

Prerequisites and tools used in DPPS procedure

Identified issues

1. Impactor Simulations

1. Justification of plausibility check impactor simulation

- Discussion ongoing

2. Corridors for plausibility check (first 5mm)

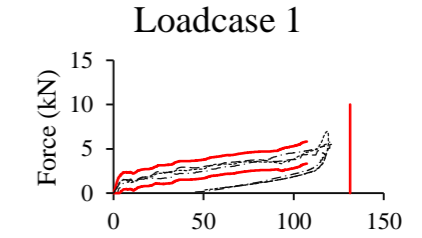
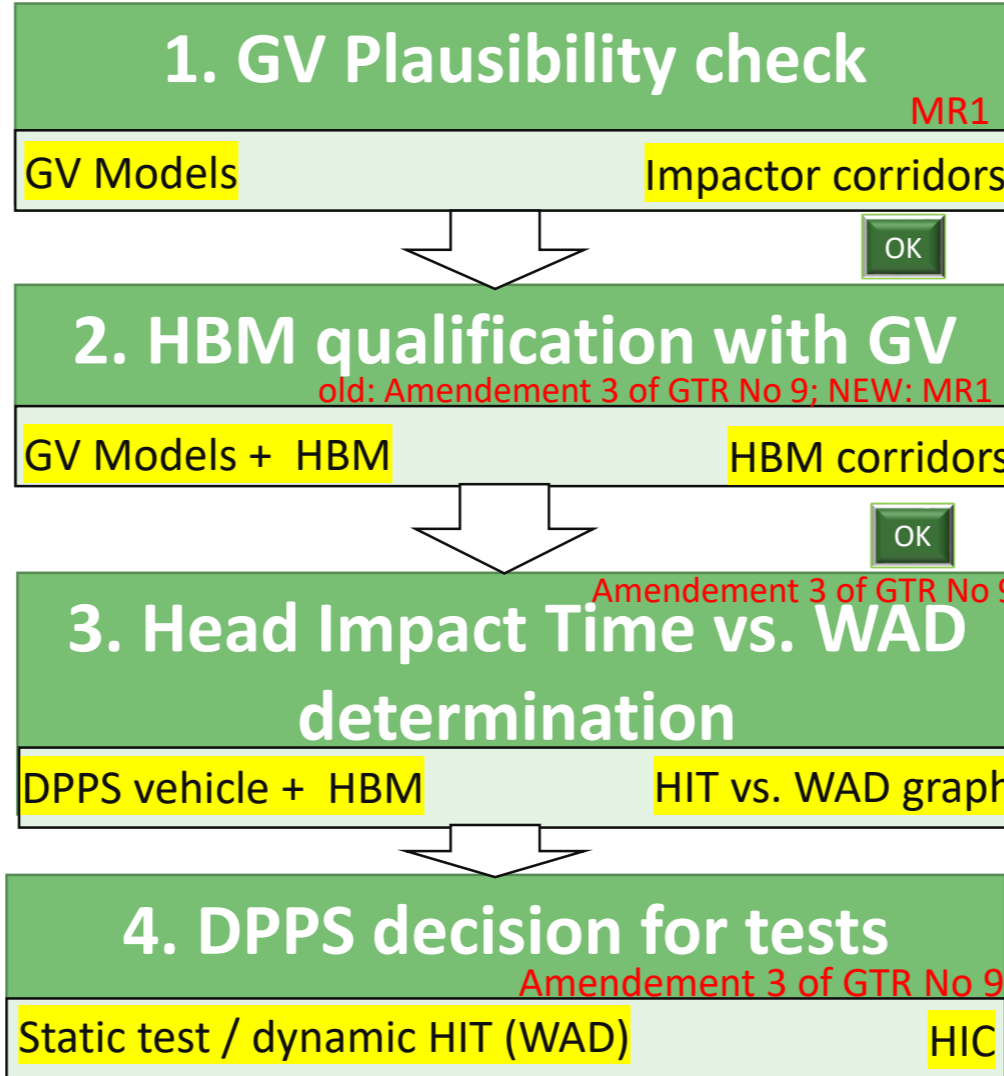
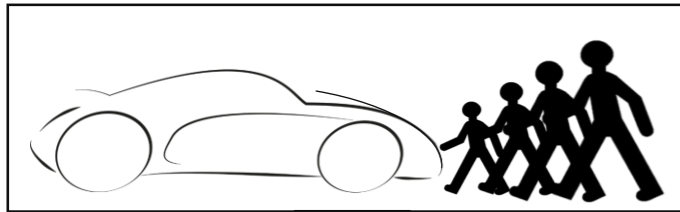
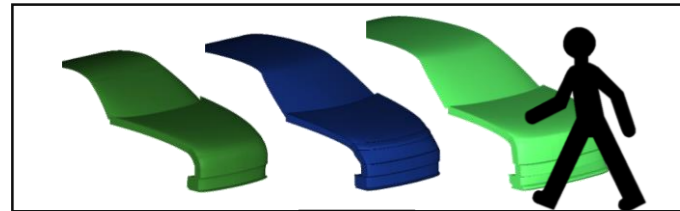
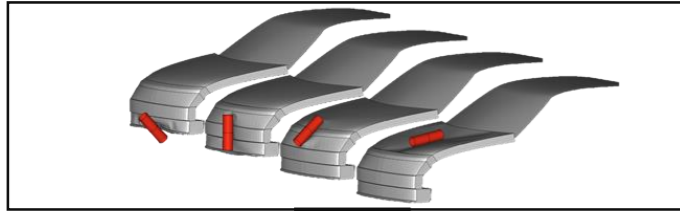
- Updated corridors – seems issue is solved; review by OEMs

