Centro de Investigación y Desarrollo en Automoción

Passive safety devices: state of European research

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"An old adage says that generals always prepare to fight the last war and so are unprepared for the peculiar demands of the next…"

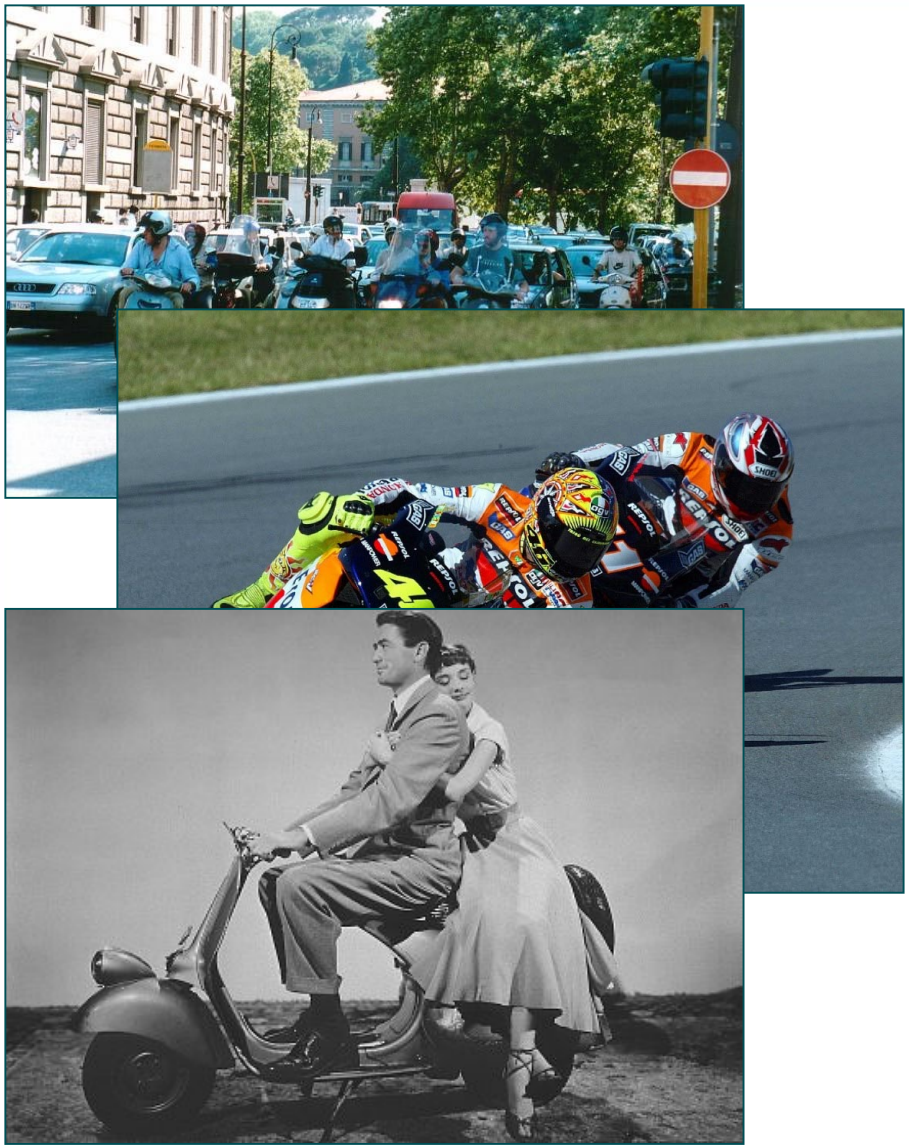
(J.V. Ouellet)

Passenger CAR Passive Safety

- Widely addressed, a lot of research done
- Seat belts, airbags, reinforced test structures, etc.

MOTORCYCLE Passive Safety

- A lot of research done but NOT so successful and implemented
- Passive Safety more complex to address: motorcycle, infrastructure, helmet, clothing, etc.
- NOT MATURE YET ➔ Further research needed



YES

- Flexible.
- Environmental care.
- Low fuel consuming.
- Traffic in the cities.
- Rest and enjoyment.

Motorcycles. DISADVANTAGES

NO

- Motorcyclist high exposure to risk.
- Relation with other vehicles.
- Relation with road infrastructure.
- Training and education.

