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World Forum for Harmonization of Vehicle
Regulations

Passive safety

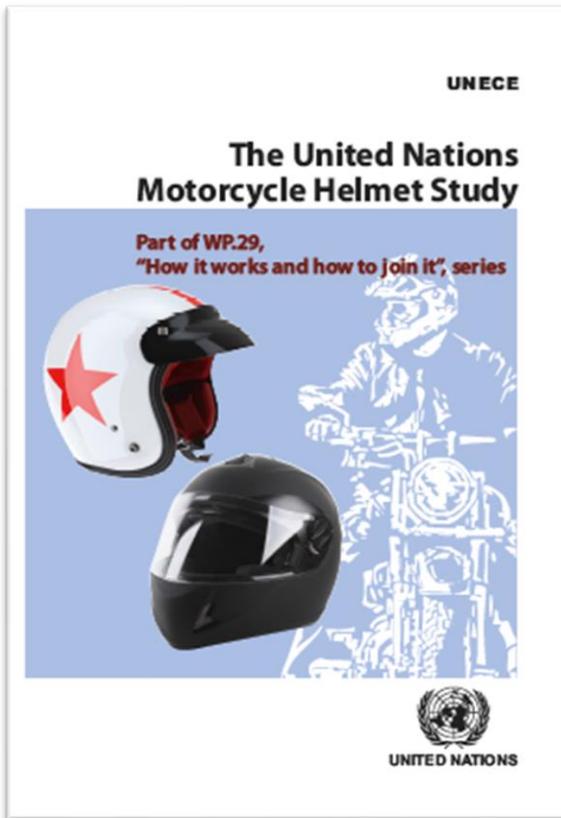
Working Party on Passive Safety (GRSP)



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Helmets

UN Regulation No. 22



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How it works

A helmet works in three ways:

- It prevents direct contact between the skull and the impacting object by acting as a mechanical barrier between the head and the object.
- It spreads the forces of the impact over a greater surface area so that they are not concentrated on a particular area of the skull; and
- It absorbs the impact energy and reduces the magnitude of the forces transmitted to the skull and brain.



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Tests

Each helmet type fitted with a visor shall undergo three major tests:

- Impact absorption test,
- Rigidity test and
- Retention (detaching) test.
- Tests on the chinstrap like micro-slip test, test for resistance to abrasion, and ease of release test for the chin strap



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Example of E-marked (Helmets)



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Background

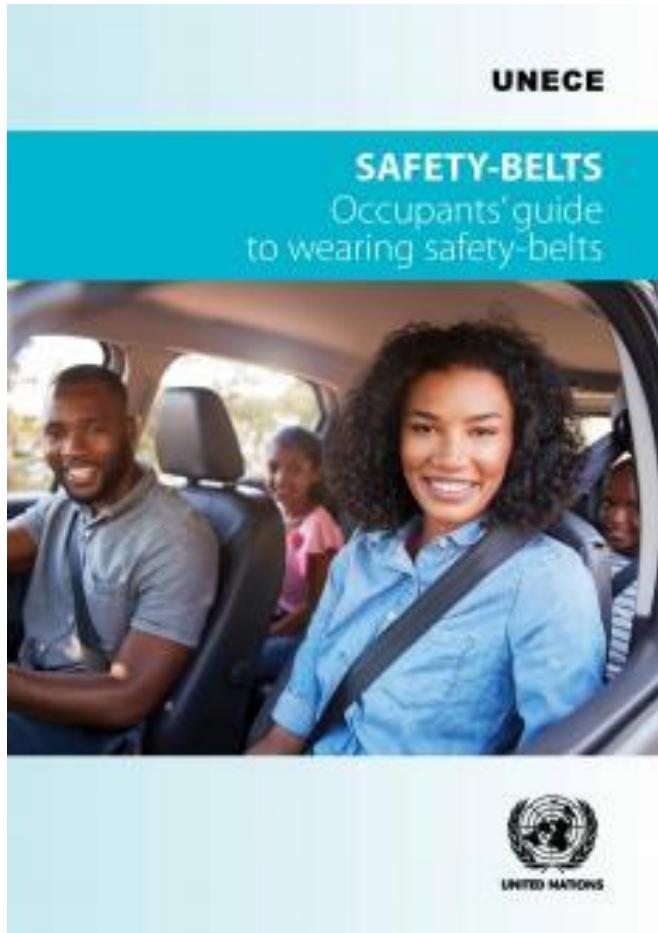
- Between 2008 and 2020, 3.4 million fatalities were caused by motorcycle crashes,
- 3 per cent were children.
- Wearing and proper use of motorcycle safety helmets can save 42 per cent of lives and avoid 69 per cent of injuries to riders.
- In low and lower-middle income countries motorcycles are often the first or only form of motorized transport.
- In South East Asia, the WHO statistics report that the 11 nations of the region account for the highest proportion of worldwide road deaths at 30.4 per cent.
- PTW account for 34 per cent of these deaths in South East Asia.



