



*YOUR DEVELOPMENT PARTNER*

Regulation ECE 94.02

Regulation ECE 95.03

Homologation  
Passenger Cars, LCV and Components

Marta Anglès

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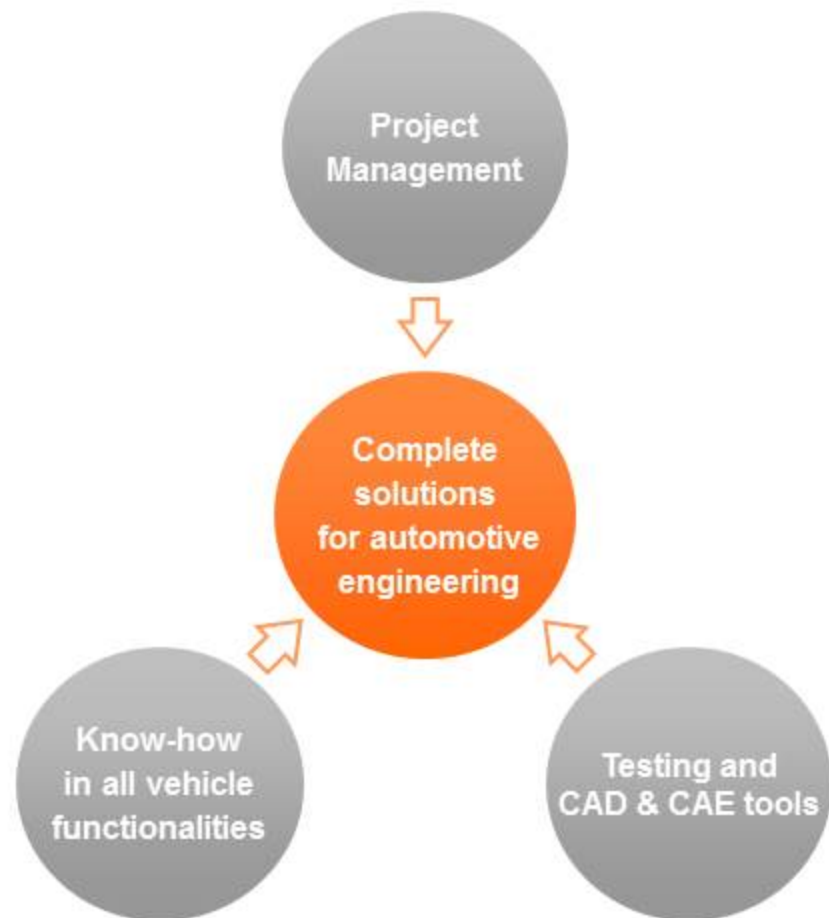
**Applus IDIADA** is an engineering partner to the automotive industry providing complete solutions for product development projects and Homologation services worldwide.

## Our assets:

- ⊕ Team of more than 1.800 professionals
- ⊕ First class state-of-the-art testing facilities
- ⊕ International presence in 23 countries with 46 local offices
- ⊕ Innovation in new services and technologies

## Our services:

- ⊕ Engineering
- ⊕ Homologation
- ⊕ Proving ground testing
- ⊕ Testing facility design



## Main Purpose of Homologation Department

To solve the homologation needs of our clients, wherever they need to export their vehicles/components, with the aim **of becoming their worldwide Homologation Partner**

- ⊕ International team of over 215 homologation experts
- ⊕ Designations as a Technical Service
- ⊕ International network of offices
- ⊕ Outstanding testing facilities in Spain
- ⊕ Network of international homologation partners
- ⊕ Participation in international rule-makers' working groups (EC/ECE)
- ⊕ Efficient multicultural – multilingual homologation teams working to satisfy the global homologation needs of our clients

⊕ Expertise background. Participation in Geneva Working groups (WP29) as technical consultants of MINETUR