(originally curves have been moved to align them – now raw input data is used; updated corridors will be uploaded to <https://openvt.eu/EuroNCAP/tb024/-/tree/GV-models-for-DPPS>)

2. Corridors for HBMs

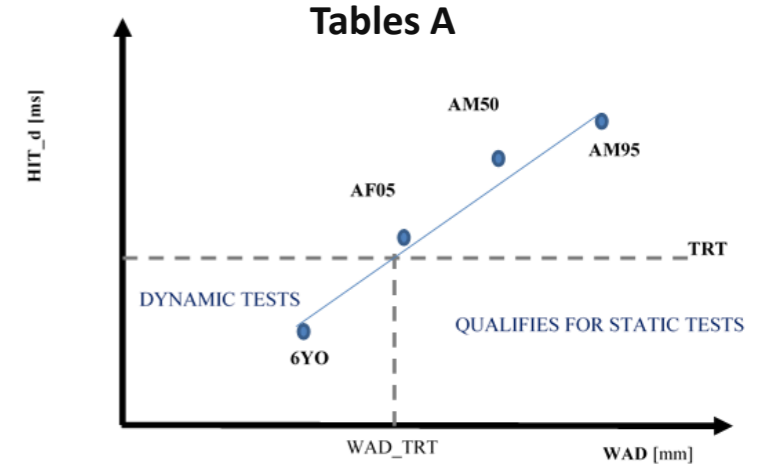
- error in simulations from CM was identified; all results are now within corridors
- proposal for small change for 6yo corridors to be reviewed

Overall DPPS Process



Deflection (mm)

| GV Type | Velocity (km/h) | HIT (ms) | | HCx (mm) | | HCz (mm) | |
|---------|-----------------|----------|-----|----------|-------|----------|------|
| | | Min | Max | Min | Max | Min | Max |
| FCR | 30 | 152 | 197 | -1438 | -1005 | 1019 | 1117 |
| | 40 | 127 | 150 | -1489 | -1105 | 1006 | 1158 |
| | 50 | 107 | 121 | -1504 | -1179 | 1024 | 1169 |
| RDS | 30 | 163 | 199 | -1574 | -1104 | 931 | 1125 |
| | 40 | 133 | 156 | -1659 | -1191 | 931 | 1178 |
| | 50 | 112 | 127 | -1665 | -1283 | 981 | 1183 |
| SUV | 30 | 127 | 144 | -1000 | -624 | 1092 | 1193 |
| | 40 | 101 | 116 | -1032 | -737 | 1103 | 1187 |
| | 50 | 86 | 99 | -1110 | -799 | 1109 | 1191 |



Inputs for the procedure – Old

GV Models

Roadster Familycar SUV

Specification and tools needed for GV Model plausibility check

Corridors for GV Model plausibility check

Loadcase 1

Force (kN)

Deflection (mm)

Qualification Process of Human Body Models for Pedestrian HIT Determination

Reference to Amendment 3 of GTR No 9

Specification for HBM qualification simulations

Corridors for HBM Qualification for Use in DPPS

| GV Type | Velocity (km/h) | HIT (ms) | | HCx (mm) | | HCz (mm) | |
|---------|-----------------|----------|-----|----------|-------|----------|------|
| | | Min | Max | Min | Max | Min | Max |
| FCR | 30 | 152 | 197 | -1438 | -1005 | 1019 | 1117 |
| | 40 | 127 | 150 | -1489 | -1105 | 1006 | 1158 |
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Tables A

