective axle reference load (Section 1.2.5). If the vehicle differs from the requirements given in this paragraph, items may be removed or added to the vehicle which has no influence on its structural crash performance. The levels of ballast in the fuel tank (equivalent in mass to 90% capacity of fuel) may also be adjusted to help achieve the desired axle weights. Any items added to increase the vehicle weight should be securely attached to the car.

1.4.8 Repeat Sections 1.4.6 and 1.4.7 until the front and rear axle weights and the total vehicle weight are within the limits set in 1.4.7. Record the final axle weights in the test details.

1.5 Vehicle Markings

1.5.1 Euro NCAP markings will be attached to the exterior of the vehicle in the following locations; centre of the bonnet and on the front half of the roof of the vehicle. Refer to figure 1.1. Areas marked with a dotted box are considered acceptable to place Euro NCAP markings within.

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


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Figure 1.1

2 DUMMY PREPARATION AND CERTIFICATION

2.1 General

2.1.1 An ES-2 test dummy shall be used in the front driver's position. It shall conform to the requirements given in document TRANS-WP29-GRSP-2002-11e, which was presented to GRSP on 13th – 17th May 2002 (thirty first session).

2.2 Certification

Full details of the ES-2 certification requirements are available in the document mentioned in Section 2.1.1, TRANS-WP29-GRSP-2002-11e, and the procedures followed are set out in the ES-2 User Manual. No manufacturer shall have access to any pre-test information regarding any of the test equipment to be used by Euro NCAP, or be permitted to influence its selection in any way.

2.2.1 The ES-2 dummy should be re-certified after every THREE impact tests.

2.2.3 If an injury criterion reaches or exceeds its normally accepted limit (eg HIC of 1000) then that part should be re-certified.

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

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

2.3 Additions and Modifications to the ES-2 Dummy

2.3.1 The ES-2 dummy neck shall be fitted only with neck buffer 80 shore colour blue, part number: E2.BBC. The assembly must meet the certification procedure detailed below.

2.4 Dummy Clothing and Footwear

2.4.1 ES-2

2.4.1.1 The dummy will be clothed in an ES-2 rubber 'wet-suit', covering the shoulders, thorax, upper parts of the arms, abdomen and lumbar spine and the upper part of the pelvis. This rubber suit will act as a nominal 'skin' for the dummy torso.

2.4.1.2 The dummy will be clothed with formfitting, calf-length, cotton stretch pants and shoes.

2.5 Dummy Test Condition

2.5.1 Dummy Temperature

2.5.1.1 The dummy shall have a stabilised temperature in the range of 18°C to 26°C.

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

2.5.1.3 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.

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

2.5.2 Dummy Joints

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

2.5.2.2 Set the torque on the shoulder screws to obtain a 1-2g holding force of the arm on its pivot.

2.5.2.3 For adjustable joints in the legs, the tensioning screw or bolt which acts on the constant friction surfaces should be adjusted 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.

2.5.2.4 The dummy joint stiffnesses should be set as close as possible to the time of the test and, in any case, not more than 24 hours before the test.

2.5.2.5 Maintain the dummy temperature within the range 18° to 26°C between the time of setting the limbs and up to a maximum of 10 minutes before the time of the test.

2.5.3 Dummy painting and marking

2.5.3.1 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.

ES-2

Head (Paint tape outline only)	Red
Shoulder/Arm	Blue
Top Rib	Red
Mid Rib	Yellow
Bottom Rib	Green
Abdomen	Red
Pelvis	Orange

NOTE: The tape should be completely covered with the coloured paints specified, with the exception of the ES-2 Head which should have only the outer edge of the tape painted.

Tape Sizes:

ES-2

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

2.6 Post Test Dummy Inspection

2.6.1 The dummy should be visually inspected immediately after the test. Any lacerations of the skin or breakages of the dummy should be noted in the test details. The dummy may have to be re-certified in this case. Refer to Section 2.2.