• GRPE (Emissions). IDIADA's expert: R. Santafè



• GRRF (Braking & Running) IDIADA's expert: I. Lafuente



• GRSP (Passive Safety). IDIADA's expert: M. Anglès



• GRSG (General Safety ). IDIADA's expert J. Borrós



• GRE (Lighting System). IDIADA's expert: J. Fonts

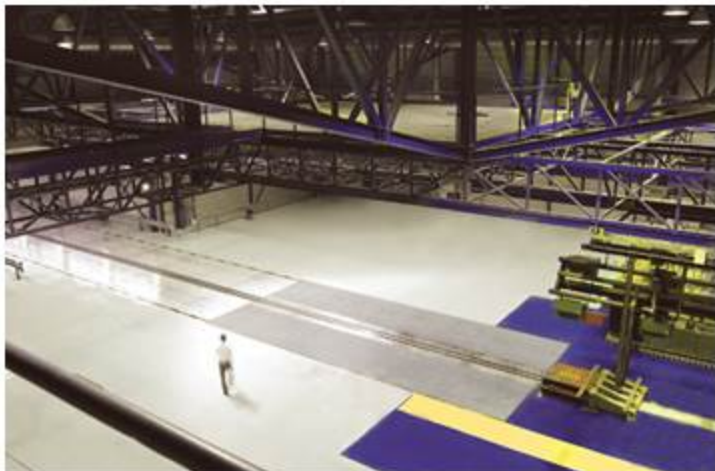


• GRB (Noise). IDIADA's expert: R. Andon

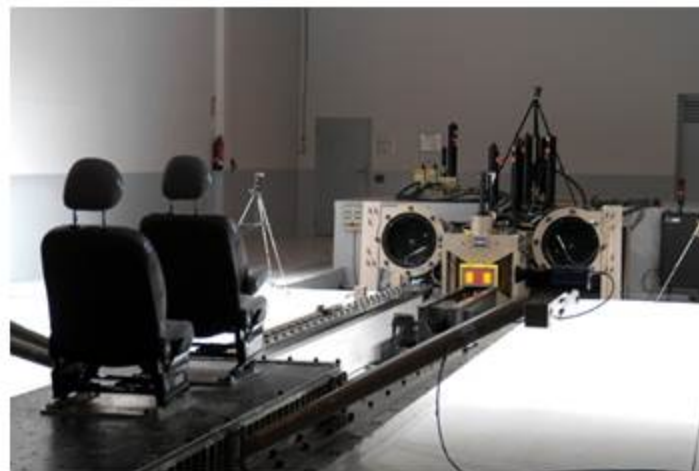
⊕ TAAM's Meetings L. Sans



## Passive Safety Laboratories



Crash test laboratory



Sled test laboratory



Pedestrian protection test lab.

State-of-the-art testing facilities accredited by Euro NCAP.

Capacity to perform:

- ⊕ 600 Full-scale crash tests per year
- ⊕ 800 Sled tests per year
- ⊕ 1.500 Ped. Pro tests per year

## Crash Test Laboratory

Range of test capabilities:

⊕ Frontal Impact tests

⊕ Side Impact tests

⊕ Rear Impact tests







## ⊕ Regulation ECE 94.02

Uniform provisions concerning the approval of vehicles with regard to the protection of the occupants in the event of a frontal collision.



## ⊕ Regulation ECE 95.03

Uniform provisions concerning the approval of vehicles with regard to the protection of the occupants in the event of a lateral collision.



# REGULATION ECE 94.02 FRONTAL IMPACT

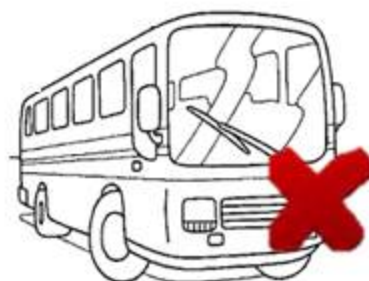
A frontal collision is the most common type of crash resulting in fatalities.

The aim of Regulation 94 is to protect the driver and the passenger during a frontal collision.

Focus on optimization of vehicles' structural interaction to improve self-protection and partner protection.

## ⊕ SCOPE

This Regulation applies to vehicles of category M1 of a total permissible mass not exceeding 2.5 tonnes; other vehicles may be approved at the manufacturer's request.

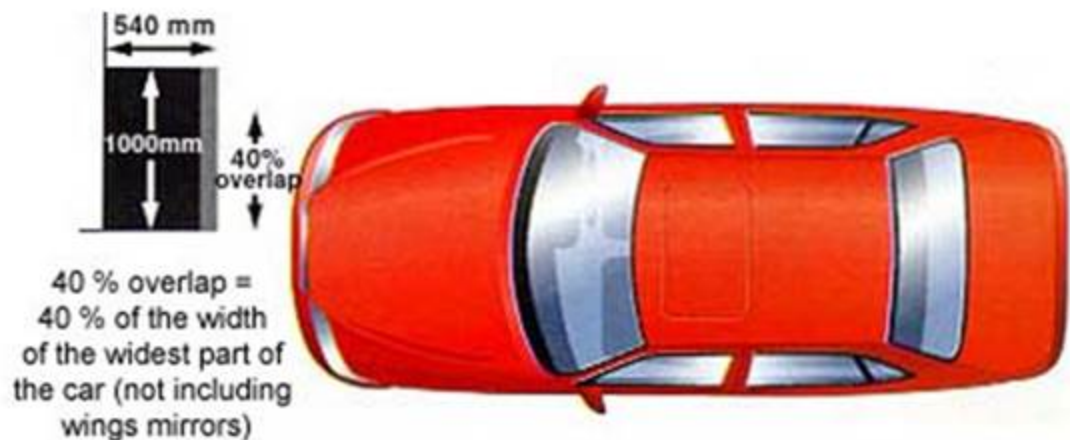


## ⊕ TEST

The car is propelled into an offset, deformable barrier at 56 km/h. The car overlaps the barrier face by 40 per cent, with first contact with the barrier on the steering-column side.