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Safety-belts and safety-belt anchorages

UN Regulations Nos. 16 and 14



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Safety-Belts (UN Regulation No. 16)

How safety-belts work

-
- **Safety-belts** are intended for individual fittings, by persons occupying forward-facing, rearward-facing and side-facing seats, designed for installation in any category of vehicles.
 - **It is an arrangement of straps** with a securing buckle, adjusting devices and attachments capable of being anchored to the interior of a vehicle and is designed to diminish the risk of injury, in the event of collision or deceleration, by limiting the mobility of the wearer's body.
 - **Such arrangement is a "belt assembly"**, which embraces any device for absorbing energy or for retracting the belt:
 - **Tension-reducing** device which is incorporated in the retractor and reduces the tension of the strap automatically when the safety-belt is fastened.
 - **Pre-loading** device which tightens the seat-belt webbing in order to reduce the slack of the belt during a crash



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Tests

All tests are based on performance requirements:

- Safety-belts are required for the buckle inspection;
- Low-temperature buckle test;
- Buckle durability test;
- Corrosion test;
- Retractor operating tests;
- Dynamic test and the buckle-opening test after the dynamic test.
- All the performance tests are simple and do not require expensive testing facilities.



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Why safety-belts are so important

Here are top 3 reasons why wearing a safety-belt saves lives:

- Passengers in a vehicle who are not wearing a seat belt can become projectiles during an accident. Unbuckled passengers can very easily be ejected through the front, rear or side windows, resulting in death.
- Passengers in the rear seat of an automobile who use safety belts are 44% more likely to survive in crash. The percentage increases to 73% for rear seat passengers in Vans or SUV vehicles.
- Wearing a safety-belt prevents passenger ejection during a severe accident that involves a rollover. The chances of surviving this type of accident increases 45% when wearing a proper safety restraint device. In pickup trucks, that number increases to 60%.



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Safety-belts anchorages(UN Regulation No. 14)

How safety-belt anchorages work

- Safety belts and safety belt anchorages are critical safety items for passengers in case of sudden acceleration/deceleration and accidents
- A safety-belt without proper anchorage does not serve any purpose. The strength of vehicle safety-belt anchorage is an important index of vehicle safety regulations and in the event of a collision, the tearing or rupture surrounding the safety-belt anchorages can be the main cause of casualties.
- A safety-belt anchorage means the parts of the vehicle structure or the seat structure or any other part of the vehicle to which the safety-belt assemblies are to be secured.



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Tests

- All the safety-belt anchorages of the same group of seats shall be tested simultaneously.
- Specific test requirements for safety-belt anchorages:
These are test carried out in configuration of a three-point incorporating a retractor having a pulley or strap guide at the upper belt anchorage.
- At the request of the car manufacturer, a dynamic sled test can be performed as an alternative to general test requirements and specific test requirement for safety-belt anchorages



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Strength of seats

UN Regulation No. 17

Tests

- Test of the strength of the seat-back and its adjustment systems
- Test of the strength of the seat anchorage and the adjustment
- Test of the performance of the head restraint
- Determination of the height of the head restraint
- Determination of the width of the head restraint
- Test for checking energy dissipation on the seat-back and head restraint.
- Test of the rear parts of seat backs and the design of devices intended to protect the occupants from the danger resulting from the displacement of luggage.
- Determination of whiplash injuries (Neck Injury Criteria (NIC)) with the use of the BioRID II UN dummy to seats having a design torso angle no less than 20° and no greater than 30°.



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Head restraints

UN Regulation No. 25

Tests

- Test to assess that no rigid and dangerous part projects from the padding of the head restraint
- Test of the head-restraint height
- Determination of the height of the head restraint
- Determination of the width of the head restraint
- Test for checking energy dissipation of head restraint.