3 INSTRUMENTATION

All instrumentation shall be calibrated before the test programme. The Channel Amplitude Class (CAC) for each transducer shall be chosen to cover the Minimum Amplitude listed in the table. In order to retain sensitivity, CACs which are orders of magnitude greater than the Minimum Amplitude should not be used. A transducer shall be re-calibrated if it reaches its CAC during any test. All instrumentation shall be re-calibrated after one year, regardless of the number of tests for which it has been used. A list of instrumentation along with calibration dates should be supplied as part of the standard results of the test. The transducers are mounted according to procedures laid out in SAE J211. The sign convention used for configuring the transducers is stated in SAE J211 (1995).

3.1 Dummy Instrumentation

The ES-2 dummy to be used shall be instrumented to record the channels listed below.

ES-2

Location	**Parameter**	**Minimum Amplitude**	**No of channels**
Head	Accelerations, A_x A_y A_z	250g	3
Shoulder	Forces, F_x F_y F_z	8kN	3
Thorax T1	Accelerations, A_x A_y A_z	200g	3
Thorax T12	Acceleration, A_y	200g	1
Ribs - Upper Middle Lower	Acceleration, A_y	700g	3
	Deflection, D_{rib}	90mm	3
Abdomen - Front Middle Rear	Forces, F_y	5kN	3
Backplate	Forces, F_x F_y	5kN	4
	Moments, M_y M_z	200Nm	
T12	Forces, F_x F_y	5kN	4
	Moments, M_x M_y	300Nm	
Pelvis	Accelerations, A_x A_y A_z	150g	3
Pubic Symphysis	Force, F_y	20kN	1
Femurs (L & R)	Forces, F_x F_y F_z	22kN	6
	Moments, M_x M_y M_z	350Nm	6
	Total Channels per Dummy		43
	1 x ES-2		43

3.2 Vehicle Instrumentation

3.2.1 The vehicle is to be fitted with an accelerometer on the unstruck B-post. The accelerometer is to be fitted in the lateral direction (A_y).

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

3.2.3 Securely attach a mounting plate for the accelerometer horizontally on to the sill.

3.2.4 Fix the accelerometer to the mounting plate. Ensure the accelerometer is horizontal to a tolerance of ±5 degrees.

VEHICLE

Location	**Parameter**	**Minimum Amplitude**	**No of channels**
B-Post (unstruck)	Acceleration, A_y	150g	1
	Total Channels per Vehicle		1

3.3 Trolley and Barrier Instrumentation

3.3.1 The trolley is to be fitted with an accelerometer at its Centre of Gravity. The accelerometer is to be fitted in the fore/aft direction (A_x). (See Section 7)