This is intended to represent a car-to-car collision with both cars travelling at 50 km/h with a 50 per cent overlap. The deformable barrier absorbs some of the energy of the impacting car and this is the reason the speed is higher in the test than in the equivalent car-to-car collision. Similarly, cars are less stiff than the barrier towards the outer edge, so the offset is reduced for the test.

Speed: 56 -0/+1 km/h



## Dummies

Hybrid III 50<sup>th</sup> percentile

Head

Head Performance Criterion (HPC).

Resultant head acceleration.

Neck

**Neck Injury Criteria.** Compressive axial force, axial tensile force and fore/aft shear forces at the head/neck interface.

Neck bending moment.

Chest

**Thorax compression criterion** is determined by the absolute value of the thorax deformation.

**The viscous criterion** ( $V * C$ ) is calculated as the instantaneous product of the compression and the rate of deflection of the sternum.

Femur

**Femur Force Criterion** (FFC) is determined by the compression load.

Knee

Knee joints sliding movement.

Tibia

**Tibia Compressive Force Criterion** (TCFC).  
**Tibia Index** (TI).

## ⊕ ACCEPTANCE CRITERIA

### Dummy acceptance criteria

Head performance criterion	HPC < 1000	
Resultant head acceleration	< 80 g in 3 ms	
Neck injury criteria	Neck tension criterion (NTC)	Figure 1
	Neck shear criterion (NSC)	Figure 2
Neck bending moment	< 57 Nm	
Thorax compression criterion (ThCC)	< 50 mm ( <b>42 mm</b> )	
Viscous criterion (V * C)	< 1,0 m/s	
Femur force criterion (FFC)	FFC	Figure 3
Tibia compression force criterion (TCFC)	< 8 kN	
Tibia index (TI)	< 1,3	
Knee joints sliding movement	< 15 mm	

Figure 1  
Neck tension criterion

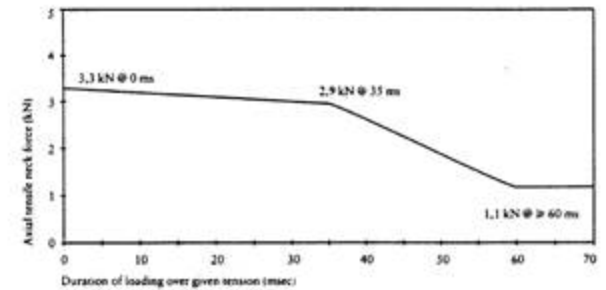


Figure 2  
Neck shear criterion

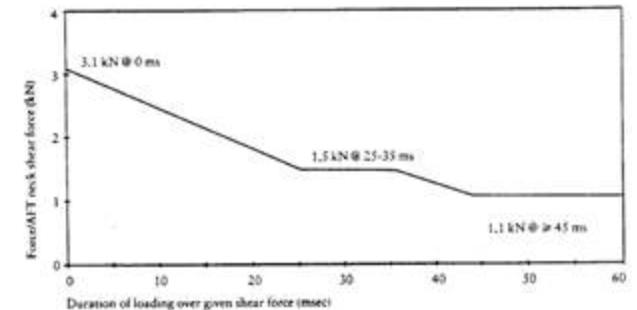
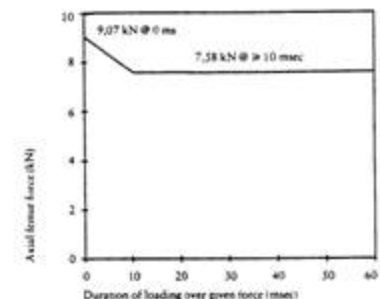


Figure 3  
Femur force criterion





## Vehicle acceptance criteria

### During the test

- ⊕ No door shall open
- ⊕ No locking of the locking system of the front doors shall occur

### After the test

- ⊕ At least one door per row shall open without the use of tools
- ⊕ Release the dummy from the restraint system without the use of tools
- ⊕ Remove the dummy from the vehicle without the use of tools
- ⊕ The rate of leakage from the fuel tank shall not exceed 30 g/min
- ⊕ Residual steering wheel displacement, measured at the centre of the steering wheel hub, shall not exceed 80 mm in the upwards vertical direction and 100 mm in the rearward horizontal direction

