LATIN AMERICAN & CARIBBEAN
NEW CAR ASSESSMENT PROGRAMME
(Latin NCAP)

ASSESSMENT PROTOCOL – ADULT OCCUPANT PROTECTION
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AKNOWLEDGEMENT

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1 INTRODUCTION

The Latin NCAP programme is designed to provide a fair, meaningful and objective assessment of the safety performance of cars and provide a mechanism to inform consumers. This protocol is based upon that used by the European New Car Assessment Programme for the adult occupant protection.

In 2020 Latin NCAP introduced relevant changes to the AOP protocol such as the overall rating scheme and together with it, pedestrian, whiplash, and safety assist systems assessment such as AEB. This current protocol continues in the same line while adding other relevant areas of assessment. Individual documents are released for the four main areas of assessment:

Assessment Protocol – Adult Occupant Protection;
Assessment Protocol – Child Occupant Protection;
Assessment Protocol – Pedestrian Occupant Protection;
Assessment Protocol – Safety Assist;

In addition to these four assessment protocols, a separate document is provided describing the method and criteria by which the overall safety rating is calculated on the basis of the car performance in each of the above areas of assessment, a document describing the testing protocols to be used and a car specification, sponsorship and testing protocol.

The following protocol deals with the assessments made in the area of Adult Occupant Protection, in particular in the frontal offset deformable impact test, the side impact barrier test, the pole test, the whiplash tests and the post-crash assessment considerations.

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

2 METHOD OF ASSESSMENT

The starting point for the assessment of adult occupant protection is the dummy response data recorded in four different test configurations: frontal impact in offset overlap, side impact movable deformable barrier, side oblique pole impact and rear impact whiplash testing. Latin NCAP can decide which test is to be performed first. Initially, each relevant body area is given a score based on the measured dummy parameters. These scores can be adjusted after the test based on supplementary requirements. For example, consideration is given to whether the original score should be adjusted to reflect occupant kinematics or sensitivity to small changes in contact location, which might influence the protection of different sized occupants in different seating positions. The assessment also considers the structural performance of the car by taking account of such aspects as steering wheel displacement, pedal movement, foot well distortion, displacement of the A pillar, structural symmetry and risk of fire or electrical shock. The adjustments, or modifiers, are based on both inspection and geometrical considerations are applied to the body area assessments to which they are most relevant.

For frontal offset impact, the score for each body area is based on the driver data, unless part of the passenger fared less well. It is stated that the judgement relates primarily to the driver. Side impact and pole impact results relate to the struck-side occupant only, while Whiplash dynamic testing results covers only front seats.

No attempt is made to rate the risk of life threatening injury any differently from the risk of disabling injury. Similarly, no attempt is made to rate the risk of the more serious but less frequent injury any differently from the risk of less serious but more frequent injury. Care has been taken to try to avoid encouraging manufacturers to concentrate their attention on areas which would provide little benefit in accidents.

The adjusted rating for the different body regions is presented, in a visual format of coloured segments within a human body outline for the driver and passenger. This is presented for the driver and front seat passenger in frontal impact, for the struck side occupant in side and pole impact and for front and rear occupants in rear impact. Finally, for the complete area of adult occupant protection assessment, the scores for frontal, side, pole, whiplash are summed along with UN R32 or UN 153, rear occupant protection and post-crash considerations such as rescue sheet, extraction modifiers as well as fire and electrical shock risk. The resulting Adult Occupant Protection Score is expressed as a percentage of the maximum achievable number of points.

2.1 Points Calculation

A sliding scale system of points scoring has been adopted for the biomechanical assessments. This involves two limits for each parameter, a more demanding limit (higher performance), beyond which a maximum score is obtained and a less demanding limit (lower performance), below which no points are scored. For the adult rating, the maximum score for each body region is four points. Where a value falls between the two limits, the score is calculated by linear interpolation.

For all tests part of the adult occupant protection assessment, capping limits are maintained for criteria related to critical body regions: head, neck and chest for the frontal impact; head, chest, abdomen and pelvis for the side and pole impact. Exceeding a capping limit generally indicates unacceptable high risk at injury. In all cases, this leads to loss of all points related to the tests. Capping limits can be equal to or higher than the lower performance limit, depending on the test.

2.2 Rating Calculation

The Adult Occupant Protection Rating is based on the score obtained in the tests by comparing the value with score limits set for each level of stars in this box. Each box has a minimum score required to score certain star level. The lower star rating achieved by any of the 4 boxes will determine the final star rating to be rewarded. The Complete rating scheme can be found on the “Overall Rating” Protocol.

3 ADULT FRONTAL IMPACT OCCUPANT PROTECTION ASSESSMENT

3.1 Criteria and Limit Values

The basic assessment criteria, with the upper and lower performance limits for each parameter, are summarized below. Where multiple criteria exist for an individual body region, the lowest scoring parameter is used to determine the performance of that region. The lowest scoring body region of driver or passenger is used to determine the score. Capping is applied on the critical body regions: head, neck and chest for the frontal impact and on the head, chest, abdomen and Pelvis for the side movable deformable barrier and pole side impact. When Capping is reached in any of the mentioned body regions by the data recorded in test or due to modifiers in inspection, the test in question will be rated zero points.

3.1.1 Head

3.1.1.1 Drivers with Steering Wheel Airbags and Passengers

If a steering wheel airbag is fitted the following criteria are used to assess the protection of the head for the driver. These criteria are always used for the passenger.

Note: HIC15 levels above 700 have been recorded with airbags, where there is no hard contact and no established risk of internal head injury. A hard contact is assumed, if the peak resultant head acceleration exceeds 80g, or if there is other evidence of hard contact.

If there is no hard contact, a score of 4 points is awarded. If there is hard contact, the following limits are used:

Higher performance limit		
HIC_{15}	500	
Resultant Acc. 3 msec exceedence	72g	
Lower performance and capping limit		
HIC_{15}	700	(20% risk of injury ≥ AIS3 [1,2])
Resultant Acc. 3 msec exceedence	80g	

3.1.1.2 Drivers with No Steering Wheel Airbag

If no steering wheel airbag is fitted, the driver will be awarded 0 points for the head and neck.

3.1.2 Neck

Higher performance limit

Shear	1.9kN @ 0 msec,	1.2kN @ 25 - 35msec,	1.1kN @ 45msec
Tension	2.7kN @ 0 msec,	2.3kN @ 35msec,	1.1kN @ 60msec
Extension	42Nm		

Lower performance and capping limit

Shear	3.1kN @ 0msec,	1.5kN @ 25 - 35msec,	1.1kN @ 45msec*
Tension	3.3kN @ 0msec,	2.9kN @ 35msec,	1.1kN @ 60msec*
Extension	57Nm* (Significant risk of injury [4])		

*(*EEVC Limits)*

Note: Neck Shear and Tension are assessed from cumulative exceedance plots, with the limits being functions of time. By interpolation, a plot of points against time is computed. The minimum point on this plot gives the score. Plots of the limits and colour rating boundaries are given in Appendix I.

3.1.3 Chest

Higher performance limit

Compression	22mm	(5% risk of injury ≥ AIS3 [5])
Viscous Criterion	0.5m/sec	(5% risk of injury ≥ AIS4)

Lower performance and capping limit

Compression	42mm*	
Viscous Criterion	1.0m/sec*	(25% risk of injury ≥ AIS4)

*(*EEVC Limits)*

3.1.4 Knee, Femur and Pelvis

Higher performance limit

Femur compression	3.8kN	(5% risk of pelvis injury [6])
Knee slider compressive displacement	6mm	

Lower performance limit

Femur Compression	9.07kN @ 0msec,	7.56kN @ ≥ 10msec*	(Femur fracture limit [4])

Knee slider compressive displacement	15mm*	(Cruciate ligament failure limit [4,7]) *(*EEVC Limit)*

Note: Femur compression is assessed from a cumulative exceedance plot, with the limits being functions of time. By interpolation, a plot of points against time is computed. The minimum point on this plot gives the score. Plots of the limits and colour rating boundaries are given in Appendix I.

3.1.5 Lower Leg

Higher performance limit		
Tibia Index	0.4	
Tibia Compression	2kN	
Lower performance limit		
Tibia Index	1.3*	
Tibia Compression	8kN*	(10% risk of fracture [4,8]) *(*EEVC Limits)*

3.1.6 Foot/Ankle

Higher performance limit	
Pedal rearward displacement	100mm
Lower performance limit	
Pedal rearward displacement	200mm

Notes:
1. Pedal displacement is measured for all pedals with no load applied to them.
2. If any of the pedals are designed to completely release from their mountings during the impact, no account is taken of the pedal displacement provided that release occurred in the test and that the pedal retains no significant resistance to movement.
3. If a mechanism is present to move the pedal forwards in an impact, the resulting position of the pedal is used in the assessment.
4. The passenger's foot/ankle protection is not currently assessed.

3.2 Modifiers

3.2.1 Driver

The score generated from driver dummy data may be modified where the protection for different sized occupants or occupants in different seating positions, or accidents of slightly different

severity, can be expected to be worse than that indicated by the dummy readings or deformation data alone. There is no limit to the number of modifiers that can be applied, neither per body region nor in total amount. The concepts behind the modifiers are explained in ***Section 10 "CONCEPTS BEHIND THE ASSESSMENTS"***

3.2.1.1 Head

3.2.1.1.1 Unstable Contact on the Airbag

If during the forward movement of the head, its centre of gravity moves further than the outside edge of the airbag, head contact is deemed to be unstable. The score is reduced by one point. If for any other reason head protection by the airbag is compromised, such as by detachment or displacement of the steering wheel with or from the column, or bottoming-out of the airbag by the dummy head, the modifier is also applied. In cases where the airbag shows a decrease in internal pressure while the head is still moving forward, increasing the risk of bottoming out, this modifier will be applied.

Note: Head bottoming-out is defined as follows: There is a definite rapid increase in the slope of one or more of the head acceleration traces, at a time when the dummy head is deep within the airbag. The acceleration spike associated with the bottoming out should last for more than 3ms.The acceleration spike associated with the bottoming out should generate a peak value more than 5 g above the likely level to have been reached if the spike had not occurred. This level will be established by smooth extrapolation of the curve between the start and end of the bottoming out spike. In the case where the modifier is applied due to a low-pressure airbag, there must be clear evidence from the high-speed videos of insufficient airbag pressure during the dummy´s forward movement as well as close proximity to the steering wheel.
Bottoming out of passenger airbag will bring a -1 modifier to passenger head.

3.2.1.1.2 Hazardous Airbag Deployment

If, within the head zone, the airbag unfolds in a manner in which a flap develops, which sweeps across the face of an occupant vertically or horizontally the -1 point modifier for unstable airbag contact will be applied to the head score. If the airbag material deploys rearward, within the "head zone" at more than 90 m/s, the -1 point modifier will be applied to the head score.

3.2.1.1.3 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 steering wheel mounted airbag is deemed to have deployed incorrectly, the penalty will be applied to the frontal impact driver's head (-1). Where, a passenger knee airbag fails to deploy correctly, the penalty will be applied to the frontal impact passenger left and right knee, femur

and pelvis (-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 deploys incorrectly in the frontal impact 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, -1 to the head and -1 to the chest.

The modifier(s) will be applied to the scores of the impacts for which the airbag was intended to offer protection, regardless of the impact in which it deployed incorrectly. For example, the penalty will be applied if a seat mounted side airbag deploys incorrectly in the frontal impact. Where any frontal protection airbag deploys incorrectly, Latin NCAP will not accept knee mapping data for that occupant.

3.2.1.1.4 Unstable Contact on a Steering Wheel without an Air Bag

If, during the forward movement of the head, its centre of gravity moves radially outwards further than the outside edge of the steering wheel rim, head contact is deemed to be unstable. The score is reduced by one point. If for any other reason head contact on the steering wheel is unstable, such as detachment of the steering wheel from the column, the modifier is also applied.

3.2.1.1.5 Displacement of the Steering Column

The score is reduced for excessive rearward, lateral or upward static displacement of the top end of the steering column. Up to 90 percent of the EEVC limits, there is no penalty. Beyond 110 percent of the EEVC limits, there is a penalty of one point. Between these limits, the penalty is generated by linear interpolation. The EEVC recommended limits are: 100mm rearwards, 80mm upwards and 100mm lateral movement. The modifier used in the assessment is based on the worst of the rearward, lateral and upward penalties.

3.2.1.2 Chest

3.2.1.2.1 Displacement of the A Pillar

The score is reduced for excessive rearward displacement of the driver's front door pillar, at a height of 100mm below the lowest level of the side window aperture. Up to 100mm displacement there is no penalty. Above 200mm there is a penalty of two points. Between these limits, the penalty is generated by linear interpolation.

3.2.1.2.2 Integrity of the Passenger Compartment

Where the structural integrity of the passenger compartment is deemed to have been compromised, a penalty of one point is applied. The loss of structural integrity may be indicated by characteristics such as:

- Door latch or hinge failure, unless the door is adequately retained by the door frame.