TROLLEY

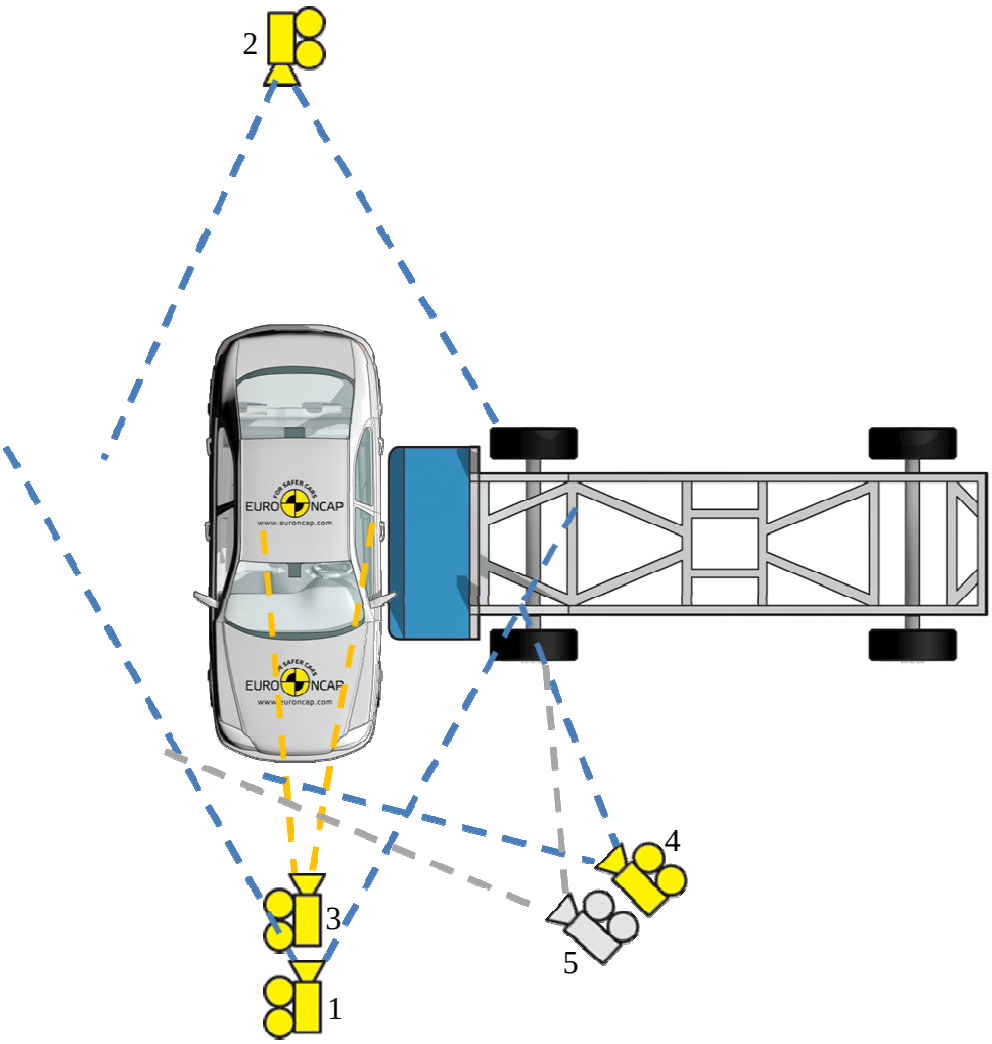
Location	**Parameter**	**Minimum Amplitude**	**No of channels**
Trolley C of G	Acceleration, A_y	150g	1
	Total Channels per Trolley		1

