Comparison of the severity between Japanese regulation based on IHRA and Phase 2 proposal based on EEVC

"To be more stringent than Japanese regulation" being one condition for accepting phase 2 as GTR, the phase-2 test angle was examined.

SUPPLEMENT



Perpendicular stroke to bonnet at HIC 1,000 S' = S x sin(impact angle + bonnet angle)

Stroke at 32km/h, HIC1,000: S = 38mm Stroke at 35km/h, HIC1,000: S = 48mm

- Premise - -

The entire impact energy is absorbed by the bonnet.



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A headform model collided into the design bonnet model to compare HIC. (Simulation of headform rotation and friction with the bonnet)



<u>Child</u>

<u>Adult</u>

Computer simulation conditions and analytical results (HIC)

| Car type | Impact condition | Headform Model | Impact Angle | Impact Speed Vel | | Bonnet angle and HIC | | | | | |
|--------------------------|---|---|---|--|--|--|---|---|--|---|---|
| | | | Ang. | | | Angle 1 | | Angle 2 | | Angle 3 | |
| | | | (deg.) | (km/h) | (m/s) | (deg.) | HIC_15 | (deg.) | HIC_15 | (deg.) | HIC_15 |
| Sedan | IHRA based | Child 3.5 | 65.0 | 32 | 8.89 | 0 | 642.6 | 15 | 764.7 | 30 | 771.9 |
| Coddin | EEVC based | Child 3.5 | 50.0 | 35 | 9.72 | 0 | 557.3 | 15 | 874.2 | 30 | 1037.8 |
| SUV | IHRA based | Child 3.5 | 60.0 | 32 | 8.89 | 0 | 572.6 | 15 | 740.5 | 30 | 772.5 |
| 001 | EEVC based | Child 3.5 | 50.0 | 35 | 9.72 | 0 | 557.3 | 15 | 874.2 | 30 | 1037.8 |
| 1BOX | IHRA based | Child 3.5 | 25.0 | 32 | 8.89 | 30 | 493.2 | 60 | 773.8 | 90 | 627.4 |
| IBOX | EEVC based | Child 3.5 | 50.0 | 35 | 9.72 | 30 | 1037.8 | 60 | 939.0 | 90 | 265.4 |
| | Impact | Headform | | Impact Speed | | Bonnet angle and HIC | | | | | |
| Quality | Impact | Headform | Impact Angle | Impact | Speed | | В | onnet an | gle and HI | С | |
| Car type | Impact condition | Headform Model | Impact Angle Ang. | Impact V | : Speed ′el | Ang | B gle 1 | onnet ang Ang | gle and HI gle 2 | C Ang | jle 3 |
| Car type | Impact condition | Headform Model | Impact Angle Ang. (deg.) | Impact V (km/h) | : Speed ′el (m/s) | Ang (deg.) | B ple 1 HIC_15 | onnet ang Ang (deg.) | gle and HI gle 2 HIC_15 | C Ang (deg.) | le 3 HIC_15 |
| Car type | Impact condition | Headform Model Adult 4.5 | Impact Angle Ang. (deg.) 65.0 | Impact V (km/h) 32 | : Speed 'el (m/s) 8.89 | Anç (deg.) 0 | B gle 1 HIC_15 475.3 | onnet ang Ang (deg.) 15 | gle and HI gle 2 HIC_15 563.9 | C Anç (deg.) 30 | ple 3 HIC_15 567.7 |
| Car type Sedan | Impact condition IHRA based EEVC based | Headform Model Adult 4.5 Adult 4.5 | Impact Angle Ang. (deg.) 65.0 65.0 | Impact V (km/h) 32 35 | : Speed 'el (m/s) 8.89 9.72 | Ang (deg.) 0 | B ple 1 HIC_15 475.3 646.1 | onnet and Ang (deg.) 15 15 | gle and HI gle 2 HIC_15 563.9 765.5 | C Ang (deg.) 30 30 | ple 3 HIC_15 567.7 773.7 |
| Car type Sedan | Impact condition IHRA based EEVC based IHRA based | Headform Model Adult 4.5 Adult 4.5 Adult 4.5 | Impact Angle Ang. (deg.) 65.0 65.0 90.0 | Impact V (km/h) 32 35 32 | Speed 'el (m/s) 8.89 9.72 8.89 | Ang (deg.) 0 0 | B ple 1 HIC_15 475.3 646.1 567.9 | onnet ang Ang (deg.) 15 15 15 | gle and HI gle 2 HIC_15 563.9 765.5 545.8 | C (deg.) 30 30 30 | le 3 HIC_15 567.7 773.7 407.3 |
| Car type Sedan SUV | Impact condition IHRA based EEVC based IHRA based | Headform Model Adult 4.5 Adult 4.5 Adult 4.5 | Impact Angle Ang. (deg.) 65.0 65.0 90.0 65.0 | Impact (km/h) 32 35 32 32 35 | E Speed (m/s) 8.89 9.72 8.89 9.72 | Ang (deg.) 0 0 0 | B IIE 1 HIC_15 475.3 646.1 567.9 646.1 | onnet and (deg.) 15 15 15 15 | gle and Hi ple 2 HIC_15 563.9 765.5 545.8 765.5 | C (deg.) 30 30 30 30 30 | HIC_15 567.7 773.7 407.3 773.7 |
| Car type Sedan SUV | Impact condition IHRA based EEVC based IHRA based IHRA based | Headform Model Adult 4.5 Adult 4.5 Adult 4.5 Adult 4.5 | Impact Angle Ang. (deg.) 65.0 90.0 65.0 50.0 | Impact (km/h) 32 35 32 35 32 32 | E Speed (m/s) 8.89 9.72 8.89 9.72 8.89 9.72 8.89 | Ang (deg.) 0 0 0 0 0 30 | B ple 1 HIC_15 475.3 646.1 567.9 646.1 565.3 | onnet ang (deg.) 15 15 15 15 15 60 | gle and HI gle 2 HIC_15 563.9 765.5 545.8 765.5 513.6 | C (deg.) 30 30 30 30 30 90 | le 3 HIC_15 567.7 773.7 407.3 773.7 160.9 |





Japanese Regulation vs. EU Phase 2 proposal

Bonnet angle

4. Summary

| | | Category1 (SEDAN) | Category2 (SUV) | Category3 (1BOX) |
|---------------------------------|-----------------|------------------------|------------------------|-------------------------|
| Bonnet angle | Child | 7.6 $^{\circ}$ or less | 1.6 $^{\circ}$ or less | 68.9 $^{\circ}$ or more |
| Japanese-HIC ? Phase2-HIC | Adult | - | - | 53.1 $^{\circ}$ or more |
| Applicable to c Japanese ma | ars in Irket | Νο | Νο | No |

The bonnet angle range: 0-30° for Categories 1&2, 30-90° for Category 3

Conclusion

- * FEM's 3D simulation also indicated that the Japanese regulation could be stricter in a certain range of possible bonnet angles, but there is no real-world bonnet angle in that range.
- * The proposed HIC 1,700 for relaxation area in phase 2 is an additional strictness factor.