- Buckling or other failure of the door resulting in severe loss of fore/aft compressive strength.
- Separation or near separation of the cross facia rail to A pillar joint.
- Severe loss of strength of the door aperture.
- Drop of door (sliding door)

When this modifier is applied, knee mapping data will not be accepted.

3.2.1.2.3 Steering Wheel Contact

Where there is obvious direct loading of the chest from the steering wheel, a one point penalty is applied.

3.2.1.2.4 Shoulder belt load (Driver and Front Passenger)

Where the shoulder belt load measured, exceeds 6kN a two point penalty is applied for the chest.

3.2.1.3 Knee, Femur & Pelvis

3.2.1.3.1 Variable Contact

The position of the dummy's knees is specified by the test protocol. Consequently, their point of contact on the facia is pre-determined. This is not the case with human drivers, who may have their knees in a variety of positions prior to impact. Different sized occupant and those seated in different positions may also have different knee contact locations on the facia and their knees may penetrate into the facia to a greater extent. In order to take some account of this, a larger area of potential knee contact is considered. If contact at other points, within this greater area, would be more aggressive penalties are applied.

The area considered extends vertically 50mm above and below the maximum height of the actual knee impact location [8]. Vertically upwards, consideration is given to the region up to 50mm above the maximum height of knee contact in the test. Horizontally, for the outboard leg, it extends from the centre of the steering column to the end of the facia. For the inboard leg, it extends from the centre of the steering column the same distance inboard, unless knee contact would be prevented by some structure such as a centre console. Over the whole area, an additional penetration depth of 20mm is considered, beyond that identified as the maximum knee penetration in the test. The region considered for each knee is generated independently. Where, over these areas and this depth, femur loads greater than 3.8kN and/or knee slider displacements greater than 6mm would be expected, a one point penalty is applied to the relevant leg.

3.2.1.3.2 Concentrated Loading

The biomechanical tests, which provided the injury tolerance data, were carried out using a padded impactor which spread the load over the knee. Where there are structures in the knee impact area which could concentrate forces on part of the knee, a one point penalty is applied to the relevant leg.

Where a manufacturer is able to show, by means of acceptable test data, that the Variable Contact and/or Concentrated Loading modifiers should not be applied, the penalties may be removed.

If the Concentrated load modifier is not applied to any of the driver's knees, the left and right knee zones (defined above) will both be split into two further areas, a 'column' area and the rest of the facia. The column area for each knee will extend 75mm from the centreline of the steering column and the remainder of the facia will form the other area for each knee. As a result, the one point penalty for Variable Contact will be divided into two, with one half of a point being applied to the column area and one half of a point to the remainder of the facia for each knee.

3.2.1.3.3 Removal of Knee Modifiers

Latin NCAP allows the vehicle manufacturer to present evidence in the form of knee mapping data in order to remove applied knee modifiers. Tests must be performed according to the Euro NCAP Sled Test Procedure Version 2.7 or later and carried out using original components only. Latin NCAP reserves the right to witness the test. Knee mapping data will be accepted under the conditions below:

- The driver and front passenger's head, neck, chest score are orange, yellow or green.
- Femur loads <3.8kN in the full vehicle test.
- Knee Slider <6mm in the full vehicle test.
- No structural modifiers applied i.e. integrity of the passenger compartment and/or footwell rupture.
- A-pillar displacements must be below 65mm (using the standard Euro NCAP measurement).
- All restraining systems must be final production and exactly as the ones fitted in the tested car, with the same characteristics and performance (volume, firing times, loads etc)

Knee mapping data must be presented for review before the 1-2-1 meeting.

3.2.1.4 Lower Leg

3.2.1.4.1 *Upward Displacement of the Worst Performing Pedal*

The score is reduced for excessive upward static displacement of the pedals. Up to 90 percent of the limit considered by EEVC, there is no penalty. Beyond 110 percent of the limit, there is a penalty of one point. Between these limits, the penalty is generated by linear interpolation. The

limit agreed by EEVC was 80mm.

3.2.1.5 Foot & Ankle

3.2.1.5.1 Footwell Rupture

The score is reduced if there is significant rupture of the footwell area. This is usually due to separation of spot welded seams. A one point penalty is applied for footwell rupture. The footwell rupture may either pose a direct threat to the driver's feet, or be sufficiently extensive to threaten the stability of footwell response. When this modifier is applied, knee mapping data will not be accepted.

3.2.1.5.2 Pedal Blocking

Where the rearward displacement of a 'blocked' pedal exceeds 175mm relative to the pre-test measurement, a one point penalty is applied to the driver's foot and ankle assessment. A pedal is blocked when the forward movement of the intruded pedal under a load of 200N is <25mm. Between 50mm and 175mm of rearward displacement the penalty is calculated using a sliding scale between 0 to 1 points.

3.2.2 Passenger

The score generated from passenger dummy data may be modified where the protection for different sized occupants or occupants in different seating positions, or accidents of slightly different severity, can be expected to be worse than that indicated by the dummy readings alone. There is no limit to the number of modifiers that can be applied. The concepts behind the modifiers are explained in ***Section 10 "CONCEPTS BEHIND THE ASSESSMENTS"***. The modifiers applicable to the passenger are:

- *Unstable Contact on the airbag*
- *Hazardous airbag deployment*
- *Incorrect airbag deployment*
- *Shoulder belt load*
- *Displacement of the A Pillar*
- *Integrity of the Passenger Compartment*
- *Knee, Femur & Pelvis, Variable Contact*
- *Knee, Femur & Pelvis, Concentrated loading*
- *Footwell rupture*

The assessments airbag stability, head bottoming-out (where present) and the knee impact areas are the same as for driver. For the outboard knee, the lateral range of the knee impact area extends from the centre line of the passenger seat to the outboard end of the facia. For the

inboard knee, the area extends the same distance inboard of the seat centre line, unless knee contact is prevented by the presence of some structure such as the centre console. The passenger knee zones and penalties will not be divided into two areas even if the Concentrated load modifier is not applied.

Passenger head contact with dashboard (no airbag case)
If, during the forward movement of the passenger's head, it contacts the dashboard, the head score is reduced by one point.

The protection offered to the passenger in a frontal passenger-side 40% offset deformable barrier crash test must also be assessed. In order to do this:

1) Check for same layers in A-pillar on driver side and passenger, door waist level reinforcement, footwell area reinforcements inside the compartment and beneath the floor under the car and compare welding spots density for passenger and driver side.
2) In case there are differences between both, or when there other evidence of sub-optimisation for driver side only, modifiers for structure, head bottoming out, knees and footwell area will be included for the adult calculation. These modifiers can subsequently be removed completely or in part by assessing a passenger-side frontal offset test.
3) In case both sides have the same reinforcements, and there is no obvious evidence of sub-optimisation, the manufacturer will provide a comparison of driver and passenger-side frontal offset results for confirmation.

3.2.3 Door Opening during the Impact

When a door opens in the test, a minus one-point modifier will be applied to the score for that test. The modifier will be applied to the frontal impact assessment for every door (including tailgates and moveable roofs) that opens. The number of door opening modifiers that can be applied to the vehicle score is not limited.

3.2.4 Door Opening Forces after the Impact

Refer to ***Section 8 "POST CRASH (RESCUE, EXTRICATION & SAFETY)"***

3.2.5 Fuel Leakage

In the case of fuel leakage after the crash test, -1 point modifier will be included in the ODB full score. Fuel leakage assessment may include additional post crash actions such as ignition of the car. In the case the fuel leakage introduces a fire risk this will be penalized as such.

3.3 Asymmetries and Borderline cases

When a modifier is applied and a borderline case is being considered, the car manufacturer may submit evidence of a higher load case test described in **Technical Bulletin #2, December 2019.**

For the ODB test, in case of asymmetry (such as variations in reinforcements, layers, and spot weld density), Latin NCAP will apply modifiers for structural instability, footwell area and knees. The manufacturer can request the removal of these modifiers by providing evidence of a passenger side (not RHD car) ODB test. No CAD data will be accepted as evidence.

It is the responsibility of manufacturers to inform the Latin NCAP secretariat in advance of testing when asymmetries are present that could potentially affect the structural or biomechanical performance of the test.

3.4 Scoring & Visualisation

The protection provided for adults for each body region in frontal offset impact are presented visually, using coloured segments within body outlines. The colour used is based on the points awarded for that body region after application of modifiers but excluding possible capping (rounded to three decimal places), as follows:

Green	4.000	points
Yellow	2.670 - 3.999	points
Orange	1.330 - 2.669	points
Brown	0.001 - 1.329	points
Red	0.000	points

For frontal impact, the body regions are grouped together, with the score for the grouped body region being that of the worst performing region or limb. Results are shown separately for driver and passenger. The grouped regions are:

- Head and Neck,
- Chest,
- Knee, Femur, Pelvis (i.e. left and right femur and knee slider)
- Leg and Foot (i.e. left and right lower leg and foot and ankle).

The contribution of the frontal impact test to the Adult Occupant Protection Score is calculated by summing the body scores for the relevant body regions, taking the lower of the driver and passenger scores for each region (16 points maximum total).

4 SIDE MOVABLE DEFORMABLE BARRIER TEST AND SIDE OBLIQUE POLE IMPACT TEST ASSESSMENT

4.1 Criteria and Limit Values

The basic assessment criteria used for both side movable deformable barrier and side oblique pole impact, with the upper and lower performance limits for each parameter, are summarised below. The assessments are divided into four individual body regions, the head, chest, abdomen and pelvis. The criteria and limits are equal for side movable barrier and side oblique pole test except for the head and chest. A maximum of four points are available for each body region. Where multiple criteria exist for an individual body region, the lowest scoring parameter is used to determine the performance of that region. There is no limit to the number of modifiers that can be applied. The concepts behind the modifiers are explained in ***Section 10 "CONCEPTS BEHIND THE ASSESSMENTS"*.**. To ensure robustness in engineering solutions, Latin NCAP decides if testing will be conducted on the passenger or driver side of the vehicle, using the same biomechanical and modifiers criteria. Capping can be reached by direct value reading or when one critical body region scores zero after modifiers are applied.

For both side and oblique pole impacts, capping is applied on the head, chest, abdomen and pelvis. Where no head protection systems are present, the oblique pole test will not be conducted and the points for that test are set to zero. Additionally, a -3 modifier for Head Protection Device (HPD) in Euro NCAP assessment is applied for the front row, and independently, a -5 modifier for the rear row HPD is applied for the rear row. Both modifiers affect the overall Adult Occupant Protection box general score. Where any of the HPD modifiers are applied, **pole impact points will not be able to score, highlighting the lack of protection for either front, rear or all occupants**.

4.1.1 Head

4.1.1.1 Side Impact

Higher performance limit		
HIC_{15}	500	
Resultant Acc. 3msec exceedence	72g	
Lower performance and capping limit		
HIC_{15}	700	(20% risk of injury ≥ AIS3 [1,2])
Resultant Acc. 3msec exceedence	80g	

4.1.1.2 Pole Impact

Capping limits

HIC_{15}	<700
Peak Resultant Acc	<80g

No direct head contact with the pole

4.1.2 Chest

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

MDB and Pole Higher performance limit

Lateral Compression	28mm	(5% risk of AIS3, 67YO)

MDB Lower performance and capping limit

Lateral Compression	50mm	(30% risk of AIS3, 45YO)

Pole Lower performance limit

Lateral Compression	50mm	(30% risk of AIS3, 45YO)

Pole Capping limit

Lateral Compression	55mm	(50% risk of AIS3, 45YO)

4.1.3 Abdomen

Higher performance limit

Lateral Compression	47mm	(33% risk of AIS3, 67YO)

Lower performance and capping limit

Lateral Compression 65mm

4.1.4 Pelvis

Higher performance limit

Pubic Symphysis Force	1.7kN	(5% risk of AIS3, 67YO)

Lower performance and capping limit

Pubic Symphysis Force	2.8kN	(20% risk of AIS3, 45YO)

4.2 Modifiers

4.2.1 Shoulder

Where the shoulder lateral force (Y direction) component is 3.0kN or above, no points will be awarded for the chest assessment.

4.2.2 Chest and Abdomen

Where the viscous criterion (V*C) is 1.0m/s or above for the chest, abdomen or both, no points will be awarded for the relevant body region assessment.

4.3 Asymmetries and borderline cases

For the MDB and Pole impact tests, no points will be scored for chest and abdomen if asymmetries are suspected to affect the structural o biomechanical performance of the car. These include, but not limited to, absence of side impact reinforcements, energy absorption parts, or dummy artifact loading devices.

The manufacturer can provide evidence of a MDB and/or Pole impact test conducted on the opposite side of the official test to have the modifiers removed. No CAD data will be accepted as evidence.

