

Informal document GRSP-74-05
(74th GRSP, 04 - 08 December 2023,
agenda item 17)

Equitable Occupant Protection, report to the 74th session of GRSP

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Meetings & Workshops 2023

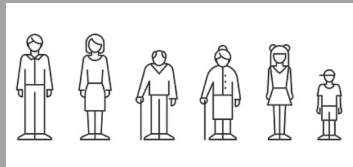
- Meetings (hybrid, and on-line only)
 - First meeting, April 6, in Yokohama
 - Second meeting, May 15, in Geneva
 - Third meeting on September 21, 2023;
 - Fourth meeting on November 22, 2023
 - Five additional task force meetings on Field Data (one in-person meeting in conjunction with the IRCOB I Conference in Cambridge)
- Workshops (in person and follow up meetings on-line)
 - First Workshop, September 21, Cologne, on Soft-tissue neck injuries in rear impact,
 - Second Workshop, October 23-25, Brussels, on Field Data,
 - Third Workshop, November 14, Munich, on Virtual Crash Testing,

EqOP Approach

0.) Field data study



Identify which loading scenarios in the field cause significant differences in injury risks for different groups of the population and review how those are currently assessed in regulations



- gender
- age
- body height
- BMI / body weight

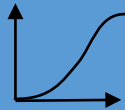
1.) Use available tools (already currently used in regulations) to address problems identified in 0.)

Change wordings in regulations

Change requirements in regulation with available tools:



a) Change what is required / voluntary?



b) Change injury criteria



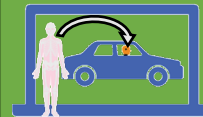
c) Change test conditions (speed, barrier, angle...)

2.) Use alternative test tools to address problems identified in 0.)

Which injury mechanisms can be predicted additionally compared to currently available tools, where problem in the field are observed?



Which alternative physical test tools are suitable for this?



What can be simulated what currently can't be tested?

Overview EqOP 2023

- Equity issues further explored.
 - Worktable used for mapping equity issues and research gaps – shall be complemented with a report.
- Virtual testing procedures in regulations reviewed.
- Benefits and challenges of virtual crash testing for occupant protection explored.
- Research gaps identified.
- Task forces defined to address equity issues.

Conclusions Workshop 1, (WAD – rear end impact) 1/2

- The injury risk increases with an incorrect height adjustment of the head restraint or an excessive distance between the head and the head restraint. A forgiving design of the back rest and head restraint should be targeted.

Conclusions Workshop 1 (WAD – rear end impact) 2/2

- One priority of the IWG regarding rear impact protection should be to eliminate poor design of back rests and head restraints:
 - Extended geometric requirements for the head restraint (e.g., as proposed by CLEPA) could reduce the possibility of head restraints to be optimised for a specific ATD.
 - Testing of worst-case scenario. (Presentation by NL)

Conclusions Workshop 2 (Equity issues)

1/2

- Field studies show that injury risk depends on
 - BMI / body weight of occupant
 - gender of occupant
 - stature of occupant
 - age of occupant
 - vehicle crashworthiness (e.g., rating result, vehicle size, mass, age of the vehicle (market introduction))
 - Occupant protection of passenger vehicles has improved over the years.
 - crash severity
 - seat position (driver vs. passenger / front vs. rear)
- Not one group at highest risk in general
 - Depending on injury and crash types
- Interaction of parameters often different for females and males
 - Difference between males and females more often reported for younger groups, age distribution for fatally injured occupants
 - Interaction of BMI and gender (different body shapes, fat distributions, belt fits)
 - Crash severity (females more likely to be in smaller and struck car)
 - Females more likely to be passenger (front and rear)

Conclusions Workshop 2 (Equity issues)

2/2

Identified equity issues based on review of field data:

- Head injuries – different conclusions in different studies; further review also with simulation studies will be required (many interacting factors).
- Soft tissue neck injuries in rear-end impact. (Females)
- Extremity injuries in frontal crashes. (Females)
- Thoracic injuries in frontal and side crashes. (Elderly)
- Abdominal injuries in frontal crashes - different conclusions in different studies; further review also with simulation studies required.

