



Headform Test Procedure for GTR 9

GRSP Task Force „GTR9 Amendment 3“

1st Meeting, 14&15 June, 2021

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Bundesanstalt für Straßenwesen



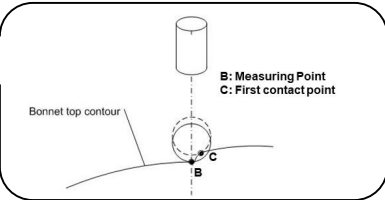
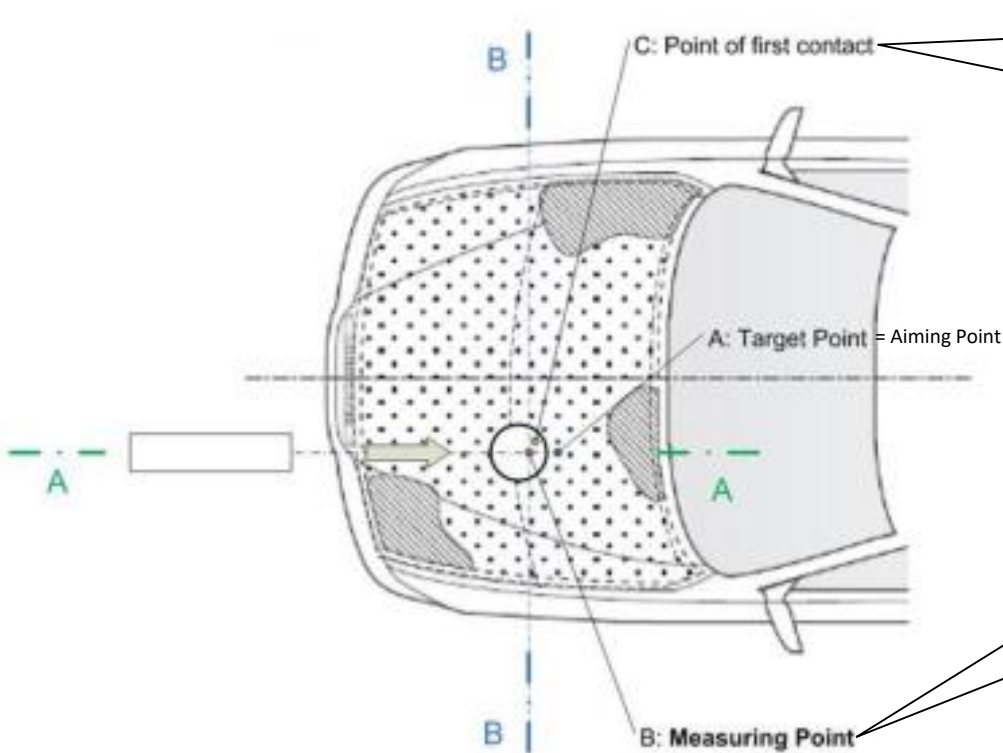
Methods

Issue #1: Glancing Headform Impact Data

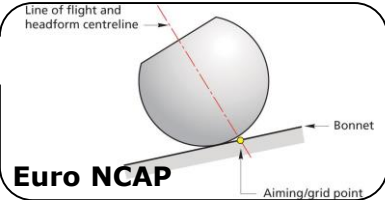
Issue #2: Uncontactable Area

Issue #3: Impact Area Size

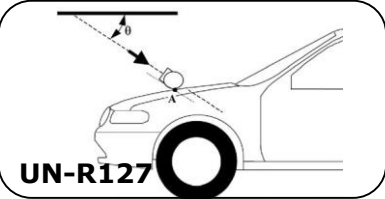
Summary & Proposal



First point of contact for the headform test is where the headform first contacts the vehicle's outer surface.



The centreline of the headform impactor shall be directly in the line of flight toward the **aiming point**.