It is the responsibility of manufacturers to inform the Latin NCAP secretariat in advance of testing when asymmetries are present that could potentially affect the structural or biomechanical performance of the test.

4.3.1 Side Head Protection Device (HPD)

Vehicles equipped with head protection side airbags, curtain, seat mounted or any other, will have the inflated energy absorbing areas evaluated by means of a geometric assessment. The airbags must provide protection for a range of occupant sizes in both the front and the rear on both sides of the vehicle. Where a vehicle does not offer sufficient protection, a penalty of -8 points, -3 for front and -5 for rear seats (according to Euro NCAP Side Airbag Head Protection Evaluation[1]), shall be applied to the overall Adult Occupant Protection (AOP). Any vehicle that does not provide a head protection device covering either the front or rear seat positions on both sides of the vehicle will attract this modifier. The HPD modifier may be applied to the front and rear positions independently.

4.3.1.1 Coverage areas

To ensure adequate head protection is offered, the head protection device coverage is assessed in the

1 Euro NCAP “OBLIQUE POLE SIDE IMPACT TESTING PROTOCOL”, Version 7.0.4, September 2018

geometric area, or the Head Protection Device (HPD) assessment zone, where the occupant head would most likely impact side structures. If the vehicle is equipped with movable rear seats the seat shall be set to the most rearward position. If there is a third row of fixed seats, these will be included in the assessment unless they are per manufacturers' recommendation not suitable for adult occupation (handbook).

4.3.1.2 Application

Where the airbags differ between the left and right hand sides of the vehicle, the airbags on both sides of the vehicle will be evaluated and the assessment will be based upon worst performing side. All areas of the airbag, both front and rear, will be evaluated and the assessment will be based upon the worst performing part of any of the airbags.

4.3.1.3 Exclusions

The head protecting airbags should cover all glazed areas within the defined zone up to the edge of door daylight opening (FMVSS201) where it meets the roofline, B-pillar, C-pillar and door waistline. Seams in the airbag will not be penalised provided that the un-inflated area is no wider than 15mm. Any other areas where the airbag layers are connected will not be penalised provided that the surrounding areas are inflated and any un-inflated areas are no larger than 50mm in diameter or equivalent area or the sum of the major and minor axes of individual areas does not exceed 100mm. In the case that the un-inflated area would be larger than described above, the OEM shall provide data to demonstrate sufficient energy absorption is guaranteed.

Where a vehicle is fitted with a third row of foldable or removable seats, the third row (only) will be excluded from the assessment.

4.3.2 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 or passenger'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). In case an MDB or Pole receives modifier(s) for airbag deployment they are carried over from MDB to Pole and vice versa.

The modifier will be applied even if the airbag was not intended to offer protection in that particular impact. For example, the penalty will be applied if a driver's knee airbag deploys incorrectly in a side impact. In this case the modifier will be applied to both frontal impact driver knee, femur and pelvis body parts. Where a frontal protection airbag deploys incorrectly, knee-mapping is not permitted for the occupant whom the airbag was designed to protect.

4.3.3 Door Opening during the Impact

When a door opens in the test, a minus one-point modifier will be applied to the score for that test. The modifier will be applied to the side and side pole impact assessment score for every door (including tailgates and moveable roofs) that opens. The number of door opening modifiers that can be applied to the vehicle score is not limited.

4.3.4 Door Opening Forces after the Impact

Refer to ***Section 8 "POST CRASH (RESCUE, EXTRICATION & SAFETY)"***

A check is made to ensure that the doors on the non-struck side can be opened. The doors on the struck side are not opened.

4.3.5 Fuel Leakage

In the case of fuel leakage after the crash test, -1 point modifier will be included in the full AOP MDB or Side Oblique Pole full scoring. Fuel leakage assessment may include additional post crash actions such as ignition of the car. In the case the fuel leakage introduces a fire risk this will be penalized as such.

4.4 Scoring & Visualisation

The protection provided for adults for each body region are presented visually, using coloured segments within body outlines. The colour used is based on the points awarded for that body region after application of modifiers, but excluding possible capping (rounded to three decimal places), as follows:

Green	4.000	points
Yellow	2.670 - 3.999	points
Orange	1.330 - 2.669	points
Brown	0.001 - 1.329	points
Red	0.000	points

For the side barrier and side oblique pole impact, all the individual regions are used. Results are shown separately for side barrier and pole impact.

The contribution of the side impact tests to the Adult Occupant Protection Score is calculated by summing the body scores for the relevant body regions. The total score in the side movable deformable barrier and side pole test is limited to 16 points. This is achieved by adding up the individual scores (after modifiers have been applied) for the side impact test (max. 16 points) and the pole test (max. 16 points) and dividing the result by two.

5 WHIPLASH SEAT ASSESSMENT

Whiplash is assessed for the front seats and the rear outboard seats. Front seats are tested statically and dynamically according to Euro NCAP Whiplash Testing Protocol. Dynamic test will be assessed using Euro NCAP medium severity pulse and will only contribute to the overall score when the static assessment score is equal or above 0. Latin NCAP may decide to perform and communicate the results of dynamic test for information purposes. Rear seats are assessed according to the Euro NCAP Rear Whiplash Protocol. The details of the front seat(s) that will be tested by Latin NCAP are contained in Latin NCAP Vehicle Specification, Sponsorship, Testing and Re-testing Protocol. Whiplash points will only be eligible to score when UN R32 or UN R153 point is awarded.

5.1 Front Seat Whiplash Assessment

5.1.1 Criteria and Limit Values

The basic assessment criteria used for front whiplash protection assessment, with the upper and lower performance limits for each parameter, are summarised below.

5.1.1.1 Static Assessments

5.1.1.1.1 Head Restraint Geometry Assessment

The assessment is based on the worst performing parameter from either the height or backset:

Higher performance limit:
Height: 0mm below top height of HPM & HRMD
Backset: 40mm

Lower performance limit:
Height: 80mm below top height of HPM & HRMD
Backset: 100mm

The geometric assessment will be based on the average height and backset taken from at least 3 measurements obtained across all of the seats provided for assessment. A minimum of three drops per seat shall be performed to ensure consistent measurements are obtained on each individual seat. Where obvious outlying HRMD/HPM measurements occur, further installations shall be undertaken on that seat to ascertain whether differences are due to the individual installation or seat to seat variability. Where a seat has a non-reversible head restraint and qualifies for a geometric assessment in the deployed position, additional seats shall be provided by the vehicle manufacturer for measurement.

The geometry assessment has two points allocated to it ranging from plus one to minus one.

5.1.1.1.2 Worst Case Geometry[2]

1/n points (where n = the number of front seats) will be available for each front seat scoring more than 0 points in the worst case geometry assessment. For seats where the occupant must adjust the head restraint, the worst case geometry shall be measured in the lowest and rearmost position regardless of whether or not the seat is equipped with an active head restraint. The assessment will be based on the average height and backset taken from at least 3 measurements in the down and back position obtained across all of the seats provided for assessment. A minimum of 3 drops per seat shall be performed to ensure consistent measurements are obtained on each individual seat. Alternatively, a means of ensuring that the head restraint is correctly positioned for different sized occupants without specific occupant action shall be offered. For these automatically adjusting head restraints, the worst case geometry assessment shall be measured in the position as obtained in Section 4.6 of the Euro NCAP Whiplash Testing Protocol[3]. This credit will only be available to seats performing well dynamically, with a raw score greater than 4.50 points after capping and all modifiers have been applied.

For the dynamic test of self-adjusting head restraints, the seat should be set in the position as obtained in Section 4.6 of the Euro NCAP Whiplash Testing Protocol[3] and the corresponding head restraint height should be used irrespective of whether this is the mid height position of the head restraint itself.

The individual front seats are scored separately for this feature as cars have been encountered in which different provisions are made for the driver and front passenger seats and the system also allows for cars with three front seats. Where the manufacturer can provide evidence that the front seats are equivalent in terms of the worst case geometry assessment, the seats will be scored equally. Where this is not the case, the manufacturer will be asked to provide an additional seat for assessment.

5.1.1.2 Dynamic Assessments

A sliding scale system of points scoring shall be applied with two limits for each seat design parameter, a more demanding higher performance limit, below which a maximum score is obtained and a less demanding lower performance limit, beyond which no points are scored. Where a value falls between the two limits, the score is calculated by linear interpolation.

The maximum score for each parameter is 1.50 points, with a maximum of 9 points available for the test. For the tests, the score for each of the seven parameters is calculated. The overall score for a single dynamic test is the sum of the scores for NIC, Nkm, Head rebound velocity, neck shear

2 Formerly referred to as “Ease of Adjustment”

3 Euro NCAP “*THE DYNAMIC ASSESSMENT OF CAR SEATS FOR NECK INJURY PROTECTION TESTING PROTOCOL*”, Version 3.3, November 2018

and neck tension, plus the maximum score from either T1 acceleration or head restraint contact time (T-HRC-start). An additional seatback deflection penalty of three points will be applied to seats with a rotation of 16.0° or greater. In the medium term, seat translation may also need to be controlled but, for the interim solution, only rotational control of the seat back is specified. The relevant performance criteria for the medium severity pulse is detailed below.

5.1.1.2.1 Medium Severity Pulse

Criterion*	**Higher performance**	**Lower performance**	**Capping Limit**
NIC	11.00	24.00	27.00
Nkm	0.15	0.55	0.69
Rebound velocity (m/s)	3.2	4.8	5.2
Upper Neck Shear Fx (N)	30	190	290
Upper Neck Tension Fz (N)	360	750	900
T1 acceleration* (g)	9.30	13.10	15.55
T-HRC	57	82	92
Seatback Deflection assessment	16.0°		

* All parameters calculated until THRC-end, except rebound velocity.

5.1.2 Front Whiplash Modifiers

5.1.2.1 Seatback Dynamic Deflection

The medium severity pulse will be subject to an additional seatback deflection assessment where a three point penalty will be applied to the overall score where seats have a rotation of 16.0° or greater.

5.1.2.2 Dummy Artefact Loading

A two point negative modifier would be applied as a means of penalising any seat that, by design, places unfavourable loading on other body areas (e.g. preventing realistic ramping up) or exploits a dummy artefact.

5.2 Rear Seat Whiplash Assessment

The assessment criteria used for rear seat whiplash protection assessment, with the points scored for each parameter, are summarized below. Only outboard seating positions are assessed.

Manufacturers will be asked to provide theoretical design data for R point position and torso angle of the two outboard seating positions. If these are the same to within the following tolerances,

R point position (vertical and horizontal): ±2.5mm
Torso angle: ±0.5°,

the two outboard seating positions will be considered symmetrical and only one position needs to be measured. Otherwise, the two outboard seating positions will be separately assessed. However, even in the case that manufacturer data indicates symmetry, the laboratory may assess the seating positions separately if they have reason to believe that the seats are not symmetrical.

5.2.1 Prerequisite

For a seating row to score points in the rear whiplash assessment, any centre seating position in that row needs to comply with the requirements of UN-ECE Regulation 17-08. This may be achieved by use of a separate head restraint or otherwise but, in any case, all vehicles in the model range must be equipped as standard with what is needed to ensure compliance. Manufacturers will be asked for evidence (approval, technical service report) that the rear centre seat complies with the requirements of UN-ECE Regulation 17-08. For example, a vehicle with 3 seating rows having a restraint as standard in row 2 but not standard in row 3 can score points for row 2 only.

Cars which have no rear centre seating position (4 seaters for example) will automatically fulfil this prerequisite.

5.2.2 Criteria and Limit Values

A maximum of four points is awarded for each seating position based on the Effective Height measurements, backset (ΔCP X) and non-use position. One and a half points are awarded if the height requirements are met. If the height requirements are met, an additional one point is awarded if the backset requirement is met in the mid head restraint position; a further half point is awarded if the backset is met in the worst-case position; and an additional point can be scored if the requirements for non-use position are met.

5.2.2.1 Effective Height requirements

The seating position shall be deemed to have met the height requirements of this protocol if either paragraph 5.2.2.1.1 or 5.2.2.1.2 is met.

5.2.2.1.1

The requirements of this paragraph are met if the effective height of the head restraint meets the requirements of both the following:

- The effective height of the restraint is, in its lowest position, no less than 720mm

- The effective height of the restraint is, in its highest position, no less than 770mm[4]

5.2.2.1.2

If the interior surface of the vehicle roofline, including the headliner or backlight, physically prevents a head restraint located in the rear outboard designated seating position from attaining the height required by paragraph 5.2.2.1.1 of this protocol, the gap between the head restraint and interior surface of the roofline, including the headliner or the backlight when measured as described below, shall not exceed 50mm when the head restraint is adjusted to its highest position intended for occupant use:

- If adjustable, adjust the head restraint to its maximum height and measure the clearance between the top of the head restraint or the seat back at all seat back angles for intended use and the interior surface of the roofline or the rear backlight, by attempting to pass a 50 ± 0.5mm sphere between them.

