

# Consideration of Vibration testing requirements for EVS-GTR

The 21<sup>st</sup> EVS-GTR IWG (20-22 April 2021)  
OICA on behalf of the US, Canada and OICA

# 1. Introduction

*This presentation provides a brief outline of the paper (EVS21-E3VP-0101) jointly submitted by the US, Canada and OICA for the 21<sup>st</sup> EVS-IWG*

- ✓ Provide technical analysis of REESS vibration testing requirements for EVS-GTR (GTR No. 20)
  - Vibration test in vehicle development
  - History of vibration requirements in EVS-GTR Phase 1
  - Summary of field information
  - Effect of vibration on safety
  - Conclusion

## 2. Vibration test in Vehicle development

- ✓ Vibration tests are **essential durability and reliability requirements**
  - ➔ In order to make competitive products, vibration tests have to be conducted in vehicle development **regardless of the vehicle's powertrain** (i.e. EV or non-EV), according to the manufacturer's own target
  - ➔ Vibration testing is **competitive and proprietary know-how** of product development
- ✓ The required strength of the vibration test **largely depends on road and environmental conditions**
- ✓ Vibration characteristics of REESS **affected by various factors** such as masses and dimensions, mounting position, vehicle structure, suspension, tire, and so on
  - ➔ **Vehicle specific vibration profile** allows optimized design of REESS without causing unnecessary increase of the mass
- ✓ ISO profiles can be a guidance when the vehicle's vibration profile is not determined yet (e.g. development by system suppliers)

# 3. History of vibration profile in EVS-GTR

- ✓ Developed about 10 years ago for UNR100-02, with urgency but without sufficient experiences
- ✓ **Not intended to simulate and reproduce the vibration profile of an actual vehicle**
- ✓ Intended to **apply reasonable level of mechanical stress** to eliminate poorly designed vehicles

## 4. Summary of field information

- ✓ **No real-world cases** of fire/explosion due to vibration have been identified

# 5. Effect of vibration on safety

- ✓ **FMEA analysis** for the potential failures caused by vibration conducted (See *EVS21-E3VP-0101* for details)

Table 1: Possible failures in REESS due to vibration and their effect on safety

Possible failures		Effect	Assessment
Area	Failure		
Cell	Disconnection of electrode tab lead welding	Loss of cell voltage (or loss of a part of jelly roll connections)	Detected by BMS either by capacity loss in case of partial disconnection of the jelly roll, or cell voltage drop if the jelly roll is totally disconnected. At worst, a thermal runaway may occur due to the joule heat but safety will be ensured by the thermal propagation requirement.
	Electrode stack / jelly roll movement and damage	Internal short circuit between the electrodes	Detected by BMS by cell voltage drop. At worst, a thermal runaway may occur but safety will be ensured by the thermal propagation requirement.
		Damage of cell sealing and electrolyte leakage	Detected by BMS, either by reduced capacity or insulation resistance fault.
	Physical contact of electrodes and cell envelope (can, pouch...)	Internal short circuit	Detected by BMS by cell voltage drop. At worst, a thermal runaway may occur but safety will be ensured by the thermal propagation requirement.
Cell connections	Cell connection welding broken	Increase of electrical resistance Loss of cell voltage	Detected by BMS by cell voltage drop At worst, a thermal runaway may occur due to the joule heat but safety will be ensured by the thermal propagation requirement.
Cell restraint in	Cell movement damages the cell insulation materials	Loss of electrical insulation	Detected by BMS as isolation failure.
		Short circuit between cells through	Harmonized design & production quality standards established within the

# 5. Effect of vibration on safety

- ✓ **FMEA analysis** for the potential failures caused by vibration conducted
- ✓ Majority of potential failures caused by vibration:
  - ◆ **Will not instantly cause fire or explosion**
  - ◆ **Can be detected** by BMS or vehicle system
    - Warning and/or REESS limitation/shut-down
  - ◆ Electric shock is prevented by isolation resistance requirements
  - ◆ The occurrence of severe events of REESS will effectively be **prevented by existing requirements** such as external short-circuit protection, thermal propagation and so on

# 6. Conclusions

- ✓ Vibration requirements in EVS-GTR will **not significantly increase the safety** of EVs
- ✓ Durability and/or reliability are ensured by each manufacturer as one of **the competitive aspect of products**

<Recommendation>

**Remove vibration testing and requirements from GTR No. 20**