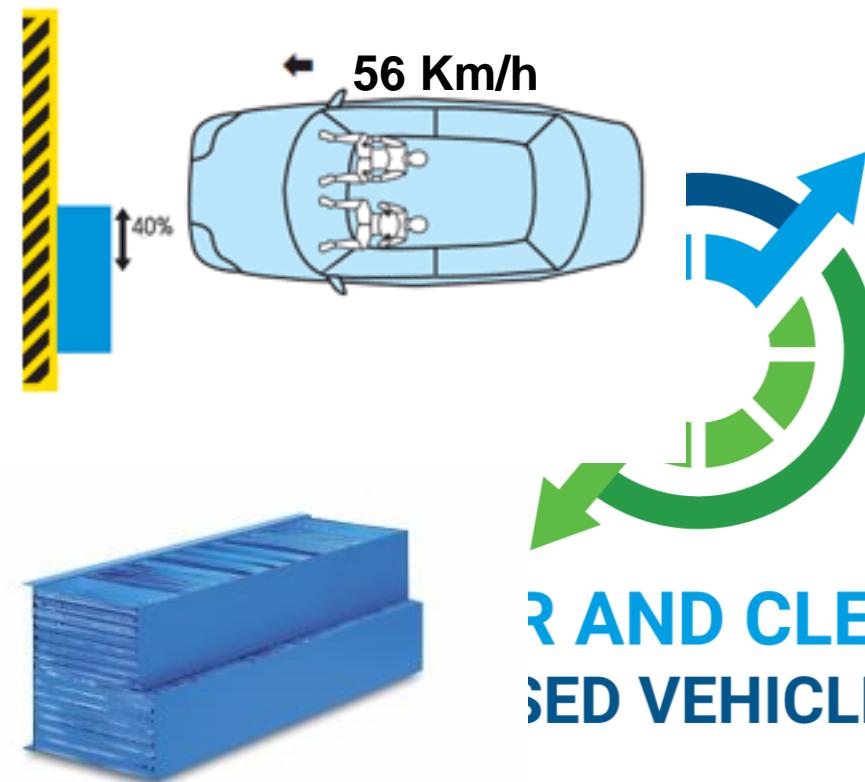
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UN Regulation No. 94 (Frontal impact)

- M₁ of a total permissible mass not exceeding 3,500 kg and to vehicles of category N₁ of a total permissible mass not exceeding 2,500 kg; other vehicles may be approved at the request of the manufacturer.

➤ Offset deformable barrier test:

- **Offset:** The vehicle shall overlap the barrier face by 40 per cent
- **Deformable barrier:** aluminium honeycomb.



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* M₁ vehicles used for the carriage of passengers and comprising not more than eight seats in addition to the driver's seat

Test

During the test

- Vehicle speed at the moment of impact shall be 56 km/h.
- Measurements on performance criteria on dummy in front seats
- No door shall open.

After the impact (Without the use of tools):

- Side doors shall be unlocked
- Steering wheel displacement
- Open at least one door
- Release the dummies from their restraint system
- Remove the dummies from the vehicle without adjustment of the seats
- In the case of a vehicle propelled by liquid fuel, no more than slight leakage of liquid
- For electric vehicles: verify protection against electrical shock, Electrolyte spillage.