5.2.2.2 Backset Requirements

Using the torso angle, the calculated limit value of backset $(\Delta CP\ X)_{LIMIT}$ is determined using the following formula:

$$(\Delta \boldsymbol{CP\ X})_{\boldsymbol{LIMIT}} = \mathbf{7.128} \cdot \boldsymbol{Torso\ angle} + \mathbf{153}$$

This limit value is applied in both mid and worst case position.

5.2.2.3 Non-Use Position Assessment

5.2.2.3.1 Automatic Return Head Restraints

The head restraint needs to automatically go to the use-position from the non-use position at ignition on or when the engine is started.

5.2.2.3.2 60° Rotation Evaluation

The difference in head restraint angle needs to be larger than 60° between the in-use and non-use position. Rearward rotation or retraction of the head restraint to set the non-use position is not compliant with the requirements of this section.

5.2.2.3.3 10° Torso Line Change

The difference in torso angle between the in-use and non-use position needs to be larger than 10°.

4 Latin NCAP will monitor legislative requirements and may revise this figure in future years.

5.2.2.3.4 Discomfort Metric

The lower edge of the head restraint (HLE) shall be not more than 460 mm, but not less than 250 mm from the R-Point and the thickness (S) shall not be less than 40 mm.

5.3 Scoring

5.3.1 Front Whiplash Score

5.3.1.1 Raw Score

The protocol allows for a maximum score of 11 points as a result of carrying out the whiplash test, assuming no negative modifiers have been applied. This score is known as the raw score and its components are explained below.

The medium severity of whiplash test pulse results in a maximum of 9 points being awarded based on the measured criteria. 1.5 points are awarded for each of NIC, Nkm, Head rebound velocity, F_x and F_z. A further 1.5 points are awarded on the basis of the best score from either T1 acceleration or head restraint contact time (T-HRC).

If any of NIC, Nkm, Head rebound velocity, neck shear or tension exceed the capping limit, no score is given for that pulse. Additionally, if both T1 and head restraint contact time exceed the lower performance limit and either one also exceeds the relevant capping limit, no score is given for the pulse.

The sum of the scores from the dynamic tests is then subject to the application of the modifiers.

	Points available
Static assessments	
HR geometry	*-1 to +1 points*
Worst case geometry	*1 point*
Dynamic assessments	
Medium severity pulse	*9 points*
Modifiers	
Seatback deflection	*-3 points*
Dummy artefact loading	*-2 points*
Maximum points	***11 points***

5.3.1.2 Scaled Front Whiplash Score

The raw score is scaled to a maximum of 3 points by multiplication by a factor of 3/11. Scaled scores less than zero are set to zero points.

5.3.2 Rear Whiplash Score

5.3.2.1 Raw Score

Seat rows having a rear centre seating position meeting the prerequisites of 5.2.1 can score points for geometry and non-use position according to the following paragraphs.

The rear whiplash score for each seat is the sum of its geometry assessment score and its non-use position assessment score. The rear whiplash score is the sum of the scores for the two rear outboard seats (double the score for one seat in the case of symmetric seating positions).

For a vehicle with a third row the scores of the second and third row are added and scaled to a maximum of 1 point. Vehicles with no subsequent seating positions after the front row are excluded from the assessment.

5.3.2.1.1 Geometry Assessment Score

Parameter		Score (per seating position)
Effective Height		1.5
$(\Delta CP\ X)^*_{mid}$	$<= (\Delta CP\ X)_{LIMIT}$	1
	$> (\Delta CP\ X)_{LIMIT}$	0.5
$(\Delta CP\ X)^*_{wc}$	$<= (\Delta CP\ X)_{LIMIT}$	0.5
	$> (\Delta CP\ X)_{LIMIT}$	0

** Points can be scored for backset only if the Effective Height requirements are met.*

5.3.2.1.2 Non-Use Score

As a prerequisite for scoring for the Non-Use Position, the height and backset assessment needs to score more than 0 points.

- If the head restraint is always in a use position, and scores more than 0 points for geometry, the seating position scores 1 point.
- Seating positions with a non-use position compliant with one of the procedures described in 6.2.2.3 and which score more than 0 points for geometry also score 1 point.
- If no points are scored for geometry, no points can be scored for use/non-use positions.

5.3.2.2 Scaled Rear Whiplash Score

The raw score is scaled down to a total maximum of one a point for rear whiplash.

5.4 Visualisation

The front and rear whiplash scores are presented separately using a coloured head and neck graphic. The colours used are based on the front seat and rear seat scores respectively, rounded to three decimal places.

5.4.1 Front Whiplash Visualisation

For whiplash, the protection provided for the neck of a front seat adult occupant is presented visually using a coloured head and neck graphic. The colour used is based on the scaled points (rounded to three decimal places), as follows:

Green	'Good'	2.250 - 3.000 points
Orange	'Marginal'	1.125 – 2.249 points
Red	'Poor'	0.000 - 0.124 points

5.4.2 Rear Whiplash Visualisation

The protection provided for the neck of the rear seat occupant is presented visually using a coloured head and neck graphic. The colour used is based on the scaled points (rounded to three decimal places), as follows:

Green	'Good'	0.667 – 1.000 points
Orange	'Marginal'	0.333 – 0.666 points
Red	'Poor'	0.000 – 0.332 points

6 REAR SEATS OCCUPANT PROTECTION

Latin NCAP aims to promote the improvement of rear occupant protection in frontal crashes. Until a full width test is included in the future, Latin NCAP requires sled test and biomechanical data from manufacturers to assess the protection to smaller occupants in rear positions, based on Euro NCAP Full Width test. When no information is provided and accepted by Latin NCAP Secretariat, a penalization will be introduced to the total AOP score.

While rear seatbelt pretensioners and load limiters are the most widespread technology to improve rear occupant protection, no technology is specified by Latin NCAP and the assessment will be based on the biomechanical criteria described below.

For the time being Latin NCAP only assess second row occupant protection in the outboard seating positions. Only two seater vehicles are excepted from this assessment. Rear limited space vehicles with valid second row seating positions are eligible for this assessment.

Under special conditions Latin NCAP may also accept at the request of the manufacturer, inhouse data from a full frontal crash test provided the contidtions below are fulfilled:

- The test must be performed in accordance to the latest verision of *Latin NCAP Testing Protocols* document.
- The test must be performed with a final production car and Latin NCAP reserves the right to select the car in the same conditions as for the rest of the tests in the assessment. Pre production, 0-series and development cars will not be accepted.
- Latin NCAP reserves the right to witness the test in person at the designated crash test facility.
- Latin NCAP may perform a full frontal audit test at any time after the official test following the same audit conditions as described in the lates version of Latin NCAP CSSTR protocol.

6.1 Sled test requirements and pulse

The sled test and its corresponding data set must be performed and provided in accordance to Latin NCAP requirements. The corresponding pulse must fulfil the criteria described in **APPENDIX III**. Latin NCAP may perform or request to the OEM an audit sled test at any time after the official test following the same audit conditions as described in the latest version of Latin NCAP CSSTR protocol.

6.2 Criteria and Limit Values

The basic assessment criteria used for the rear occupant safety sled or full width test, with the

upper and lower performance limits for each parameter, are summarized below. With the exemption of the neck assessment, where multiple criteria exist for an individual body region, the lowest scoring parameter is used to determine the performance of that region.

6.2.1 Head

If there is no hard contact seen on the high speed film, the score is based on the 3ms resultant acceleration.

Higher performance limit

Resultant Acc. 3 msec exceedance	72g

Lower performance and capping limit

Resultant Acc. 3 msec exceedence	80g

If there is hard contact confirmed on the high speed film, the following limits are used:

Higher performance limit

HIC15	500
Resultant Acc. 3 msec exceedence	72g

Lower performance and capping limit

HIC15	700
Resultant Acc. 3 msec exceedence	80g

6.2.2 Neck

Higher performance limit

Shear	1.2kN
Tension	1.7kN
Extension	36Nm

Lower performance limit

Shear	1.95kN
Tension	2.62kN
Extension	49Nm

For the rear passenger dummy, the neck score is the sum of all three criteria, with the following maximum score per criterion:

Shear	1 point

Tension	1 point
Extension	2 points

6.2.3 Chest

Higher performance limit

Compression	18mm
Viscous Criterion	0.5m/sec

Lower performance and Capping limit

Compression	42mm
Viscous Criterion	1.0m/sec

6.2.4 Knee, Femur and Pelvis

The knee, femur, pelvis region is assessed by the femur compression:

Higher performance limit

Femur compression	2.6kN

Lower performance limit

Femur Compression	6.2kN

6.3 Modifiers

The score generated from dummy data may be modified where the protection for different sized occupants or occupants in different seating positions, or accidents of slightly different severity, can be expected to be worse than that indicated by the dummy readings or deformation data alone. There is no limit to the number of modifiers that can be applied.

6.3.1 Head

Exceeding forward excursion line

The score is reduced for excessive forward excursion. Where the head of the Rear Passenger exceeds the 450mm or 550mm forward excursion line as defined in the full width test protocol, a 2 or 4 point modifier respectively is applied. The modifier can be removed when it is shown by means of a sled test that the HIII-50M does not contact the front passenger seat when in the 50M seating position, or when the HIC15 value is below 700 in case of contact with the front passenger seat.

6.3.2 Chest

Shoulder belt load
Where the shoulder belt load filtered at CFC60 exceeds 6.0kN a two point penalty is applied.

6.3.3 Knee, Femur & Pelvis

Submarining (Rear Passenger)
The score for the Knee, Femur & Pelvis is reduced by 4 points when submarining occurs. The modifier is applied when a drop in any of the two iliac forces measured is seen within 1 ms and when the submarining is confirmed on the high speed film.

6.4 Scoring & Visualisation

The protection provided for adults in the rear seats for each body region are presented visually, using coloured segments within body outlines. The colour used is based on the points awarded for that body region (rounded to three decimal places), as follows:

Green	'Good'	4.000	points
Yellow	'Adequate'	2.670 - 3.999	points
Orange	'Marginal'	1.330 - 2.669	points
Brown	'Weak'	0.001 - 1.329	points
Red	'Poor'	0.000	points

The body regions are grouped together, with the score for the grouped body region being that of the worst performing region or limb. The grouped regions are: Head (4 points), Neck (4 points), Chest (4 points) and Knee, Femur & Pelvis (i.e. left and right femur) (4 points).

Latin NCAP level of acceptance for this area of assessment is that all body parts are color Green ('Good'), Yellow ('Adequate') or Orange ('Marginal'). Failing to provide this information, biomechanical performance below the mentioned acceptance or when not accepted by Latin NCAP Secretariat, a penalization of **8 points** will be introduced to the total AOP score.

7 REAR END COLLISION VEHICLE BEHAVIOUR

Failing to meet the UN R32 or UN 153 structural rear impact test requirements will result in a -**1 point** modifier to the AOP score. If no UN R32 or UN R153 certificate, an audit test will be required.

8 POST CRASH (RESCUE, EXTRICATION & SAFETY)

Rescue services require detailed but easily understood information regarding the construction of individual vehicles to extract trapped occupants as quickly and safely as possible. This is becoming more pressing as vehicles become stronger (e.g. use of high strength steels or composite materials), use different sources of power (e.g. electric/hybrid, hydrogen) and are equipped with an increasing number of safety devices (e.g. airbags, pre-tensioners, active pedestrian protection bonnets).

Through the application of this protocol Latin NCAP promotes the appropriate availability of ISO 17840 compliant rescue sheets and response guides for new car models. To further assist the extrication efforts of first responders, the correct functioning of automatic door locks, i.e., unlocking after a crash, is checked. Assessments in this chapter follow Euro NCAP *RESCUE, EXTRICATION & SAFETY TEST & ASSESSMENT PROTOCOL, Version 2.3 May 2023.*

The assessments to be performed in the areas of Rescue, Extrication and Safety contribute to the adult occupant protection rating. The requirements detailed in this protocol are divided into three areas:

1) **Rescue**: Information for First Responders – Rescue Sheet

2) **Extrication**: Unlocking of automatic door locking, door opening forces, seat belt unbuckling forces, compliance with ECE regulations post-crash for EV vehicles, and accuracy of eCall data. Markings on vehicles to help with disabling direct hazards by rescuers attending the vehicle.

3) **Safety**: E-Call Systems

In the future, Latin NCAP plans to incorporate additional considerations such as Emergency Response Guide (ERG), advanced E-Call features and vehicle submergence.

8.1 Rescue Sheet

Failing to provide a Rescue sheet in accordance with ISO 17840-15 criteria or the incorrect Rescue sheet will result in a -**1 point** modifier to the AOP score. The rescue sheet must be available on the manufacturer's website of each market where the car is sold and in the official language of the market.

