European Transport Safety Council

POSITION PAPER

Revision of the regulation on protection of pedestrians and other vulnerable road users 78/2009

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Contents

1 Introduction 3
2 Background 5
3 Regulated car design can help mitigate serious pedestrian injuries 7
4 ETSC priorities for the testing procedures 9
4.1 Pedestrian upper leg and pelvis to bonnet leading edge protection 9
4.2 Pedestrian adult head to windscreen protection 10
4.3 Automated Emergency Braking for pedestrians 12
5 Cyclist safety 14
Acknowledgments 15

1 Introduction

The European Transport Safety Council (ETSC) welcomes the initiative of the European Commission to review the legislation on the protection of pedestrians and other vulnerable road users (VRUs). It is of paramount importance that the EU takes steps to improve the safety of this often neglected category of road users.

In 2013, 5542 pedestrians and 2002 cyclists were killed on European Union roads[1]. As more car occupant deaths are prevented every year due to better in-vehicle protection, the decrease in the number of vulnerable road users' deaths and serious injuries has not followed the same pace[2]. Figure one highlights this difference. Thus there is an urgent need to further improve vehicle crash design for those outside of the vehicle.

Different vehicle factors can influence impact severity between motor vehicles and cyclists or pedestrians, the most important being speed of travel, vehicle mass and the level of crash protection provided by the vehicle[3]. Pedestrian-friendly car fronts resulting from regulations are a key element of the EU's road safety framework. Pedestrians are the most numerous and the most vulnerable of all road users and, while presenting no danger on the road themselves, they have no protection. Pedestrians represent around 21% of total EU (28) road traffic deaths[4], while cyclists account for 8% of all road deaths, but big disparities exist between European countries and the share can be higher in countries where cycling is more predominant[5]. There is also a high level of underreporting of collisions involving pedestrians and cyclists[6]. Cars are the most frequent collision partner with VRUs[7] and the majority of pedestrians and cyclist fatalities were caused by collisions with cars, 68% and 52% respectively. Also, most pedestrian and cyclist fatalities occur on urban roads, 69% and 56% respectively[8].

ETSC argues that both passive and active in-vehicle safety have an important role in

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1 ETSC (2015) PIN Flash Report 29 Making Walking and Cycling on Europe's Roads Safer on Vulnerable Road Users http://etsc.eu/making-walking-and-cycling-on-europes-roads-safer-pin-flash-29/

2 Ibid.

3 DaCoTA (2013) Vehicle Safety

4 European Commission (2015) Road Safety Vademecuum

5 Ibid.

6 ETSC (2015) PIN Report on Vulnerable Road Users

7 Otte, D., Jansch, M., Haasper, C. (2010) Injury protection and accident causation parameters for vulnerable road users based on German In-depth Accident Study GIDAS, Accident Analysis and Prevention 44 (2012) 149-153

8 http://www.europarl.europa.eu/RegData/etudes/STUD/2015/563415/IPOL_STU(2015)563415_EN.pdf

reducing the number of pedestrian and cyclist collisions.

In light of the new EC Report accompanying the Commission Staff working Document COM (2016) 787[9], ETSC supports the proposal to mandate the head to windscreen/A-pillar test. Many serious pedestrians and cyclists head injuries arise from impact with windscreen. This will incentivise the industry to change the design of the windscreen and A-pillars or provide airbags. Some manufacturers are already providing airbags for this purpose.

ETSC deeply regrets however that the Commission text does not mandate the upper leg form to bonnet leading edge test, a crash test critical to improving pedestrian protection.