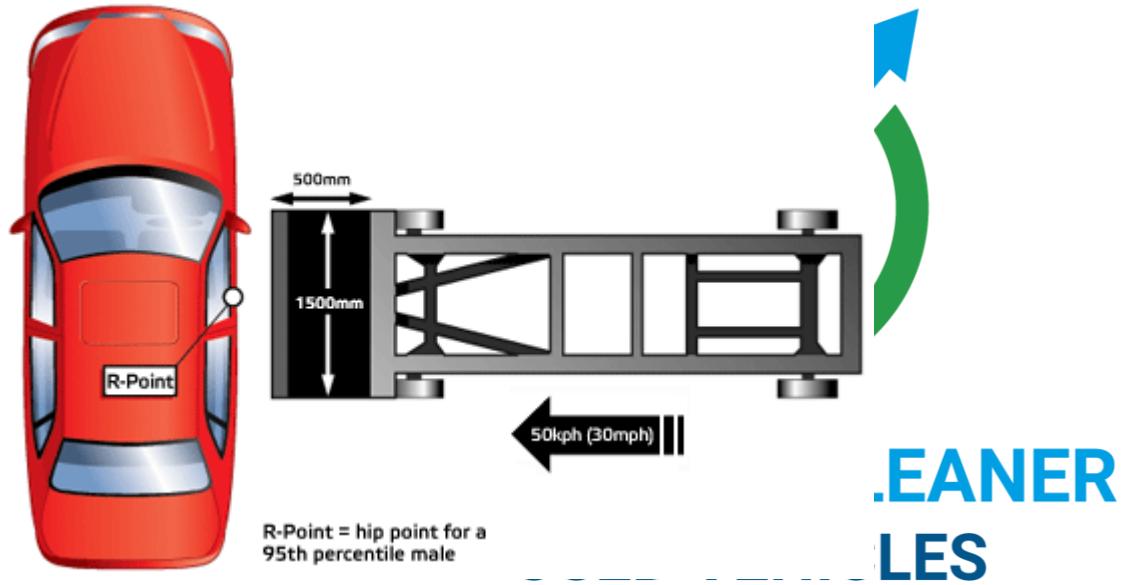
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UN Regulation No. 95 (Lateral impact)

- This Regulation applies to vehicles of category M1 with a maximum permissible mass not exceeding 3,500 kg and to vehicles of category N1

- **Mobile deformable barrier test**
It consists of a trolley and an impactor crashing against the vehicle:

- **Impactor:** Crushable section mounted on the front of mobile deformable barrier.
- **Trolley:** wheeled frame free to travel along its longitudinal axis at the point of impact.



N1* Vehicles used for the carriage of goods and having a maximum mass not exceeding 3.5 tonnes.

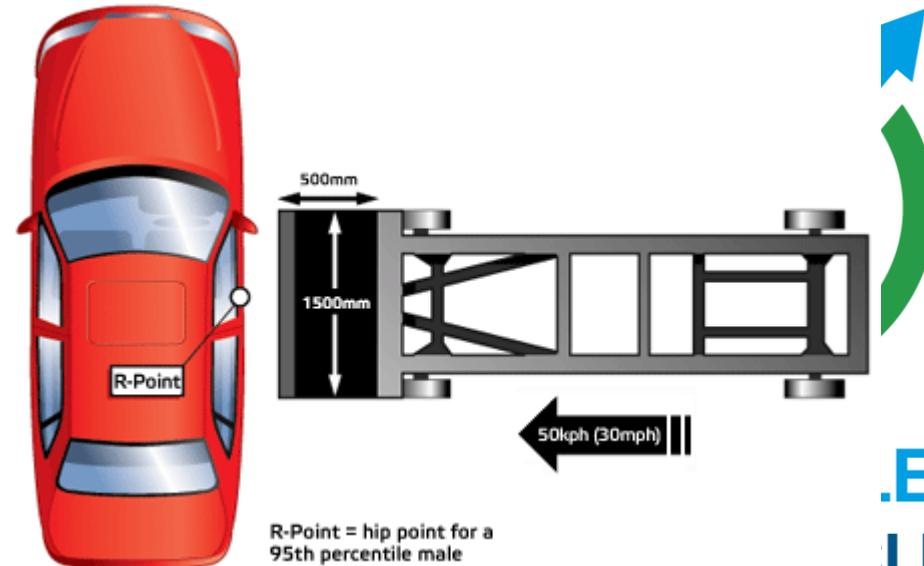
Test

➤ During the test

- Vehicle speed at the moment of impact shall be 50 km/h.
- Measurements on performance criteria on dummy in driver seat*
- No door shall open.

➤ After the impact (Without the use of tools):

- The side doors on the non-struck side shall be unlocked.
- Open a sufficient number of doors provided for normal entry and exit of passengers
- Release the dummy from its restraint system
- In the case of a vehicle propelled by liquid fuel, no more than slight leakage of liquid
- For electric vehicles: verify protection against electrical shock, Electrolyte spillage.



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N1* Vehicles used for the carriage of goods and having a maximum mass not exceeding 3.5 tonnes.