5 *https://www.iso.org/obp/ui/#iso:std:iso:17840:-1:ed-1:v1:en*

8.2 eCall

Latin NCAP aims to promote the availability of eCall systems in the region as a standard in all upcoming vehicles. Following EU technical standards, eCall systems should offer a minimum basic emergency data transmission, that can also be paired with more advanced features to further assess and manage the emergency response.

8.2.1 Preconditions

8.2.1.1 The system cannot be disabled by the driver.

8.2.1.2 The system must be fully operational without requiring user´s activation, it must be fully functional from the factory or point of sale.

8.2.1.3 The system must function independently. It should not rely on pairing with third-party devices or smartphones for functionality to be eligible for scoring.

8.2.1.4 The system must be offered **free of cost** to the consumer for the entire lifespan of the vehicle.

8.2.1.5 Pairing the system with advanced features such as roadside assistance, navigation or stolen vehicle safety assistance is allowed as long as it meets the basic eCall requirements described in 8.2.2. Advanced features are not required to be offered free of charge.

8.2.1.6 Consumers should be provided with a realistic overview of the eCall in-vehicle system and/or of the TPS eCall system, if the vehicle is equipped with one, as well as comprehensive and reliable information regarding any additional functionalities or services linked to the private emergency service, in-vehicle emergency or assistance call applications on offer, and regarding the level of service to be expected with the purchase of third party services and the associated cost.

8.2.1.7 A minimum of 28 points in AOP box is required to be eligible to score the E-Call points in the AOP Box.

8.2.2 General Requirements

8.2.2.1 The system will always automatically initiate the call without any action required by the vehicle occupants in the event of a crash. The system can also be activated by a button on demand.

8.2.2.2 The system will automatically transmit the event´s location, travel direction, time of the event and vehicle identification number (VIN) to the national emergency services. Additionally, it may utilize third party services (TPS) to transmit this information to the national emergency services.

8.2.3 Scoring

Vehicles equipped with eCall systems fulfilling 8.2.1 and 8.2.2 and the fitment requirements described in the Overall Rating protocol will be able to score **2 points** in the AOP box.

8.3 Extraction

8.3.1 Automatic door locking (ADL)

8.3.1.1 Latin NCAP understands the need for vehicles to be equipped with automatic door locks due to such issues as security when stopped in traffic. However, in the event of an accident the locked doors should automatically unlock, post impact, to allow the occupants to exit but also for entry by first responders.

8.3.1.2 The Latin NCAP Secretariat will check with the OEM if their vehicle is fitted with automatic locking door latches as standard and inform the test laboratory accordingly.

8.3.1.3 If ADL is fitted as standard and by default always ON then the doors will be locked by the lab personnel prior to ALL full-scale tests. The test lab will be informed by the OEM of the procedure to ensure the doors are manually locked for the tests.

8.3.1.4 If ADL is not fitted as standard, or not by default always ON, but fitted to the test variant then doors will be locked in the frontal ODB test and unlocked in the side oblique Pole **and** side Barrier test.

8.3.1.5 Post-test the lab personnel will immediately check if any of the side doors in the front crash test and any of the non-struck side doors in the side crash tests has remained locked/has not automatically unlocked. A maximum -1 point penalty will be applied if this issue is identified in at least one of the two tests where the doors were locked pre impact. This will follow the procedure for door opening in 8.3.2.

8.3.2 Door opening forces

8.3.2.1 The post impact door opening forces are measured after the frontal impact test. Only the side doors (not the tailgate for example) will be checked.

8.3.2.2 The unlatching/unlocking of the side doors will already have been checked as part of the automatic door locking section.

8.3.2.3 Using a gauge attached to the door handle, pull the door handle until a maximum force of 750N is registered. The opening force should be applied perpendicular to the door, in a horizontal plane, unless this is not possible. If the door opens before the 750N level is reached note down the opening force. If the door does still not open upon reaching 750N then use tools to open the door.

8.3.2.4 When dealing with a sliding door the opening force of [750N]* shall be applied in a direction following the vehicle centreline – door should be pulled in this direction once the door unlatching forces have been carried out. (as mentioned previously the unlatching/unlocking check of the side doors will already have been checked as part of

the automatic locking doors section.)

8.3.2.5 An open hinged door is defined as a door that is opened to an angle of at least 45° relative to the door hinge axis, allowing enough room for occupant extraction.

8.3.2.6 An open sliding door is defined as a door that, when opened, presents a minimum opening of at least 500mm compared to the closed position of the door, that would allow the extrication of an occupant.

8.3.2.7 To summarise there are 2 stages to the door opening forces procedure: Load gauge up to 750N and then tools.

8.3.2.8 Penalty only applied if load exceeds 750N and tools are required to open a door.

8.3.2.9 A maximum -1 point penalty will be applied if this issue is identified for at least one of the side doors in at least one of the frontal test.

**Force shown is monitored for sliding doors at present, value may be adjusted depending on test experience*

8.3.3 Additional criteria for electric or concealed handles retracting into door panel and having no possibility for physical grip

More and more vehicles are now coming to the market with electric retracting door handles that sink into the door panel flush/level with the door panel surface. Obviously this can create an issue in an emergency situation where first responders need to be able to use the door handle to open the door.

8.3.3.1 The door handle should be in the retracted / vehicle in motion position for the test.

8.3.3.2 The OEM should inform both the Latin NCAP Secretariat and the test laboratory if any special action is needed, for example if the engine must be running for the retracting door handles to operate as normal in the test.

8.3.3.3 For a retracting and some manual door handle it is permitted to apply special actions at the handle to have access to it. For example, pushing in one corner to pivot it and then hold the handle (if no tools are needed at all). This needs to be discussed with Latin NCAP Secretariat prior to tests and it must be explained in the Rescue Sheet and also in the vehicle handbook.

8.3.3.4 For the full scale tests, with the exception of the struck side doors in the side impacts, the handles of all side doors must be in the extended/ready to open (as explained in 5.3.3) position immediately after the test. It is assumed that by design the door handles will extend outwards ready for use when the SRS system deploys any airbag/detects a severe impact or the door handle remains 2023 RES Protocol Version 2.3 May 2023 8 in its retracted position but can be grabbed nevertheless by the first responder without any tool. The test laboratory personnel will note down the status of each door handle post

impact.

8.3.3.5 A maximum penalty of -1 point will be applied where any of the side door handles listed in 5.3.4 cannot be used as normal or accessed without tools after the test.

8.3.3.6 It is not acceptable to direct the user/owner/rescuer of the vehicle to a cable release for the door in the luggage area for example or to have to connect a slave battery to the vehicle in order to extend the door handles. A vehicle equipped with electric door handles will not be given any special treatment compared to a vehicle with conventional door handles.

8.3.4 Seat belt buckle unlatching

No extrication assessment would be complete without also dealing with the belted occupants and ensuring that the seat belt itself can be unlatched as normal to allow extrication of the occupant.

8.3.4.1 Any position where the seat belt is used for the full scale tests shall be checked post-test once all of the door opening forces have been measured. (For both adult and child if car seatbelt is used to restrain child dummy and/or CRS in test).

8.3.4.2 Frontal and Side impacts - The seat belt buckle shall completely open under a load of no more than 60N for frontal impact tests and 100N for side impacts applied directly to the centre point and in the direction of the opening movement of the buckle release button. The operator shall hold the buckle with one hand ensuring the application of the force measurement in the correct orientation with the other hand to measure in the axis of the buckle opening movement. The metal probe of the measurement device should only make contact with the button of the belt buckle and not the surrounding material of the buckle body. The application of force shall be conducted slowly and constantly. The measurement device shall provide load versus time information, with a frequency of at least 200Hz. This will identify potential measurement artefacts of the opening behaviour, which could be derived from a second contact of the buckle release button after release with the buckle housing. In such a case, the maximum value of force before the first quick drop shall be interpreted as the opening force. It is permitted to move the adult dummy, child dummy or CRS in order to access the buckle.

8.3.4.3 No further steps will be taken to open the buckle or tools allowed to cut the belt, unbolt the buckle from the car etc.

8.3.4.4 The test laboratory should note the load at which each buckle releases.

8.3.4.5 A maximum penalty of -1 will be applied where any of the buckles used in the frontal or

side tests open beyond the limits defined in 8.3.4.2.

8.4 EV safety, electrical shock, and fire risk

8.4.1 Fire risk

In the case that after any of the tests, there is evidence of fire or evidence of risk of fire, AOP points will be capped to zero.

8.4.2 EV Safety

After crash checks according to EVs post-crash requirements in ECE R94, ECE R95, ECE R135 and ECE R137. Failing to comply with the “protection against electrical shock” chapter as described in the regulation will result in the AOP points capped to zero.

The relevant items evaluated under the protection against electrical shock are:

- Absence of high voltage.
- Low electrical energy.
- Physical protection.
- Isolation resistance:
    - Electrical power train consisting of separate DC- or AC-buses OR
    - Electric power train consisting of combined DC- and AC-buses.
- Electrolyte leakage.
- REESS retention.
- REESS fire hazards.

Latin NCAP reserves the right to penalize or highlight electrical shock risks in addition to the ones described in the regulation if justified.

8.4.3 Identification of Direct Hazard Disabling Equipment

The making safe/disabling of on-board energy in vehicles (high-voltage electricity, pressurised or liquified gas etc) is a major challenge for the safe execution of emergency operations. As part of good practice, many vehicle manufacturers have taken the initiative to position stickers on vehicles, specifying for some, the type of energy on board, and for others the location and/or action to be carried out (e-plug handling, service plug handling, valve handling, isolation loop section etc). In response to the increasing number of manufacturers' differing instructions on energy neutralisation and the absence of harmonisation of procedures, there is a need for OEMs to produce common markings and in turn aid rescuers attending the vehicle.

8.4.3.1 A maximum -1 point penalty will be applied if hazards are not correctly marked on the vehicle. See Appendix II for reference on Gaseous fuel vehicles and, Battery electric and

hybrid vehicles.

8.4.3.2 In order to aid first responders stickers/markings should be present on the vehicle in order to identify the disabling equipment (shown on the Rescue Sheet under heading 3 for disabling equipment of high-voltage electricity and / or pressurised or liquified gas), with symbols and colours from ISO 17840:

- Background - ISO energy colour.
- First pictogram - Firefighter helmet (specific pictogram used up to OEM).
- Second pictogram – ISO pictogram used to identify equipment.
- Third pictogram – Explanatory symbol – not mandatory.

The stickers/markings are recommended for low voltage batteries (from 24V to 60V), if specific instructions to disable the hazard are shown under heading 3 in the rescue sheet.

9 ROOF CRUSH

9.1 Background

Latin NCAP aims to increase occupant safety in case of rollovers by an introduction of a roof crush evaluation through an inverted vehicle drop test. The objective is to improve structural integrity, reducing the risk of severe head and neck injuries for occupants in a rollover.

With a disproportionate number of death and serious injuries compared to other crash scenarios, the relevance of rollover crashes should not be underrated, particularly in a region with challenging infrastructure. This is particularly concerning in fleets, for example in the extractive industry, where aftermarket solutions such as internal roll bars are often added. These solutions aim to reduce compartment deformation, but can increase the risks of fatal or life threatening injuries during a rollover due to body parts directly impacting the aftermarket device, or intrusion into the vehicle restrain systems, obstructing its regular functionality.

9.2 Scope

Latin NCAP will introduce this area of assessment by focusing on vehicles popular among fleets. As a first stage for 2026 and 2027, the test will focus on single and double cabin pickup trucks. Additional vehicle types may be considered for the assessment after 2027.

9.3 Assessment protocol, scoring and visualization

The assessment will be based on SAE J996 protocol, with a drop height of 500 mm. For 2026 and 2027 Latin NCAP may inform in its website the results of the evaluation. From 2027 onwards Latin NCAP may decide to include roof crush performance in the AOP overall score.

The main parameter of the assessment will be total overall deformation in terms of percentage pre and post crush, as well as linear deformation using H point as a reference or virtual dummy to assess occupant to car interaction.

10 CONCEPTS BEHIND THE ASSESSMENTS

10.1 Frontal Impact

10.1.1 Head

CONCEPT*: The driver's head should be predictably restrained by the airbag, and should remain protected by the airbag during the dummy's forward movement. There should be no bottoming out of the airbag during the official test. Under slightly different test conditions, for example, speed, dummy size and dummy position, the head should also be predictably restrained by the airbag.*

CONCEPT: *Hazardous airbag deployment*
The deployment mode of the airbag should not pose a risk of facial injury to occupants of any size.

CONCEPT: *Incorrect airbag deployment*
All airbags that deploy during an impact should do so fully and in the designed manner so as to provide the maximum amount of protection to occupants available. It is expected that, where required, all airbags should deploy in a robust manner regardless of the impact scenario.

