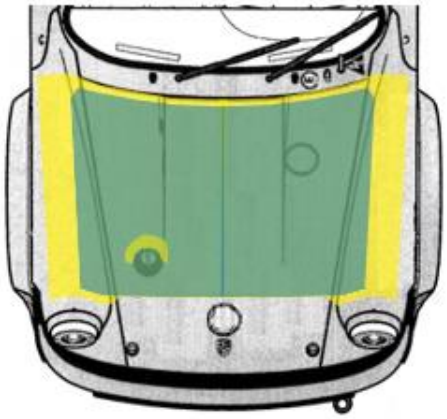
US write-up of demonstration at 2nd meeting

- Drafted by NHTSA -

Remark: The subsequent text does not contain the Meeting Minutes in the original version, but a summary of the discussions (Chapter 6) as perceived by NHTSA.

At the 2nd meeting of the technical sub-group on Amendment 3, Peter Martin (PM) demonstrated how NHTSA would conduct a compliance using a 1:12 scale vehicle model 1976 Porsche 934 as an example. PM noted that this car was identified by Oliver Zander (OZ) in an earlier meeting as one that has many contours that would be a good subject to assess the test protocol. For the sake of time, the SRL, WAD1000, WAD1700, BRRL, and 82.5 offset margins had been carefully "pre-drawn" on the vehicle the night before the meeting. During the meeting, a 2/3 HIC1000 border was hand drawn in real-time to demonstrate how a NHTSA lab would receive a "map" from the OEM (green area in pic above) and transfer it to the vehicle.



Afterwards, the compliance lab verifies that the ratio of the HIC1000 area provided by the OEM (and applied to the actual bonnet) to the area of the marked off bonnet top (which includes the 82.5 margins) is required to be at least 2/3. PM noted that the areas must be computed from the actual, marked off bonnet when viewed from above and in the X-Y plane (not the actual surface area). Finally, the 82.5 offsets are drawn. PM noted that GTR does not cover another contingency similar to the one noted by Benjamin Buenger (BB) earlier: that a portion of the HIC1000 may lie within the 82.5 margin

OZ commented that for the marking of performance zones, only one method could be applied, either based on the reference lines or the offset lines as outer limits.

PM explained there were three different zones: HIC1000, HIC1700 and “no requirements zone” PM noted that many in the Technical Working Subgroup refer to the area within the 82.5 margin as a "no test" zone, which infers that a test is invalid if the headform impacts this area. However, PM pointed out that the GTR does not describe a "no test" zone or use those words. PM noted that it is more in line with the GTR to refer to it as a “no requirement zone” in that it is permissible to run a test where the headform would touch within this zone, and the HIC associated with the zone is HIC-unlimited.

Further discussion on this concept ensued, but it was not clear that all members were in agreement with this concept, and some seemed to believe that a “no test zone” is the correct term, maintaining that a test would be invalid in case of the impactor touching this zone.

PM then demonstrated how a NHTSA lab would carry out a headform launch. First, the lab would position the headform atop the bonnet in the exact spot where first contact would be desired. PM noted that a NHTSA test lab can launch a headform from anywhere as long as the required test conditions are met and the first point of contact is within a HIC1000 or HIC1700 area. We do not need to test a particular point agreed upon with an OEM. PM demonstrated how a NHTSA lab might select any headform position in which the lab technician thinks may produce a high HIC. To demonstrate this, a position near a cap on the rear of the bonnet (where a secondary fuel fill line exists) was selected in which the headform touched only one point lying on the edge of the cap and not in-line with the headform CoG. This point was then observed to lie within the HIC1000 area, thus setting the launch requirement. From there, the NHTSA lab would retract the headform into its launch position, launch it, record acceleration, and compute HIC. If HIC is less than 1000, that launch would be recorded as a PASS. Otherwise, it would be recorded as a FAIL. PM asked how this process could go wrong, because evidently it could not. PM then demonstrated that the process would be essentially the same using the Amendment 3 Slice concept, and thus this implies that nothing would be improved going to the Slice concept.

At this point, BB asked, how 1/3 and “no requirement zones” were separated from each other. PM demonstrated a hypothetical situation unique to the 934 in which a circular hole in the bonnet exists, which apparently serves as the primary fuel fill port. The hole diameter is slightly less than the headform diameter. PM demonstrated that a headform launch position could be chosen wherein the headform strikes directly within the hole and thus touches an infinite amount of points along the periphery of the hole simultaneously. In the hypothetical OEM markup, half of the points are within the HIC1000 area and half within the HIC1700 area. PM pointed out that the GTR does not cover this contingency, but that NHTSA would interpret the requirement as being HIC1000, the more stringent of the two requirements, for this particular launch.

PM demonstrated that if the Slice were applied to the exact same launch position, two points would be

touched by the Slice: one within the HIC1000 area and one within the HIC1700 area. Thus, the same contingency applies as with the hemisphere method and thus nothing is gained or clarified by using the Slice method.

PM also noted that one of the tenets of Amendment 3 is for each test result must be assigned to a single point on the bonnet, but this would be violated. Regarding NHTSA's application of the GTR, PM reiterated what had been discussed earlier, stating that there is no need to assign a HIC score to a point. Instead, the HIC zones are used to assign a HIC requirement to a particular launch position, which then correspond to a first point of contact within that HIC zone.

BB commented that the Slice would minimize the problem to a great extent with two contact points only. PM commented that there was no problem to begin with. BB described the problem as being related to the inability of an OEM to carry out a "market survey" which is needed to map out the HIC1000 and HIC1700 areas unless the Slice method is employed. (This is discussed later on).