European Research wrt Motorcycles. State-of-the-art

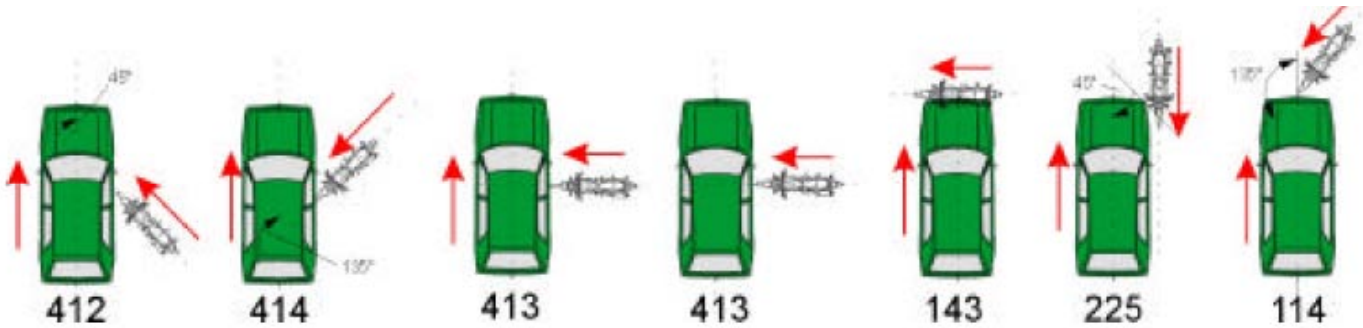
- Within **APSN WP5 UG2** (Advanced Passive Safety Network) Motorcycle Safety is addressed.

- 2 INVENTORY Reports have been recently released that collect research related activities (studies, projects and standards) with regard to the motorcycle, the infrastructure, helmets, clothing and compatibility

- These reports give an overview of the current status of the research activities on motorcycle issues.

MOTORCYCLE

- **Research since the early 70's**
- **Focus on airbag and leg protectors (both fitted in the motorcycle)**
- **ISO 13232:** Motorcycles - Test and Analysis Procedures for Research Evaluation of Rider Protective devices fitted on Motorcycles ➔important contribution to the use of **common methodology**



- **MAIDS:** Motorcycle Accidents In-Depth Studies

INFRASTRUCTURE

- A lot of work since the 80's
- Focus on forgiving guardrails and improvement of the existing ones

Initiatives in different countries

Italy

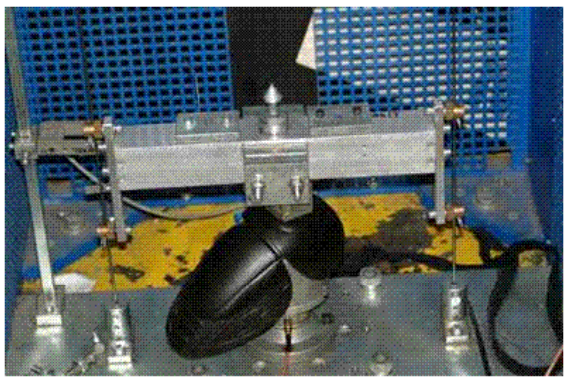
Spain

France

- NO European Standard to assess the performance of Roadside Furniture

PROTECTIVE CLOTHING

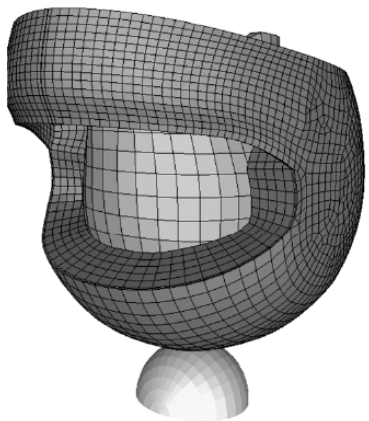
- **Most of the studies refer to the clothing effectiveness**
- **Testing procedures defined and used as EN1621(**Motorcyclists' protective clothing against mechanical impact. Requirements and test methods for impact protectors)

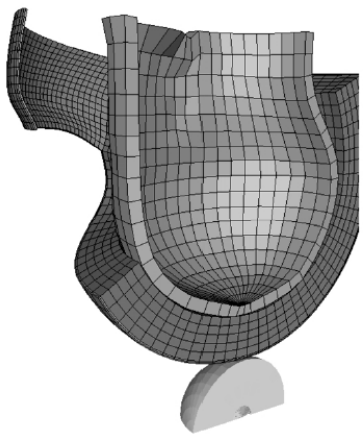


- **New materials and technologies are being developed**

HELMETS

- **Most of the studies refer to the helmet design and materials**
- **COST 327 (2001): Motorcycle Safety Helmets,** has been an important project that intended to propose a specification for the future testing of motorcycle helmets in Europe taking into account the severity of injuries and head & neck injury mechanisms.
- **Standard for the requirements and test methods to apply: ECE R22.05 (2003)**





ACCIDENTOLOGY:

- National accident databases.
- In-depth databases.