CONCEPT*: Geometric control of steering wheel movement is needed to ensure that the airbag launch platform remains as close as possible to the design position, to protect a full range of occupant sizes****.***

10.1.2 Neck

CONCEPT: *Neck injuries are frequent, but relatively little is known about appropriate injury criteria. The neck criteria recommended by EEVC are used to identify poorly designed restraint systems. It is not expected that many cars will fail these requirements****.***

In addition to the EEVC recommended limits, additional ones have been added, at the request of the car manufacturers. It is assumed that good restraint systems will have no problems meeting these criteria.

10.1.3 Chest

CONCEPT*: Rib compression is used as the main guide to injury risk. It is expected that the Viscous Criterion will only identify cars with poorly performing restraint systems.*

The injury risk data is relevant for seat belt only loading rather than combined seat belt and airbag loading. No change is made in the event of combined seat belt and airbag restraint. This avoids value judgements about the extent of airbag restraint on the chest and is in line with the EEVC recommendation.

CONCEPT: *There is an interrelationship between chest loading, as measured by the above dummy criteria, and intrusion. To ensure that a good balance is struck, a geometric criterion on waist level intrusion, as measured by door pillar movement at waist level, is used.*

CONCEPT: *When the passenger compartment becomes unstable, any additional load can result in unpredictable excessive further collapse of the passenger compartment. When the passenger compartment becomes unstable the repeatability of the car's response in the test becomes poor and confidence in the car's performance is reduced.*

CONCEPT: *The chest performance criteria are developed for loads applied by a seat belt. The more concentrated loading from a "stiff" steering wheel exposes the chest to direct loading injury.*

10.1.4 Abdomen

Protection of the abdomen is important, but no criteria or assessment techniques are available at present.

10.1.5 Knee, Femur & Pelvis

CONCEPT*: Transmitting loads through the knee joint from the upper part of the tibia to the femur can lead to cruciate ligament failure.*

Zero knee slider displacement is both desirable and possible. The higher performance limit allows for some possible movement due to forces transmitted axially up the tibia.

CONCEPT: *The knee impact area should have uniformly good properties over a wide area of potential impact sites. This is to account for people sitting with their knees in different positions and slight variations in impact angle. The characteristics of the area should not change markedly if knee penetration is slightly greater than that observed with the 50 percentile dummy in this test. This takes into account the protection of different sized occupants or occupants in different seating positions.*

CONCEPT*: Loading on the knee should be well distributed and avoid concentration that could result in localised damage to the knee.*

The injury tolerance work that supports the legislative femur criterion was conducted with padded impactors that spread the load over the knee.

10.1.6 Lower Leg

CONCEPT: *Loads resulting in fracture of the tibia produce bending moments and forces measurable at the upper and lower ends of the tibia. These measurements on the tibia relate to risk of tibia fracture.*

At the request of the car manufacturers, further limits were added to those proposed for lower leg protection. These limits can be expected to help protect the ankle joint.

CONCEPT: *Pedal blocking*
There should be no blocking of any foot operated pedals which have displaced rearward after the impact; blocked pedals represent a greater hazard to the lower limbs of the driver than non-blocked pedals.

10.1.7 Foot and Ankle

CONCEPT: *Expert opinion suggests that a Tibia Index of less than 0.2 would be necessary to prevent ankle joint failure. Until a biofidelic ankle and foot become available, the assessment will be based on intrusion. Intrusion is highly correlated with the risk of injury.*

CONCEPT*: Rupture of the footwell exposes the occupant to additional dangers. Objects outside the passenger compartment may enter, parts of the occupant may contact items outside the passenger compartment, there is a risk from exposed edges and the structure may become unstable. Other risks include significant volume reduction, instability due to detachment of spotwelds, bended reinforcements inside or outside the occupant compartment, structural elements plastically deformed and rupture with sharp edges.*

10.1.8 Door Opening (front, side and pole)

CONCEPT: *The intention is to ensure that the structural integrity is maintained. The underlying principle is to minimise the risks of occupant ejection occurring.*

The 'door opening' modifier will be applied if any of the following have occurred:

- the latch has fully released or shows significant partial release, either by release of its components from one another, or effective separation of one part of the latch from its

supporting structure

- the latch has moved away from the fully latched condition
- if any hinge has released either from the door or bodyshell or due to internal hinge failure
- if there is a loss of structure between the hinges and latches
- if door or hinges fail whilst the door opening tests are being conducted post impact, as loading from an occupant could have a similar effect.
- if there was any potential risk of occupant ejection and/or partial ejection/entrapment from openings such as sliding doors or moveable roofs. Dynamic opening during the impact of any apertures, such as roofs, will also be considered even if the openings have closed post test.
- if both side doors latch together with no b-pillar or other form of restraint, the modifier may apply to both the front and rear doors.

10.2 Side and Pole Impact

CONCEPT: *Incorrect airbag deployment*
All airbags that deploy during an impact should do so fully and in the designed manner so as to provide the maximum amount of protection to occupants available. It is expected that, where required, all airbags should deploy in a robust manner regardless of the impact scenario.

CONCEPT: *Seat position in side impact*
Effective side impact protection needs to consider all sizes of occupants. This concept is included in the EU Directive. Currently, side impact tests are conducted with the seat in the design position. In future, consideration may be given to the level of protection in other seating positions.

10.2.1 Door Opening (Front, Side, Pole Impact)

CONCEPT: *The intention is to ensure that the structural integrity is maintained. The underlying principle is to minimise the risks of occupant ejection occurring.*

The ‘door opening’ modifier will be applied if any of the following have occurred:

- the latch has fully released or shows significant partial release, either by release of its components from one another, or effective separation of one part of the latch from its supporting structure.
- the latch has moved away from the fully latched condition.
- if any hinge has released either from the door or bodyshell or due to internal hinge failure.
- if there is a loss of structure between the hinges and latches.

- if door or hinges fail whilst the door opening tests are being conducted post impact, as loading from an occupant could have a similar effect.
- if there was any potential risk of occupant ejection and/or partial ejection/entrapment from openings such as sliding doors or moveable roofs. Dynamic opening during the impact of any apertures, such as roofs, will also be considered even if the openings have closed post test.
- If both side doors latch together with no b-pillar or other form of restraint, the modifier may apply to both the front and rear doors.

10.3 Whiplash

10.3.1 Geometry Assessment

CONCEPT: *This is used to encourage front seats to have optimum geometry in terms of both height and backset.*

10.3.2 Worst Case Geometry

CONCEPT: *The head restraint should be ideally placed for optimal dynamic performance without occupants of different sizes taking any action other than simply adjusting the seat to suit their leg length. This implies that the head restraint should either be fixed, automatically adjust to the optimal position or should be an adjustable restraint that provides an optimum position even in its fully down (worst case) position.*

10.3.3 Seatback Dynamic Deflection

CONCEPT: *The seat distortion should be controlled so that a front occupant is not liable to ejection from behind the seat belt in a rear impact and the risk of interaction between the front and rear occupants is minimised.*

10.3.4 Dummy Artefact Loading

CONCEPT: *A two point negative modifier will be applied to any seat that, by design, places unfavourable loading on other parts of the body as a result of the head restraint mechanism. This modifier shall also penalise any design feature aimed at exploiting any dummy artefact. This is seen as a clear incentive to avoid such design, and an essential feature to safeguard Latin NCAP's position for future designs.*

11 REFERENCES

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4 Mertz, H. *Anthropomorphic test devices.* Accidental Injury - Biomechanics and Prevention, Chapter 4. Ed. Alan Nahum and John Melvin. Pub. Springer-Verlag 1993.

5 Mertz, H., J. Horsch, G. Horn and R Lowne. *Hybrid III sternal deflection associated with thoracic injury severities on occupants restrained with force-limiting shoulder belts.* SAE paper 910812. 1991.

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7 Viano, D., C. Culver, R. Haut, J. Melvin, M. Bender, R. Culver and R. Levine. *Bolster impacts to the knee and tibia of human cadavers and an anthropomorphic dummy.* SAE Paper 780896, Proc 22nd Stapp conference.

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10 Lowne, R. and E. Janssen. *Thorax injury probability estimation using production prototype EUROSID.* ISO/TC22/SC12/WG6 document N302.