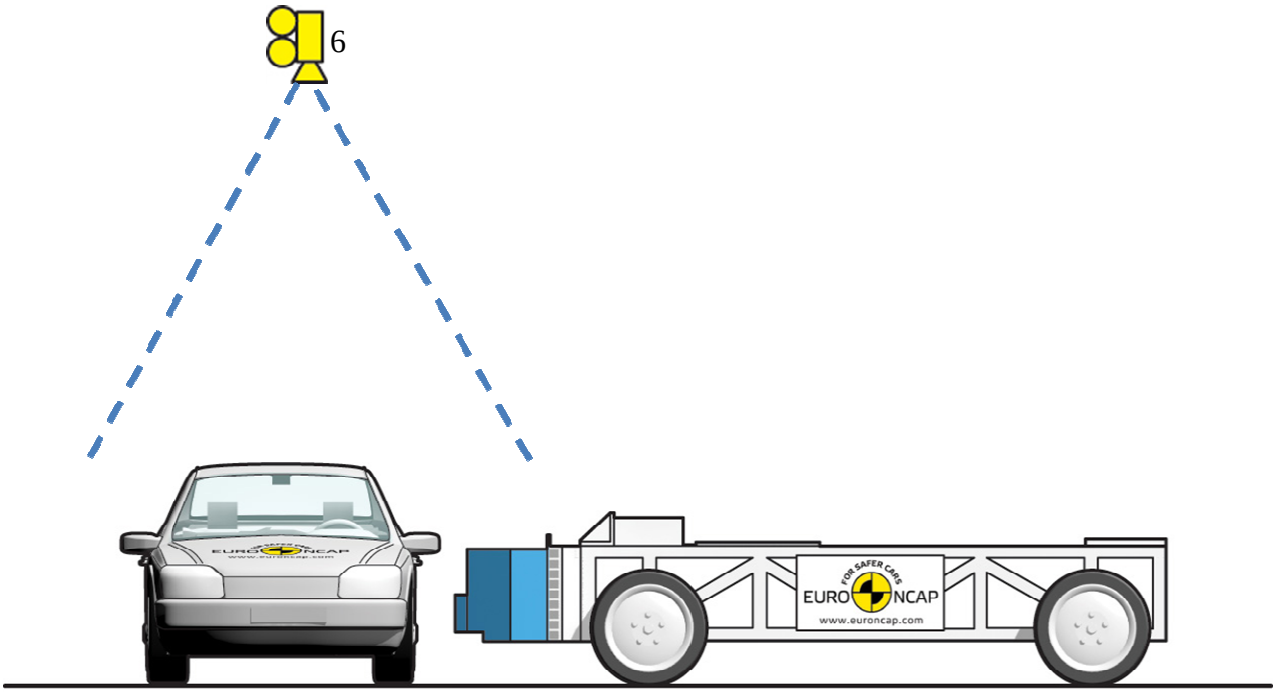
TOTAL CHANNELS

1x Driver ES-2	43
1x Vehicle	1
1x Trolley	1
TOTAL	45

4 CAMERA LOCATIONS

Set up high speed film cameras according to the following diagrams





Camera No.	Camera Type	Shot Content
1	>/= 500 fps high speed	Front view of vehicle and trolley (wide)
2	>/= 500 fps high speed	Rear view of vehicle and trolley (wide)
3	>/= 500 fps high speed	Front view of driver and impact point (tight)
4	>/= 500 fps high speed	Angled view of vehicle and trolley (wide)
5	>/= 10 fps normal speed	Angled view of vehicle and trolley (wide)
6	>/= 500 fps high speed	Plan view of car and trolley (tight)

4.1 The Euro NCAP High Speed Digital Film Specifications are contained in a separate document.

4.2 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. Please note for view number 7 the passenger side headrest should be removed if possible.

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5 PASSENGER COMPARTMENT ADJUSTMENTS

Adjustment	Required Setting	Notes	Methods
Seat Fore/Aft	Mid position as defined in 5.1	Set to first notch rearwards of mid position if not lockable at mid position	See Section 5.1
Seat Base Tilt	Manufacturer's design position	Permissible Up to mid position	See Section 5.2
Seat Height	Same height as non-adjustable version of front seat	If only adjustable seats available, set to mid-position	
Seat Back Angle (as defined by torso angle)	Manufacturer's design position	Otherwise 25° to Vertical	See Section 6.1
Seat Lumbar Support	Manufacturer's design position	Otherwise fully retracted	
Front Head Restraint Height & Tilt	Mid locking position	As whiplash test position	See Section 7.2 Whiplash testing protocol.
Steering wheel - vertical	Mid position		See Section 5.4
Steering wheel - horizontal	Mid position		See Section 5.3
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 5.5.1
Rear Seat Back Angle	Manufacturer's design position	Otherwise 25° to Vertical	See Section 6.1
Rear Seat Facing	Forward		See Section 5.5.1
Rear Head Restraint Height	As recommended in vehicle handbook.	Where no details are provided in the handbook, set to mid or next lowest position. Must not interfere with CRS installation.	
Rear Head Restraint Tilt	Mid locking position (where adjustable)	As whiplash test position	See Section 7.2 Whiplash testing protocol.
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 - Raised Rear - Raised		
Gear change lever	In the neutral position		
Parking Brake	Disengaged		
Pedals	Normal position of rest		
Doors	Closed, not locked		
Roof	Raised	Where applicable	
Sun Visors	Stowed position		
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. If both an adjustable and non-adjustable seat is fitted, the adjustable seat should be set to the same position as the non-adjustable version.