Accident scenarios: selection

What should be improved and how?

MOTORCYCLISTS

- Helmets.
- Clothing.

VEHICLE

ROADSIDE INFRASTRUCTURE

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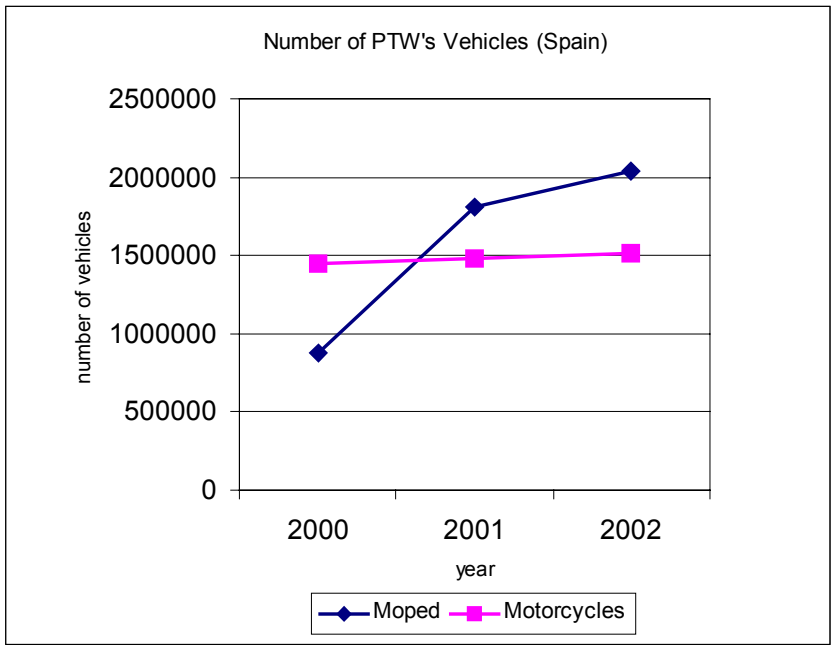
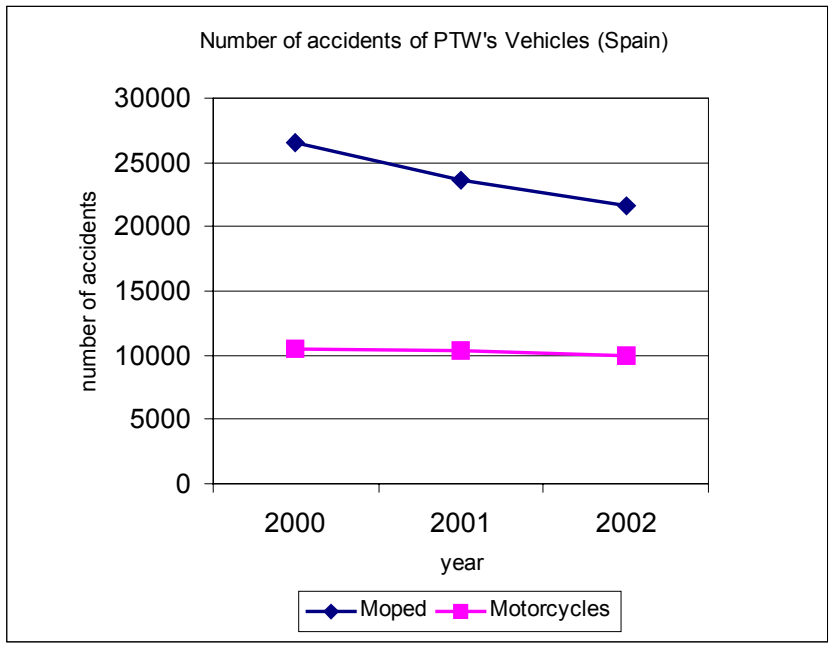
ROADSIDE INFRASTRUCTURE

Increasing the number of registered vehicles, but also increasing the number of fatalities and serious injured





SPAIN Situation

- APROSYS SP4 data from: Germany, Italy, The Netherlands and Spain
- Similar results for the four countries (regarding the motorcycles accidents trends)

In-depth Accident Databases: MAIDS.