The **measuring point** is where the headform's profile contacts the vehicle's outer surface cross section in a vertical longitudinal plane through the center of gravity of the headform

Topic 1: High share of impactor rotation during impact

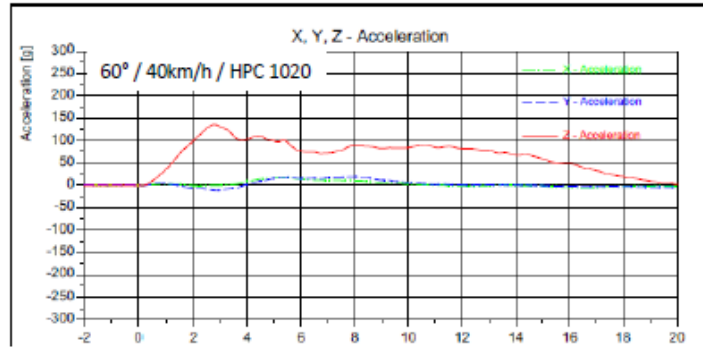
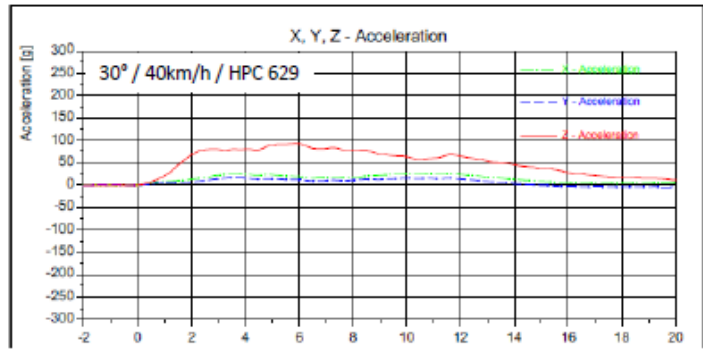
➔ Impactor spin-off



➔ High rotation cannot be reflected by linear accelerations

➔ Calculated HIC becomes meaningless

Countermeasure: limit impactor rotation
 Steeper angles ➔ lower rotation!
 ➔ ensured by markup and minimum offset requirements





Topic 2: More severe impact due to glancing blow

➔ Impactor rotation associated with unbiofidelic behaviour



Less rotation:
Polar-III



More rotation:
Isolated adult headform

0ms 15ms 30ms 45ms 60ms 75ms

➔ Impactor rotating into a structure that was not intended to be tested

➔ Wrong result allocated to the intended test point

Countermeasure: avoid glancing blow
➔ already assured by GTR9, Chapter 7.3.2 of GTR9:
“No impact point shall be located so that the impactor will impact the test area with a glancing blow resulting in a more severe second impact outside the test area.”



Some target points on the vehicle front may not be contacted during the time of first contact of the headform.

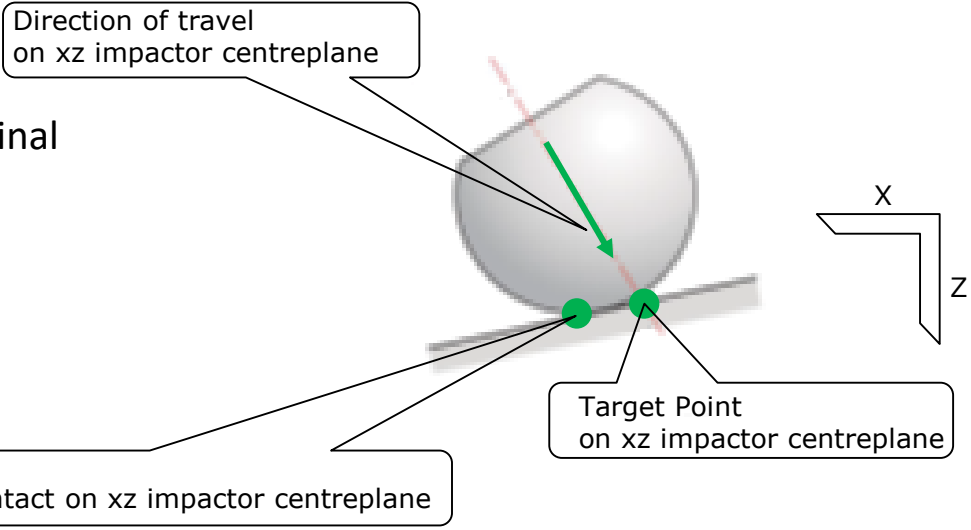
This can happen while applying both methods, the measuring point method as well as point of first contact method.