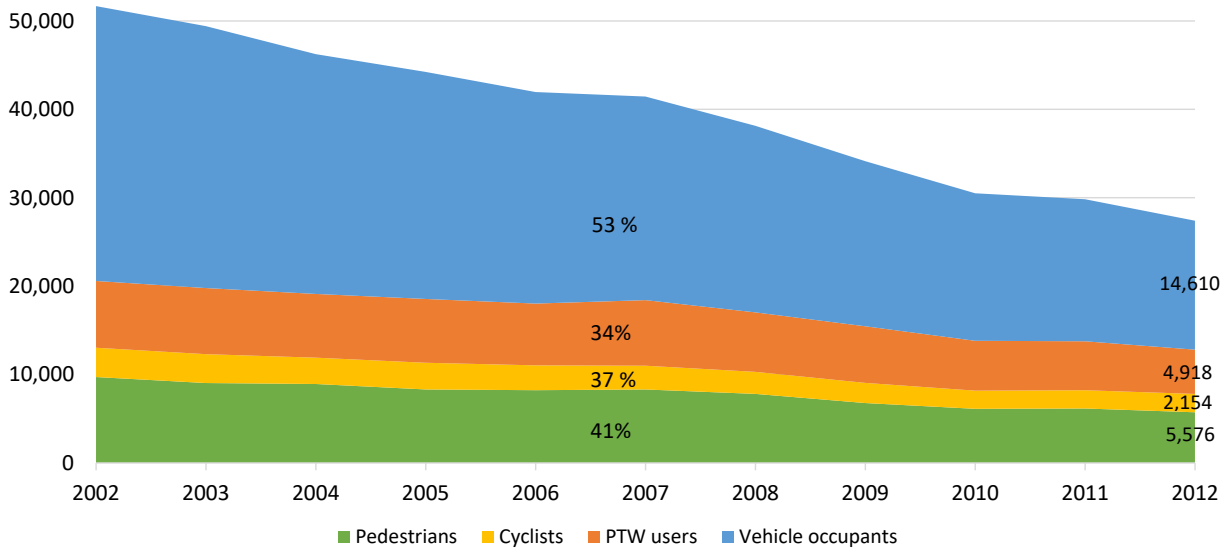

Fig. 1 Reduction in road deaths since 2002 for cyclists, PTW, pedestrians and other road users[10].

[9] http://ec.europa.eu/DocsRoom/documents/20508/attachments/2/translations/
[10] Ibid.

2 Background

Pedestrian protection measures on cars are there for when a collision occurs. Collision avoidance technology will reduce the number of collisions but it will not eliminate them all. In the cases where collision avoidance systems are able to reduce the impact speed, they will complement but not replace the need for pedestrian protection through vehicle deformation.

As the EU has exclusive competence on vehicle safety measures and vehicle type approval under Article 114 of the EU treaty, this legally-binding tool represents one of the most direct and effective measures the EU has at its disposal to further reduce deaths and injuries on the road. Regulation 78/2009 is the only element in European legislation ensuring passive safety standards requirements that lead to less aggressive car fronts for pedestrians and cyclists.

The review will require bold action to ensure that road deaths continue to fall, and that vehicle safety improvements are not limited to only reducing risks for car occupants.

For car occupants, protection levels have been set to provide protection for a much higher proportion of potential casualties than the current pedestrian Regulation. ETSC is aware that, unfortunately, the level of pedestrian protection that can be provided by improvements to the vehicle's front cannot match occupant protection for a number of reasons, principally due to the feasibility of providing sufficient crush depth to protect VRUs above 40 km/h. Providing pedestrian protection by vehicle deformation above this speed becomes rapidly more onerous. Avoidance systems that in some cases can prevent the impact or reduce the vehicle's speed before impact should be used to increase the proportion of pedestrians protected, not as a reason to remove protection.

The European Commission published its first Milestone towards a Serious Injury Strategy in March 2013. In 2014, at least 26,025 people were killed in the European Union as a consequence of road collisions[11]. In the same year, more than 199,000 people were recorded by the police as seriously injured[12]. ETSC believes the Pedestrian Protection Regulation should take into account this renewed focus and address passive vehicle safety measures that target reducing serious injuries among road users.

Data from Euro NCAP shows that, as the legislation started to come in, the manufacturers

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11 ETSC (2014) 8th PIN Annual Report Ranking EU Progress on Road Safety.
12 Ibid.

started to respond. Without EU legislation on pedestrian protection, we would not have achieved such progress in the past. The legislation has created the base line that has allowed Euro NCAP to continue to push. There is evidence that the market does not deliver on its own in this domain.

3 Regulated car design can help mitigate serious pedestrian injuries

ETSC argues for the adoption of testing procedures that would lead to improved vehicle design for the purpose of pedestrian and cyclist protection.

Regulation 79/2009 asked Member States Type-Approval authorities to monitor the results of two type of tests in order to assess the feasibility for compulsory mandating. The monitoring concerns the protection assessed by an upper leg form to bonnet leading edge test and an adult headform to windscreen test.

The results[13] of the type-approval monitoring tests show that only one vehicle model out of all the cars currently approved in Europe meets the limits proposed by the two monitoring testing requirements with regard to the protection of pedestrians and vulnerable road users[14]. The same report asserts that the levels suggested for the upper legform test are more stringent for current vehicle designs than those for the adult headform meaning that more vehicles would meet the headform limit than the upper legform limit[15]. An update of these tests is clearly overdue.