5.1 Determination of and Setting the Fore/aft Position of the Seat.

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

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

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

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

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

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

5.1.7 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.

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

5.1.9 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.

5.1.10 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.

5.2 Setting the Seat Base Vertical, Tilt and Lumbar Positions

5.2.1 If the seat is adjustable for height, the manufacturer will be asked whether the vehicle is made with non-adjustable seats for driver or passenger. If this is the case, the manufacturer will be asked what the height of the H-point is for the non-adjustable version.

5.2.2 Using the procedure described more fully in Section 6.1, sit the H-point manikin in the seat

5.2.3 Adjust the height of the seat until the H-point of the manikin is at the same height as that given by the manufacturer's information.

5.2.4 If the vehicle is not available with non-adjustable seat height, set the seat to its middle position.

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

5.2.6 Seat Lumbar Setting. If the seat back is adjustable for lumber support it should be set to the fully retracted position, unless the manufacturer specifies otherwise or the dummy prevents this.

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

5.3 Setting the Steering Wheel Horizontal Adjustment

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

5.3.2 Move the steering wheel to the most forward position of its travel

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

5.3.4 Move the steering wheel to the most rearwards position of its travel

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

5.3.6 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.

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

5.3.8 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.

5.4 Setting the Steering Wheel Vertical Adjustment

5.4.1 A method that is in principle the same as Section 5.3 should be used to find 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.

5.5 Setting the rear seat (if adjustable).

5.5.1 If the vehicle rear seat position is adjustable put it in the same fore/aft position as that used in the frontal with the same seat back angle.

6 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.Dummy installation (on boards)	Before test day
3. Dummy placement	Test day
4.Dummy positioning	Test day
5. Dummy positioning measurements	Test day - after vehicle has been positioned for test

6.1 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 ± 10kg 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.

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

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

6.1.1.2 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.

6.1.1.3 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 that specified here. If so the fully supported request to vary the set up should be made to the Secretariat.

6.1.2 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.

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

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

6.1.5 Attach lower legs to machine, ensuring that the transverse member of the T-bar is parallel to the ground.
6.1.6 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.
6.1.7 Place left foot at equal distance from centre line of machine as the right leg is from centre line. Place foot flat on footwell.
6.1.8 Apply lower leg and thigh weights
6.1.9 Tilt the back pan forwards to the end stop and draw the machine away from the seat back.
6.1.10 Allow the machine to slide back until it is stopped by contacting the seat back.
6.1.11 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.
6.1.12 Return the machine back to the seat back.
6.1.13 Install the right and left buttock weights.
6.1.14 Apply the torso weights alternately left and right.
6.1.15 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 T-bar should be parallel to the ground.
6.1.16 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.
6.1.17 Return the machine back to the seat back.
6.1.18 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.
6.1.19 Adjust the seat back angle to the angle determined in 6.1.1, 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.
6.1.20 Measure and record in the test details the position of the H-point relative to some easily identifiable part of the vehicle structure.

6.2 Dummy Installation

It is the intention that the dummy should not be left to sit directly on the seat for more than 2 hours prior to the test. It is acceptable for the dummy to be left in the vehicle for a longer period, provided that the dummy is 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 2 hours, then the dummy should be sat on plywood boards placed over the seat. This should eliminate unrealistic compression of the seat.

6.3 Dummy Placement

6.3.1 *H-point*

Note that the H-point of the ES-2 dummy is situated 21mm forward of that of the H-point determined by the H-point manikin (Section 6.1). The H-point of the manikin is indicated by 'Hm' on the H-point back plate of the dummy.