This however could be of an issue only in case of the target point being located on a vertical longitudinal plane different to the centreplane of the impactor.

For a meaningful result, the target point and its associated measuring point need to be on the same vertical longitudinal plane, i.e. the xz impactor centreplane.



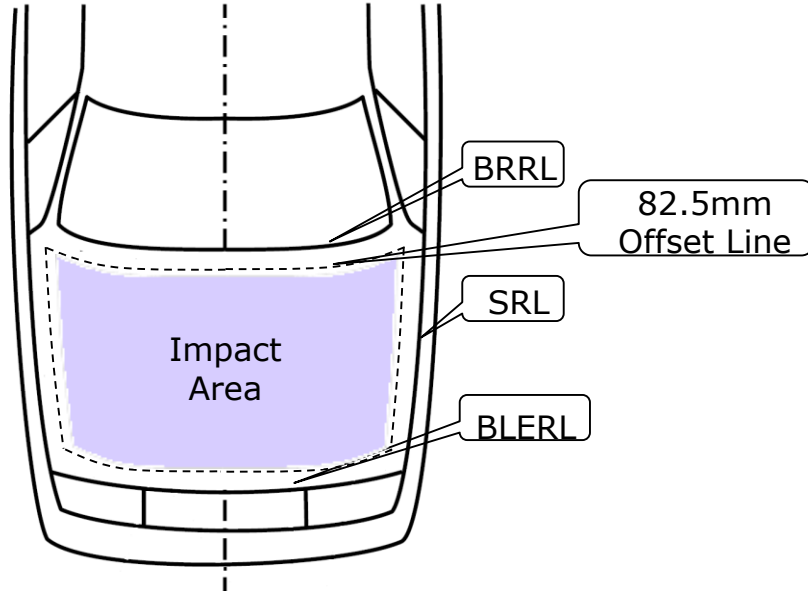
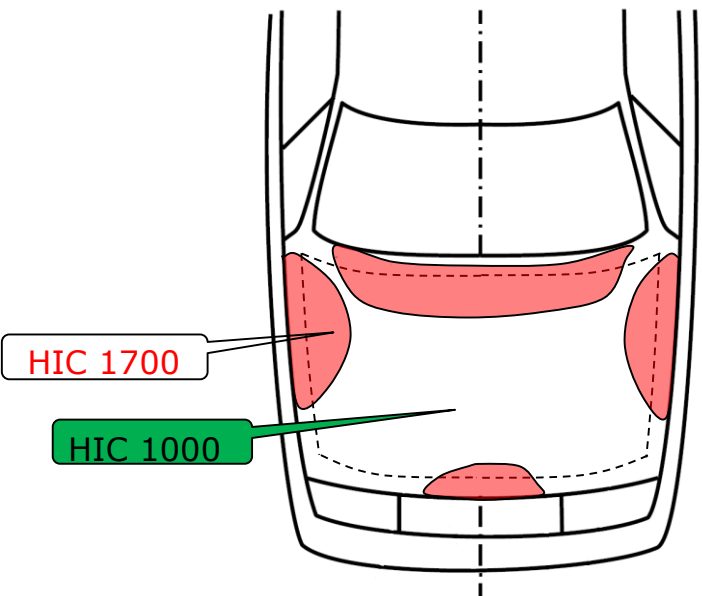
Source - https://www.alibaba.com/product-detail/well-sales-lowes-corrugated-sheet-metal_60447065953.html





In GTR9, the zone for determination of the HIC 1000 and the HIC 1700 zones includes the 82.5mm „offset“ zones.

