



autostrade
per l'Italia



BARRIERE DI SICUREZZA STRADALI

La normativa e le soluzioni innovative – Le prospettive future

***Le prospettive di evoluzione della normativa in ambito
dispositivi di ritenuta
Legislazione nazionale ed europea***

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- **Marco Anghileri:**

- Docente di “Sicurezza Passiva” e “Strutture Aerospaziali” al Politecnico di Milano.
- Direttore del laboratorio di Sicurezza Passiva del Politecnico di Milano.
- **Ambito norme barriere di sicurezza in EU/Italia:**
 - Membro del CEN TC226/WG1
 - Coordinatore del CEN/TC226/WG1/TG5 (Computational Mechanics Europe)
 - Coordinatore dei gruppi di lavoro UNI:
 - UNI/CT 012/SC 01 "Attrezzature stradali"
 - » UNI/CT 012/SC 01/GL01 “Barriere di sicurezza”,
 - » UNI/CT 012/SC 01/GL07 “Meccanica computazionale”,
 - » UNI/CT 012/SC 01/GL21 “Sicurezza passiva in ambito pali”,
 - UNI/CT 012/GL04 “Ricostruzione degli incidenti”
 - Coordinatore scientifico IntoRoads.



EN1317

- **EN1317 has been developed following the EC mandate M111:**

This mandate is issued by the Commission to CEN/CENELEC within the context of the Council Directive of 21 December, 1988 on the approximation of laws, regulations and administrative provisions of the Member States relating to construction products (89/106/EEC), hereafter referred to as "the Directive" or "the CPD".

One of the aims of the Directive being the removal of technical barriers to trade in the construction field, in so far as they cannot be removed by means of mutual recognition among Member States, it seems appropriate that standardisation mandates cover, at least during a first phase of the mandating programme, construction products likely to be subject to technical barriers to trade.

D)-ROAD RESTRAINT SYSTEMS
Vehicle restraint systems, crash cushions, transitions, barriers, cables, parapets
Pedestrians restraint systems including pedestrians bridge parapets

ESSENTIAL REQUIREMENTS	CHARACTERISTICS	DURABILITY
1		Y
2		
3		
4	-performance under impact -height of parapets -resistance to horizontal loads	
5		
6		



EN1317

- **Scope:**
 - Remove barriers to trade.
 - Evaluate performances of products.
 - Should not say what is good or bad. Only give a measure of the performances for the classification.
- **What is NOT EN1317:**
 - Must NOT:
 - give indication on the use of products.
- **Member states must decide how to use products tested according to EN1317**



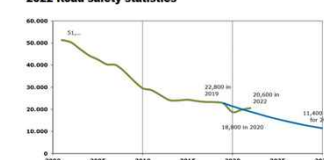
EN1317.

- **Current version:**
 - ***hEN1317-1 Terminology and general criteria for test methods 2010***
 - ***hEN1317-2 Performance classes, impact test acceptance criteria and test methods for safety barriers including vehicle parapets. 2010***
 - ***hEN1317-3 Performance classes, impact test acceptance criteria and test methods for crash cushions. 2010.***
- **Vehicles, test matrix, acceptance criteria have been defined 1993-1998.**



EU

2022 Road safety statistics



- EU countries are completely different for population, density of vehicles, road design, traffic.
- In 2023 20380 fatalities EU road (about 50000 in 2001, 30000 in 2011).
- France, Germany and Italy about 3000 fatalities per year.
- UK about 1600 fatalities per year.
- Sweden 200 fatalities per year.
- Fatality rate (deaths per million inhabitants):
 - Sverige 22
 - UK 27
 - Italy, France, Germany 50-55
- Italy, Germany, France and UK comparable population, road design and traffic volumes.



EN1317 and national regulations

- **EN1317 is assessing the performances of a road restraint system.**
- **What about the use? What install and where?**
 - **This is left to competence of single Member States**
 - Some have recent rules
 - Some have them since years
 - Some don't have
- **Result: differences on the market and on the containment level in different countries (UK compared to France, Italy and Germany).**
- **For CE marked products member states are not allowed to ask for additional requirements but..... German example.**



Italy

Tipo di traffico	TGM	% Veicoli con massa >3,5 t
I	≤1000	Qualsiasi
I	>1000	≤ 5
II	>1000	5 < n ≤ 15
III	>1000	> 15

Tipo di strada	Tipo di traffico	Barriere spartitraffico	Barriere bordo laterale	Barriere bordo ponte ⁽¹⁾
Autostrade (A) e strade extraurbane principali(B)	I II III	H2 H3 H3-H4 ⁽²⁾	H1 H2 H2-H3 ⁽²⁾	H2 H3 H3-H4 ⁽²⁾
Strade extraurbane	I	H1	N2	H2
secondarie(C) e Strade	II	H2	H1	H2
urbane di scorrimento (D)	III	H2	H2	H3
Strade urbane di quartiere	I	N2	N1	H2
(E) e strade locali(F).	II	H1	N2	H2
	III	H1	H1	H2



Safety barriers installed on the road in EU

Situation in the EU countries :
Overview on motorways

		Side Barrier	Central Barrier	Bridge Barrier
	Austria	H2	H2	H3
	Belgium	H2	H2	H4b
	Denmark	H1	H2	H3
	Finland	N2	N2	H2
	France	N2	H1	N2
	Germany	H2	H2	H1
	Ireland	N2	H2	H2
	Italy	H2	H3	H4b
	Holland	H2	H2	H2
	Norway	N2	N2	H2
	Spain	H1	H2	H3



EN1317. According to M111.

- EN 1317 has been developed by CEN (European Center for Standardization) following the mandate M111 given by DG Transport (now Industry) to develop harmonized standards for the following construction products:
 - Safety barriers
 - Crash cushion
 - Transition
 - Cables (??)
- Terminals are not in the mandate.
- EN 1317 has been created to evaluate the performances also for other products but, in this case, the product will not have the CE:
 - Temporary barriers
 - Motorcyclist products
 - TMA



Different documents

- **EN1317 contains different type of documents**
 - **hEN (harmonized European Norm):**
 - Related to CE marked products (mandate M111). All the EU countries must use hEN and accept CE marking. The standard is mandatory.
 - **EN (European Norm):**
 - All the EU countries must use EN. The standard is mandatory. No CE marking. The product must have a national approval.
 - **TS (Technical Specification):**
 - Early stage of EN. The standard is not mandatory. No CE marking. The product must have a national approval.
 - **TR (technical report):**
 - Not a standard. Simple collection of testing methods. Member states need to decide what to use.