The MAIDS (Motorcycle Accident In-Depth Study) Research confirmed the fact that the most frequent in a motorcycle accident is a passenger car (60%) and that in Europe more than 50% of PTW accidents are due to faults of the other vehicle driver.

Impacts against road barriers are less frequent, however in these accidents injuries classified as AIS 3+ were 35% of the total number of the injuries sustained by the riders.

MAIDS
In-depth investigations of accidents involving powered two wheelers

OTHER ACCIDENT STUDIES

France and Germany: Collisions against Metal Crash Barriers

- FRANCE: **'Etude des accidents de motorcyclists avec choc contre glissieres de securite' (Bradley 1998). Conclusions for 1993, 1994, 1995:**
  - 188 Fatalities
  - 342 Serious Injuries
  - 385 Slight injuries
  - 8% of all motorcycle fatalities involved a crash barrier

- GERMANY: **'Guardrail post protection for improving the safety of motorcycle riders' (Ellmers 1997). 25% of motorcycle accidents in one year involved metal crash barriers**
  - 11% Fatalities
  - 50% Serious Injuries
  - 39% Slight injuries

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Accident scenarios: selection

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VEHICLE

ROADSIDE INFRASTRUCTURE

SCENARIOS SELECTED

- Urban. Moped. Car. Intersection.
- Urban. Moped. Car. Straight.
- Urban. Motorcycle. Car. Intersection.
- Urban. Motorcycle. Car. Straight.
- Non-urban. Motorcycle. Single vehicle accident.
- Non-urban. Motorcycle. Car. Straight.
- Non-urban. Motorcycle. Car. Intersection.

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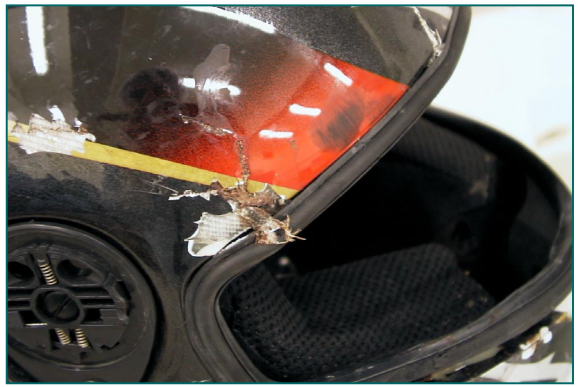
VEHICLE

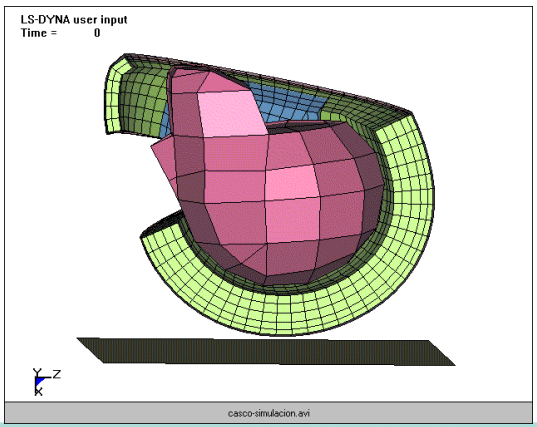
ROADSIDE INFRASTRUCTURE

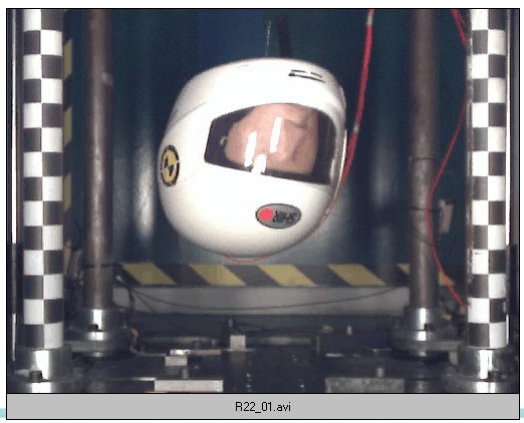
HELMETS

– Effects of rotational acceleration: improvement of ECE R-22 standard.