6.3.1.1 Position the dummy in the seat, with its back against the seat and its centreline coinciding with the seat centreline.
6.3.1.2 Manoeuvre the dummy until its "Hm" position is in a circle with a radius of 10 mm round the H-point of the H-point Manikin as determined in Section 6.1.

6.3.2 *Alignment*

Visually check that the dummy sits square and level in the seat before taking any measurements of the H-point position.

6.3.3 *Legs and Feet*

6.3.3.1 Position the left foot perpendicular to the lower leg with its heel on the floorpan in a transverse line with the heel of the right foot.

6.3.3.2 Carefully position the dummy's right foot on the undepressed accelerator pedal with the heel resting as far forward as possible on the floorpan.

6.3.3.3 Measure the separation of the inside surfaces of the dummy's knees and adjust until they are 150±10mm apart from each other.

6.3.3.4 If possible within these constraints, place the thighs of the dummy on the seat cushion.

6.3.3.5 Check again the position of the H-point, the levelness of the pelvis and the squareness of the dummy in the seat. If everything is in position, set the arms.

6.3.4 *Arms*

The arms of the ES-2 dummy have click-stops corresponding to fixed angles between the torso reference line and the arms.

6.3.4.1 Move both arms of the dummy until they have clicked at those positions corresponding to 40° angle between the arms and the torso reference line.

6.3.5 *Seat belt*

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

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

6.3.5.3 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.

6.3.5.4 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.

6.3.5.5 After following the above steps, the seatbelt should lie in a natural position across the dummy sternum and shoulder clavicle. Where this is not the case, for example the belt is close to or in contact with the neck or the belt is above the shoulder rotation adjustment screw, and the upper belt anchorage is adjustable the anchorage should be lowered and steps 6.3.5.3 and 6.3.5.4 repeated.

6.3.5.6 The upper anchorage should be lowered by a sufficient amount to ensure a natural belt position following the repetition of .steps 6.3.5.3 and 6.3.5.4 repeated. This may require multiple attempts.

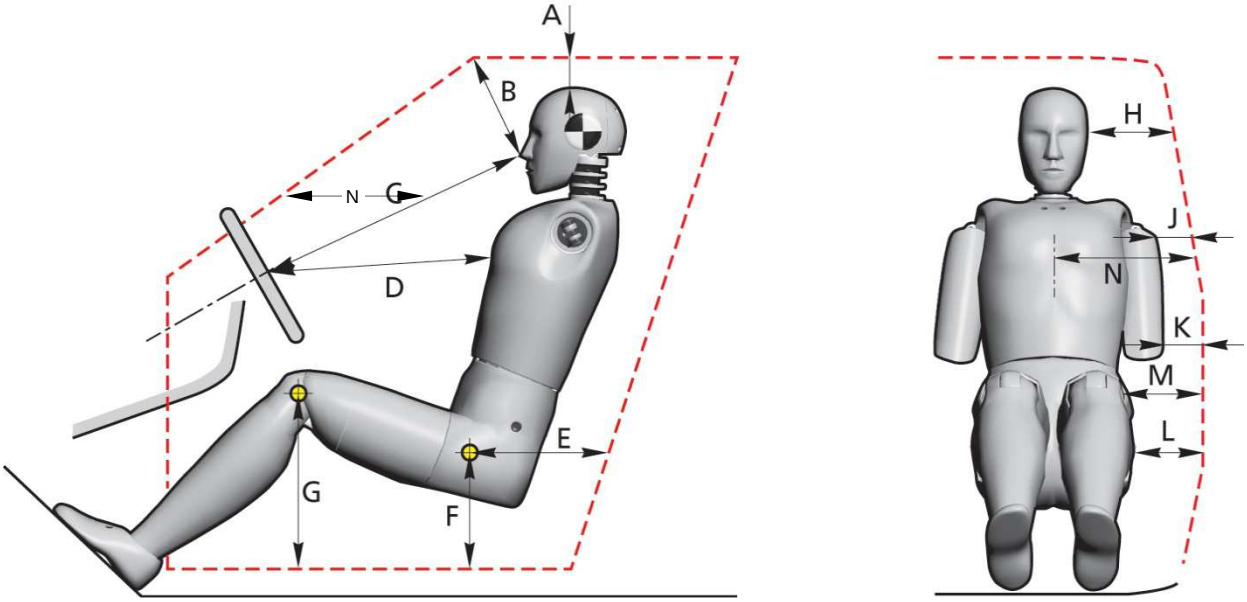
6.3.5.7 Once the belt is positioned the location of the belt should be marked across the dummy chest to ensure that no further adjustments are made. Mark also the belt at the level of the D-loop to be sure that the initial tension is maintained during test preparation.