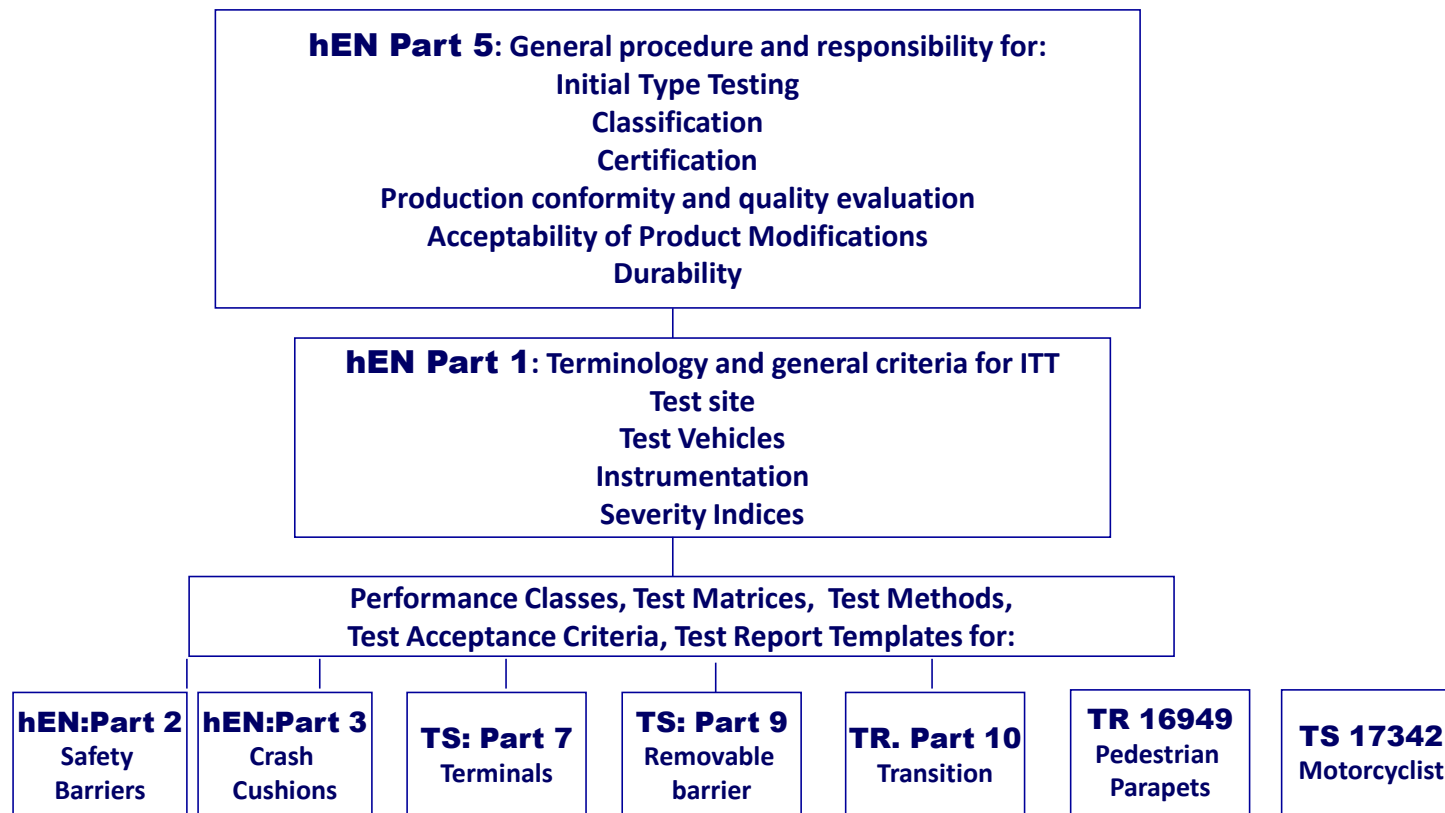


Update of European Standards.

- **Harmonized/not harmonized standards:**
 - **Harmonized standards (hEN):** standards related to products with CE marking. These products can be placed on the market in any member states without additional documentation (example: a product that received the CE marking in Italy can be placed on the market in Belgium without additional documentation).
 - Products included in harmonized parts of EN1317:
 - Safety Barriers.
 - Crash cushions.
 - Besides testing, CE marking is assessing also the factory production control (FPC).
 - Comparison with MASH tested products.
 - **Not harmonized standard:** standards related to products without CE marking. Same testing as CE marked products but different rules in different member states for the acceptance.
 - Products included in not harmonized parts of EN1317 :
 - Terminals
 - Gate closure
 - Transition
 - Motorcyclist protection.
 - TMA
 - Pedestrian parapets.
 - No factory production control. Requirements only on testing.
 - Need for approval from the member states.

