Choose certainty.
Add value.

Testing of E-Vehicles

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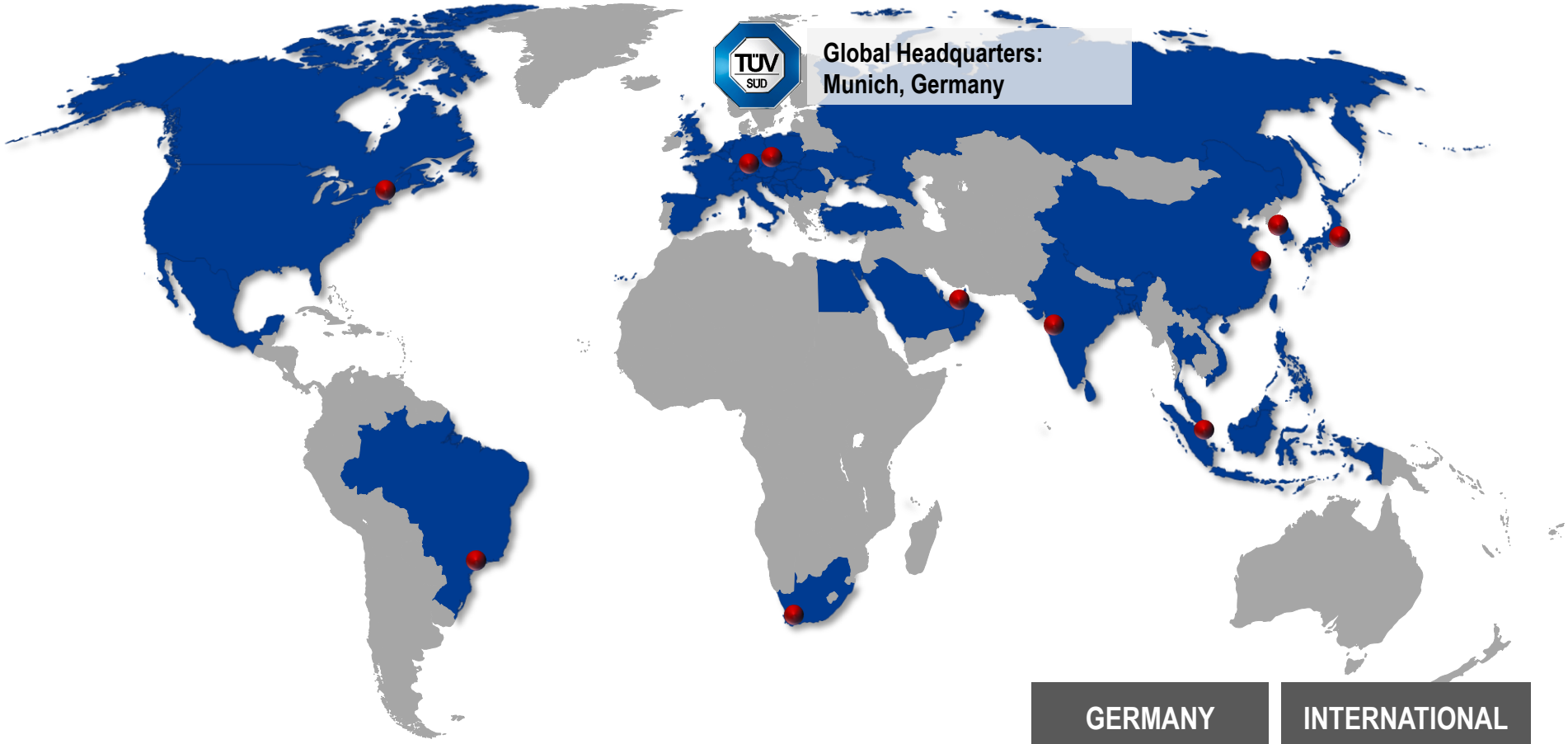
TÜV SÜD

TÜV SÜD in numbers: Growing from strength to strength

1	One-stop technical solution provider
150	years of experience
800	locations worldwide
1,800	million Euro in sales revenue 2012
18,800	employees worldwide

Global expertise. Local experience.