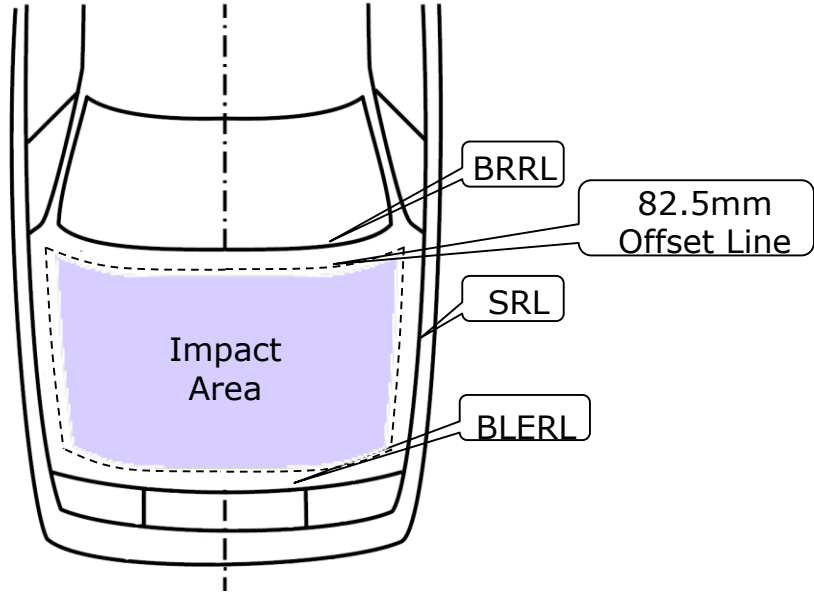
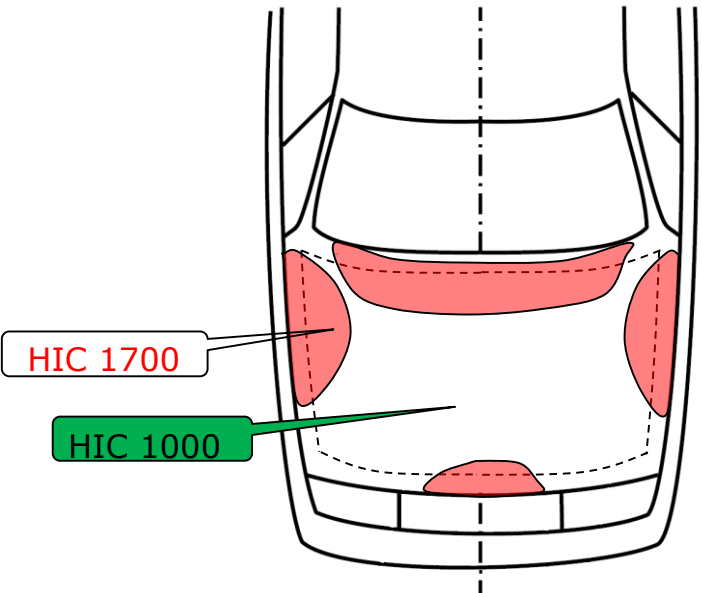
The actual impact area does not include the 82.5mm „offset“ zones.

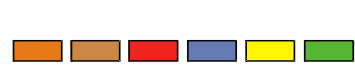




For a realistic prediction, no increase of proportion (1/3) of the HIC 1700 zones in the impact area should be expected.

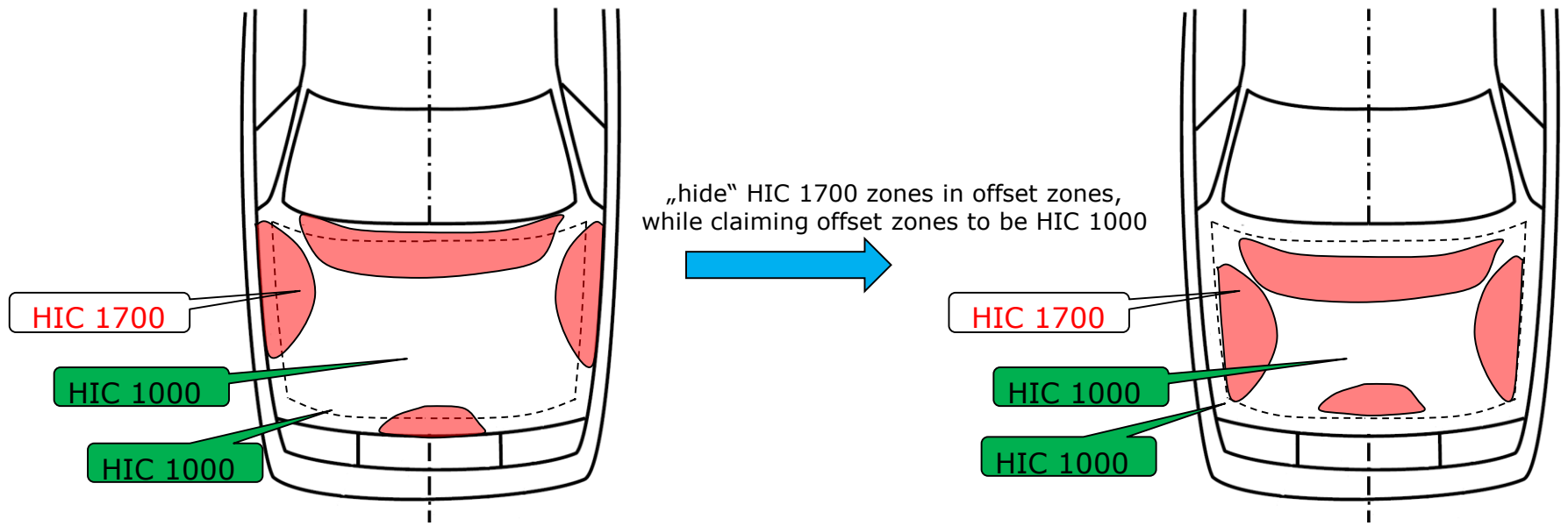
Change of procedure not necessary.