## Acceptance criteria for electric vehicles

- ⊕ For the electrical powertrain on high voltage at least one of the following criteria shall be met:
  - ⊕ Absence of high voltage  $V_b, V_1$  and  $V_2 \leq 30 \text{ VAC}$  or  $V_b, V_1$  and  $V_2 \leq 60 \text{ VDC}$
  - ⊕ Low electrical energy TE (total energy) < 20 joules
  - ⊕ Physical protection
    - IPXXB degree shall be provided. (Direct contact)
    - Resistance between exposed conductive parts and the electrical chassis shall be < 0.1 Ohm (indirect contact)
  - ⊕ Isolation resistance
    - Separate DC buses  $R_i \geq 100 \Omega/V$
    - Separate AC buses  $R_i \geq 500 \Omega/V$
    - Combined DC or AC buses  $R_i \geq 500 \Omega/V$
  
- ⊕ Electrolyte Spillage < 7% (with a maximum of 5.0 litres) shall spill outside the passenger compartment
  
- ⊕ RESS Retention
  - RESS inside the passenger compartment shall remain in the initial location
  - RESS outside the passenger compartment cannot enter the passenger compartment

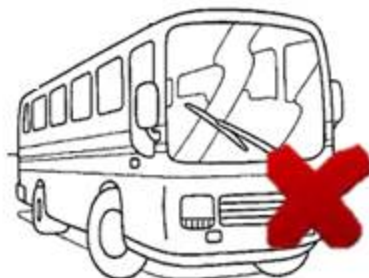
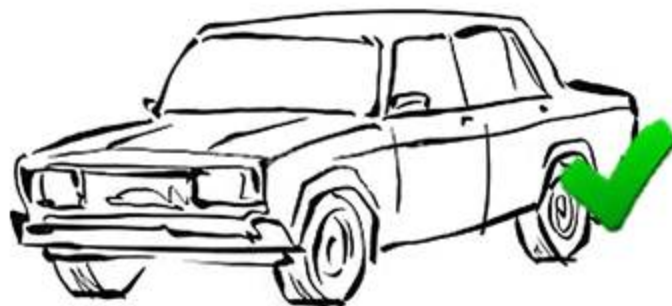
# REGULATION ECE 95.03 LATERAL IMPACT

Simulates an intersection crash situation, where one car crashes into the driver's side of another.

The aim of Regulation 95 is to protect the driver when the side collision occurs.

## ⊕ SCOPE

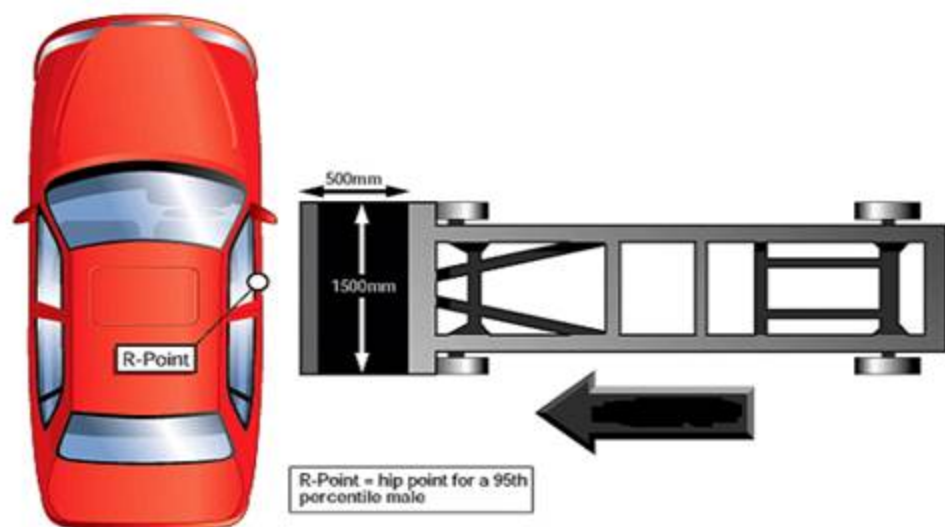
This Regulation applies to the lateral collision behaviour of the structure of the passenger compartment of M1 and N1 categories of vehicles where the "R" point of the lowest seat is not more than 700 mm from ground level when the vehicle is in unladen mass, increased by a mass of 100 kg.



## ⊕ TEST

The test will be carried out on the driver's side unless asymmetric side structures, if any, are so different as to affect the performance in a side impact.