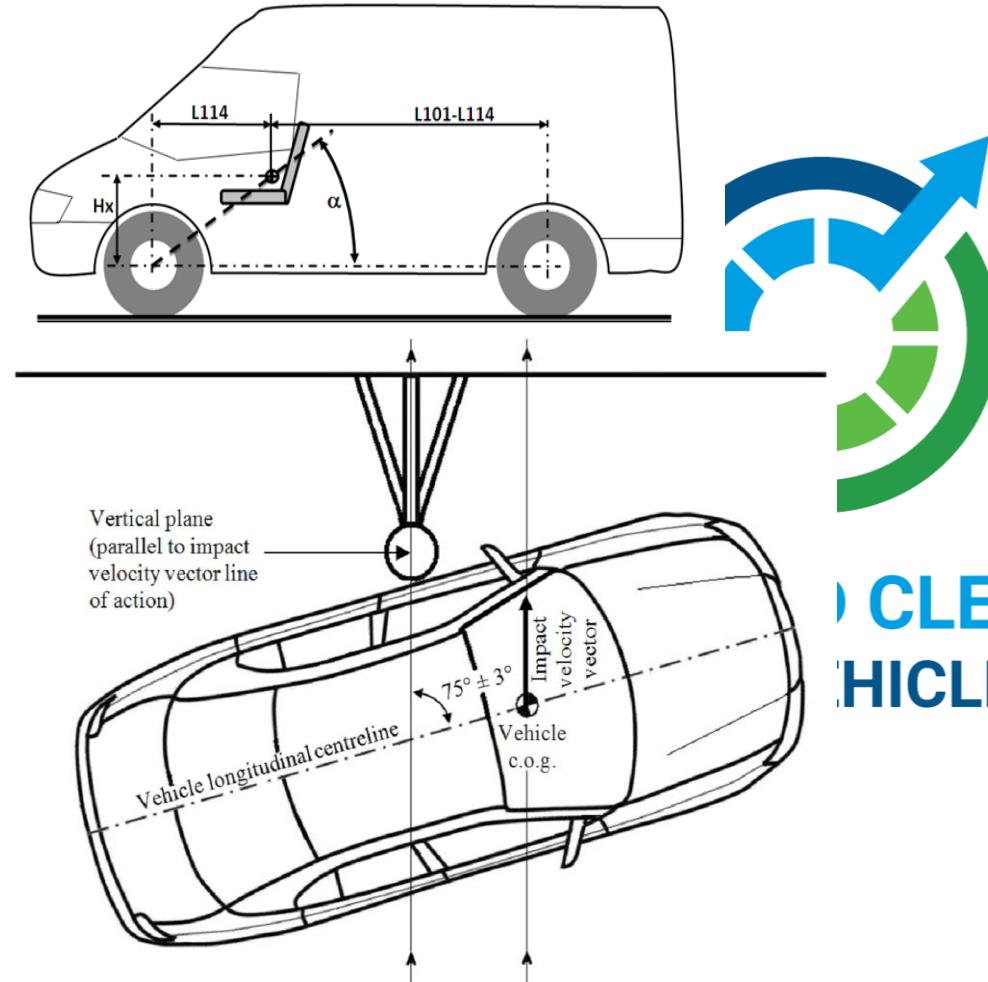
UN Regulation No. 135 (Pole side impact)

➤ This Regulation applies to

- (a) Category M1 vehicles with a gross vehicle mass of up to 3,500 kg; and
- (b) Category N1 vehicles where the acute angle alpha (α), measured between a horizontal plane passing through the centre of the front axle and an angular transverse plane passing through the centre of the front axle and the R-point of the driver's seat is less than 22.0 degrees

➤ Pole side impact test

- It consists of an impact against fixed rigid vertically oriented metal structure with a continuous outer cross section diameter of 254 mm
- The test vehicle speed at the moment of first vehicle-to-pole contact shall be 32 ± 1 km/h.