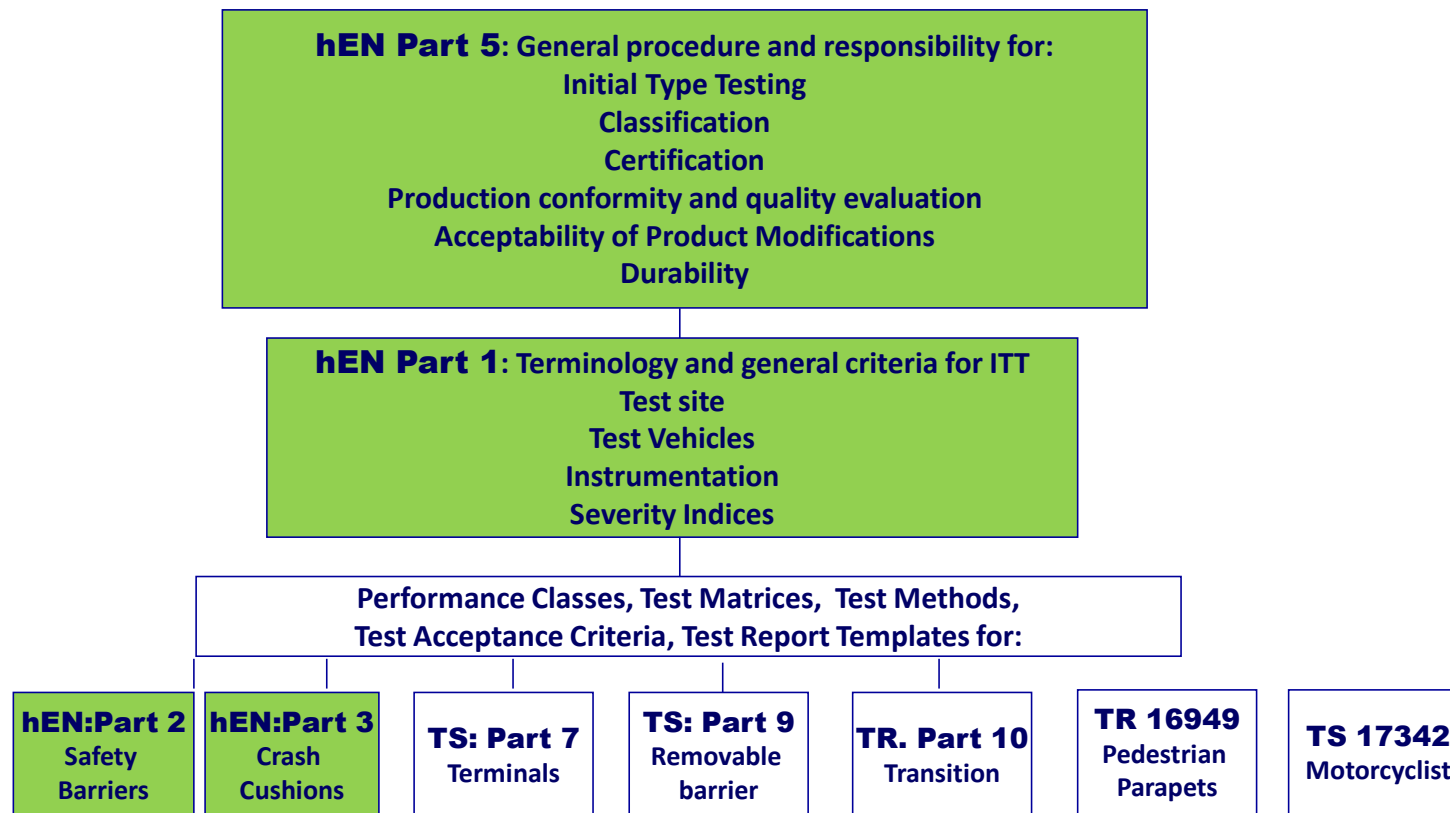


Structure of EN 1317





Structure of harmonized EN 1317





Update of European Standards

- **Not harmonized standards recently approved:**
 - TS: “Road restraint systems - Impact tests and test methods for removable barrier sections”
 - TS: “Road restraint systems – Performance characterisation and test methods for terminals of safety barriers”
 - TR: “Road restraint system — Assessment methods and design guidelines for transitions and terminal and crash cushion connection – transitions”
- **Not harmonized standard in approval:**
 - TR: ” Determination of collision forces on bridges”



EN1317 revision brief history.

- In 2012 CEN TC226/Wg1 started the revision of EN1317:
 - Single document with all products (with or without CE marking).
 - Introduction of new measures/performances:
 - Load transferred to the bridge deck.
 - Fragment position.
 - Use of virtual testing.
 - Requests from member states (Germany)
 - ...
- After about 5-6 years of discussion (2018) everything has been stopped.
- The revision is restarting now.



Why the revision has been stopped?

- Member states different needs/request.
- Difficulties to develop harmonized standards for some product (transitions).
- EC new vision of standards.
- CPR revision.



European Commission (EC) new approach.

- **Following the court case C-613/14 ('James Elliot').**
 - Supply of rock aggregate by Irish Asphalt Limited to James Elliott Construction Limited.
- **EC understood that:**
 - hENs form part of EU law.
 - EC responsibility in initiating, managing and monitoring hENs
- **Consequently EC is now adopting a legal approach when assessing hENs.**
- **Result:**

	Candidate hENs offered	hENs cited in OJEU
2018	17	6
2019	19	0



CPR

- **2011 CPR (REGULATION (EU) No 305/2011 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL) has been strongly criticized.**
 - Not uniform assessment of CE marking.
 - Inside DOP and CE marking lack of fundamental information for the use of road restraint system.
 - Not clear definition of simplified procedures.
 - Approval of modified products without a clear approach.
- **Revision of CPR was needed.**



Update of European Standards. EN 1317

- In April 2022 the document:
 - “REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL. Laying down harmonised conditions for the marketing of construction products, amending Regulation (EU) 2019/1020 and repealing Regulation (EU) 305/2011” . CPR
- has been published
- This document contains the new vision of harmonized standards approval. Globally the old scheme is confirmed.
 - In 2024 activities for the revision of EN 1317 restarted.



EN1317 revision.

- Definition of essential characteristics (WW,DD,ASI....) by an “ad hoc” group.
- Definition of the “standardization request” to substitute the M111 mandate.
- Confirm or not CE marking (Germany and all the Nordic countries are against)
- Testing methods to be revised.
- Time needed: 10 years....
- What can be done:
 - Research to create knowledge:
 - IntoRoads
 - Trust
- Create TS or TR (Member state contribution)



Questions and proposals to TC: marco.anghileri@polimi.it - 2024-06-0		
1. Programme of work		
- CEN/TC 226 CIB on Draft Decision d758c/2024: adoption of the revision of CEN/TS 17342:2019 as PWI till 2024-07-25 (CEN/TC 226 N 2118). - A discussion started on future opportunities for the reliable use of virtual testing for VRSs in addition to physical crash testing. Opportunities might include the reduction and the number of physical crash test necessary or improvement in safety through supplementary verifications. - A discussion on the future update of vehicle characteristics is about to start in preparation for the next revision of the EN 1317. WG 1 was informed of the IntORoadS study on vehicle characteristics which is expected to provide data.		
2. CPR Acquis Fast Track Route		
During its last meeting WG 1 opened an initial discussion on the products to be covered and not covered in the future Standardization request in advance of development of national positions. Feedback on national positions is expected at the October WG 1 meeting.		
The following initial indicative information was proposed pending confirmation in October:		
<u>CE-marking</u>		
"Vehicle restraint systems" including:	Already CE marked	Already covered by M/111
• Road safety barriers including vehicle parapets?	Y	Y
• Crash cushions?	Y	Y
• Terminals?	N	N
• Transitions? (connections/ crash cushions / terminals? Depending on the length? Different assessment methods?...)	N	Y
• Removable barrier sections?	N	N
• Motorcycle road restraint systems? (possibly as part of the barrier CE-marking?)	N	N
<u>Non CE-marking</u>		
Products	Already CE marked	Already covered by M/111
Temporary barriers	N	N
Pedestrian restraint systems?	N	Y
Truck Mounted Attenuators?	N	N
<i>In-situ concrete barriers clarification needed on the future application of CE marking for these barriers with respect to the CPR revision</i>	Y/N	Y/N
<u>M/111</u>		
Products	Future CE marking	Comments
Vehicle restraint systems	Partial (see above)	CE marking needed for certain types of VRSs.
Crash cushions	Y	
Transitions	Y	
Barriers	Y	
Cables	N	Cables do not correspond to a type of VRS.
Parapets	Y/N	Description unclear-vehicle parapets included in barriers.
Pedestrian restraint systems including pedestrian bridge parapets	N	WG 1 is not aware of any request for the CE marking of pedestrian systems.