German and Swedish research into the correlation between EuroNCAP testing procedures scores and reduction of pedestrian deaths and serious injuries shows that the higher the EuroNCAP pedestrian protection rating, the more chances of survivability. A study from the German Federal Highway Research Institute (BASt) found a significant correlation between high pedestrian protection ratings and injury outcomes in a sample of 27 143 pedestrian to car collisions. Comparing a vehicle scoring 5 points and one scoring 22 points, pedestrians' probability of fatal injury is reduced by 35% and of serious injury by

[13] Results refer to 323 vehicle types (vehicle classes ranging from small city cars or electric super mini to large luxury vehicles and grand tourer sports and supercars) in Hynd, D., et al. (2015) Benefit and Feasibility of a Range of New Technologies and Unregulated Measures in the fields of Vehicle Occupant Safety and Protection of Vulnerable Road Users, Transport Research Laboratory
[14] Hynd, D., et al. (2015) Benefit and Feasibility of a Range of New Technologies and Unregulated Measures in the fields of Vehicle Occupant Safety and Protection of Vulnerable Road Users, Transport Research Laboratory. Pg.31
[15] Ibid.

16%[16].

Another study correlating EuroNCAP pedestrian protection scores and injury outcomes in car-to-pedestrian and car-to-cyclist injury collisions, found that large reductions in injury severity for all levels of injury can be achieved – particular for MAIS2+ and MAIS3+ as well as in the risk of permanent medical impermanent[17]. The reduction was most evident for head injuries where the risk of sustaining an AIS2+ injury was reduced by 90% for high performing cars (3 to 4 EuroNCAP stars). Also for head injuries leading to medical impairment, the risk was reduced by approximately 80%-90%. With regard to leg injuries, and injuries to other body regions, the reduction was also significant.

The study also showed that pedestrian friendly car fronts can yield benefits for cyclists too, although the injury reduction was slightly lower with a benefit for cyclists being most evident in the case of cars rated between medium (2 star) and high performing cars, and especially for head injuries. It concluded that since pedestrian protection requires only minor additional technology in the design phase, the cost could be considered low compared to other vehicle safety systems relative to their benefits.

[16] Pastor, C. Correlation between pedestrian injury severity in real-life crashes and Euro NCAP pedestrian test results. Federal Highway Research Institute (BASt), Germany. Paper Number 13-0308

[17] Strandroth et al. (2014) Correlation between Euro NCAP Pedestrian Test Results and Injury Severity in Injury Crashes with Pedestrians and Bicyclists in Sweden, Stapp Car Crash Journal 58.

4 ETSC priorities for the testing procedures

4.1 Pedestrian upper leg and pelvis to bonnet leading edge protection

Unfortunately, the European Commission is not considering this test and it is most likely that it will be removed from current regulations.

The upper leg form to Bonnet Leading Edge (BLE) test was developed on the basis of accident data and reconstruction tests involving vehicles that generally had squarer profiles than the more rounded profiles of car designs since the year 2000. However, there is some evidence in the GIDAS data that bonnet leading edge heights of cars introduced after 2005 are higher than those before the year 2000. As underlined in previous years[18], it is not appropriate to have an unregulated pedestrian impact area, particularly since the bonnet leading edge makes significant contact in most pedestrian accidents. The injury potential of the BLE depends on the vehicle shape as well as the BLE stiffness. The increase and popularity[19] of larger vehicles such as off-road vehicles, soft-roaders, large pick-up trucks, and sports utility vehicles is likely to increase the risk of mid-body injuries, as many of these vehicles have higher or more prominent BLEs. Also, due to the higher bonnet, there is greater potential to see an increase in the number of thorax injuries.

The BLE test is currently performed only for monitoring purposes by using an upper legform impactor representing the adult upper leg and pelvis to record bending moments and forces caused by the contact with the bonnet leading edge. ETSC has advocated since 2008 that the test should be mandated. Although considerable reduction in the injuries caused by the BLE of cars of more modern design has been reported[20], injuries to the pelvis, hip and femur are still prevalent in hospital admissions[21]. GIDAS research on injuries and collision parameters based on real-world collisions, found that there was no significant difference between old and new vehicles in relation to the injury rate of all other body regions, apart from head injuries (where contact with newer cars results now

18 ETSC (2008) Pedestrian Protection Position Paper
19 ACEA (2014) http://www.acea.be/uploads/statistic_documents/20140225_4x4_1312.pdf
20 Lube et al. (2011) in TRL (2014), in Reference.
21 TRL (2014) Draft Impact Assessment Report for GSR (Update for GSR Report 2015)

in less serious injuries)[22].