12 APPENDIX I

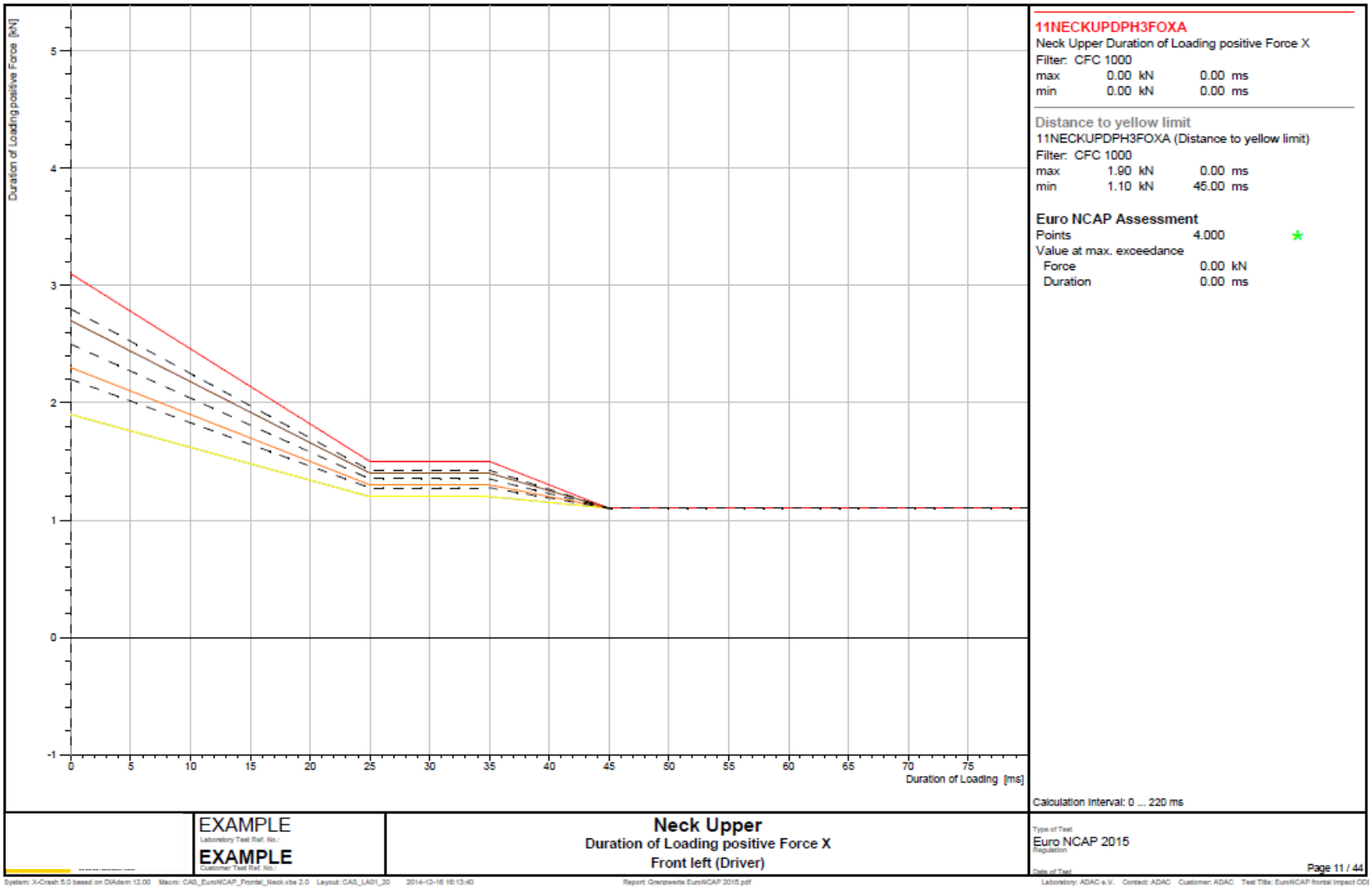
GRAPHICAL LIMITS FOR CUMULATIVE EXCEEDENCE PARAMETERS

1 Upper Neck Shear FX - Positive

2 Upper Neck Shear FX - Negative

3 Upper Neck Tension FZ

4 Femur Compression


Duration of Loading positive Force [kN]
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3
2
1
0
-1
0
5
10
15
20
25
30
35
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50
55
60
65
70
75
Duration of Loading [ms]
11NECKUPDPH3FOXA
Neck Upper Duration of Loading positive Force X
Filter: CFC 1000
max 0.00 kN 0.00 ms
min 0.00 kN 0.00 ms
Distance to yellow limit
11NECKUPDPH3FOXA (Distance to yellow limit)
Filter: CFC 1000
max 1.90 kN 0.00 ms
min 1.10 kN 45.00 ms
Euro NCAP Assessment
Points 4.000 *
Value at max. exceedance
Force 0.00 kN
Duration 0.00 ms
Calculation Interval: 0 ... 220 ms
EXAMPLE
EXAMPLE
Neck Upper
Duration of Loading positive Force X
Front left (Driver)
Euro NCAP 2015
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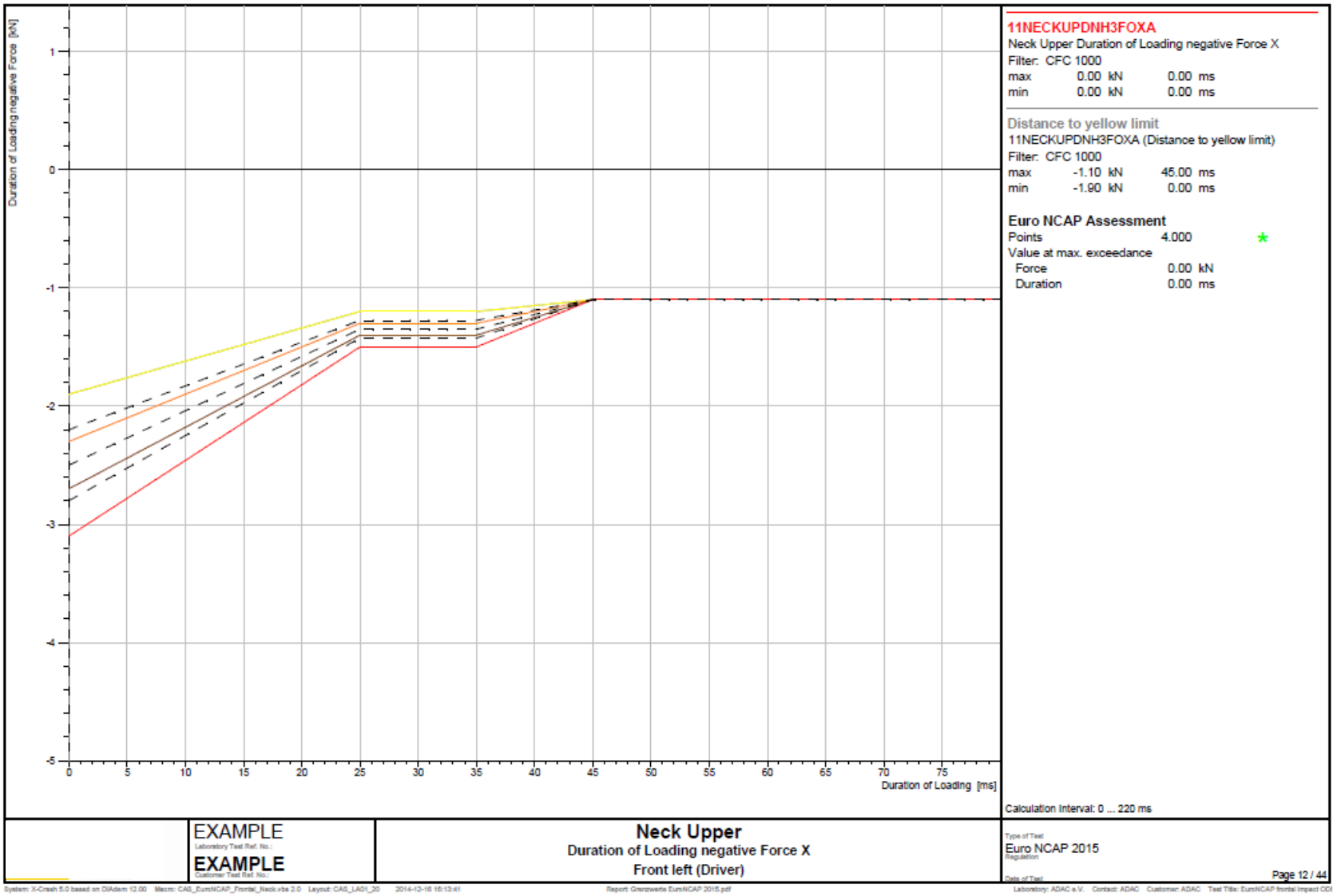
Duration of Loading negative Force [kN]
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-1
-2
-3
-4
-5
0
5
10
15
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25
30
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45
50
55
60
65
70
75
Duration of Loading [ms]
11NECKUPDNH3FOXA
Neck Upper Duration of Loading negative Force X
Filter: CFC 1000
max 0.00 kN 0.00 ms
min 0.00 kN 0.00 ms
Distance to yellow limit
11NECKUPDNH3FOXA (Distance to yellow limit)
Filter: CFC 1000
max -1.10 kN 45.00 ms
min -1.90 kN 0.00 ms
Euro NCAP Assessment
Points 4.000 *
Value at max. exceedance
Force 0.00 kN
Duration 0.00 ms
Calculation Interval: 0 ... 220 ms
EXAMPLE
EXAMPLE
Neck Upper
Duration of Loading negative Force X
Front left (Driver)
Euro NCAP 2015
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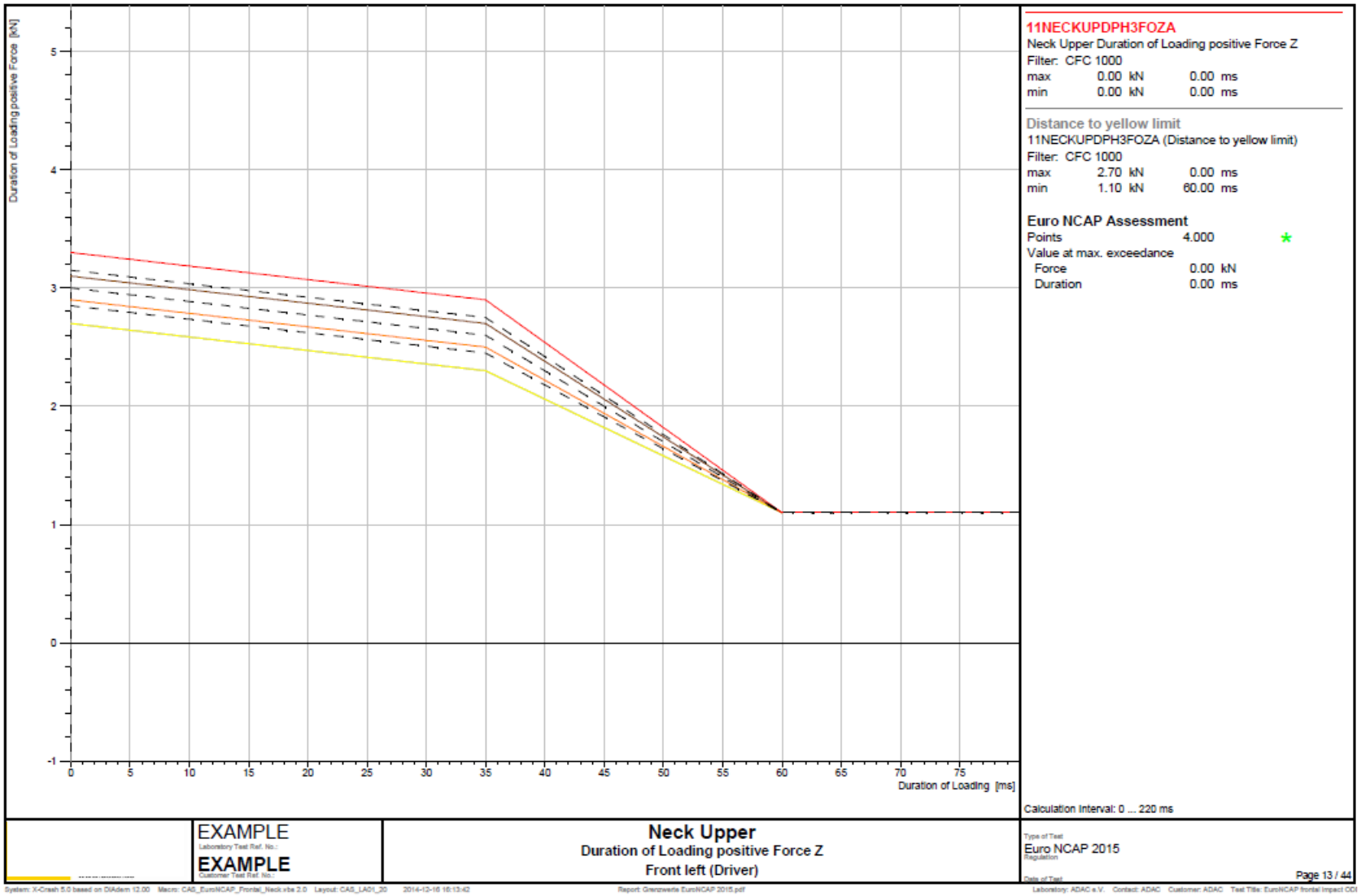
Duration of Loading positive Force [kN]
5
4
3
2
1
0
-1
0
5
10
15
20
25
30
35
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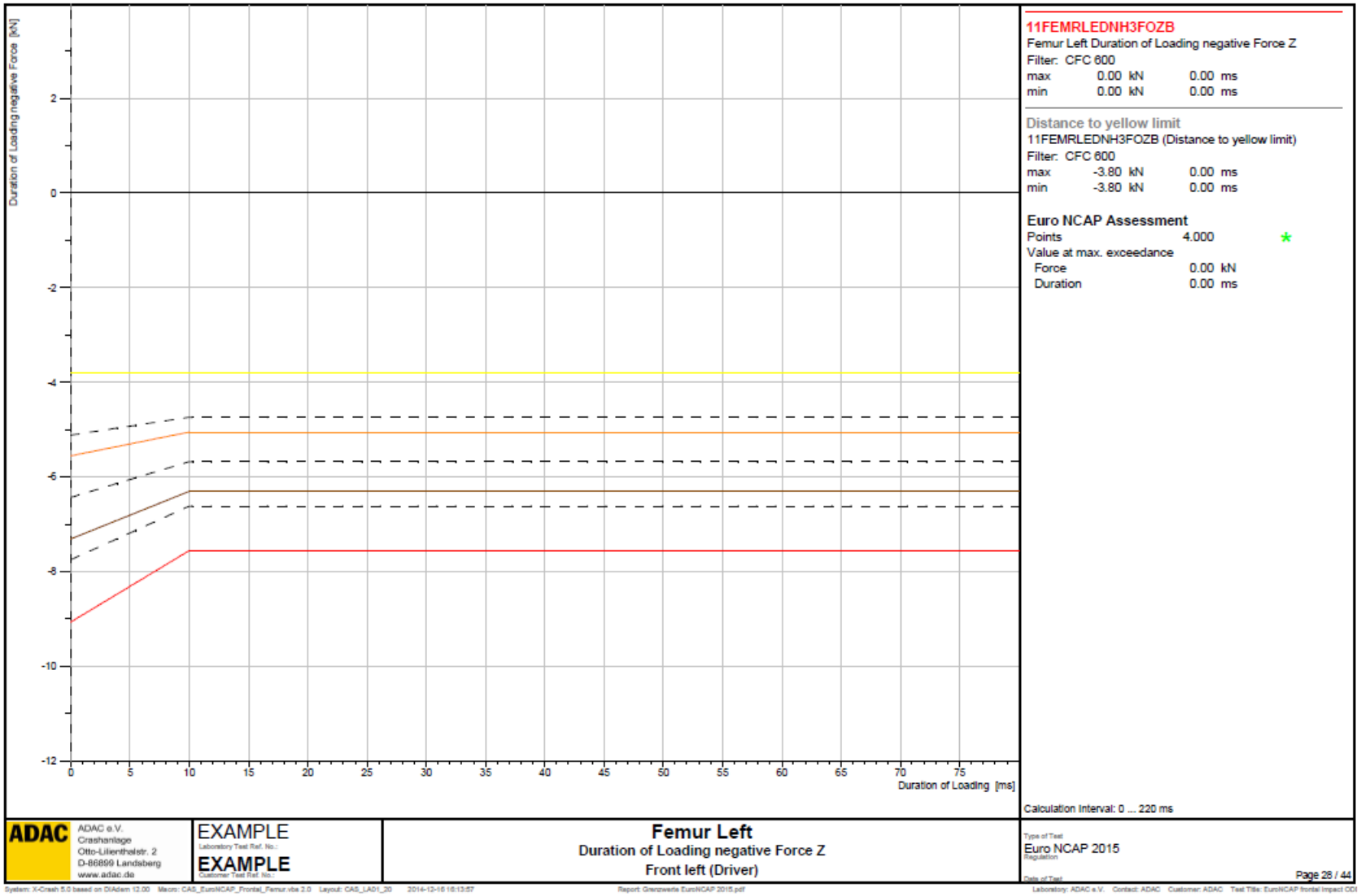
50
55
60
65
70
75
Duration of Loading [ms]
11NECKUPDPH3FOZA
Neck Upper Duration of Loading positive Force Z
Filter: CFC 1000
max 0.00 kN 0.00 ms
min 0.00 kN 0.00 ms
Distance to yellow limit
11NECKUPDPH3FOZA (Distance to yellow limit)
Filter: CFC 1000
max 2.70 kN 0.00 ms
min 1.10 kN 60.00 ms
Euro NCAP Assessment
Points 4.000 *
Value at max. exceedance
Force 0.00 kN
Duration 0.00 ms
Calculation Interval: 0 ... 220 ms
EXAMPLE
EXAMPLE
Neck Upper
Duration of Loading positive Force Z
Front left (Driver)
Euro NCAP 2015
Page 13 / 44