Speed: 50 +/-1 km/h



## Dummies

### ES-2 50th percentile



#### Head

**Head Performance Criterion (HPC).**

#### Chest

**Chest deflection.** Maximum value of deflection on any rib as determined by the thorax displacement transducers.

**Viscous criterion.**

#### Abdomen

**Abdomen protection criterion** is the peak abdominal force.

#### Pelvis

**Pelvis performance criterion** is the pubic symphysis peak force (PSPF), which is the maximum force measured by a load cell at the pubic symphysis of the pelvis.

## ⊕ ACCEPTANCE CRITERIA

### Dummy acceptance criteria

Head performance criteria	HIC <1000
Thorax performance criteria	Rib Deflection Criteria <42 mm V*C (Soft tissue criteria) <1,0 m/s (monitoring purposes)
Pelvis performance criteria	Pubic Simphysys Peak Force <6 kN
Abdomen performance criteria	Abdominal Peak Force <2,5 kN



## Vehicle acceptance criteria

### During the test

- ⊕ No door shall open
- ⊕ No locking of the locking system of the front doors shall occur

### After the test

- ⊕ At least one door per row shall open without the use of tools
- ⊕ Release the dummy from the restraint system without the use of tools
- ⊕ Remove the dummy from the vehicle without the use of tools
- ⊕ The rate of leakage from the fuel tank shall not exceed 30 g/min

## Acceptance criteria for electric vehicles

- ⊕ For the electrical powertrain on high voltage at least one of the following criteria shall be met:
  - ⊕ Absence of high voltage  $V_b, V_1$  and  $V_2 \leq 30 \text{ VAC}$  or  $V_b, V_1$  and  $V_2 \leq 60 \text{ VDC}$
  - ⊕ Low electrical energy TE (total energy)  $< 20$  joules
  - ⊕ Physical protection
    - IPXXB degree shall be provided. (Direct contact)
    - Resistance between exposed conductive parts and the electrical chassis shall be  $< 0.1 \text{ Ohm}$ . (indirect contact)
  - ⊕ Isolation resistance
    - Separate DC buses  $R_i \geq 100 \Omega/V$
    - Separate AC buses  $R_i \geq 500 \Omega/V$
    - Combined DC or AC buses  $R_i \geq 500 \Omega/V$
  
- ⊕ Electrolyte Spillage  $< 7\%$  (with a maximum of 5.0 litres) shall spill outside the passenger compartment
  
- ⊕ RESS Retention
  - RESS inside the passenger compartment shall remain in the initial location
  - RESS outside the passenger compartment cannot enter the passenger compartment

# **NEW REGULATION ON FRONTAL IMPACT**

**(PROPOSAL ONLY)**

**Differences between the Regulation ECE 94.02**

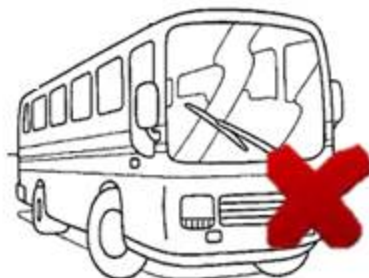
The full frontal crash test is more suitable for evaluating restraint systems such as seat belts and airbags.

Focus on optimization of the restraint system to improve self-protection and partner protection.

Reduce fatal and serious injuries on the chest for elderly and female occupants in the front passenger seat.

## ⊕ SCOPE

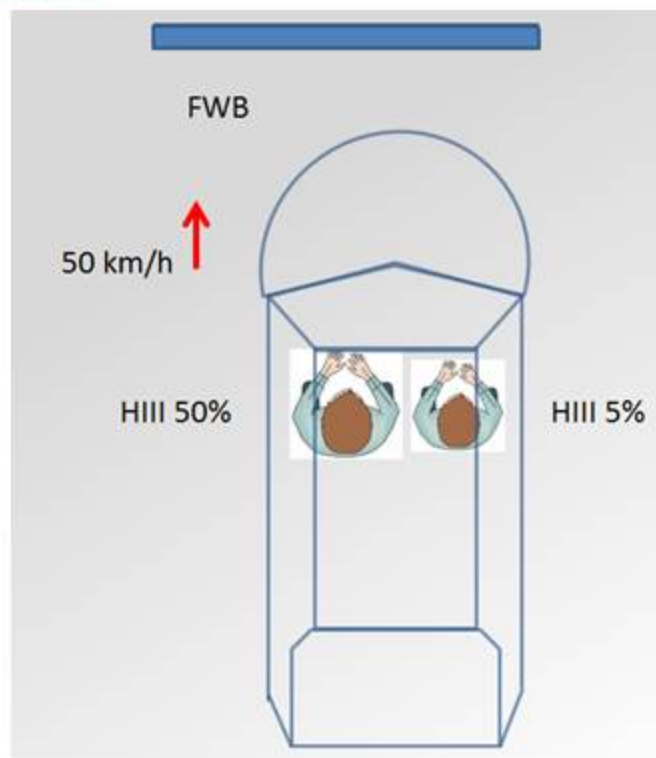
This Regulation applies to vehicles of category M1 with a maximum permissible mass below **3.5 tonnes**; other vehicles may be approved at the manufacturer's request.