Conclusions Workshop 2 (Research gaps)

1/2

- Understanding of the interaction of gender with other parameters:
 - Age
 - Anthropometry
 - Height
 - Weight
 - BMI
 - The Waist-to-Hip Ratio (WHR)
 - Shoulder Height Sitting (SHS)

Conclusions Workshop 2 (Research gaps)

2/2

- Pregnant females.
- Understand the injury mechanisms causing equity issues for leg injuries, in particular lower leg & ankle.
- Missing accepted tools and criteria for injuries and sizes which have not been in focus before.

Conclusions Workshop 2 (Agreed task forces)

1. TF Drafting Team for the Report on equity issues: continue to work on the worktable and draft written report.
2. TF on rear impact seat assessment with focus on soft tissue neck injuries / whiplash associated disorders (Remark: presentations by NL and CLEPA at the next GRSP.)
3. TF on Virtual Crash Testing
4. TF on restraint system requirements.
 - a. Geometric requirements for seatbelt
 - b. Dynamic requirements / system performance
5. TF on extension of assessments towards currently not considered injury types with high frequency and risk of PMI.
 - a. Lower extremity injuries in frontal and side impacts
 - b. Upper extremity injuries in frontal and side impacts
 - c. Brain injuries in frontal and side impacts
 - d. Soft tissue neck injuries in frontal and side impacts

Conclusions Workshop 3 (Virtual crash testing, VCT)

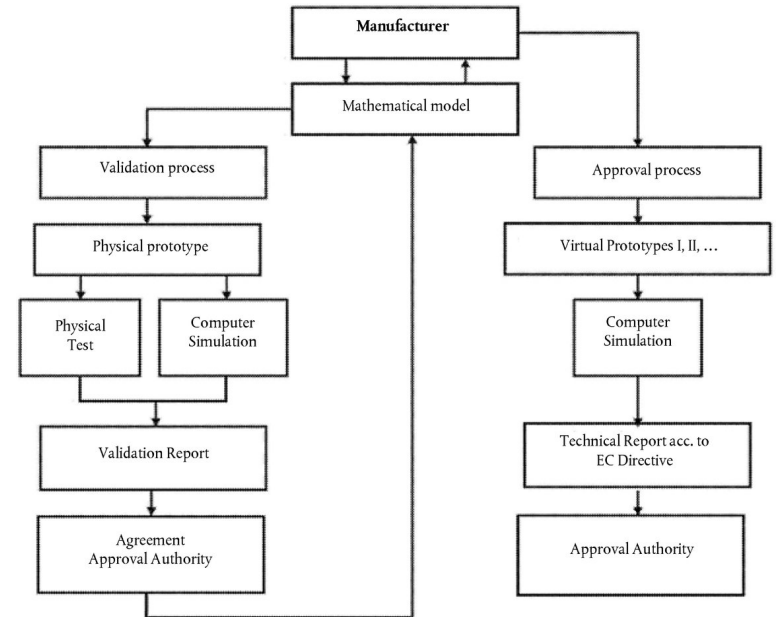
- Virtual testing already possible in several regulations
- Opportunities, barriers and ideas, to overcome them to implement virtual testing for occupant safety assessments have been discussed

Virtual testing in type approval 1/3

- UN R13 Uniform provisions concerning the approval of vehicles of categories M, N and O with regard to braking
 - ANNEX 21, §2.1.3. “The vehicle stability function shall be demonstrated to the Technical Service [...]. As an alternative to carrying-out dynamic manoeuvres for other vehicles and other load conditions, fitted with the same vehicle stability system, the results from actual vehicle tests or computer simulations may be submitted.”
 - Appendix 1-3 specifies how simulations need to be validated and reported
- E/ECE/TRANS/505/Rev.3 "worst-case", selection
 - Schedule 8: General conditions for virtual testing methods

Virtual testing in type approval 2/3

- REGULATION (EU) 2018/858
- Article 30(7): "At the request of the manufacturer, and subject to the agreement of the approval authority, virtual testing methods may be used in accordance with Annex VIII as alternatives to the tests referred to in paragraph 1."
- ANNEX VIII: "CONDITIONS FOR THE USE OF VIRTUAL TESTING METHODS BY A MANUFACTURER OR A TECHNICAL SERVICE"