One option put forward by the TRL study to improve the existing test is to revise the conditions without referencing look-up curves (two options are given here: the approach proposed by Snedeker et al. (2005) or the Euro NCAP implementation protocol).

Recommendations to the EU:

- Mandate the bonnet leading edge test according the latest 2015 EuroNCAP pedestrian testing protocol.
- Mandate an evaluation study to investigate the type of injuries resulting from vehicle to pedestrian and cyclist collisions.
- Ask national type-approval authorities that the results are communicated more frequently and results are made available every three years.

4.2 Pedestrian adult head to windscreen protection

The second monitoring test is designed to observe the impact of an adult headform to the windscreen and the protection offered by vehicles in this area. The area in the centre of the windscreen is now considered to be the safest one but at the same time many head injuries do arise from this contact, and there is little agreement among manufacturers over the method by which this should be tested. Currently this test is performed at 35 km/hour using child and adult headform impactors.

Severe and fatal head injuries in pedestrians are most frequently caused by head-windscreen impacts[23]. This area was found to be the most frequent source of head injury in 543 accident cases investigated within the GIDAS database[24].

GIDAS research on injuries and collision parameters found that pedestrians suffer head injuries less in collisions with newer vehicles in comparison to older cars[25]. The same study found that 53.2% of pedestrians suffer head injuries at impact speeds below 40 km/h

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[22] Dietmar, O., Birgitt, W., (2012) Comparison of Injury Situation of Pedestrians and Bicyclists in Car Frontal Impacts and Assessment of Influence Parameter on Throw Distance and Injury Severity.

[23] Yang, J.: Review of injury biomechanics in car-pedestrian collisions, report to European Passive Safety
Network, Gothenburg, Sweden (2002) in Otte, D. , Thorsten, F., Birgitt, W., (2015) Wrap Around Distance WAD of Pedestrians and Bicyclists and the Relevance as Influence Parameter for Head Injuries (draft)

[24] Otte D, Severity and mechanism of head impacts in car-to-pedestrian accidents, IRCOBI, 1999

[25] Dietmar, O., Birgitt, W., (2012) Comparison of Injury Situation of Pedestrians and Bicyclists in Car Frontal Impacts and Assessment of Influence Parameter on Throw Distance and Injury Severity.

and the frequency increases to 85.3% at speeds above 40 km/h[26].

According to a TRL study[27], approximately 15% of all pedestrian injuries occur from the contact with the windscreen of the vehicle but 80% of serious and fatal pedestrian injuries are to the head. Furthermore, 80% of head contacts are with the vehicle's windscreen.

According to TRL, the adult headform to windscreen monitoring test results are different from the upper legform to bonnet leading edge tests in that far more cars would pass the threshold value in the Regulation. The results of the tests should be compared with the possible target of HPC 1,000 (HIC_{15}). Using this criterion, 124 of the 323 vehicles (38%) tested would have met the requirements. However, only 271 of the vehicles with monitoring test data had adult headform to windscreen results. Therefore, of the vehicles with test data, 46% would have met the requirements. Data from the monitoring tests supports the principle that more can be done to improve safety in the windscreen area.

From the European Commission's report[28], we know that the Commission is considering to:

- Extend the adult head impact zone
- Make mandatory for M1 and N1 vehicles (that are derived from M1)
- Coupled with AEB application

May consider introduction of reduced impact speeds with AEB pedestrian and cyclist detection (for windscreen and cyclist detection (for windscreen and A-pillar testing only)

- 01/09/2024 new types
- 01/09/2026 all new vehicles
- All N1 vehicles 2-year off-set to the above dates

ETSC experts strongly believe that reducing impact speeds of testing procedures for cars equipped with AEB pedestrian and cyclist detection is not beneficial for this road user category – especially since the introduction date for this type of AEB is set for 2024 (pedestrians) 2026 (cyclists).