## ⊕ TEST

The aim of this new regulation is to change the deformable barrier element and revise the testing procedure.

Test speed: **50 -0/+1 km/h**



## ⊕ TEST

### Installation and preparation of the vehicle

- Barrier**
- Block of reinforced concrete not less than 3 m wide in front and not less than 1.5 m high.
  - Vertical and perpendicular to the axis of the run-up track.
  - It shall be covered with plywood boards 20 ±2 mm thick.



Specifications for the restraint system test (Full Width Rigid Barrier test)

Hybrid III 50th percentile driver's seat

Hybrid III 5th percentile passenger's seat

## Head

**Head Performance Criterion (HPC).**

## Neck

**Neck Injury Criteria** axial tensile force and the fore/aft shear forces at the head/neck interface

**Neck bending moment**

## Chest

**Thorax compression criterion** is determined by the absolute value of the thorax deformation.

**The viscous criterion** ( $V * C$ ) is calculated as the instantaneous product of the compression and the rate of deflection of the sternum.

## Femur

**Femur Force Criterion (FFC)** is determined by the compression load.

**Knee**

**Tibia**





## Dummy acceptance criteria

Hybrid III 50th percentile		
Head performance Criterion	HPC < 1000	
Resultant head acceleration	< 80 g in 3 ms	
Neck injury criteria	Axial tensile neck force	< 3,3 kN
	fore/aft shear forces at the head/neck interface	< 3,1 kN
Neck bending moment	< 57 Nm	
Thorax compression criterion (ThCC)	< 42 mm	
Viscous criterion (V * C)	< 1,0 m/s	
Femur force criterion (FFC)	FFC	< 9,07 kN
Tibia compression force criterion (TCFC)	< 8 kN	
Tibia index (TI)	< 1,3	
Knee joints sliding movement	< 15 mm	

Hybrid III 5th percentile		
Head performance Criterion	HPC < 1000	
Resultant head acceleration	< 80 g in 3 ms	
Neck injury criteria	Axial tensile neck force	< 2,9 kN
	fore/aft shear forces at the head/neck interface	< 2,7 kN
Neck bending moment	< 57 Nm	
Thorax compression criterion (ThCC)	< 42 mm	
Viscous criterion (V * C)	< 1,0 m/s	
Femur force criterion (FFC)	FFC	< 7 kN
Tibia compression force criterion (TCFC)	< 8 kN	
Tibia index (TI)	< 1,3	
Knee joints sliding movement	< 15 mm	

# NEW REGULATION ON POLE SIDE IMPACT REGULATION 135

Differences between the Regulation ECE 95.03

Simulates a vehicle crashing into a fixed object with contact in the line of the head of the seated driver.

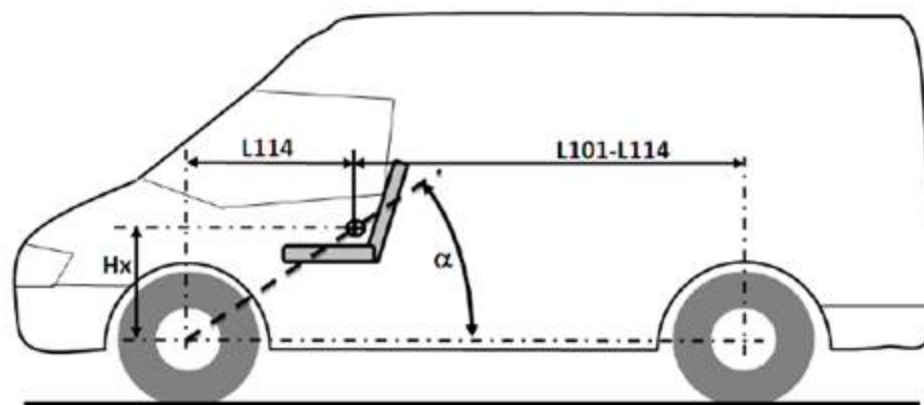
The pole causes major penetration into the side of the car.

