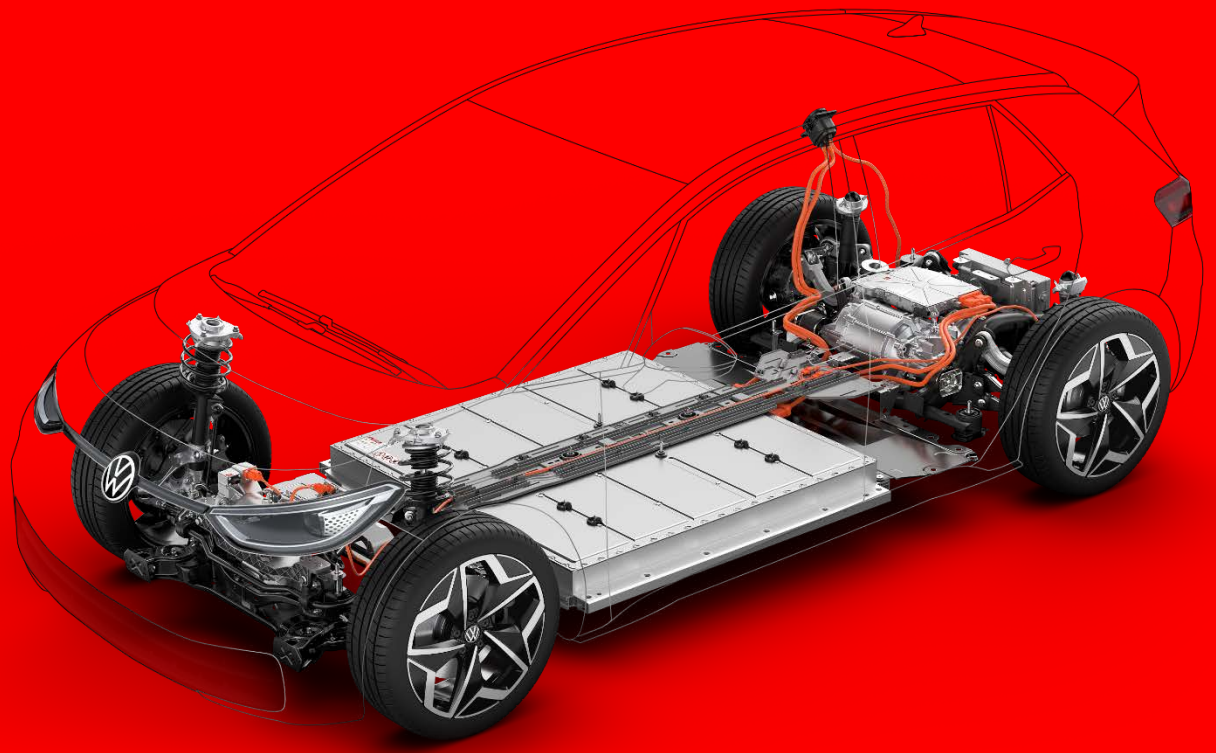
REESS Vibration Profile in ISO 6469-1 - Explanation

ISO TC22 SC37 – Chairperson
Dr. Michael Herz



Introduction of ISO TC22 SC37
Electrically Propelled Vehicles

ISO TC22 SC37

- Safety aspects and terminology
- Performance and energy consumption
- Rechargeable energy storage
- Systems and components connected to electric propulsion systems

Scope:
Specific aspects of electrically propelled road vehicles, electric propulsion systems, related components and their vehicle integration.

Participating - Members:

Austria (ASI)
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Canada (SCC)
China (SAC)
Czech Republic (UNMZ)
Denmark (DS)
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South Africa (SABS)
Ukraine (DSTU)

Introduction of ISO 6469-1

Electrically propelled road vehicles — Safety specifications — Part 1: **Rechargeable energy storage system (RESS)**

Scope:

This document specifies safety requirements for rechargeable energy storage systems (RESS) of electrically propelled road vehicles for the protection of persons...