Conclusions Workshop 3 (Next steps)

1. Define wording (glossary) related to virtual crash testing
2. Sketch a general process (for type approval / self certification)
3. Definition of load cases (in collaboration with other TFs)
4. Define requirements for occupant simulation models (ATDs & HBM)
5. Define requirements for vehicle model validation (standards)
6. Define processes to combine occupant and vehicle model to a simulation load case/scenario
7. Requirements for FE Software
8. Requirements for outputs and documentation

Working plan for future work in EqOP

Task Force Descriptions

Task Forces – the following tasks will be important in several task forces

- Reviewing research
- Close collaboration between industry and research for filling knowledge gaps
- Review of concerned regulatory requirements
- Explore opportunities to improve robustness of concerned regulations
- Prioritization based on relevance of the injury type

Task Force 1: Drafting Team – Report on Equity Issues

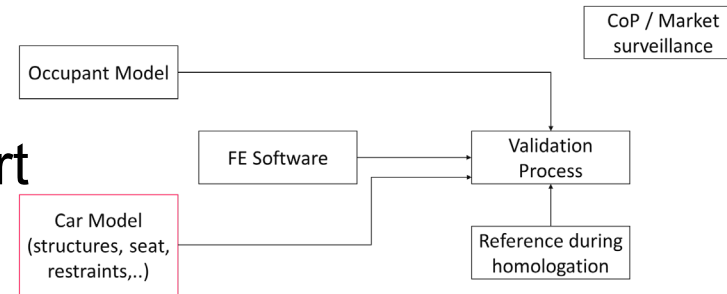
- Report will capture the literature review effort and associated findings
- Report will be:
 - Distributed for review within CP organizations
 - Summarize and discuss findings (including where conflicts exist in the literature)
 - Conclusions will be clearly supported by the summarized findings of the literature review
 - Publicly available

Task Force 2: Rear impact assessment

- Explore and discuss how to address the need for a forgiving design of the seat – focus on head restraints and back rest.
 - Eliminate poor design of back rest and head restraints.
- Explore the SETs – Seat Evaluation Tools that have been developed in VIRTUAL.
- Identify any shortcomings of existing regulations and related standards.
 - Can current test protocols be used to optimize crash performance for the specific test conditions and test dummies in a narrow way that is detrimental to the protection of a diverse population?
- Discuss and understand the possibilities and challenges with virtual crash testing.
 - Knowledge gaps?
 - How can we develop a robust regulation?

Task Force 3: Virtual testing

- Explore benefits of virtual crash testing to overcome equity issues.
- Define procedures how virtual crash testing can be implemented to assess occupant protection (type approval vs. self certifying countries)
- Define requirements for all building blocks of the procedure
- Strong collaboration with other expert groups and initiatives



Task Force 4: Restraint system requirements

- Geometric requirements for seatbelt
 - Define how to assess improved belt fit for a diverse population in all seats
- Dynamic testing requirements / restraint system performance
 - Define how to assess adaptive protection
- Identify any shortcomings of existing regulations and related standards.
 - Can current test protocols be used to optimize crash performance for the specific test conditions and test dummies in a narrow way that is detrimental to the protection of a diverse population?
- Investigate the possibilities and challenges with virtual crash testing regarding evaluation of restraint system performance in regulations

Task Force 5: Extension to new injury types

- TF on extension of assessments towards currently not considered injury types with high frequency and risk of PMI (*where equity issues have been identified*)
 - 4a) Lower extremity injuries in frontal and side impacts
 - 4b) Upper extremity injuries in frontal and side impacts
 - 4c) Brain injuries in frontal and side impacts
 - 4d) Soft tissue neck injuries in frontal and side impacts
- Explore how these injuries could be assessed in regulations
 - review ideas on injury criteria & tools to assess them
 - physical tools (ATDs)
 - virtual tools (HBMs)
 - Discuss and explore how identified knowledge gaps can be closed

Thank you!

Questions?