## ⊕ SCOPE

This Regulation applies to:

(a) Category M1 vehicles; and

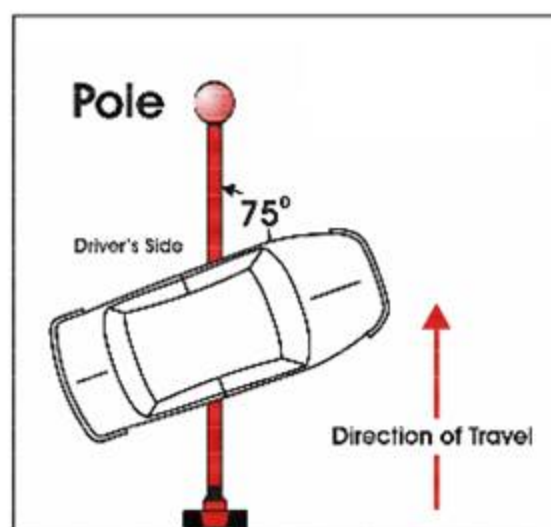
(b) Category N1 vehicles where the angle alpha ( $\alpha$ ), measured rearwards from the centre of the front axle to the R-point of the driver's seat is less than 22.0 degrees; or the ratio between the distance from the driver's R-point to the centre of the rear axle (L101-L114) and the centre of the front axle and the driver's R-point (L114) is less than 1.30.



## ⊕ TEST

The aim of this regulation is to simulate fatalities occurring in pole side impacts; those impacts with narrow objects such as telegraph poles, signposts and trees.

Test speed: 26 -0/+7 km/h



## ⊕ TEST

### Installation and preparation of the vehicle

- Barrier**
- Fixed rigid vertically oriented metal structure with a diameter of  $254 \text{ mm} \pm 6 \text{ mm}$
  - Beginning no more than 102 mm above the lowest point of the tyres
  - Extending at least above the highest point of the roof of the test vehicle



## Dummies

### 50th percentile WorldSID



#### Head

**Head Performance Criterion (HPC).**

#### Shoulder

**Shoulder performance criteria.** The peak lateral (y-axis) shoulder force.

#### Chest

**Thorax performance criteria.** Is the maximum deflection of any (upper, middle or lower) thorax rib.

#### Abdomen

**Abdominal performance criteria.** Is the maximum deflection of any (upper or lower) abdominal rib.

#### Pelvis

**Pelvis performance criteria.** The peak pubic symphysis force.

## Dummy acceptance criteria

Head performance criteria	HIC < 1000	
Shoulder performance criteria	Peak lateral shoulder force	< 3.0 kN
Thorax performance criteria	Rib deflection criteria	< 55 mm
Abdominal performance criteria	Maximum abdominal rib deflection	< 65 mm
	Resultant lower spine acceleration	< 75 g in 3 ms
Pelvis performance criteria	Peak pubic symphysis force	< 3.36 kN



- ⊕ Vehicles are safer than ever in the event of an accident due to the new Passive Safety Regulations.
- ⊕ Passive Safety focusses on protecting the vehicle occupants and also pedestrians.
- ⊕ Passive Safety Regulations are under continuous revision to add new test scenarios to better represent real life accidents.
- ⊕ World class Passive Safety testing and simulation capabilities, such as the ones of IDIADA, play an important role in supporting the automotive industry in meeting increasingly demanding Passive Safety targets.
- ⊕ IDIADA's role as a Worldwide Homologation Partner of the automotive industry, and, in particular, IDIADA's active participation in WP29 working groups allow IDIADA to be fully informed about improvements in the ECE Regulations.

Thank you very much for your kind attention

# Applus<sup>+</sup> IDIADA

**YOUR DEVELOPMENT PARTNER**

#### Applus IDIADA Belgium

T +32 2 719 02 45 (Brussels)  
e-mail: [idiada\\_belgium@idiada.com](mailto:idiada_belgium@idiada.com)

#### Applus IDIADA Brazil

T +55 41 3373 0411 (Curitiba)  
T +55 11 4330 9880 (São Paulo)  
T +55 15 3205 2952 (Tatuí)  
e-mail: [idiada\\_brasil@idiada.com](mailto:idiada_brasil@idiada.com)

#### Applus IDIADA China

T +86 10 8446 3317 (Beijing)  
T +86 431 8190 9680 (Changchun)  
T +86 23 6756 8060 (Chongqing)  
T +86 20 2282 9202 (Guangzhou)  
T +86 (21) 6210 0894 (Shanghai)  
T +86 (772) 3166 619 (Liuzhou)  
T +86 (755) 29184532 (Shenzhen)  
e-mail: [idiada\\_china@idiada.com](mailto:idiada_china@idiada.com)