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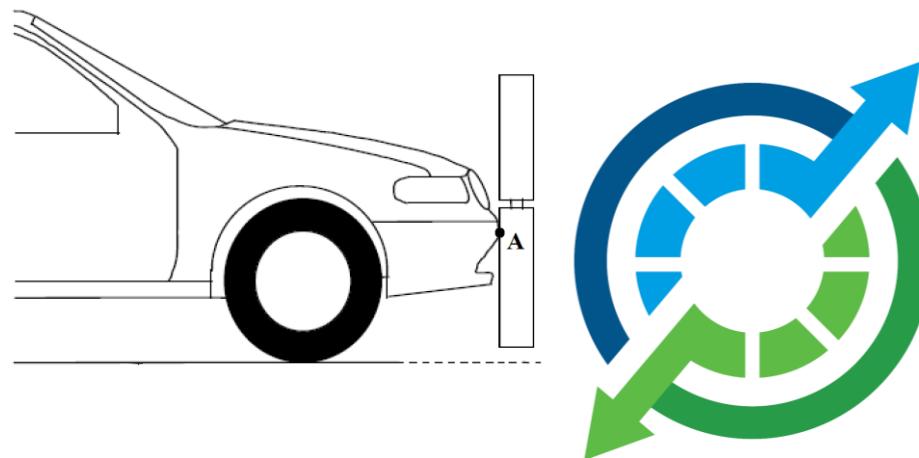
UN Regulation No. 127 (Pedestrian safety)

➤ This Regulation applies to

- This Regulation applies to motor vehicles of categories M1 and N1

➤ Legform test

- Lower leg-form (tibia), against the car bumper.
- Upper leg-form (adult femur and pelvis) against bonnet leading edge.
- Legforms strike tested vehicle in "free flight" at the speed of 11 m/s (40 km/h) to reproduce real world condition of a pedestrian accident.

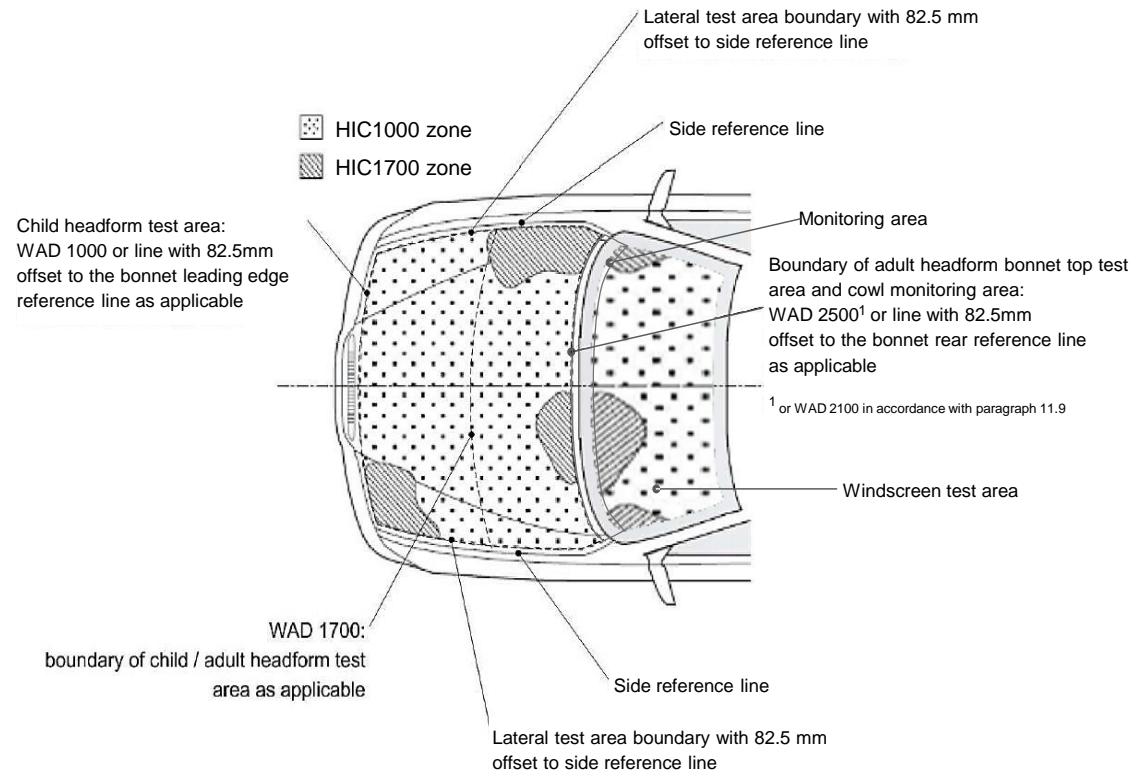


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UN Regulation No. 127 (Pedestrian safety)