– New materials: reducing weight without damaging the protection against impact. Comfort.



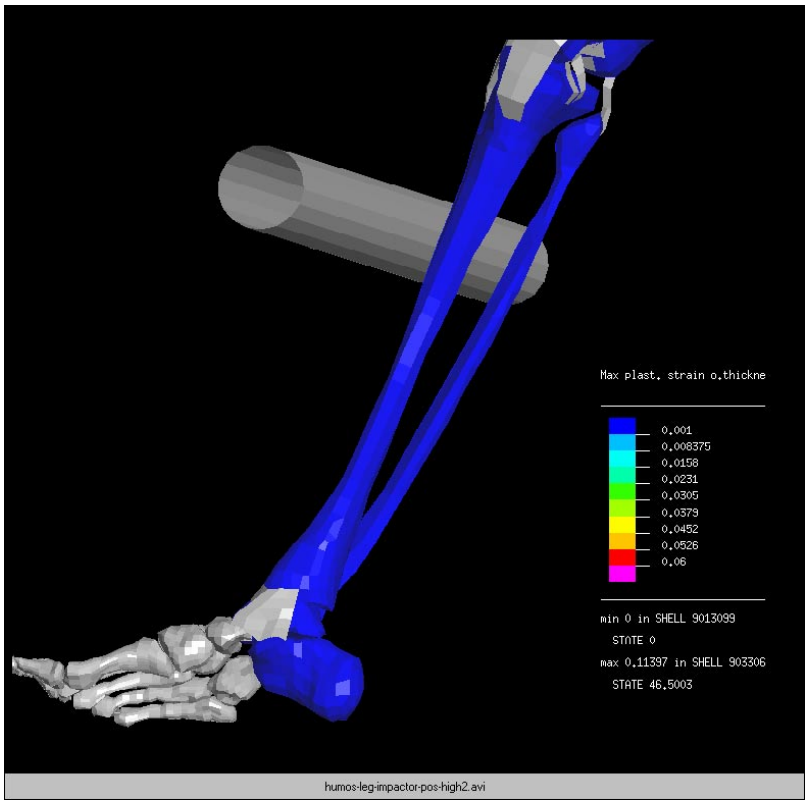




PROTECTIVE CLOTHING

– Improvement of impact protectors.

– Passive safety systems: communication with the vehicle (sensors: crash detection).



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ROADSIDE INFRASTRUCTURE

ACCIDENTOLOGY:

– National accident databases: magnitude of the problem.

– In-depth databases: specific information.

Reconstruction of accidents:

– Injuries.

– Physical crash parameters

DEFINITION OF A STANDARD

BIOMECHANICS:

– What injuries?

– What dummy? Modifications?

TEST PARAMETERS

– Trajectories.

– Velocities

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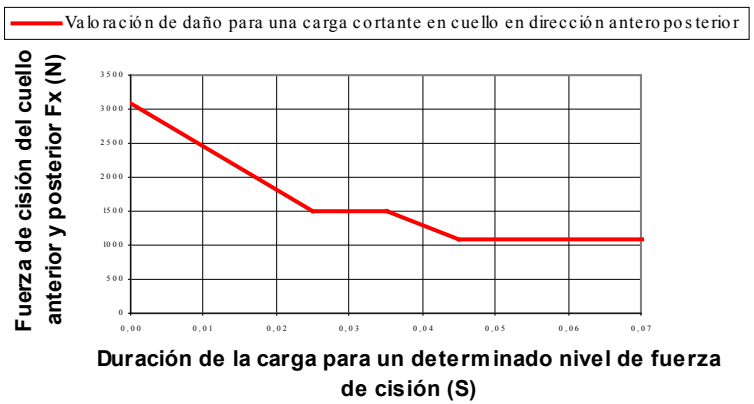
Necessity of CORRELATION between the physical parameters measured by the dummy and a human injuries under the same impact conditions

¿=?

Head Injury Criteria (HIC_{36}).
Neck Injury Criteria.

