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Frontal Impact Crash Test for Powered Two-Wheelers

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Currently, Powered Two-Wheelers (PTW) are regarded as one of the most dangerous modes of road transport. Statistically the risk of death for motorcyclists is 20 times that of car occupants. Data shows more than 12 riders die every day on European roads and more than 100 are severely injured. Although head protection in the form of a helmet is generalised, the use of other Personal Protective Equipment (PPE) is still very low (<1% in some European countries). IDIADA is part of a consortium involved in a European project named PIONEERS within the Horizon 2020 (H2020) programme.

PIONEERS is the acronym of Protective Innovations of New Equipment for Enhanced Rider Safety. This project aims to help in the reduction of the number of PTW fatalities and the severely injured by increasing the safety performance, comfort and usage rate of PPEs and the development of innovative on-board safety devices. As part of IDIADA's role in PIONEERS, the task was to design and implement new PTW full-scale crash testing methodologies and the associated assessment criteria to ensure the protection of the PTW user with the best balance between repeatability, reproducibility and reliability. Therefore, this paper will be focused on the frontal crash test configuration which has been developed at IDIADA as an extension of the scope of PIONEERS project.

According to the European accident database CARE, collisions between cars and L3 vehicles (two-wheeled vehicles with an internal combustion engine cylinder capacity above 50cm³) appear to represent the most critical accident scenario, accounting for 60% of the total accidents involving PTWs. The CARE database reveals that most lower-capacity PTW fatalities occur in urban areas and the majority of higher-capacity PTW fatalities occurred in rural or out of town areas.

The MAIDS database states that the centre front (29%) and the left side (22%) were the most frequently reported first collision contact points in PTWs and Opponent Vehicles (OV), respectively. In addition, an in-depth analysis of the EDA, inSAFE and iGLAD databases for this type of accident scenario showed 51% of PTWs had an impact speed between 30-60 km/h and 71% of OVs had an impact speed between 0-25 km/h. The following frontal crash test configuration (Fig. 1) has been designed to validate on-board safety systems both passive and active and all types of PTW rider PPE. This crash test consists of a left-side 30° frontal collision between a Kymco Agility City 125 (125 cm3 scooter) and a SEAT León (compact city car). Both commercial vehicles were selected because they were the best-selling vehicles of its class in Spain during 2019. A 30° impact angle was chosen based on the author's personal experiences considering a vehicle entering or exiting a road junction and the data stated above regarding intersection collisions between PTWs and a four-wheel vehicle.

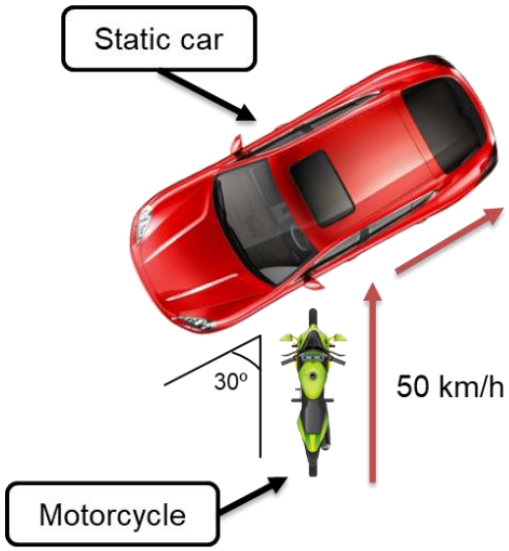

Fig.1 Frontal testing protocol for PPE validation and development.

The actual impact point of the PTW to OV was difficult to define due to specific impact points not being recorded in accidentology databases, but the PTW impact speed of 50 km/h, including the OV acting as a static element, were considered as a result of the literature review collected in section 2.1. The authors suggest as a good reference point to set the OV A-pillar in line with the centre of the propulsion track. Of course, this can be altered depending on purpose of test and the resulting data that is required. The defined urban speed limit in mainland Spain is set at 50 km/h, which also aligned with accident data and made the test definition more feasible using this speed as a reference when designing this test mode protocol. A specific motorcycle crash-test 50th %ile male dummy from Dynamic Research, Inc. (California, US), a company specialised in crash test dummy development, will be used. More information regarding the motorcycle dummy can be found in section 2.3.3, as well as its clothing and instrumentation. Another consideration could be using a moving opposing vehicle, therefore PTW impacting the moving OV at a pre-determined speed. This would need to be analysed and agreed upon prior to test definition.

By developing this frontal test protocol for motorcycle impact testing, the authors hope to achieve a more realistic and robust motorcycle test methodology. This will in turn provide better physical data for PTW manufacturers, as well as for the ongoing development of on-board protective equipment, crash avoidance systems and rider PPE suppliers.

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