Head-form test

- Adult and child head-form testing
- The head-form velocity at the time of impact shall be 9.7 m/s ± 0.2 m/s.
- The manufacturer shall identify the zones of the bonnet top test area and of the windscreen test area where the HIC shall not exceed 1,000 (HIC1000 zone) or 1,700 (HIC1700 zone)



UN Regulation No. 44 (Child Restraint Systems)

- Child restraint system is device as a carrycot, infant carrier, a supplementary chair and/or an impact shield, capable of being anchored to a power-driven vehicle.
- Diminish the risk of injury to the child, in the event of a collision or of abrupt deceleration of the vehicle, by limiting the mobility of the child's body
- ISOFIX: is a system for the connection of child restraint systems to vehicles which has two vehicle rigid anchorages, two corresponding rigid attachments on the child restraint system



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Test/Specifications

Child restraints fall into five “mass groups”:

- Group 0 for children of a mass less than 10 kg.
- Group 0+ for children of a mass less than 13 kg.
- Group I for children of mass from 9 kg to 18 kg.
- Group II for children of mass from 15 kg to 25 kg.
- Group III for children of mass from 22 kg to 36 kg.
- Child restraint can be positioned in front or rear seat position
- A complete child restraint shall be subject to the corrosion test, energy absorption, overturning test and dynamic test.



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UN Regulation No. 100 (Electric power trained vehicle and battery safety)

➤ This Regulation applies to

- Part I: Safety requirements with respect to the electric power train of road vehicles of categories M and N , with a maximum design speed exceeding 25 km/h
- Part II: Safety requirements with respect to the Rechargeable Electrical Energy Storage System (REESS), of road vehicles of categories M and N



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Tests

- i. Protection against electrical shock
- ii. Protection from electrolyte spillage after a crash
- iii. Fire protection
- iv. Functional safety requirements

Part II (REESS)

- i. Thermal shock and cycling
- ii. Mechanical shock/integrity/vibration
- iii. Fire resistance
- iv. External short circuit/overcurrent/overcharge
- v. Over-temperature protection
- vi. Thermal propagation
- vii. Water exposure resistance
- viii. Gas management



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UN Regulation No. 136 (UN Regulation No. 136 - Electric vehicles of category L (EV-L))

➤ This Regulation applies to

- This Regulation applies to motor vehicles of categories L (Motor vehicles with less than four wheels)

➤ Specifications/Tests – Are those of UN Regulation No. 100

- Protection against electric shock.
- Functional Safety:
- Determination of hydrogen emissions to be carried out on all vehicles equipped with open type traction batteries
- Requirements of a Rechargeable Electrical Energy Storage System (REESS) with regard to its safety
- Vibration test:
- Thermal shock and cycling teste
- Mechanical test
- Fire resistance test
- External short circuit protection
- Over-discharge protection.
- Over -temperature protection



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UN Regulation No. 29 (Cabs of commercial vehicles)

➤ This Regulation applies to

➤ This Regulation applies to vehicles with separate driver's cab of category N (Commercial vehicles) with regard to the protection of the occupants of the cab.

➤ Tests

- Front Impact Test: steel impactor strikes the cab in the front
- Front Pillar Impact test: the impactor shall strike the cab at the front in the area of the windshield
- Roof Strength Test: The impactor shall strike the upper side of the cab



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General safety

Working Party on General Safety Provisions (GRSG)



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UN Regulation No. 107 (General construction of buses and coaches)

➤ This Regulation applies to

- This Regulation applies to every single-deck, double deck, rigid-deck or articulated vehicle of category M2 or M3

➤ Specifications/Tests

- Stability test: point at which overturning occurs would not be passed if the surface on which the vehicle stands were tilted to both sides in turn to an angle of 28 degrees from the horizontal.
- Protection against fire risks: ensure the vehicle is protected from threats of fire within and outside the bus and coach.
- Engine compartment: No flammable sound-proofing material or material shall be used in the engine compartment unless the material is covered by an impermeable sheet.
- Electrical equipment and wiring: all cables shall be well insulated and all cables and electrical equipment shall be able to withstand the temperature and humidity conditions . All batteries shall be well secured.
- Fire extinguishers and first-aid equipment: Space shall be provided for the fitting of one or more fire extinguishers (one being near the driver's seat) and or more first-aid kits.
- Fire detection: Vehicles shall be equipped with an alarm system detecting either an excess temperature or smoke in toilet compartments, driver's sleeping compartments and other separate compartments.