EN1317- 1

- **Contains:**
 - Terminology and general criteria for TT
 - Test site
 - Test Vehicles
 - Instrumentation
 - Severity Indices
- **“The range of possible vehicular impact scenarios in an on-road road restraint system is extremely large in terms of speed, approach angle, vehicle type, vehicle attitude, and other vehicle and road conditions. Consequently the actual on-road impacts which occur may vary considerably from the specific standard test conditions.”**

EN1317- 1. Vehicles

Table 1 — Vehicle specifications

MASS kg ±								
Total mass	900 ± 40	1 300 ± 65	1 500 ± 75	10 000 ± 300	13 000 ± 400	16 000 ± 500	30 000 ± 900	38 000 ± 1 100
Test inertial mass ^a	825 ± 40	1 300 ± 65	1 500 ± 75	10 000 ± 300	13 000 ± 400	16 000 ± 500	30 000 ± 900	38 000 ± 1 100
Including maximum ballast ^b	100	160	180	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
ATD installed	78 ± 4	Not required	Not required	Not required	Not required	Not required	Not required	Not required
DIMENSIONS m (Limit deviation ± 15 %)								
Wheel track (front and rear)	1,35	1,40	1,50	2,00	2,00	2,00	2,00	2,00
Wheel radius (unloaded)	Not applicable	Not applicable	Not applicable	0,46	0,52	0,52	0,55	0,55
Wheel base (between extreme axles)	Not applicable	Not applicable	Not applicable	4,60	6,50	5,90	6,70	11,25
CENTRE OF MASS LOCATION^{c,d} m								
Longitudinal distance from front axle (CGX) ± 10 %	0,90	1,10	1,24	2,70	3,80	3,10	4,14	6,20
Lateral distance from vehicle centre line (CGY)	± 0,07	± 0,07	± 0,08	± 0,10	± 0,10	± 0,10	± 0,10	± 0,10
Height above ground (CGZ):								
— Vehicle mass (± 10 %)	0,49	0,53	0,53	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
— Load (+ 15 %, - 5 %)	Not applicable	Not applicable	Not applicable	1,50	1,40	1,60	1,90	1,90
TYPE OF VEHICLE	Car	Car	Car	Rigid HGV	Bus	Rigid HGV	Rigid HGV	Articulated HGV
Number of axles ^e	1S + 1	1S + 1	1S + 1	1S + 1	1S + 1	1S + 1/2	2S + 2	1S + 3/4

^a Including load for heavy goods vehicles (HGV).

^b Including measuring and recording equipment.

^c The vehicle's centre of mass shall be determined when the ATD is not in the car.

^d The centre of mass of vehicles with two axes shall be determined in conformity with ISO 10392.

^e S: steering axle.



EN 1317: 900 kg





EN1317: 1.300 kg





EN1317: 1.500 kg





EN1317: 10.000 kg





EN1317: 13.000 kg





EN1317: 16.000 kg





EN1317: 30.000 kg





EN1317: 38.000 kg





EN1317-1. Severity indices definition.

- EN 1317 requires, to evaluate performances, to measure the following severity indices:
 - ASI
 - THIV
- Based on acceleration measured during the certification test on the vehicle CG.



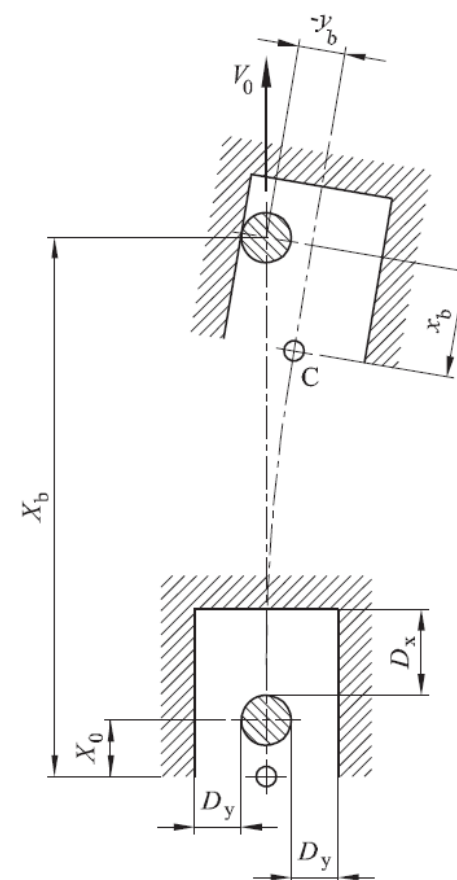
EN1317-1. ASI. Acceleration Severity Index

- “The index ASI is intended to give a measure of the severity of the vehicle motion for a person seated in the proximity of point P (CG) during an impact.”
 - Steps:
 - Measure three acceleration components of vehicle CG.
 - Evaluate Asi as:
- $$ASI(t) = \sqrt{\left(\frac{\bar{a}_x}{a_{x\lim}}\right)^2 + \left(\frac{\bar{a}_y}{a_{y\lim}}\right)^2 + \left(\frac{\bar{a}_z}{a_{z\lim}}\right)^2}$$
- ASI has been developed for rigid vehicles (re-entry capsule).
 - Influence of vehicle structure on ASI value.



EN1317-1. THIV

- **Thiv** is the velocity of a theoretical head that, during the motion of the car in contact with the road restraint system, is impacting the internal surface of the cockpit.





EN1317-2. Safety barriers.

- Longitudinal systems installed to divide opposite lanes or to protect the departure on a side of a road.
- Must contain and redirect all the vehicles, including large trucks, that are statistically significant on that particular section of road.
- Must contain large vehicles being also not aggressive with small cars.