PM demonstrated another headform position in which the headform touched two points: one within the HIC1000 area and another point forward of WAD1000 (i.e., no requirement). Similar to the hole situation, PM pointed out that the GTR does not cover this contingency, but that NHTSA would interpret the requirement as being HIC1000 for this particular launch. It was noted that neither of the contact points was in-line with the headform CoG. It was also noted that the position chosen (touching two points) seems like it could produce a higher HIC than a nearby position where only a single point in the WAD1000 area was contacted because a HIC reduction due to “roll off” would be avoided.

OZ noted that the philosophies of the 3D method differed from the basic view, homologation, and verification of self-certification. Mary Versailles (MV) stated that no discrete test points were checked but areas and whatever the first contact would be in those tests, the compliance to that particular zone was assessed. OZ emphasized that however these points were the basis for all differentiation of the zones. BB added that the 3D method would raise far more questions than the 2D method, with the impactor creating values for structures that were located outside the zones. Stefan Schinke (StS) mentioned that clear result allocation and reproducibility was compromised by 3D first contact as the duplication of test results was a challenge when it came to verification tests.

All parties appeared to understand that from the OEM standpoint drawing up the map depended on whether the sphere or the slice was used. Currently the map is drawn using the slice; if the procedure changed to the sphere the OEM would need to go back and redraw and take into account all inconsistencies

between the 2D and 3D methods. This was demonstrated on the 934 within the crevices inboard and rearward of the headlights where the touch points differed greatly. In other words, a Slice-based map may differ from a Hemisphere-based map.

After the demo concluded, OZ raised the question how a hard point would be generally tested according to NHTSA interpretation. A discussion ensued on a special case in which the headform contacted a protruding wiper spindle. Antje Sipido (AS) pointed out that a headform strike to the spindle could produce different HIC scores, depending if the spindle was perfectly in-line with the headform CoG or slightly offset. AS commented that this is problematic because different HIC scores would be assigned to the same point. PM asserted that the map is used to assign a requirement to the launch, and that there is no requirement of assigning a HIC score to a point, nor does the GTR require the impact point to be in-line with the headform CoG.

OZ concluded that the measuring point was the more relevant point for worst case HIC results. BB further explained that market surveillance was all about one technical service approving a vehicle and then another one checking it. In this context, the 2D method would provide one lateral location only, while the 3D method had various ones, leaving unnecessary room for interpretation.

PM (and later, Lou Molino (LM)) pointed out that the spindle lies in a known HIC zone (HIC1000, HIC1700, or HIC unlimited) which determines the requirement for all such tests, so NHTSA did not see a problem and thus could see no benefit using the 2D slice method in this instance. In addition, it was clarified that the 3D hemisphere method can also be used to test for the worst-case condition. PM added that, from NHTSA's point of view, the Slice method and the hemisphere method differ most significantly along the SRL margin, because that is the only place where the slice method restricts the launch position of the headform. In comparison to the 2D slice method, the 3D hemisphere method permits a launch position that may be slightly more outboard depending on the contour of the bonnet edge.

At this point in the discussion, the topic of "reproducibility" was discussed further. BB expanded on the concept of reproducibility as related to market surveillance in which tests must be replicated precisely within different laboratories, including the OEMs and multiple technical services. BB explained that this is needed by OEMs in order to develop a HIC1000 zone for any particular vehicle.

BB and AS implied that the Slice method facilitates test replication more easily, since a unique launch is associated with a particular point on the bonnet. In other words, if the point identified by the Slice method is known, that is all that is needed to replicate a launch.

On the other hand, as in the case of a spindle contact, it would be more difficult to replicate a launch if all that is known is the first point of contact(s). PM noted that NHTSA test labs would most likely report the launcher coordinates, so this should not be an issue and there should be no loss in objectivity. A NHTSA test report would likely contain all the information necessary to replicate a launch. BB explained that type approval labs do not report launch positions.

PM noted that the concept of a regulation needing to easily facilitate market surveillance is not mentioned in the GTR. PM again noted that the Slice and Hemisphere methods, from a safety standpoint, are equivalent everywhere on the bonnet EXCEPT along the SRL line.

Towards the end of the discussion, a new idea was brought up. NHTSA stated that the GTR allows the condition wherein the center of gravity of the impactor may be within the 82.5 margin. PM suggested that, if the Slice method is highly desired for no other reason than market surveillance, it may be possible to redraw the SRL margins, or add a third line between the SRL and the margin to serve as the Slice outermost target in a way that would yield equivalent launch area coverage for both the Slice and current Hemisphere methods (see figure below).

Reaction to this idea was not conclusive. Further discussion related to testing along the SRL margin ensued. It was replied that this was different to what has been done in type approval during the past 16 years. BB stated that there was clear data available showing in case of using the 3D method this would lead to an impactor outside of the reference lines, i.e. with the CoG outside. OZ emphasized that the 2D “slice” was not to be positioned within the offsets because this would mean the introduction of a new requirement not yet established in GTR9. PM answered that this difference was always the issue in NHTSA interpretation. MV mentioned that there should be no tests within the offset zones. Only the definition of the “aiming” was to be clarified.

NHTSA did acknowledge that the CoG could lie within the margin when the 3D hemisphere method is applied as long as the first point of contact remains inboard of the margin, and that the GTR does not restrict this condition. NHTSA also acknowledged that the Slice method has been used in type approval for 16 years. However, NHTSA stated again that the current GTR, as written, does accept the condition where the headform CoG lies within the margin and Amendment 3, as currently drafted, proposes to revise the GTR so as to *not* accept it. NHTSA stated that the proposed Slice method would reduce pedestrian safety relative to the wording of the GTR. From NHTSA's point of view, they state that there needs to be a valid rationale for lessening the safety requirements of the GTR.