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UN Regulation No. 43 (Safety glazing)

➤ This Regulation applies to

- All vehicles
- Safety glass is manufactured to reduce the likelihood of injury if it breaks.
- Includes all transparent parts such as e.g. the windshield, the side, and the rear windows

➤ Specifications/Tests

- Mechanical strength test: to assess the penetration resistance of automotive safety glass (e.g. to avoid an object to penetrate in the vehicle through the windscreen);
- The headform test: to limit the injury in the event of impact of the head against the glass (e.g. occupants thrown against the windscreen in the case of a car crash);
- Multiple tests of resistance: such as resistance to abrasion, high temperature, radiation, humidity, temperature changes and foreign chemicals. Multiple tests to assess the optical qualities and ensure perfect vision for the driver: such as light-transmission test, optical-distortion.



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UN Regulation No. 46 (Devices for indirect vision)

➤ This Regulation applies to

- All compulsory and optional devices for indirect vision
- Devices for indirect vision means devices intended to give a clear view of the rear, side or front of the vehicle within the fields of vehicles vision defined.
- They can be conventional mirrors, camera-monitor system (CMS) or other devices able to present information about the indirect field of vision to the driver.

➤ Device requirements

- All rear-view mirrors shall have the edge of the reflecting surfaces enclosed in a protective housing (holder).
- Other than mirrors: scanning the field of vision shall not take more than 2 seconds
- Devices for Indirect Vision: Shall not move to change the field of vision even when the vehicle is moving at speeds of up to 80% of its maximum design speed



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UN Regulation No. 58 (Rear underrun protective devices (RUPDS))

Underride truck crashes occur when a passenger car rides under the rear of a large truck. RUPD at the rear of trucks prevent these occurrences.

➤ This Regulation applies to

- RUPDS of vehicles of categories M, N and O (Trailers)
- Vehicles with regard to the installation of a RUPD
- Vehicles with regard to their RUPDS

➤ Device requirements

- Dimensional requirements
- Shall offer resistance to forces applied to the longitudinal axis of the vehicle
- The RUP may be so designed to have several positions at the rear



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UN Regulation No. 93 (Front underrun protective devices (FUPDS))

The front underrun protection prevents smaller vehicles in frontal crashes from being dragged under the body of a large truck. It provides test procedure for energy-absorbing front under run protection systems for trucks.

➤ This Regulation applies to

- FUPDS of vehicles of categories M1 and N1
- Vehicles with regard to the installation of a FUPDS
- Vehicles with regard to their FUPDS

➤ Device requirements

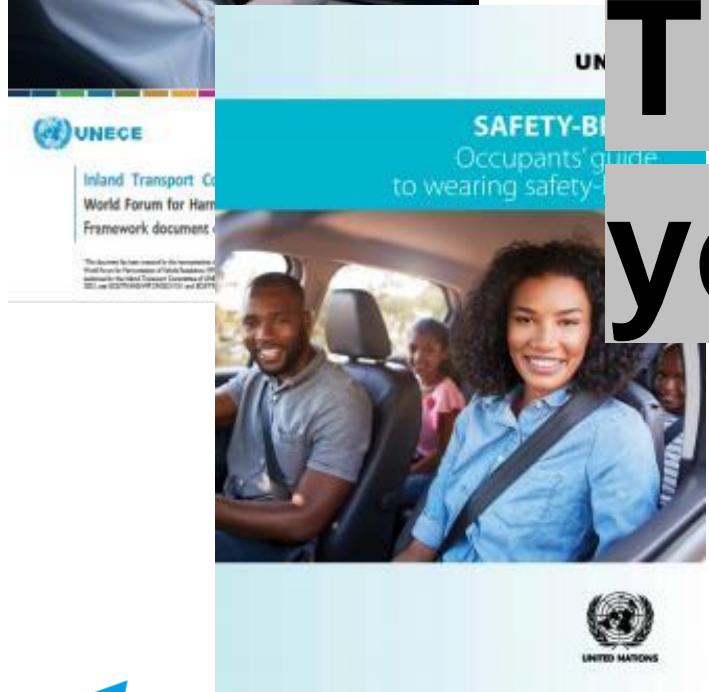
- Dimensional requirements
- Adequate resistance to forces applied parallel to the longitudinal axis of the vehicle
- The FUPDS may be so designed to have several positions at the front



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Helmet Study

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