EN1317-2. Definition of tests:

Table 1 — Vehicle impact test descriptions

Test	Impact speed km/h	Impact angle °	Total mass kg	Type of vehicle
TB 11	100	20	900	Car
TB 21	80	8	1 300	Car
TB 22	80	15	1 300	Car
TB 31	80	20	1 500	Car
TB 32	110	20	1 500	Car
TB 41	70	8	10 000	Rigid HGV
TB 42	70	15	10 000	Rigid HGV
TB 51	70	20	13 000	Bus
TB 61	80	20	16 000	Rigid HGV
TB 71	65	20	30 000	Rigid HGV
TB 81	65	20	38 000	Articulated HGV



EN 1317-2. Containment levels:

Table 2 — Containment levels

Containment levels			Acceptance test
Low angle containment	T1		TB 21
	T2		TB 22
	T3		TB 41 and TB 21
Normal containment	N1		TB 31
	N2		TB 32 and TB 11
Higher containment	H1		TB 42 and TB 11
	L1		TB 42 and TB32 and TB 11
	H2		TB 51 and TB 11
	L2		TB 51 and TB32 and TB 11
	H3		TB 61 and TB 11
	L3		TB 61 and TB32 and TB 11
Very high containment	H4a H4b		TB 71 and TB 11 TB 81 and TB 11
	L4a L4b		TB 71 and TB32 and TB 11 TB 81 and TB32 and TB 11

NOTE 1 Low angle containment levels are intended to be used only for temporary safety barriers. Temporary safety barriers can also be tested for higher levels of containment.

NOTE 2 A successfully tested barrier at a given containment level should be considered as having met the containment requirements of any lower level, except that N1 and N2 do not include T3, H-Levels do not include L-Levels and that H1, ..., H4b do not include N2.

NOTE 3 Because testing and development for very high containment safety barriers in different countries has taken place using significantly different types of heavy vehicles, both tests TB 71 and TB 81 are included in the standard at present. The two containment levels H4a and H4b should not be regarded as equivalent and no hierarchy is given between them. The same holds for the two containment levels L4a and L4b.

NOTE 4 The performance of Containment Classes L is enhanced in respect to the corresponding H classes by the addition of test TB 32.



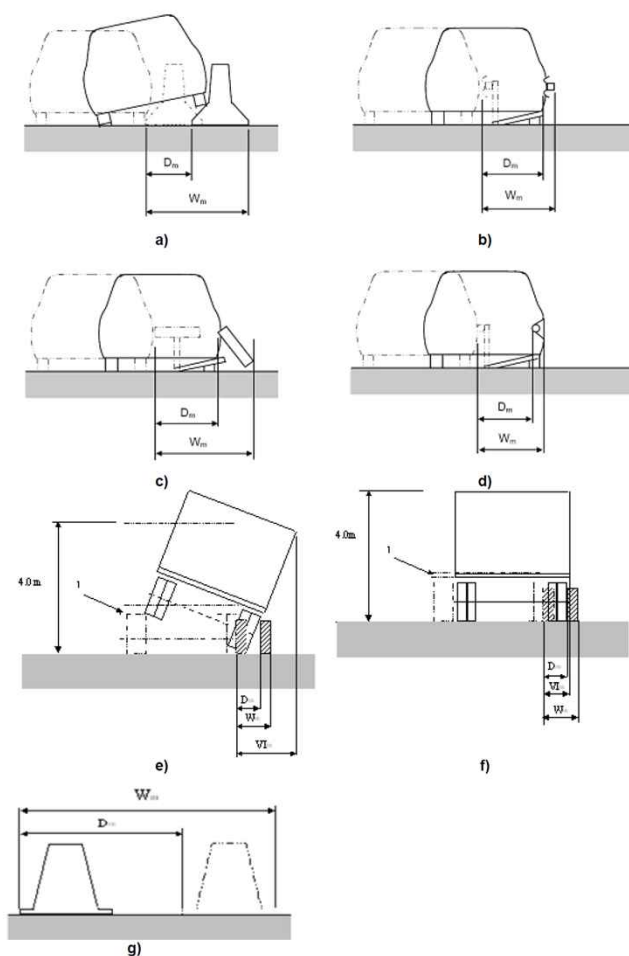
EN1317-2. Severity measure:

Table 3 — Impact severity levels

Impact severity level	Index values		
A	$ASI \leq 1,0$	and	$THIV \leq 33 \text{ km/h}$
B	$ASI \leq 1,4$		
C	$ASI \leq 1,9$		



EN1317-2. Barrier deformation and vehicle intrusion.





EN1317-2. working width and vehicle intrusion.

Table 4 — Levels of normalised working width

Classes of normalised working width levels	Levels of normalised working width m
W1	$W_N \leq 0,6$
W2	$W_N \leq 0,8$
W3	$W_N \leq 1,0$
W4	$W_N \leq 1,3$
W5	$W_N \leq 1,7$
W6	$W_N \leq 2,1$
W7	$W_N \leq 2,5$
W8	$W_N \leq 3,5$
NOTE 1 In specific cases, a class of working width level less than W1 may be specified.	
NOTE 2 The dynamic deflection, the working width and the vehicle intrusion allow determination of the conditions for installation of each safety barrier and also to define the distances to be provided in front of obstacles to permit the system to perform satisfactorily.	
NOTE 3 The deformation depends on both the type of system and the impact test characteristics.	

Table 5 — Levels of normalised vehicle intrusion

Classes of normalised vehicle intrusion levels	Levels of normalised vehicle intrusion m
VI1	$VI_N \leq 0,6$
VI2	$VI_N \leq 0,8$
VI3	$VI_N \leq 1,0$
VI4	$VI_N \leq 1,3$
VI5	$VI_N \leq 1,7$
VI6	$VI_N \leq 2,1$
VI7	$VI_N \leq 2,5$
VI8	$VI_N \leq 3,5$
VI9	$VI_N > 3,5$
NOTE 1 In specific cases, a class of vehicle intrusion level less than VI1 may be specified.	
NOTE 2 The dynamic deflection, the working width and the vehicle intrusion allow determination of the conditions for installation of each safety barrier and also to define the distances to be provided in front of obstacles.	