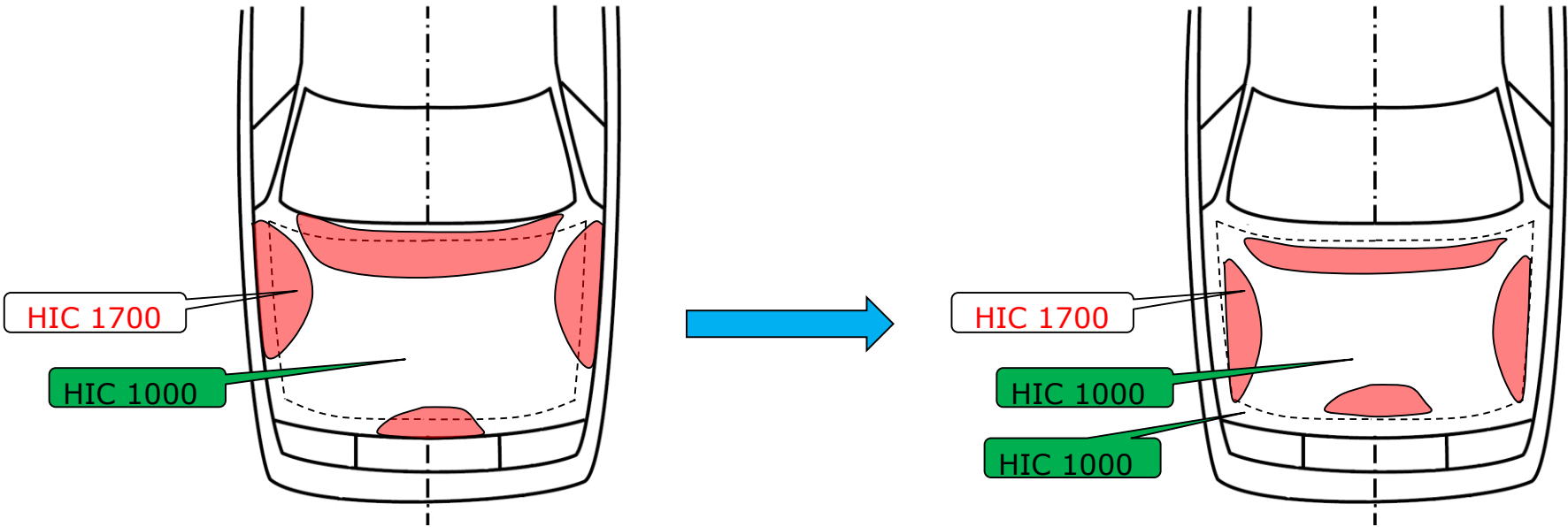
Concern: „Offset area“ could be abused for „hiding“ HIC 1700 performing structures.

This could, in theory, enlarge the proportion of the HIC 1700 zones in the impact area.





Possible countermeasure: Move HIC 1000/1700 determination zone to impact area, only.