Documentation + Guideline what needs to be done if corridors shall be revised in the future in GTR No. 9

HBM Validations (comparison with PMHS tests) – „Qualification“ of Human Body Models to be used for corridor definition

| | HIT (ms) | | ΔHCx (mm) | | HCz (mm) | |
|--|----------|-----|-----------|-------|----------|------|
| | Min | Max | Min | Max | Min | Max |
| Reference from PMHS Tests | 117 | 159 | -1653 | -1402 | 1020 | 1271 |
| GHBMC M50-PS v5.3.4 LS-DYNA MPP R10.2 | 136.6 | | -1492 | | 1160 | |
| GHBMC M50-PS v1.5 Radioss 2019.2.5 | 139.4 | | -1614 | | 1181 | |
| GHBMC M50-PS v5.33 R1.09 VPS 2019.0.4 | 130.3 | | -1500 | | 1186 | |
| GHBMC M50-P v5.3.4 LS-DYNA MPP R10.2 | 140.7 | | -1503 | | 1182 | |
| JAMA pedestrian_AM50 ver6.2.1. LS-Dyna MPP R10.0 | 141.9 | | -1586 | | 1191 | |
| THUMS v4.02 TB024 (05/22) LS-Dyna MPP R9.3 | 141.6 | | -1622 | | 1223 | |
| THUMS v4.02 (licensed) LS-Dyna MPP R12 | 140.5 | | -1609 | | 1224 | |
| THUMS v4.02 VWG006.2 Aud165VH VPS 2020.54 | 135.6 | | -1574 | | 1219 | |

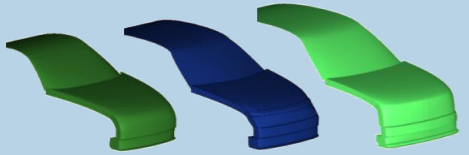
Tables B

Addendum 5 – Generic Vehicle (GV) models for qualification of HBMs for HIT determination simulations

Addendum 6 – Reference Results of Human Body Models for HIT determination simulations (HBM corridors)

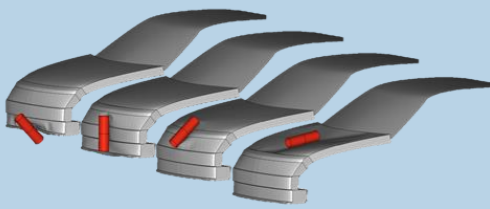
Inputs for the procedure – NEW

GV Models



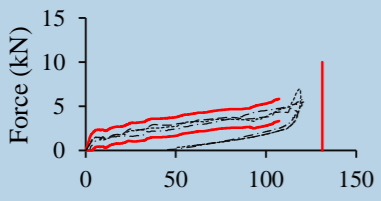
Roadster Familycar SUV

Specification and tools needed for GV Model plausibility check



Corridors for GV Model plausibility check

Loadcase 1




Force (kN)

Deflection (mm)

Qualification Process of Human Body Models for Pedestrian HIT Determination

Reference to Amendment 3 of GTR No 9

Specification for HBM qualification simulations

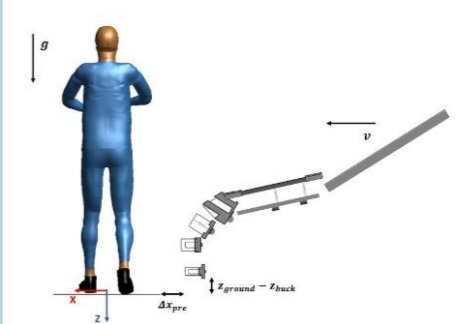


Corridors for HBM Qualification for Use in DPPS

| GV Type | Velocity (km/h) | HIT (ms) | | HCx (mm) | | HCz (mm) | |
|---------|-----------------|----------|-----|----------|-------|----------|------|
| | | Min | Max | Min | Max | Min | Max |
| FCR | 30 | 152 | 197 | -1438 | -1005 | 1019 | 1117 |
| | 40 | 127 | 150 | -1489 | -1105 | 1006 | 1158 |
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Tables A

Documentation + Guideline what needs to be done if corridors shall be revised in the future in GTR No. 9



HBM Validations (comparison with PMHS tests) – „Qualification“ of Human Body Models to be used for corridor definition

| | HIT (ms) | | ΔHCx (mm) | | HCz (mm) | |
|--|----------|-----|-----------|-------|----------|------|
| | Min | Max | Min | Max | Min | Max |
| Reference from PMHS Tests | 117 | 159 | -1653 | -1402 | 1020 | 1271 |
| GHBMC M50-PS v5.3.4 LS-DYNA MPP R10.2 | 136.6 | | -1492 | | 1160 | |
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| THUMS v4.02 VWG006.2 Aud165VH VPS 2020.54 | 135.6 | | -1574 | | 1219 | |

