Pedestrian Safety: Deflection of Bonnets in Active Pedestrian Protection Systems

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OICA members note that there are some issues with the analyses done by BASt (refer to document “Deflection of Deployable Bonnets in DB Systems”):

- The whole bonnet deflection is meant to assess the comparison of reaction forces of the supports of passive and active bonnets and their structures themselves - it was never meant to be an assessment of a potential impact situation
- Not all under-bonnet parts are rigid and therefore causing injury risks
- Deflection due to the upper body does not necessarily influence the actual contact of the head with the bonnet
- The vertical distance between bonnet surface and underlying components is mixed with the distance in impactor flight direction

In general, defining an under-bonnet clearance is design restrictive

No requirements on this exist for vehicles with “standard” (non-deployable) bonnets
Example:
Engine compartment of a large family car with a passive bonnet, bonnet lowered 80 mm (grey area), showing parts with intrusion:

- Only dark-green parts are structural parts, most parts are rubber, plastics, composite materials etc.
- Many parts nowadays are attached so that they move away (e.g. brake fluid container), are collapsible (e.g. engine cover), etc.

Reference:
Kinsky, 8 – 9 Sept. 2005, TÜV Rheinland Conference Pedestrian Protection
Acc. to the original study, the max. bonnet deflection in the head area is 12.5 mm (or about 1/3\textsuperscript{rd} of the deflection caused by the upper body)

- In addition, the FE model of the vehicle needs to be proven for correlation to the real vehicle
- MADYMO shoulder characteristics tend to be too stiff and therefore shoulder intrusion shown may be too high
Bonnet Deflection: Body vs. Head

- In the tests of BASt (and as required by Euro NCAP) the engine compartment package was not present.
- The missing package, however, does not represent surface intrusions comparable to a potential impact situation where the shoulder may be decelerated by under-bonnet components.
- Consequently, the intrusion in the area of the head impact also does not represent potential impact situation.
- In the study summary, the head was positioned to the shoulder location.

- **A requirement of 80 mm vertical clearance will lead to an over-engineering of the bonnet and will lead to stiffer overall bonnets – with possible disadvantages for VRUs!**
- **Criteria should be performance based and not design restrictive!**
Thank you!

For detailed questions please refer to the authors, Dr. Thomas Kinsky (Opel), Benjamin Buenger (Opel) and Martin Harvey (Jaguar Land Rover)