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

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

6.5 Dummy Positioning Measurements

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



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

* Horizontal distance from steering wheel centre

7 BARRIER AND TROLLEY

The trolley will be fitted with a deformable barrier face and ventilation frame conforming to the specifications of Amendment 3, July 2003, Regulation ECE R95 (lateral collision protection). See also Appendix I.

7.1 Trolley Preparation

7.1.1 A trolley should be used which has a wheelbase of 3000 ±10mm and a track at the front and at the rear of 1500 ±10mm.

7.1.2 The trolley may be fitted with an emergency abort system. This is optional, the test facility may elect to test without an abort system.

7.1.3 Inflate all tyres of the trolley to the same pressure.

7.1.4 Fix the deformable barrier to the front of the trolley such that its bottom edge is at a height of 300mm +/- 5mm from the ground.

7.1.5 Mark a line along the vertical centreline of the barrier which may be used to check the alignment of the barrier with the R point of the test vehicle.

7.1.6 Measure the wheelbase of the trolley, left and right

7.1.7 Determine the average wheelbase from Section 7.1.6 and record in the test details.

7.1.8 Record in the test details the track of the trolley at the front and at the rear.

7.1.9 Measure the weights at all four wheels and record in the test details. The total weight of the trolley should be **950 ±20kg**.

7.1.10 Calculate the fore/aft position of the centre of gravity from:

$$x = W_{rear}.\text{Wheelbase}/(W_{rear} + W_{front})$$

where x is the distance of the centre of gravity from the front axle, W_{rear} and W_{front} are the rear and front axle weights from Section 7.1.9 and Wheelbase is the average determined in Section 7.1.7.

The fore/aft centre of gravity should be 1000 ±10mm from the centre of the front axle.

7.1.11 Record the position of the centre of gravity in the test details.

7.1.12 Ensure that the weight distribution is as even as possible left to right.

7.1.13 Record in the test details the final weights measured at each of the wheels.

7.2 Trolley Markings

7.2.1 Euro NCAP markings will be stuck to the front of the trolley on both sides.

7.2.2 Test house logos may be added to the trolley provided that they do not detract attention from the Euro NCAP markings.

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.

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, from front of vehicle.
5	Car RHS, with camera centred on B-post waist, showing full car.
6	Car RHS, with camera centred on B-post waist, showing the rear passenger compartment.
7	Car RHS, with camera aimed at waist height, showing driver's compartment.
8	Car RHS at 45 degrees to rear.
9	Car RHS at 45 degrees to front.
10	Front view of car.
11	Car LHS, with camera centred on B-post waist, showing full car.
12	Car LHS, with camera centred on B-post waist, showing the rear passenger compartment.
13	*To show position of all door latches and/or open doors.
14	Driver & seat through open driver's door to show driver compartment and position of seat relative to the sill.
15	To show area immediately in front of driver.
16	*Car and barrier at rest at 45 degrees to front of car.
17	*Car and barrier at rest at 45 degrees to rear of car.

* Post-test only.

After Dummy Removal

20	*View through LHS front door of driver's door & paint marks from dummy ribs.

Note: The above photos are for a RHD car, for a LHD car camera locations 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 (1995).