Test procedures cover the following areas:

- Mechanical
- Climatic
- Simulated vehicle accident
- Electrical
- Functional

Introduction of ISO 6469-1 3rd edition

- Published in April 2019 with 100% approval
- Main changes compared to 2nd edition:
  - water immersion
  - electrical
  - vibration

Votes by members					
Country	Member	Status	Approval	Disapproval	Abstention
Australia	SA	O-Member			X
Austria	ASI	P-Member			X
Belgium	NBN	P-Member			X
China	SAC	P-Member			X
Denmark	DS	P-Member			X
Egypt	EOS	O-Member			X
France	AFNOR	P-Member			X
Germany	DIN	Secretariat	X *		
Indonesia	BSN	P-Member			X
Israel	SII	P-Member			X
Italy	UNI	P-Member	X		
Japan	JISC	P-Member	X *		
Korea, Republic of	KATS	P-Member	X		
Netherlands	NEN	P-Member	X		
Portugal	IPQ	P-Member			X
Romania	ASRO	O-Member	X		
Russian Federation	GOST R	P-Member	X		
Spain	UNE	P-Member	X		
Sweden	SIS	P-Member	X *		
Switzerland	SNV	P-Member			X
United Kingdom	BSI	P-Member	X		
United States	ANSI	P-Member	X		
TOTALS			11	0	11
(*) A comment file was submitted with this vote					

Mechanical Requirements of ISO 6469-1

5.1 Mechanical requirements

The RESS shall provide the safety performance as specified below under mechanical loads due to vibration and mechanical shock, which an RESS will likely experience during the normal operation of a vehicle over its lifetime.

The general safety requirements in accordance with 4.2 shall be fulfilled.

Compliance shall be tested in accordance with 6.2.

Differences Between Requirements for Safety and Design for Durability

Mechanical safety requirement and test in ISO 6469-1:

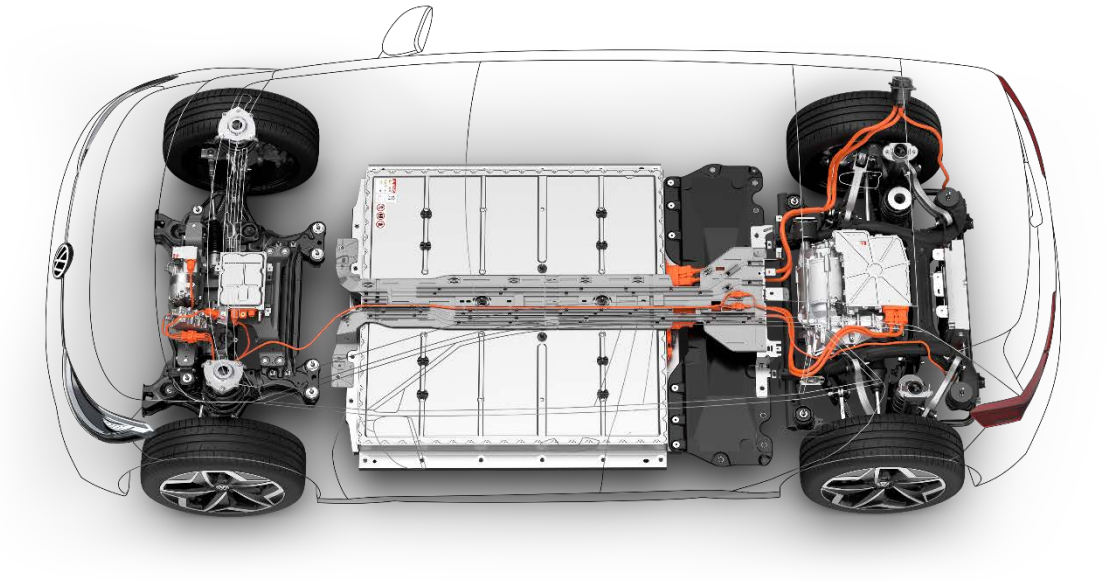
- no hazard for persons at any time
- improvement of the proven and well established safety profile of ECE R100

Design for durability by OEM:

- provide functionality until the end of service life under consideration of vehicle category and typical vehicle usage
- durability is not in the scope of a safety standard