#### Applus IDIADA Czech Republic

T +420 493 654 811 (Hradec Králové)  
T +420 482 424 243 (Liberec)  
T +420 326 736 860 (Mladá Boleslav)  
e-mail: [info@idiada.cz](mailto:info@idiada.cz)

#### Applus IDIADA France

T +33 (0) 141 146 085 (Sèvres)  
e-mail: [idiada\\_france@idiada.com](mailto:idiada_france@idiada.com)

#### Applus IDIADA Germany

T +49 (0) 841 88538-0 (Ingolstadt)  
T +49 (0) 89 309056-0 (Munich)  
T +49 (0) 5371 875100-0 (Wolfsburg)  
e-mail: [idiada\\_germany@idiada.com](mailto:idiada_germany@idiada.com)

#### Applus IDIADA India

T +91 986 0098 659 (Bangalore)  
T +91 994 0679 933 (Chennai)  
T +91 124 4028 888 (New Delhi)  
T +91 203 0556 900 (Pune)  
e-mail: [idiada\\_india@idiada.com](mailto:idiada_india@idiada.com)

#### Applus IDIADA Indonesia

T +6221 2939 1143 (Jakarta)  
e-mail: [idiada\\_indonesia@idiada.com](mailto:idiada_indonesia@idiada.com)

#### Applus IDIADA Italy

T +39 011 016 0205 (Leini / Maranello)  
e-mail: [idiada\\_italia@idiada.com](mailto:idiada_italia@idiada.com)

#### Applus IDIADA Japan

T +81 (0) 42 512 8982 (Tokyo)  
e-mail: [idiada\\_japan@idiada.com](mailto:idiada_japan@idiada.com)

#### Applus IDIADA Madrid

T +34 915 095 795 (Madrid)  
e-mail: [idiada\\_madrid@idiada.com](mailto:idiada_madrid@idiada.com)

For further information:

#### Applus IDIADA

Main Technical Centre  
L'Albornar – PO Box 20  
E-43710 Santa Oliva (Tarragona) Spain  
T +34 977 166 000  
F +34 977 166 007  
e-mail: [idiada@idiada.com](mailto:idiada@idiada.com)

[www.idiada.com](http://www.idiada.com)

#### Applus IDIADA Malaysia

T +603 9207 7018 (Kuala Lumpur)  
e-mail: [idiada\\_malaysia@idiada.com](mailto:idiada_malaysia@idiada.com)

#### Applus IDIADA Mexico

T +52 (1) 222 170 6722 (Puebla)  
e-mail: [idiada\\_mexico@idiada.com](mailto:idiada_mexico@idiada.com)

#### Applus IDIADA Poland

T +48 61 6226 905 (Poznan)  
e-mail: [idiada\\_polska@idiada.com](mailto:idiada_polska@idiada.com)

#### Applus IDIADA Russia

T +7 (831) 297 94 32 (Nizhny Novgorod)  
T +7 (831) 261 37 06 (Togliatti)  
e-mail: [idiada\\_russia@idiada.com](mailto:idiada_russia@idiada.com)

#### Applus IDIADA Saudi Arabia

T +966 53 4147 301 (Riyadh)  
e-mail: [idiada\\_GCC@idiada.com](mailto:idiada_GCC@idiada.com)

#### Applus IDIADA South Africa

T +27 83 450 8925 (Pretoria)  
e-mail: [idiada\\_southafrica@idiada.com](mailto:idiada_southafrica@idiada.com)

#### Applus IDIADA South Korea

T +82 31 478 1821 (Seoul)  
e-mail: [idiada@idiada.co.kr](mailto:idiada@idiada.co.kr)

#### Applus IDIADA Taiwan

T +886 47 810 702 (Lu-Kang)  
e-mail: [idiada\\_taiwan@idiada.com](mailto:idiada_taiwan@idiada.com)

#### Applus IDIADA Thailand

T +66 86 7917 071 (Bangkok)  
e-mail: [idiada\\_thailand@idiada.com](mailto:idiada_thailand@idiada.com)

#### Applus IDIADA Turkey

T +90 216 250 6050 (Istanbul)  
e-mail: [idiada\\_turkey@idiada.com](mailto:idiada_turkey@idiada.com)

#### Applus IDIADA UK

T +44 2476 328 083 (Nuneaton)  
e-mail: [idiada\\_uk@idiada.com](mailto:idiada_uk@idiada.com)

#### Applus IDIADA USA

T +1 248 978 0111 (Detroit)  
e-mail: [idiada\\_USA@idiada.com](mailto:idiada_USA@idiada.com)

#### CTAG IDIADA

T +34 986 900 300 (Pontevedra)  
e-mail: [ctag\\_idiada@idiada.com](mailto:ctag_idiada@idiada.com)