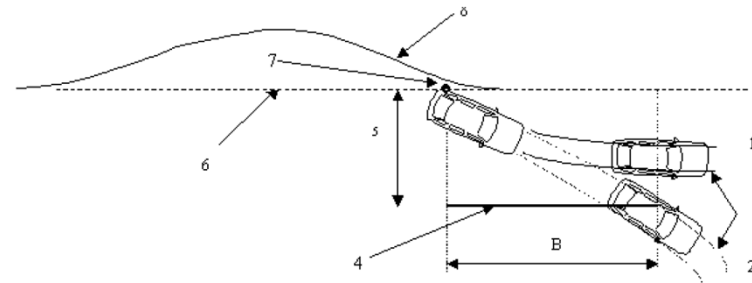
EN1317-2. Criteria.

- The safety barrier shall contain the vehicle without complete breakage of any of the principal longitudinal elements of the system.
- Elements of the safety barrier shall not penetrate the passenger compartment of the vehicle.
- Foundations, ground anchorages and fixings shall perform according to the design of the safety barrier.
- During and after the impact, no more than one of the wheels of the vehicle shall completely pass over or under the safety barrier.
- The vehicle shall not roll over (including rollover of the vehicle onto its side) during or after impact



EN1317-2. Criteria

- **Exit box.**



- **Families of barriers. Simplified procedure for barriers with different containment class but made with the same components.**



EN1317-2. Critical points.

- **Length of installation:**
 - The length of the safety barrier tested shall be sufficient to demonstrate the full performance characteristic of any longer installation.
- **Deck loads (EN1317-1):**
 - The vehicle restraint system's manufacturer shall provide details of the maximum forces which can be transmitted by anchorages to the foundation. Such maximum forces shall be those generated at the ultimate failure of the vehicle restraint system by any conceivable impact, and shall normally be greater than those that can be measured during the impact. Hence the ultimate forces which can be transmitted to the bridge deck shall be obtained by calculations or by ad-hoc tests.



Topics to be discussed for the EN1317 revision.

- CE marking.
- Essential characteristics.
- Vehicles.
- Testing conditions (speed/angle...)
- Evaluation criteria (ASI/THIV, trajectories...)
- Use of virtual testing.
- Intoroads activities:
 - Vehicle database
 - Round robin on rigid barrier
 - Round robin on deformable barrier



IntOroads activity. Round Robin.

- **Round Robin 1999-2004**
 - **RR1:**
 - Interlaboratory tests on a single rigid barrier with the same vehicle
 - Interlaboratory tests on a single rigid barrier with different vehicles
 - **RR2:**
 - Interlaboratory test on a single N2 barrier with different vehicles
- **Laboratories involved:**
 - TRL-CIDAUT-LIER-AUTOSTRADA(AISICO)-HUT-BAST



INTOROADS
International Organization
for Road Safety



1999-2004 Round Robin

- **Scope:**
 - Verify repeatability of tests.
 - Identify improvements for EN1317.
- **Results:**
 - PHD deletion from road restraint system assessment.
 - Introduction of class C for ASI.
 - Improving of testing procedures.





1999-2004 Round Robin

- Round robin was more than 20 years ago.
 - New vehicles are giving different results?
 - What about the 1500 kg car defined in EN1317? This vehicle has never been tested with the RR barrier..
 - What is the influence of different angle and/or speed?
 - If we are going to increase the angle/speed, severity evaluation limits are still valid?
- Round robin activity is one of most relevant initial activity that has been performed.
- Scope: provide data for the revision of EN1317.



IntOroads restarted “round robin” testing.

- Rigid barrier (800 mm height).
- TB11: 900 kg, 100 km/h, 20°
- TB32: 1500 kg, 110 km/h, 20°
- Tests already performed by IntOroads in AISICO:
 - 8 Tb11 tests
 - 3 Tb32 tests
 - 1 TB11 at 25°
 - 2 TB32 at 25°
 - 1 TB32 at 130 km/h
- Very interesting results already available.

Test Level	Vehicle		Actual impact conditions		
	Model	Year	Impact speed [km/h]	Impact angle [deg]	Mass [kg]
TB11	Nissan MICRA	1999	102.5	20	930.5 ^(*)
TB11	Fiat UNO	1992	100.1	20.1	861.0 ^(*)
TB11	Nissan MICRA	1998	100.1	20	863.0 ^(*)
TB11	Nissan MICRA	2002	102.9	20	919.5 ^(*)
TB11	Ford KA	1999	100	20	933.3 ^(*)
TB32	Volvo 850 GLT	1995	110.2	20.1	1516.2
TB11	Ford KA	1997	102.5	20	928.3 ^(*)
TB32	Volvo V70	1998	110	20.2	1528.6
TB11	Ford KA	2002	100.4	20	939.9 ^(*)
TB11	Toyota AYGO	2013	100.3	20	934.3 ^(*)
TB32	Volvo V70	2000	110.3	20	1565.7
TB11_25	Ford KA	1998	100	25	936.5 ^(*)
TB11_25	Nissan MICRA	2000	100.2	25	922.0 ^(*)
TB32 130km/h	Volvo V70	2000	130	20	1557.3
TB32_25	Volvo V70	2002	110	25	1536.8
TB32_25	Volvo V70	2002	110.1	25	1564.8