$HIC_{36} \leq 1000$ to have a risk of 20% of AIS3+

aceleraciones
fuerzas
momentos



$$HIC = \left\{ (t_2 - t_1) * \left(\frac{1}{t_2 - t_1} * \int_{t_1}^{t_2} a(t) * dt \right)^{2.5} \right\}_{max}$$

HYBRID III 50%:

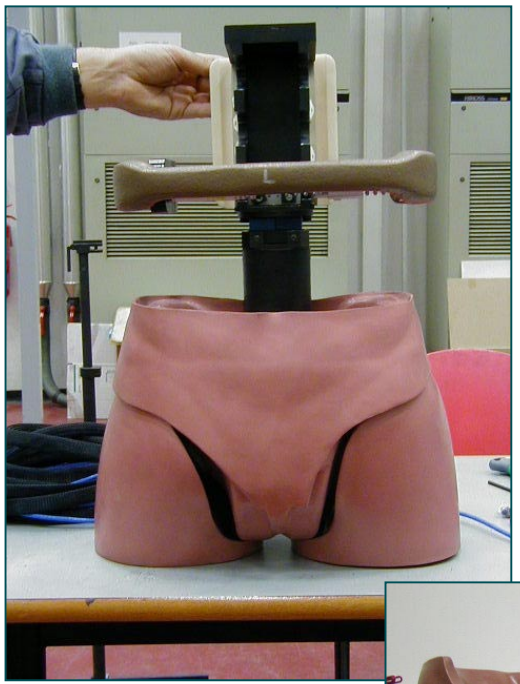
Developed for **frontal impact**.

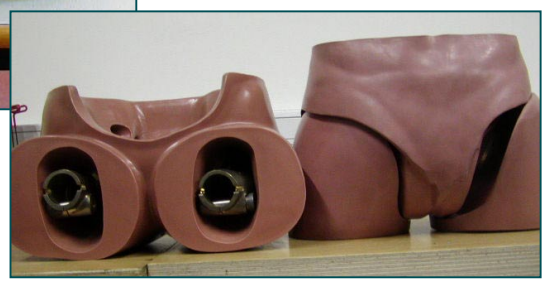
NO BIOFIDELITY in results for motorcyclists

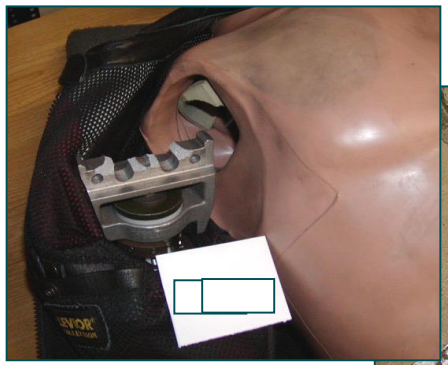
Dummy modification needed

BIOMECHANICS

- Dummy modifications: “kit” pedestrian.
- Shoulder: too rigid ➔ no biofidelity in different impact configurations







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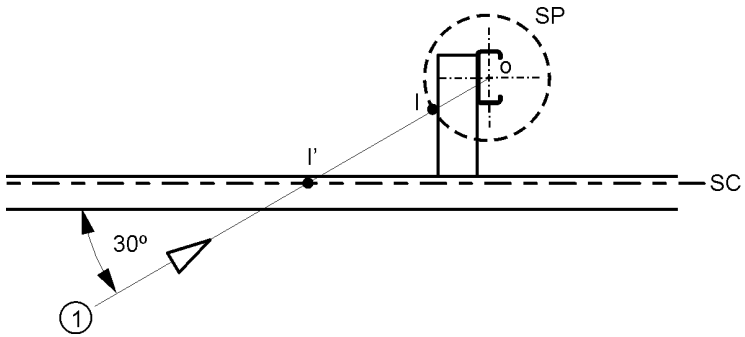
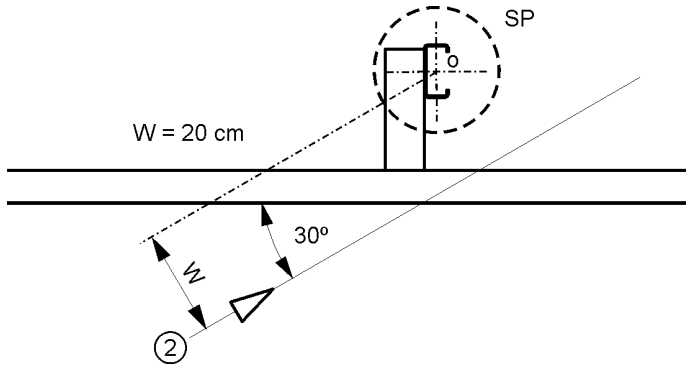
TEST PARAMETERS