Influencing Factors for Mechanical Stress in Vehicle Design

- Vehicle category
- Vehicle suspension
- Typical road usage profile
- Battery mounting and location
- Battery and vehicle mass
- Prospective vehicle service life and vehicle service plan



Consequence:

There is no common durability profile possible

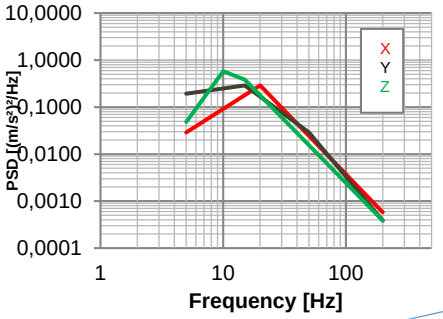
Approach of the ISO 6469-1 Project Team Regarding Testing

Multiple delegations contributed and compared

- Vehicle measurements under consideration of vehicle category and test track
- Measurement methods and test points
- Method of calculation

Conclusion: no differences in methodology

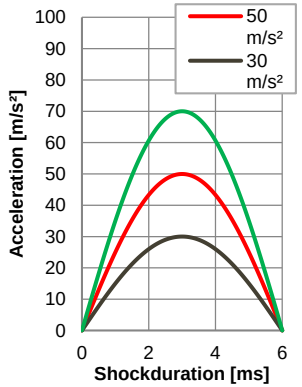
Mechanical Test of ISO 6469-1



6.2 Mechanical test

Vibration test AND **Mechanical shock test**

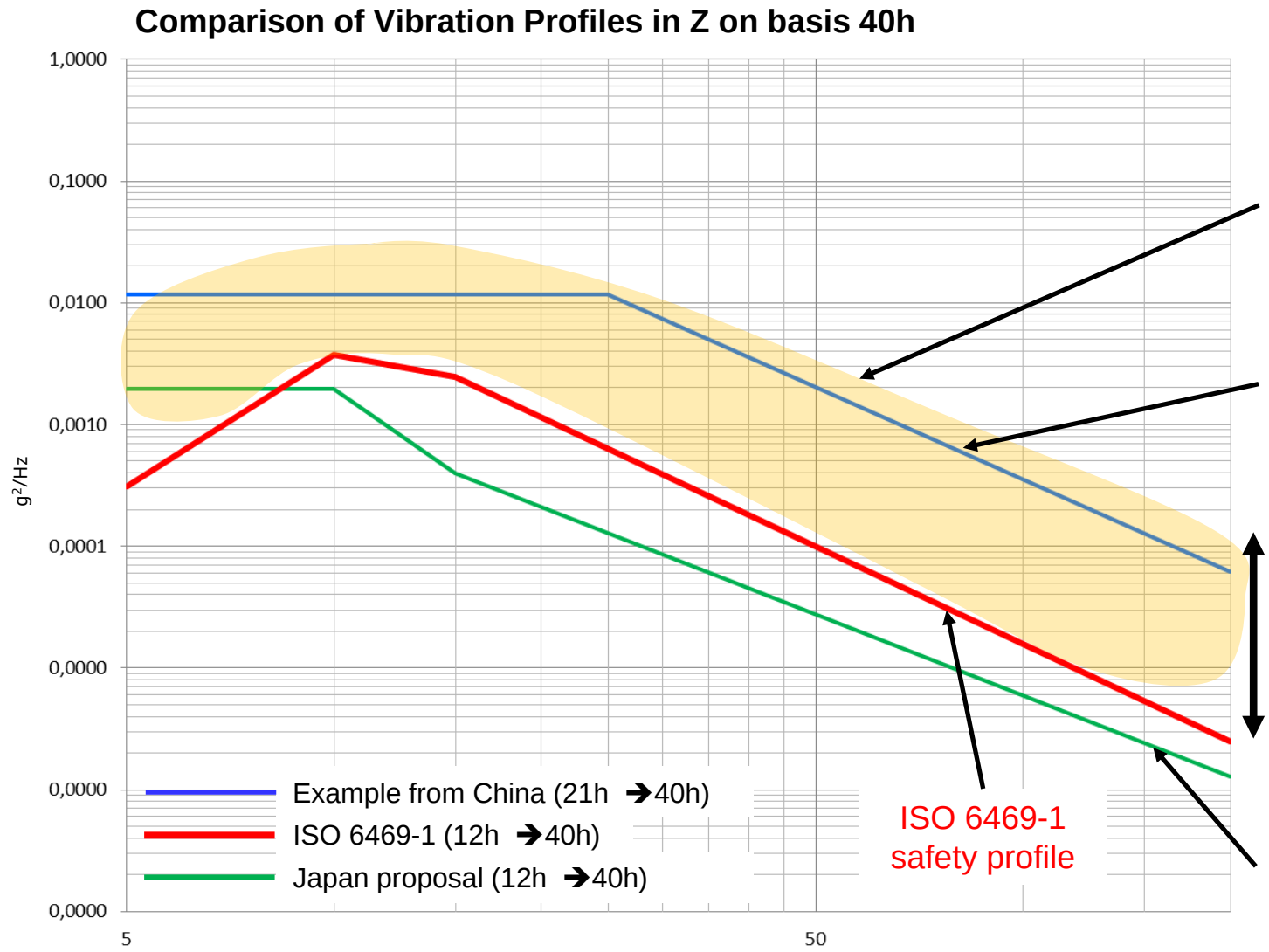
Option 1 – safety profile OR **Option 2 – based on vehicle measurement (preferred), but not below the safety profile**