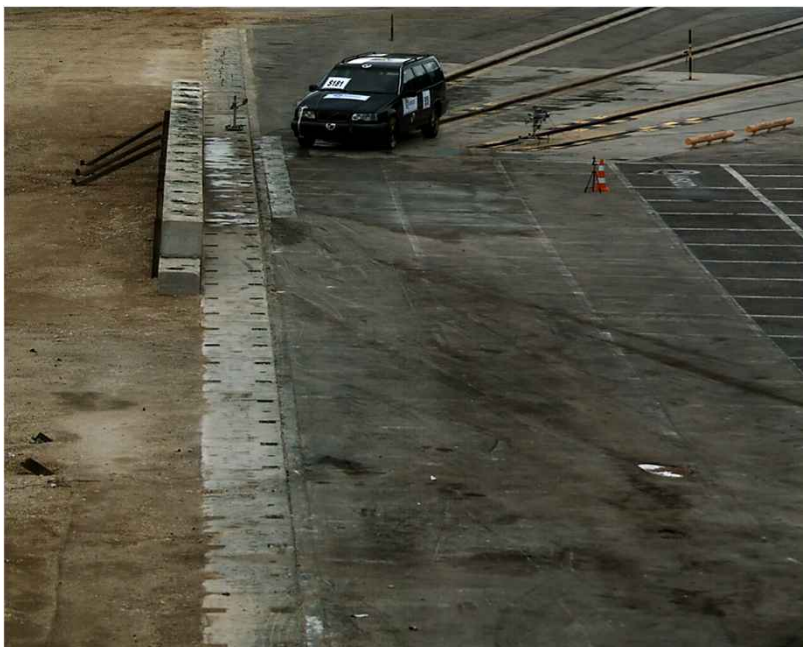


Round Robin



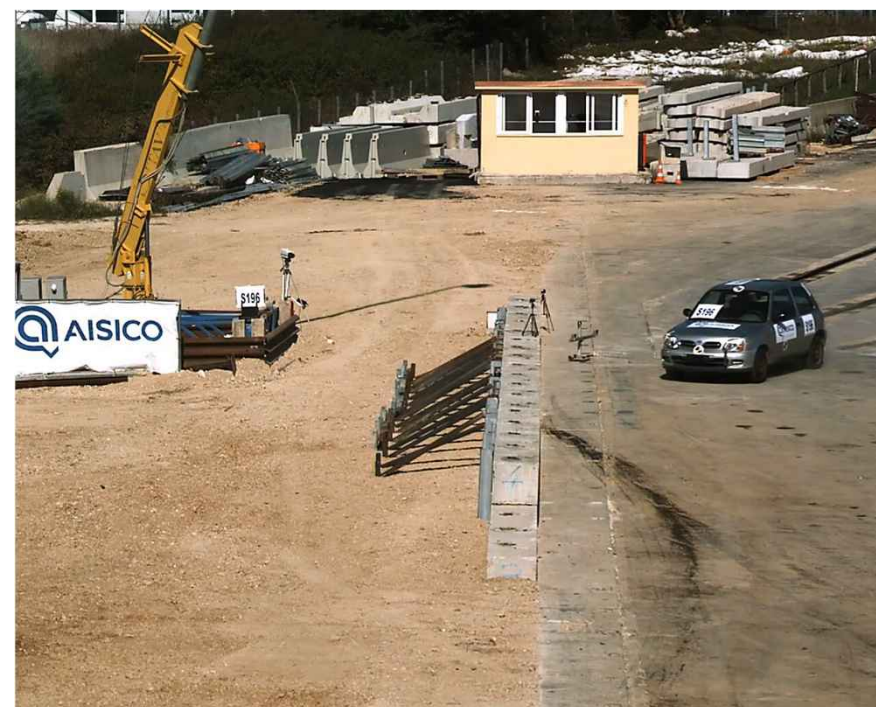


Round Robin TB32



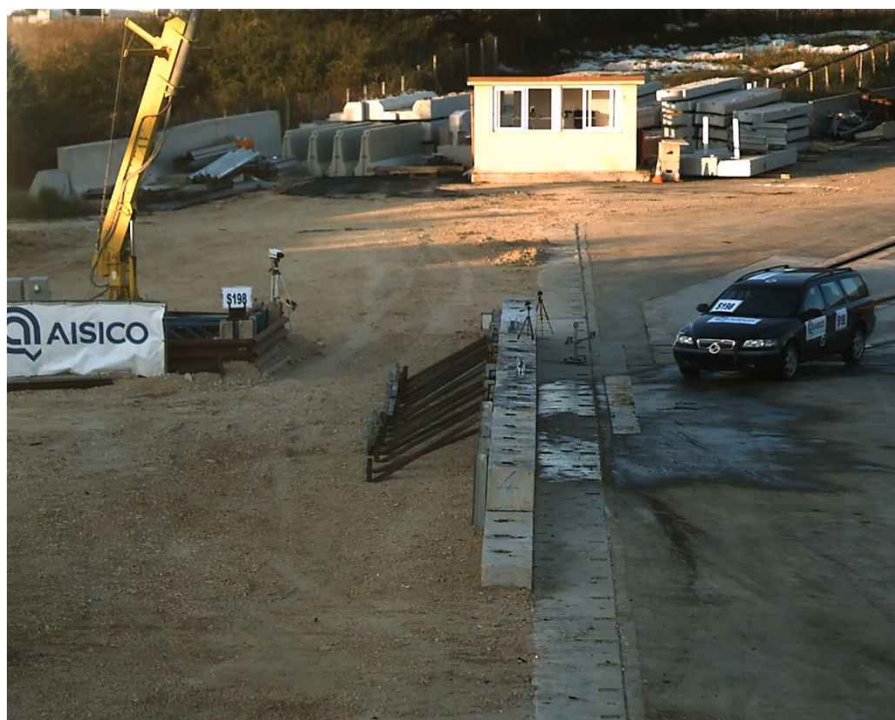


Round Robin TB11 25°



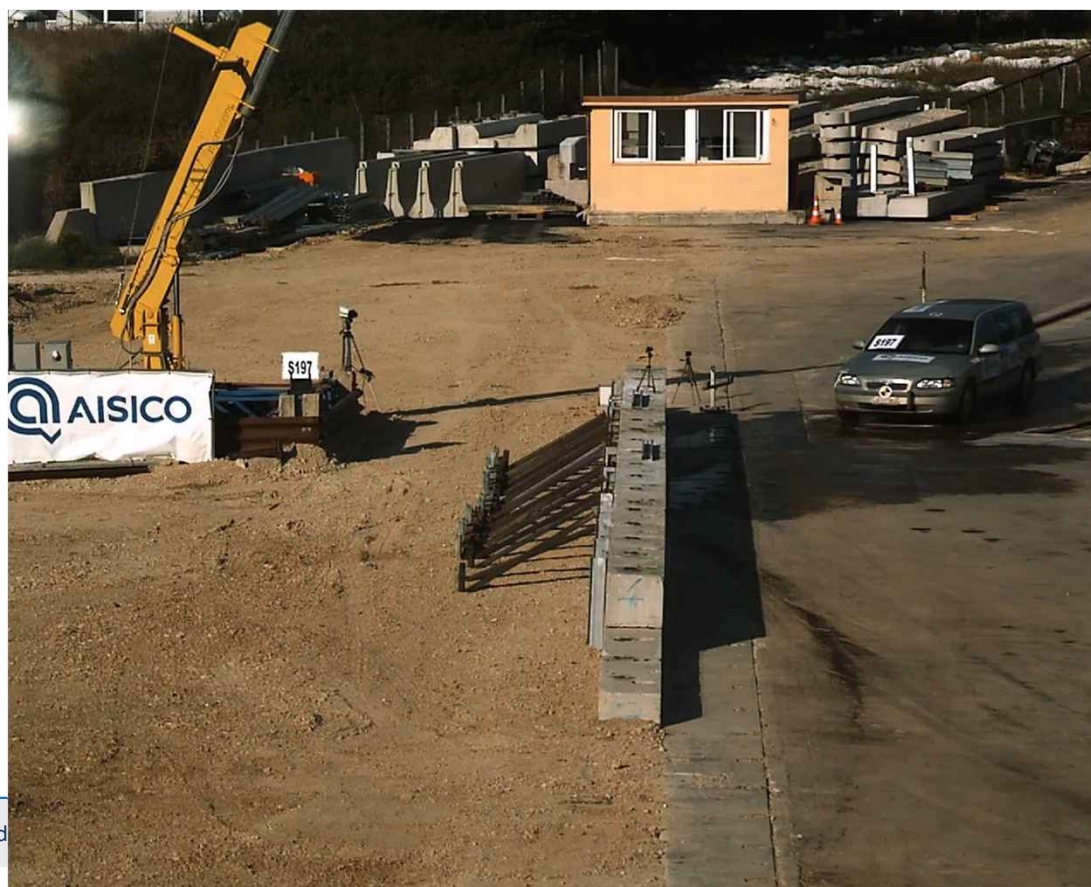


Round Robin TB32 25°





Round Robin TB32 130 km/h





Results.

- TB11 tests results.

Test n.	Test Level	Vehicle		Actual impact conditions			Severity indices	
		Model	Year	Impact speed [km/h]	Impact angle [deg]	Mass [kg]	ASI [-]	THIV [km/h]
S176	TB11	Nissan MICRA	1999	102.5	20	930.5 ^(*)	2.1	32
S177	TB11	Fiat UNO	1992	100.1	20.1	861.0 ^(*)	1.8	29
S178	TB11	Nissan MICRA	1998	100.1	20	863.0 ^(*)	2	31
S179	TB11	Nissan MICRA	2002	102.9	20	919.5 ^(*)	2	31
S180	TB11	Ford KA	1999	100	20	933.3 ^(*)	2.3	35
S182	TB11	Ford KA	1997	102.5	20	928.3 ^(*)	2	31
S183	TB32	Volvo V70	1998	110	20.2	1528.6	2.1	29
S184	TB11	Ford KA	2002	100.4	20	939.9 ^(*)	2.1	32
S185	TB11	Toyota AYGO	2013	100.3	20	934.3 ^(*)	2.3	33



TB11 test results.

- Results of TB11 at 25°.

Test Level	Vehicle		Actual impact conditions			Severity indices	
	Model	Year	Impact speed [km/h]	Impact angle [deg]	Mass [kg]	ASI [-]	THIV [km/h]
TB11_25	Ford KA	1998	100	25	936.5 ^(*)	2.6	40
TB11_25	Nissan MICRA	2000	100.2	25	922.0 ^(*)	2.5	39



TB11 test results

- Current ASI scatter cannot be accepted as an acceptance criteria for certification.
- ASI value with recent cars is about 20% higher than the maximum allowable value (1.9).
- Good news:
 - Test houses are using few models of vehicles. The real scatter should be smaller. But if we use EN1317-1 table 1 the differences are large.
 - For lower ASI value the scatter is less.



Results.

- TB32 tests on Round Robin barrier:
- Never tested before.

Test Level	Vehicle		Actual impact conditions			Severity indices	
	Model	Year	Impact speed [km/h]	Impact angle [deg]	Mass [kg]	ASI [-]	THIV [km/h]
TB32	Volvo 850 GLT	1995	110.2	20.1	1516.2	2.1	29
TB32	Volvo V70	1998	110	20.2	1528.6	2.1	29
TB32	Volvo V70	2000	110.3	20	1565.7	2.3	36



Results.

- TB 32 at 25°

Test Level	Vehicle		Actual impact conditions			Severity indices	
	Model	Year	Impact speed [km/h]	Impact angle [deg]	Mass [kg]	ASI [-]	THIV [km/h]
TB32	Volvo 850 GLT	1995	110.2	20.1	1516.2	2.1	29