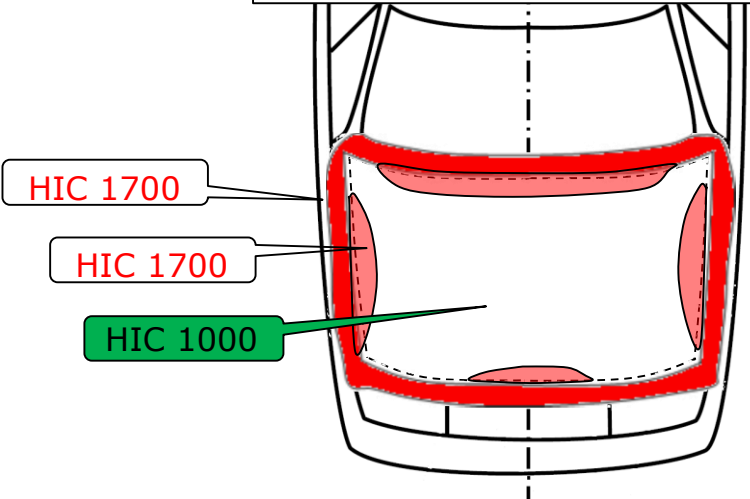
This countermeasure would only work in the aforementioned case of „hiding“ HIC 1700 performing structures in the „offset“ zone.



This countermeasure would however penalize all correctly predicted zones and thus be counterproductive in terms of pedestrian safety!

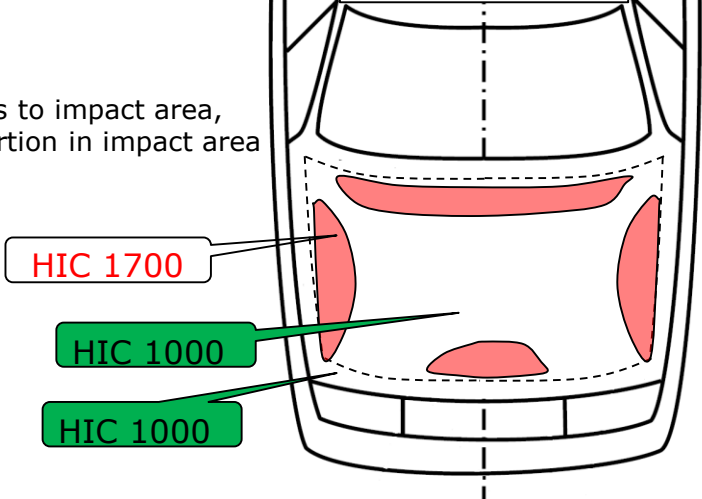
Assumption: Offset zone = 10%, Impact area = 90%

Impact Area:
HIC 1700: $(23 \frac{1}{3}\%)/90 * 100 = 25,93\%$
HIC 1000: $(66 \frac{2}{3}\%)/90 * 100 = 74,07\%$



move HIC 1700 zones to impact area,
enlarge HIC 1700 proportion in impact area

Impact Area:
HIC 1700: $33 \frac{1}{3}\%$
HIC 1000: $66 \frac{1}{3}\%$





What happened in case of changing the HIC 1000/1700 determination zone exclusively to the impact area?