Advantages of the safety profile over the ECE R100 test:

- more realistic for vehicle application
- no artifacts due to harmonics because of random profile
- wider frequency range

Derivation and Comparison of the Safety Profile



74 measurements from all relevant vehicle categories of different OEMs with a mixture of load conditions taking highway, urban, rural und rough road into account

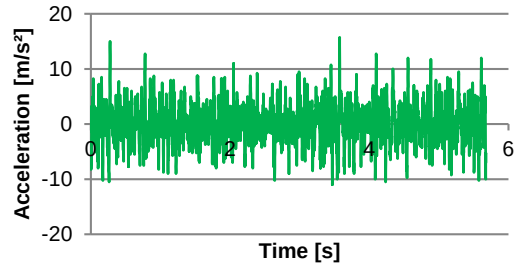
Example of the OEM specific test provided by China in Annex B of ISO 6469-1

Range of typical durability design
➔ Vehicle specific durability profile

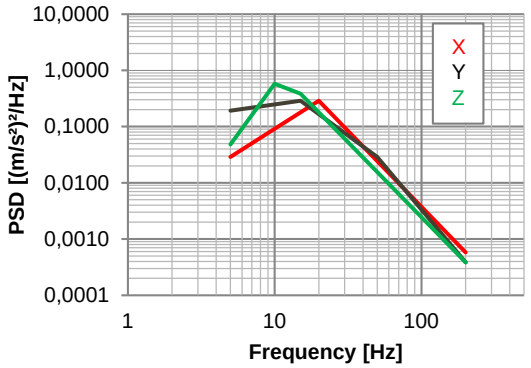
Alternative safety profile proposal contributed by Japan for ISO 6469-1 technical work (not used in published standard)