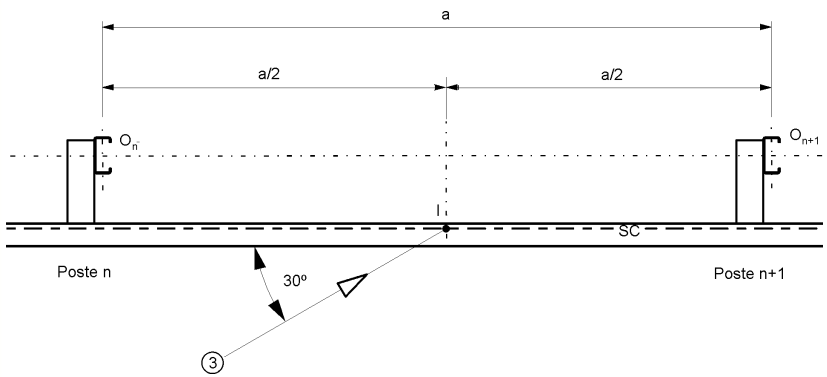
UNE 135900 (Current Spanish Standard)



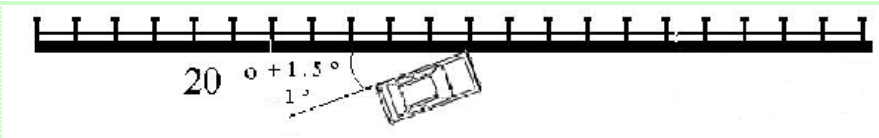
Trajectory 1: **Post Centred**



Trajectory 2: **Post Des-Centred**



Trajectory 3: **Vain Centred**



Tests according to **UNE EN 1317**

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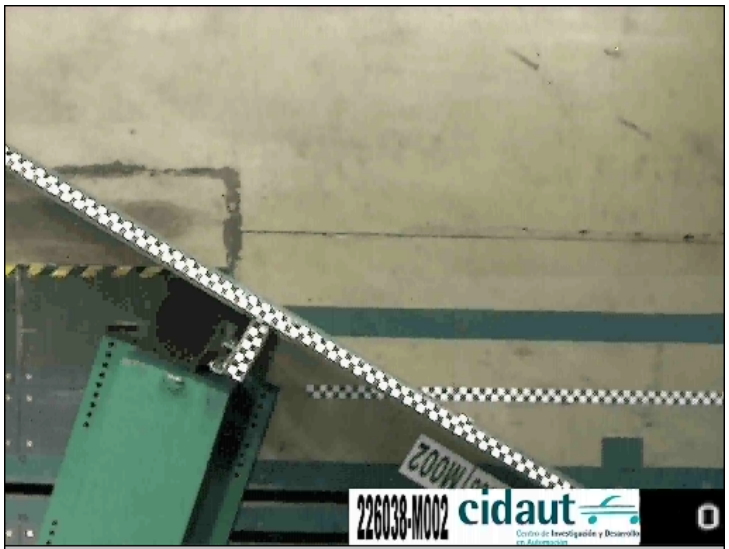
STANDARD DEFINITON



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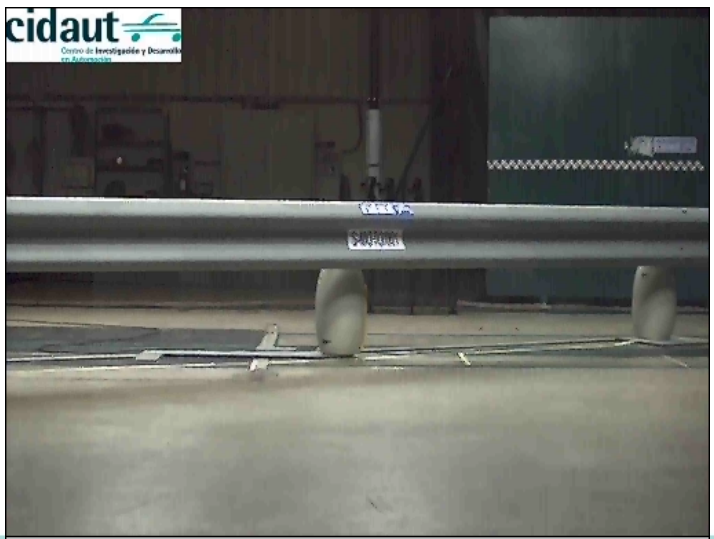
Poste-cenital.avi



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