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 Speed

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

9.1.2 Record the actual test speed in the test details.

TARGET SPEED = 50km/h ± 1km/h

9.2 Post-Impact Braking

A method must be employed to eliminate secondary impacts between the barrier and the car. This may be an emergency braking system on the trolley or other method but should be activated only **after the first impact is complete**. Do NOT start the braking *at* the point of initial impact or the trolley will be decelerating during the test.

9.3 Alignment

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

9.3.2 This pin should align with the vertical 'R' point line previously marked on the car (Section 1.4)

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

TARGET ALIGNMENT = CENTRELINE OF BARRIER COINCIDENT WITH 'R' POINT LINE OF VEHICLE ± 25mm

TARGET VERTICAL ALIGNMENT = ± 25mm

After Test

9.4 Door Opening Force

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

9.4.2 Try to open each of the doors on the unstruck side (front door followed by rear door) 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 500N, 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° in the test details.

9.4.3 If a door does not open with a force of 500N then try the adjacent door on the same side of the

vehicle. If this door then opens normally, retry the first door.

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 Dummy Removal

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

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

9.5.3 If the dummy still can not be removed, try to slide the seat back on its runners.

9.5.4 If the dummy still can not be removed, the seat can be cut out of the car.

Where a specified requirement has not been met, Euro NCAP reserves the right to decide whether or not the test will be considered as valid.

10. ASSESSMENT PARAMETERS

10.1 Head

Higher performance limit

HIC_{36}	650
Resultant Acc. 3 msec exceedence	72g

Lower performance and capping limit

HIC_{36}	1000
Resultant Acc. 3 msec exceedence	88g

10.2 Chest

The assessment is based on the worst performing individual rib lateral compression.

MDB Higher performance limit

Lateral Compression	22mm
Viscous Criterion	0.32

MDB Lower performance and capping limit

Lateral Compression	42mm
Viscous Criterion	1.0

10.3 Abdomen

Higher performance limit

Total Abdominal Force	1.0kN

Lower performance and capping limit

Total Abdominal Force	2.5kN

10.4 Pelvis

Higher performance limit

Pubic Symphysis Force	3.0kN

Lower performance and capping limit

Pubic Symphysis Force	6.0kN

For dummy results above or below the lower and higher performance limits, 0 to 4 points is available. For dummy results falling between these two limits a score of 2 points is automatically awarded. (Sliding scales not used for L7e vehicles).

11 Modifiers

11.1 Backplate

Fy

Higher performance limit	1.0kN
Lower performance limit	4.0kN

11.2 T12

Higher performance limit

Fy 1.5kN ; Mx 150Nm

Lower performance limit

Fy 2.0kN **;** Mx 200Nm

11.3 Incorrect Airbag Deployment

Any airbag(s) which does not deploy fully in the designed manner will attract a -1 point modifier applicable to each of the most relevant body part(s) for the affected occupant. For example, where a head curtain airbag is deemed to have deployed incorrectly, the penalty will be applied to the side impact driver's head (-1). Where the incorrect deployment affects multiple body parts, the modifier will be applied to each individual body part. For example, where a seat or door mounted side airbag fails to deploy correctly that is intended to provide protection to the head as well as the thorax, abdomen and pelvis, the penalty will be applied to two body regions, the head (-1) and the chest (-1).

11.4 Partial Ejection

If any of the 4 main body regions of the dummy are ejected outside of the vehicle during the test a 1 point modifier is applied to the relevant body region that was ejected.

Head Assessment	**-1**
Chest Assessment	**-1**
Abdomen Assessment	**-1**
Pelvis	**-1**

11.5 Failure of a fundamental restraint component

If a fundamental restraint item fails during the test, such as a belt webbing tear, belt anchorage failure, belt buckle release, etc each body region is automatically downgraded by 1 point to reflect the serious vehicle restraint failure.

Head Assessment	**-1**
Chest Assessment	**-1**
Abdomen Assessment	**-1**
Pelvis	**-1**