Comparison of the Safety Profiles of ISO 6469-1 and ECE R100

ISO 6469-1

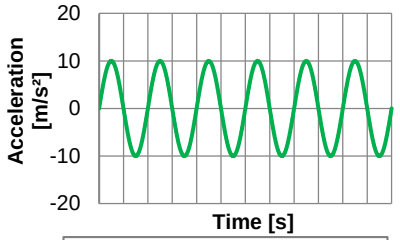


Noise

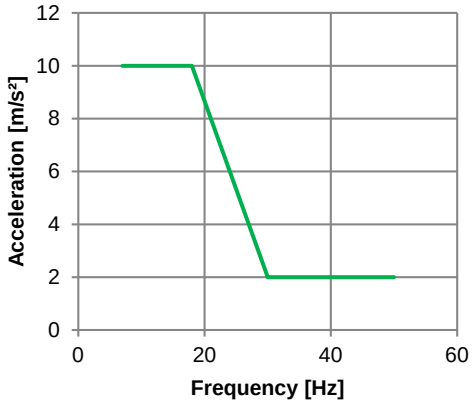


Direction: Z, X, Y

ECE R100



Sinus sweep



Direction: Z

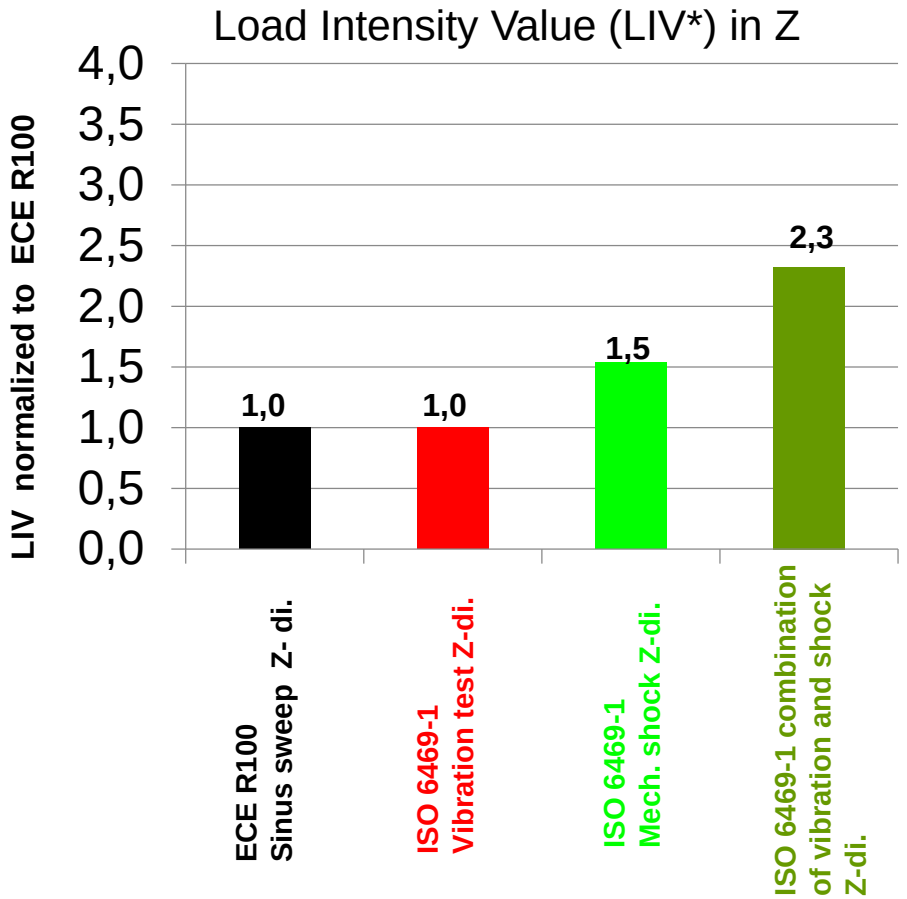
- ECE R100 profile was derived from UN38.3 (regulation for transport for dangerous goods)
- So far no field problems from transportation sector identified
- ISO 6469-1 safety profile was chosen to be load equivalent to ECE R-100

Conclusion

- Good design practice uses vehicle measurements for final design
- The ISO 6469-1 safety profile is derived from a broad range of experimental data
- The ISO 6469-1 safety profile is the state of the art safety requirement for all vehicle and battery categories

Thank you for your attention!

Comparison of the Mechanical Stress of ECE R100 and ISO 6469-1



* **LIV**
= Sum of the weighted load amplitudes
(for more details see annex)

ECE R100 does not consider x- and y-directions

Explanation: Load Intensity Value (LIV)

Based on Miner's Rule (cumulative damage calculation) all single loads of a load spectrum can be condensed into one single number (designated as LIV) as follows:

$$LIV = \sum (LS_K / LS_{SN})$$

Amplitude