Tables B

Structure of MR1 Addendum 5

Human Body Models for Pedestrian HIT Determination Simulations (formerly Annex 2 to GTR9)

1. Introduction
2. Qualification Procedure and Corridors / Reference Results
3. Documentation of results

Annex A – Reference Systems

1. *Global Coordinate System*
2. *Human Body Model Reference Axis*
3. *Human Body Model with Skeleton*
4. *Human Body Model without Skeleton*

Annex B – Background – Validation of Reference Human Body Models (formerly Chapter 2 of Addendum 6)

Annex C – Generic Vehicle Models for Qualification of HBMs for HIT Determination Simulations (formerly Addendum 5)

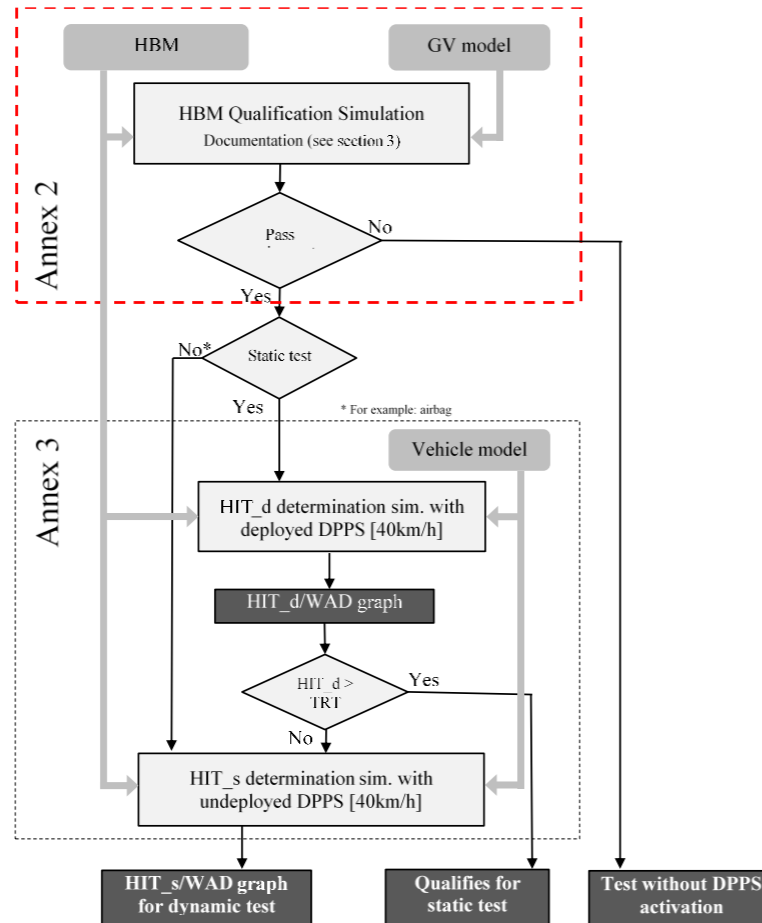
1. *General Provisions*
2. *User Manual*
3. *General Design*
4. *Plausibility Check*

Appendix C1 – File List of Generic Vehicle Models (Files available on UNECE Website)