Duration of Loading negative Force [kN]
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-4
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-10
-12
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5
10
15
20
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30
35
40
45
50
55
60
65
70
75
Duration of Loading [ms]
11FEMRLEDNH3FOZB
Femur Left Duration of Loading negative Force Z
Filter: CFC 600
max 0.00 kN 0.00 ms
min 0.00 kN 0.00 ms
Distance to yellow limit
11FEMRLEDNH3FOZB (Distance to yellow limit)
Filter: CFC 600
max -3.80 kN 0.00 ms
min -3.80 kN 0.00 ms
Euro NCAP Assessment
Points 4.000 *
Value at max. exceedance
Force 0.00 kN
Duration 0.00 ms
Calculation Interval: 0 ... 220 ms
ADAC
ADAC e.V.
Crashanlage
Otto-Lilienthalstr. 2
D-86899 Landsberg
www.adac.de
EXAMPLE
EXAMPLE
Femur Left
Duration of Loading negative Force Z
Front left (Driver)
Euro NCAP 2015
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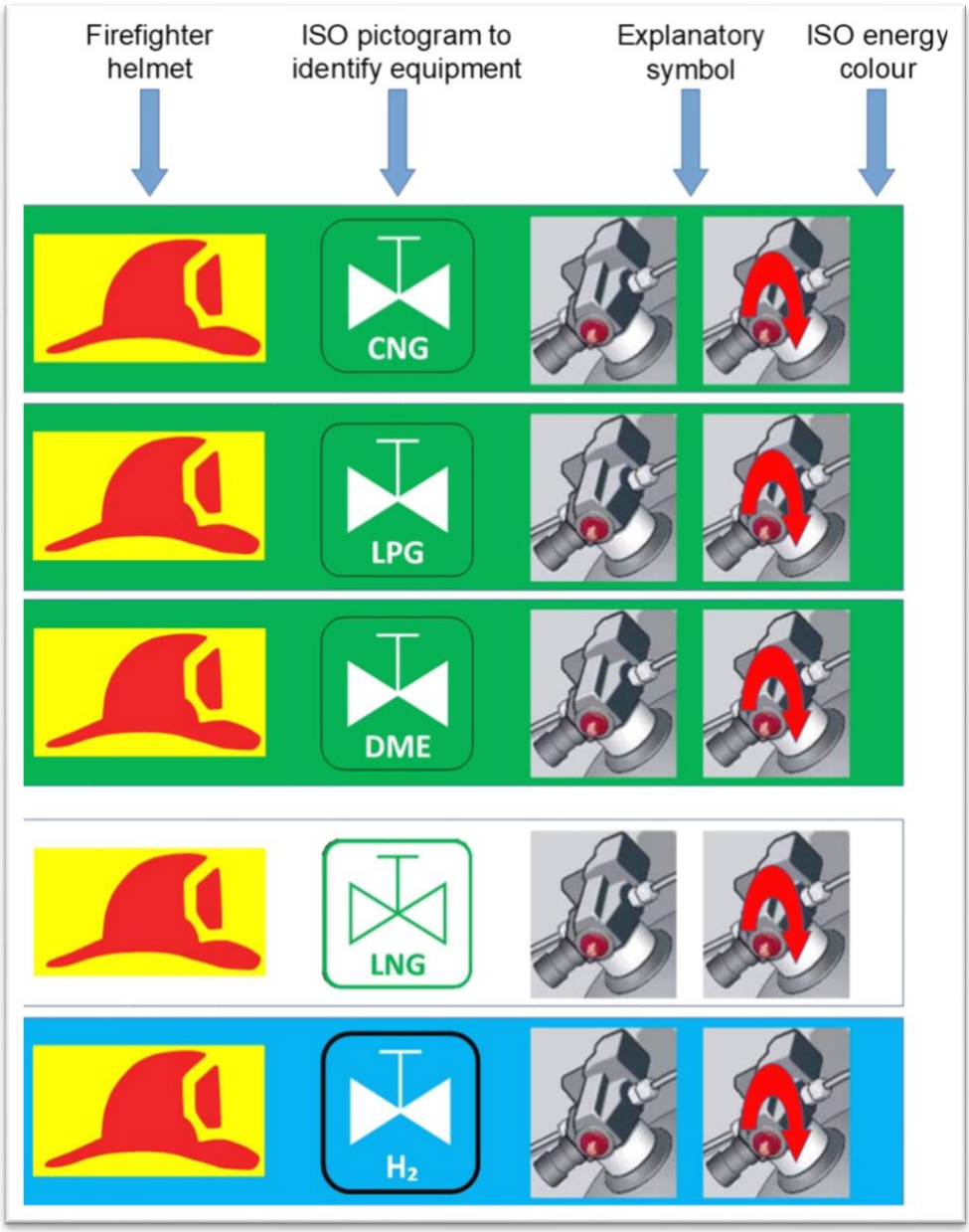
13 APPENDIX II

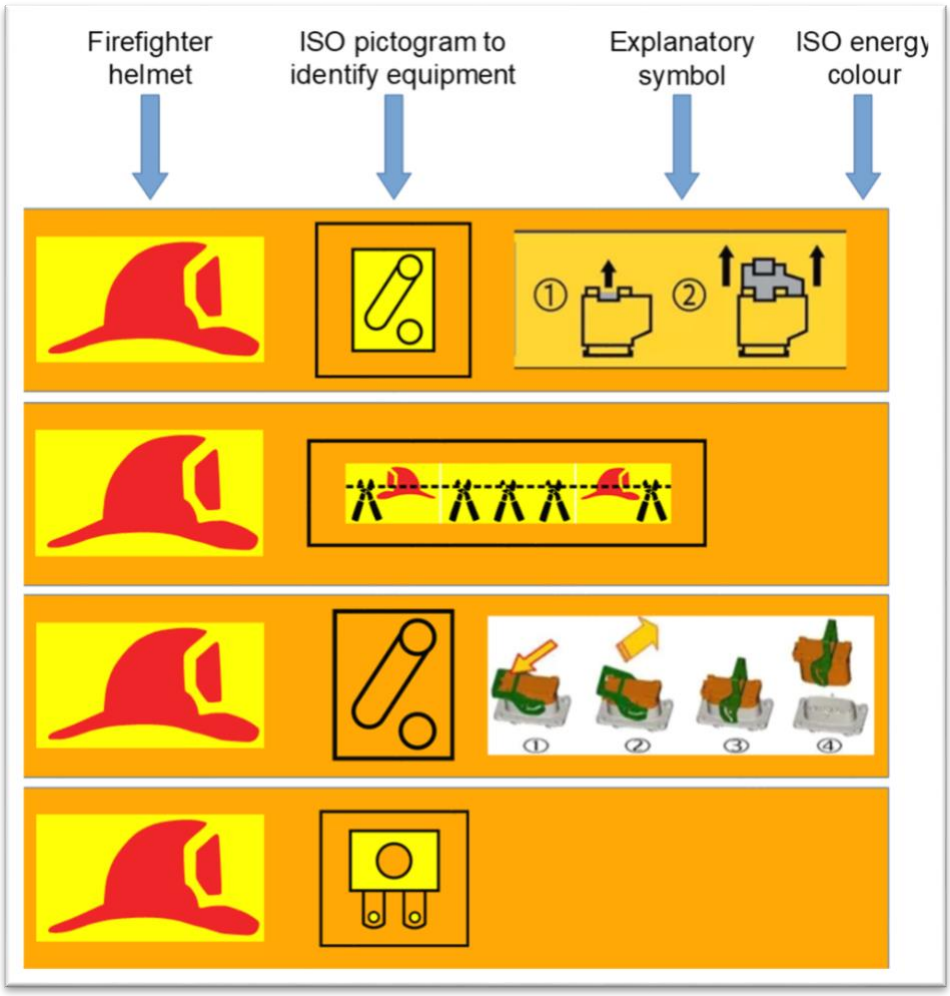
Gaseous fuel vehicles:

The fire helmet may be replaced with another fire helmet appropriate to cultural requirements.



Battery electric and hybrid vehicles:

The fire helmet may be replaced with another fire helmet appropriate to cultural requirements.



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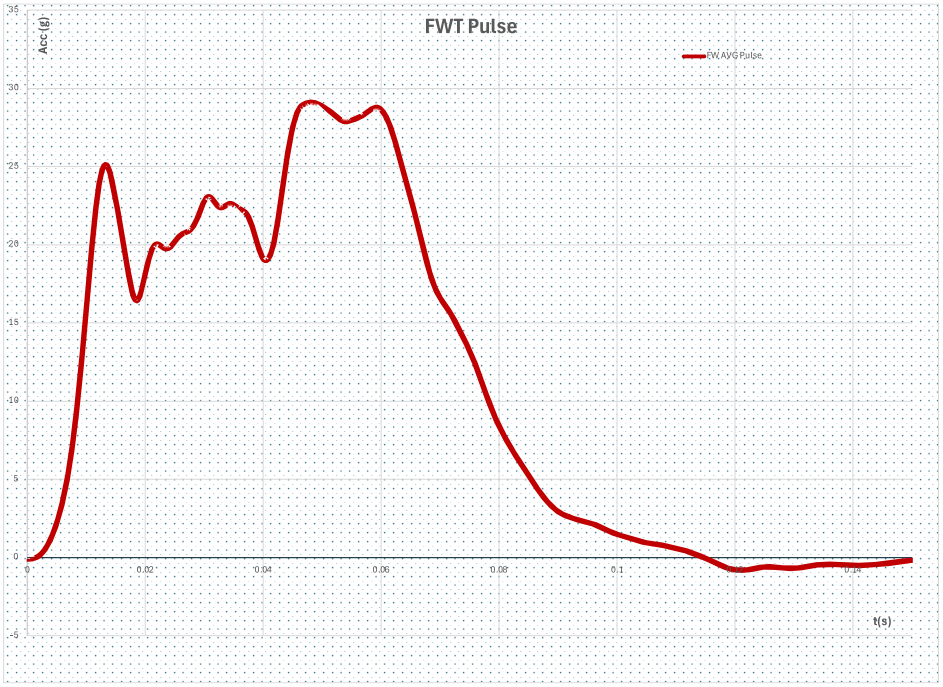

Figure 1 - FWT average pulse

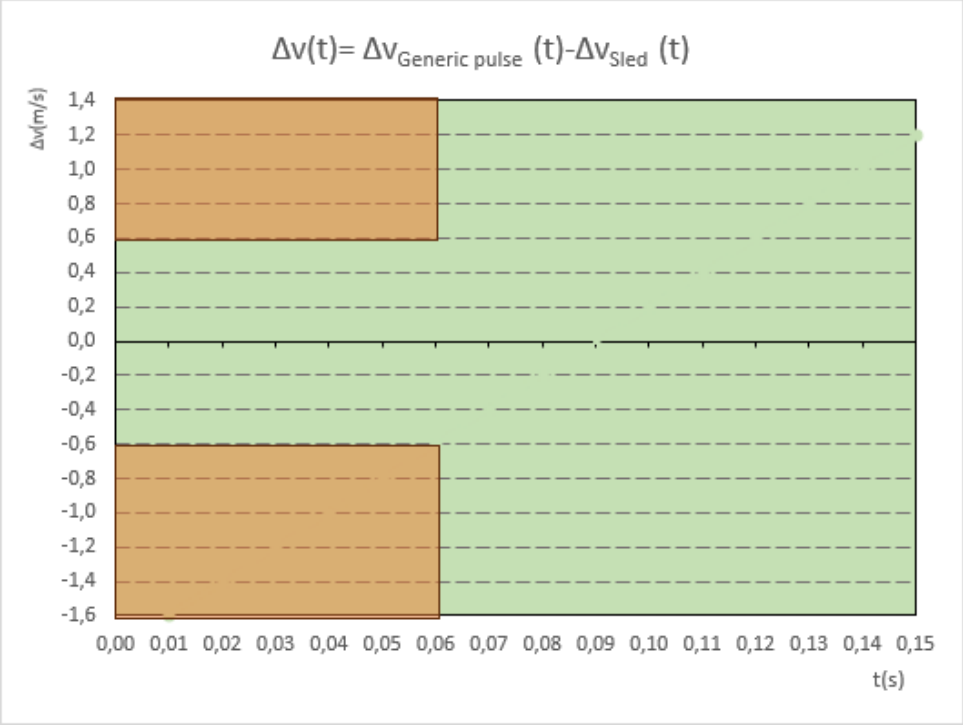

Figure 2 - Delta V acceptance requirement