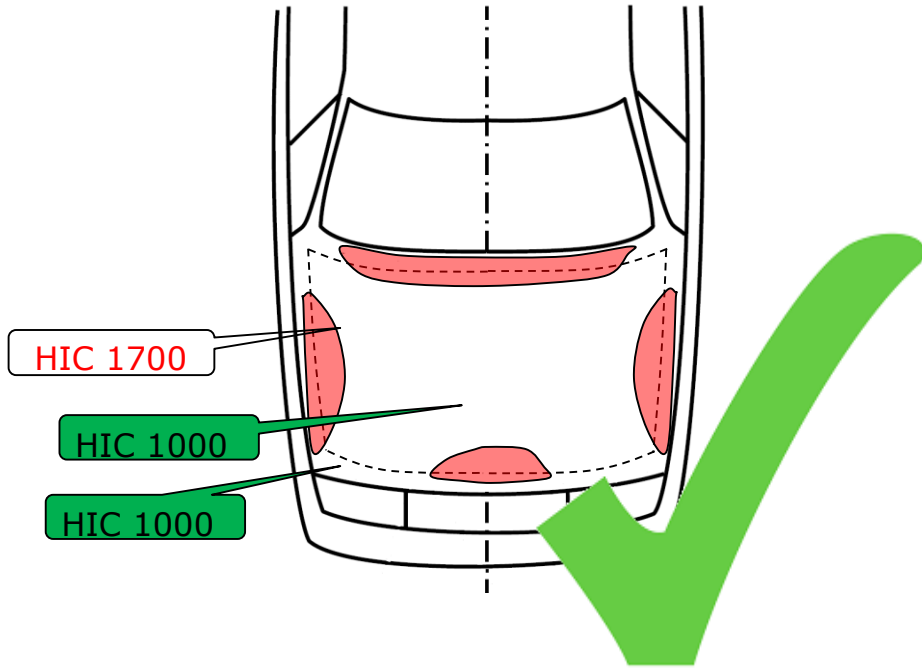
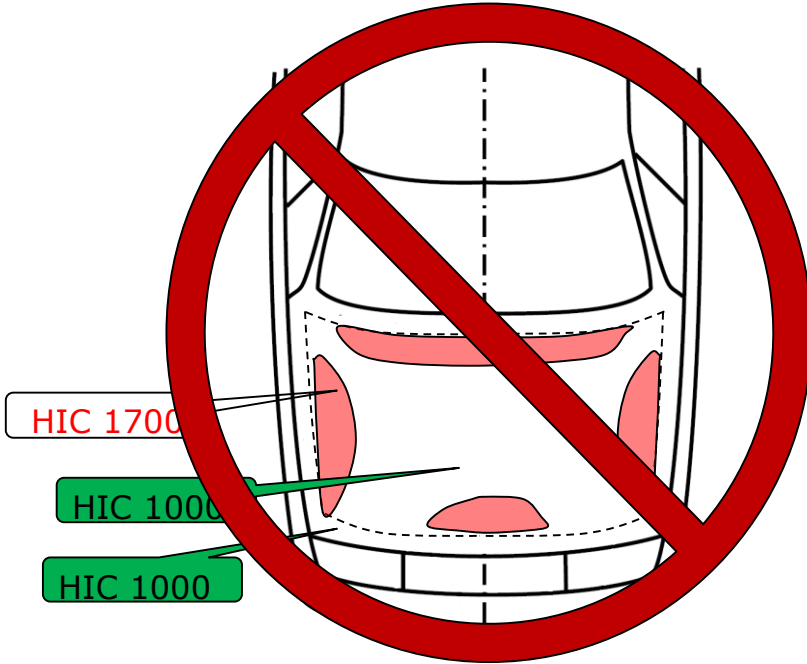
A) In case of the offset zones were previously (wrongly and abusively!) predicted with a better performance (HIC 1000), the proportion of the HIC 1000 zones in the impact area would increase → increase of requirements.

B) In case of the offset zones were previously (correctly) predicted with a worse performance (HIC 1700), the proportion of the HIC 1700 zones in the test area would increase → relaxation of requirements.

→ Changing the HIC 1000/1700 determination zone to the impact area would be a countermeasure only against „cheating“. However, assuming a majority of OEMs with proper forecast, the change would be counterproductive for pedestrian safety.



Proposal: An area directly inside [or within a distance of 100mm to] the 82.5mm offset zone shall not be predicted worse than the adjacent area in the offset zone.





Issue 1: Glancing Headform Impact Area

Solution topic 1: Minimize impactor rotation by markup and offset requirements already implemented within GTR9 → already optimized for measuring point method

Solution topic 2: Avoid glancing blows, as already implemented within GTR9 → already optimized for measuring point method

Issue 2: „Uncontactable“ area

Solution: Measuring point method ensures the result from a target point being allocated to the most appropriate adjacent point (located on the same vertical longitudinal plane as the headform velocity vector) → already optimized for measuring point method

Issue 3: Measuring point method could reduce impact area or „enlarge“ HIC 1700 area within impact area.

Avoid a situation counterproductive to pedestrian safety!

Solution: An area directly inside [or within a distance of 100mm to] the 82.5mm offset zone shall not be predicted worse than the adjacent area in the offset zone.



Thank you for your Attention!

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