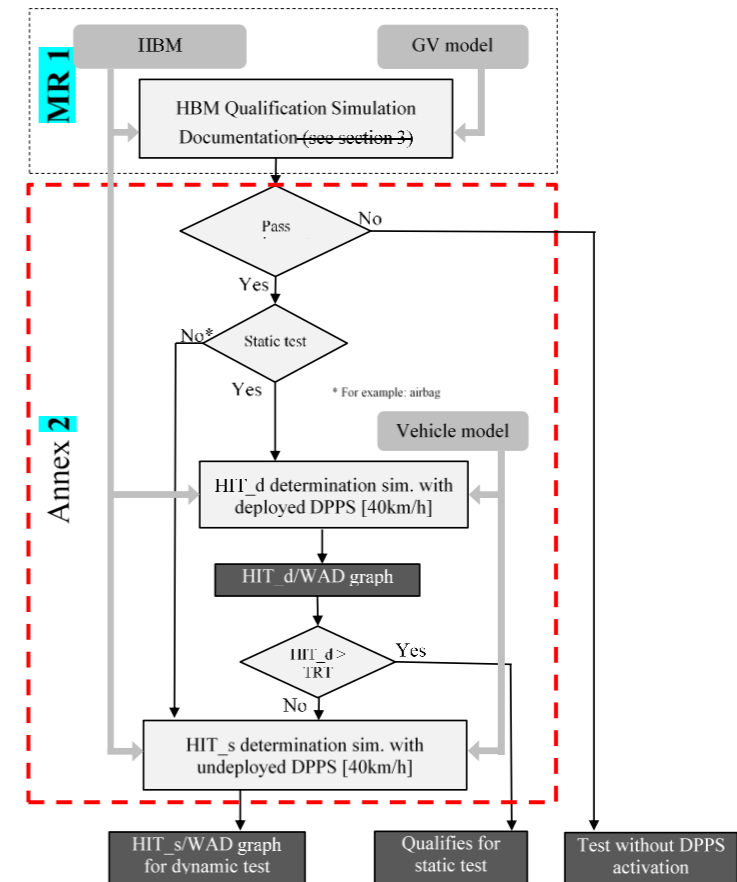
Appendix C2 – Auxiliary Files

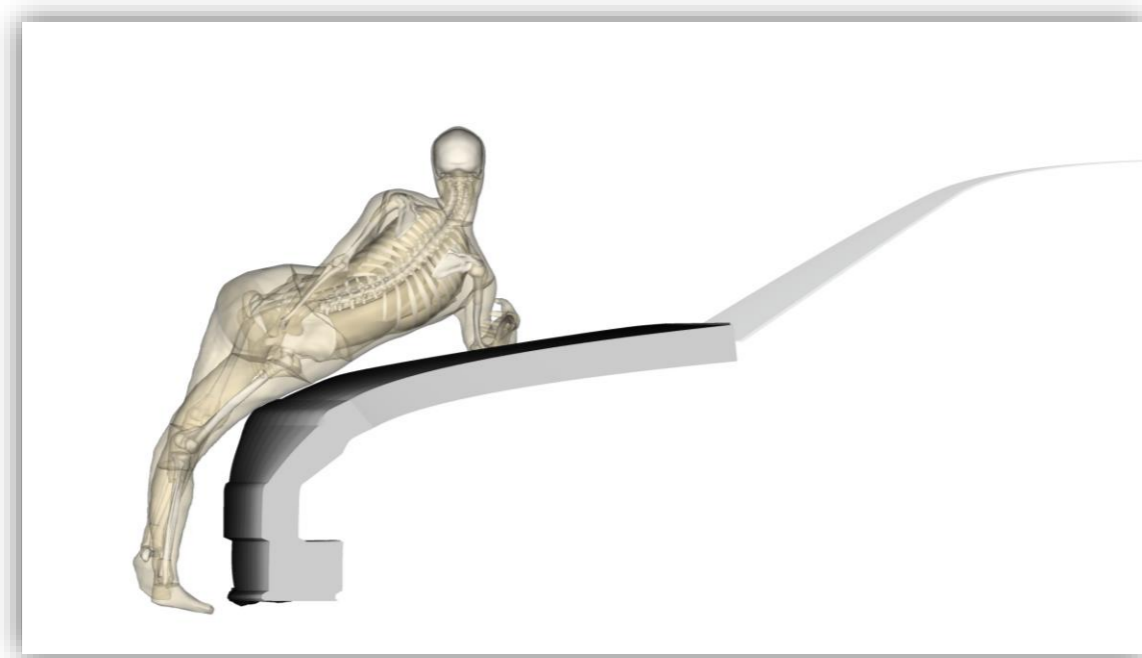
What does this mean for the GTR 9 Document?

Old:



NEW:





Vehicle Safety Institute

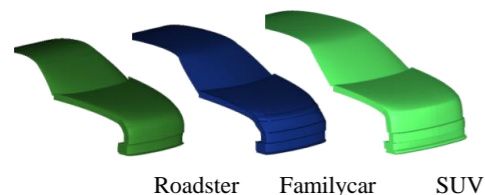
Graz University of Technology

Inffeldgasse 23/1

8010 Graz Austria

www.vsi.tugraz.at

Building Blocks



Roadster Familycar SUV

Finite Element Software

(supplied by code-houses to Industry)



Generic Vehicle Models
available on UNECE website
– MR1



Human Body Models
(openly available or by suppliers)

Vehicle Simulation Models with DPPS of Vehicle Manufacturer



1. Plausibility check

2. Human Body Model qualification

3. HIT vs. WAD determination

4. Use HIT for DPPS decision