TB32	Volvo V70	1998	110	20.2	1528.6	2.1	29
TB32	Volvo V70	2000	110.3	20	1565.7	2.3	36
TB32_25	Volvo V70	2002	110	25	1536.8	2.4	40
TB32_25	Volvo V70	2002	110.1	25	1564.8	2.5	41



Results.

- TB32 at 130 km/h.

Test Level	Vehicle		Actual impact conditions			Severity indices	
	Model	Year	Impact speed [km/h]	Impact angle [deg]	Mass [kg]	ASI [-]	THIV [km/h]
TB32	Volvo 850 GLT	1995	110.2	20.1	1516.2	2.1	29
TB32	Volvo V70	1998	110	20.2	1528.6	2.1	29
TB32	Volvo V70	2000	110.3	20	1565.7	2.3	36
TB32 130km/h	Volvo V70	2000	130	20	1557.3	2.5	39
TB32_25	Volvo V70	2002	110	25	1536.8	2.4	40
TB32_25	Volvo V70	2002	110.1	25	1564.8	2.5	41



TB 32 tests results

- TB32 tests on Round Robin barrier average ASI/THIV value: 2.16/30 (limits 1.9, 33)
- TB32 at 25° test on Round Robin barrier average ASI/THIV value: 2.45/40 (limits 1.9, 33)
- TB32 at 130 km/h on Round Robin barrier ASI/THIV value: 2.5/39 (limits 1.9, 33)
- Notes:
 - Considering EN1317 all the above tests are failed.
 - Considering safety, are these tests pass or fail?
 - Fail:
 - Round robin barrier is dangerous.
 - Pass:
 - EN1317 criteria must be revised....
 - Can TB32 test at 25° or 130 km/h be used to assess road restraint systems?



Findings.

- The discussion for EN1317 new vehicles or new speed/angle must include the discussion of severity evaluation methods.
- Possible solutions:
 - Define a single vehicle for testing.
 - Scatter reduced.
 - ASI limits must be revised.
 - Vehicle definition and ASI limits must be revised every xx years to reflect existing fleet.
 - Modify severity indices.
 - Adopt a criteria not based on acceleration peaks (ASI) but on components of velocities (trajectory).
 - Different from THIV.
 - Use of trolley or boogie..



Conclusion.

- EN 1317 revision restarted.
- Research is needed to avoid the risk of having a non reliable EN1317.
- Road authorities, infrastructures managers, producers, notified bodies, test (real and virtual) houses, research centres must actively participate to the activities for the revision.
- Since the new standard will require 10 years of activities, road authorities must be active (German example).



autostrade
per l'Italia



GRAZIE PER L'ATTENZIONE

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