Nobody suggests that speed limits could be raised for cars offering pedestrian protection

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26 Ibid.
27 Hynd, D., et al. (2015) Benefit and Feasibility of a Range of New Technologies and Unregulated Measures in the fields of Vehicle Occupant Safety and Protection of Vulnerable Road Users, Transport Research Laboratory.
28 http://ec.europa.eu/DocsRoom/documents/20508/attachments/2/translations/

or where high friction road surfaces exist, as these would compensate for other protection measures so why accident avoidance should be treated differently? Casualty reduction requires the application of different measures that are able to complement each other, rather than replace, so providing increased protection. ETSC believes that the provision of accident avoidance technologies should have no influence on the requirement to provide pedestrian protection. Hopefully, they will increase the relatively small proportion of pedestrians for whom protection can be provided.

Recommendations to the EU:

- Mandate the adult headform to windscreen protection test.
- Mandate an evaluation study to investigate the type of injuries resulting from vehicle to pedestrian and cyclist collisions and update the existing test.
- Update the headform to windscreen test, adjusting the impact speed to at least 40km/h, a level appropriate to real life collision circumstances.
- Ask type-approval authorities that the results are communicated more frequently and results be made available every 3 years.
- No vehicle design concessions should be made by type-approval authorities for vehicles equipped with collision avoidance technologies.

4.3 Automated Emergency Braking for pedestrians

ETSC stresses that no vehicle design concessions should be made by type-approval authorities for vehicles equipped with Automatic Emergency Braking, as the system should be complementary and not a substitute for passive safety. ETSC is calling for the extension of AEB to all vehicle types within the context of the Revision of the General Safety Regulation[29].

Driver assistance systems and in-vehicle safety technology will not prevent all vehicle to VRU collisions. Even if technologies such as Automatic Emergency Braking (AEB) are effective at saving lives and preventing MAIS 3+ outcomes, many pedestrians will still be struck at speeds above 20 km/h.

Furthermore, ETSC is concerned about cyclists, and it is unknown how well current systems (either pedestrian or standard AEBS systems) detect these and are able to prevent

[29] ETSC (2015) Position Paper on the Revision of the General Safety Regulation 2009/661

deaths and injuries[30]. Therefore, secondary safety through vehicle design remains extremely important to reduce vulnerable user MAIS 2 and MAIS 3+ injuries.

Recommendations:

- Introduce Autonomous Braking Systems which operate at all speeds, as well as those that can detect pedestrians and cyclists.
- Detect cyclist when approaching the bigger vehicle from the front.

[30] Hynd, D., et al. (2015) Benefit and Feasibility of a Range of New Technologies and Unregulated Measures in the fields of Vehicle Occupant Safety and Protection of Vulnerable Road Users, Transport Research Laboratory

5 Cyclist safety

Cyclist injuries from collision with cars is an often-neglected topic. The review of the Regulation should consider investigating injury mechanisms for cyclist and car collisions. New research from the German Insurers Association argues that compared to pedestrians, the risk of severe head injuries for cyclists is much higher. Often, the corresponding figure for the same collision speed of the car is twice as high as for the pedestrian. The design of the vehicle front plays a major role in the severity of the injury[31]. A recent study found that impactor testing as currently done for pedestrians is basically a suitable methodology, but adjustments are needed to account for some differences between pedestrian and cyclist impact. First of all the head impact area needs to be adjusted, furthermore the impact conditions (angle / velocity) must be reviewed[32].

Other research suggested that the damage inflicting mechanisms during cycling and pedestrian collisions are similar[33] and looking at cyclist injuries, the group presents lower injury rates to the head than the pedestrian counterparts. A GIDAS accident investigation study found that 33.7% of the cyclists in collisions with newer vehicles were injured on the head and 41.5% of the cyclists in collisions with older vehicles. Significantly lower frequency could be established for cyclists compared to pedestrians at higher speed ranges with 72,2% versus 85,3%, respectively. For cyclists, the collision speed was also confirmed as a special parameter influencing the severity of head injuries (72.2% at speeds above 40 km/h vs. 35.2% at speeds up to 40 km/h).

Recommendations:

- Update existing tests and extend scope of regulation 78/2009 to include cyclist protection.
- Specify the word ''cyclist'' in the regulation instead of ''other vulnerable road users''
- Revisit the impact conditions in terms of impact velocity and impact angle, but use the same impactors as today.

31 http://udv.de/de/radfahrer/radfahrer-profitieren-kaum-vom-pkw-fussgangerschutz
32 AGU Zurich, 2017, Study on Safer Motor Vehicles for Cyclists in the context of the EU Pedestrian Protection Regulations
33 http://www.actabio.pwr.wroc.pl/Vol15No1/13.pdf

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