

Consideration of test levels
(vehicle or REESS/REESS subsystem)
for thermal propagation requirements

OICA



Background - General

- In general, vehicle level assessment will be the most representative test scenario for the most of regulatory requirements
- Nevertheless, lower-level test objects (i.e. system or component) are accepted for several type approval tests for several reasons:
 - Practicality for conducting the test (e.g. scale/cost of test set-up, duration, environmental conditions, etc.)
 - Effective representation of various vehicle configurations
 - Business practice between the vehicle manufacturer and the supplier
- UN-R100 (02 series or later) also adopts testing of REESS/REESS subsystem as well as component type approval of REESS



Remark: Related definitions (in UN-R100)

2.37. "Rechargeable Electrical Energy Storage System (REESS)" means the rechargeable energy storage system that provides electric energy for electrical propulsion.

A battery whose primary use is to supply power for starting the engine and/or lighting and/or other vehicle auxiliaries' systems is not considered as a REESS.

The REESS may include the necessary systems for physical support, thermal management, electronic controls and casing

2.38. "REESS subsystem" means any assembly of REESS components which stores energy. A REESS subsystem may or may not include the entire management system of the REESS.

2.44. "Tested-Device" means either complete REESS or REESS subsystem that is subjected to the tests prescribed by this Regulation.

Typical configuration of "REESS subsystem" is a battery pack that does not contain full BMS functionalities.

In case of vehicle with multiple battery pack, there will be a central controller that communicate with "partial" management functions in each battery pack. In such cases, each battery pack may not be regarded as complete REESS but regarded as REESS subsystem.

If the test with REESS is allowed, the test with "REESS subsystem" should also be allowed, provided the manufacturer can demonstrate the representativity.



Discussion at SIG-TP#1

- JRC proposed that vehicle level test should be the default because:
 - Vehicle level will better represent the actual use of the vehicle
 - Smoke inside the passenger compartment will be a critical hazard
- OICA proposed to keep component (REESS) level test as a manufacturer's option because:
 - Lack of evidence showing the difference of propagation phenomena between vehicle level test and REESS level test
 - No objective judgement criteria for smoke assessment
 - Cost benefit of vehicle level test is not considered so far
- Agreed to review the benefit/deficit of each test level and verify the data of vehicle level and component level experiments



Overview of thermal propagation test

1. Pre-tests on cell/module to determine the initiation method and the test parameters
2. Instrumentation of initiation device and measuring sensors within the battery pack
3. SOC adjustment and system functionality check
4. Placement at the test site, either indoor or outdoor
5. Confirmation of test conditions (e.g. REESS temperature, wind, humidity, etc.)
6. Start initiation device and measurements
7. On-site observations, stop initiation device at appropriate timing
8. Analysis of measured data and video
9. Post-test inspection (if necessary) and post test treatment

Pass/fail criteria:

During the egress or 5 minutes after the activation of warning signal, no evidence of:

- (a) Fire
- (b) Explosion
- (c) Smoke inside the passenger compartment



Visual inspection
without disassembly
(i.e. no numerical threshold)



Potential benefit of vehicle-level test

- More realistic behavior of thermal propagation
 - Influence of vehicle structure to the thermal propagation behaviour
 - **The magnitude of the influence has not sufficiently been examined**
 - Direct analysis of vehicle response (e.g. warning indication, cooling, etc.)
 - Assessment of smoke inside the passenger compartment
 - There is **no reported field incident** with any occupant casualty caused by the smoke from REESS

Expected benefit will be very limited and unquantified



Potential issues of vehicle-level test (1)

- REESS Suppliers will not be able to obtain REESS type approval independently from vehicle manufacturer
 - Restrictions for suppliers' business that may hamper technological evolutions
- Higher cost and longer time required for test vehicle preparation
 - Need to obtain vehicle with final-level quality at a higher cost
 - only available at the late stage of product development
 - Need to dismantle and re-install REESS
 - Pre-instrumentation of REESS will anyway be the most realistic way
 - Need at least 1 complete vehicle on the top of pre-installed REESS
- Large scale test site will be required
 - Limited number of indoor facilities capable to conduct vehicle-level test
 - Limited availability of outdoor sites and temporary wind/rain proof needed



Potential issues of vehicle-level test (2)

- Difficulty in visual observation
 - REESS may not be observed directly
 - Inside the passenger compartment can only be observed through camera installed in the test vehicle → The camera may be burned out after the test
- Post-test treatment
 - Need to de-energize REESS before moving the vehicle
 - May need to wait until the vehicle is fully burned out
→ more time required to burn out
 - Higher amount of waste management

Heavy burdens for industry that will be reflected to product price



Balance?



Limited and unquantified benefits

Unbalanced requirement may influence the market growth of BEVs

Heavy burdens anticipated

- ◆ Business restrictions
- ◆ Cost/time for vehicle preparation
- ◆ Test-site limitations
- ◆ Test observations
- ◆ Post-test treatment



Suggested direction

- Allow manufacturer's choice of vehicle level test or REESS/REESS subsystem level test as the principle
- Consider pragmatic and reasonable way to assess the hazard from smoke inside the passenger compartment