GERMANY	INTERNATIONAL
Euro 1,130 mio 10,200 staff	Euro 690 mio 8,600 staff

Legend:

- Countries with TÜV SÜD offices
- Regional headquarters

TÜV SÜD's electric mobility services offering

Testing and "accreditation" of hydrogen refueling points; fuel cell testing

Testing and certification charging infrastructure

Battery testing: performance, reliability & safety

Testing of e-bikes

Homologation; vehicle safety; functional safety services

Fleet management, carbon-footprint; eHU

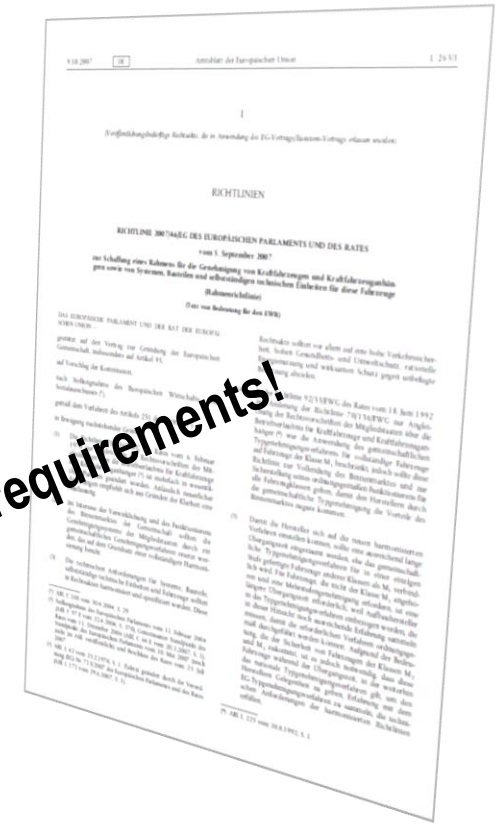
Training and seminars: e.g. high voltage in vehicles

Vehicle and Component Testing – Electric Vehicles

- **Mandatory homologation tests**
- **Company internal testing requirements**
- **Consumer tests**

Mandatory homologation tests:

- **The most common categories of electric vehicles with four and more wheels:**
  - L7e – heavy quadricycles – total unladen mass without battery does not exceed 400 kg resp. 450 kg (550 kg resp. 600 kg for quads intended for carrying goods)
    - **No crash test**
  - M1 – Passenger car
    - In small series only ECE R 12
  - M3 – busses
    - Urban busses no crash tests



Different Safety requirements!

- **Different documents:**
  - Directive 2007/46/EC – passenger cars, trucks and busses
  - Directive 2002/24/EC and Regulation (EU) 168/2013 – two- or three-wheel vehicles and quadricycles

E-Homologation

- **Homologation**
  - 3 levels according to the size of series
    - Individually manufactured vehicle
    - Small series (e.g. M1 up to 1000 pcs/year in the EC Countries)
    - Large series

Specific UN ECE regulations for (H)EV:

- ECE R100 safety requirements
- ECE R101 energy consumption
- ECE R 85 measurement of electric drive power

Which Category?

Which Category?

2002/24/EC – two or three-wheel motor vehicles, light four-wheelers (quads)

Category L7e:

- **Quad**
- **Unladen mass without battery up to 400 kg resp. 550 kg**

Passive Safety of L7e

- G Wiz: EuroNCAP test @ 64km/h (40 mph)

Source: dailymail.co.uk – “Crash test conducted by British car magazine Top Gear at 40mph”

ECE R100.02 type approval for batteries

Addendum 99: Regulation No. 100

Revision 2

Incorporating all valid text up to:

Supplement 1 to the 01 series of amendments – Date of entry into force: 26 July 2012
Supplement 2 to the 01 series of amendments – Date of entry into force: 15 July 2013
02 series of amendments to the Regulation - Date of entry into force: 15 July 2013

Uniform provisions concerning the approval of vehicles with regard to specific requirements for the electric power train

UNITED NATIONS

R100.02 already available

Transition period till **07/2016**

Annex 8 is defining test standards for the type approval of batteries for:

- **Hybrids**
- **Plug-In Hybrids**
- **Electric vehicles**

Safety requirements according to ECE R 100.02

Vehicles category M a N

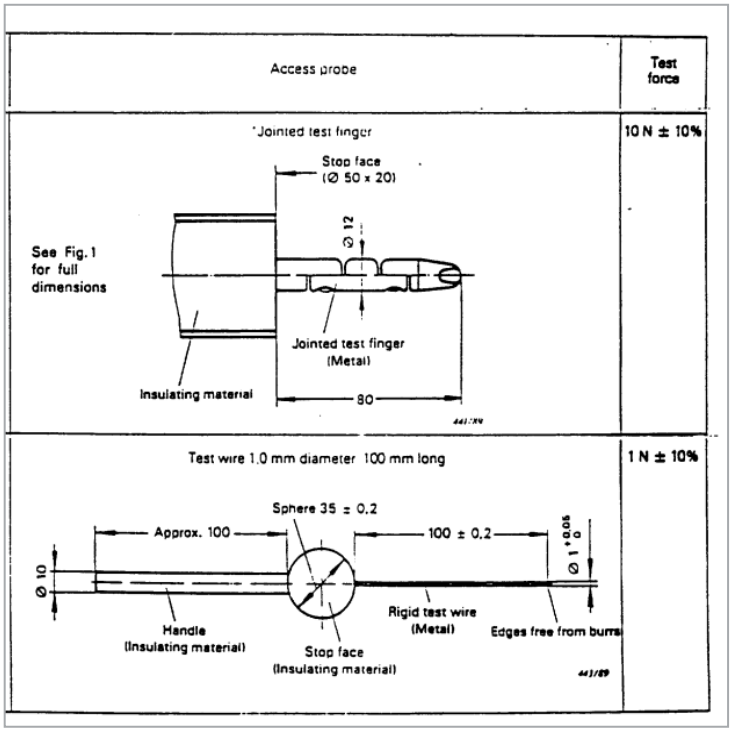
- Marking
  - Orange HV cables

- Electrical safety
  - Separated +/- wiring
  - protection of persons against access to hazardous parts
    - Test finger
    - Test wire
  - Isolation resistance
  - board isolation resistance monitoring system

- General requirements on Functional Safety (charging, EMC)

- //Hydrogen emissions – Pb accumulators//

- Rechargeable Energy Storage System (REESS)



ECE R100.02 type approval for REESS

9 Tests to be performed:

- Vibration test
- Thermal shock cycling
- Mechanical shock (crash simulation requires a slide test bench!)
- Mechanical integrity (crush test)
- Fire resistance (fuel fire test)
- External short circuit
- Overcharge protection
- Over-discharge protection
- Over-temperature protection

Safety testing area necessary!

Tests for Electrical Energy Storages

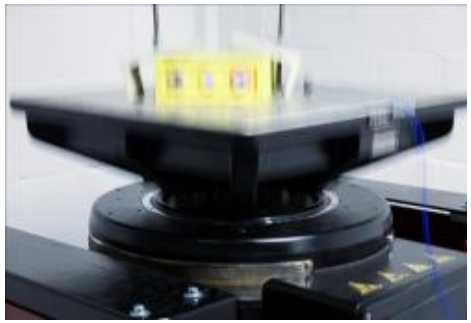
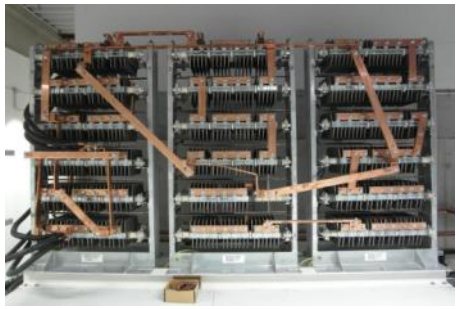
- **Performance- / Durability testing:**
  Cycle testing, Temperature influences
  Parameter determination

- **Environmental testing / Durability testing:**
  Vibration / Shock ,Dust, Humidity, Thermal Shock, EMC, immersion testing, Altitude simulation, dew, Chemical influences

- **Safety testing:**
  Short circuit, Overcharge, Over-Discharge, Nail penetration, Crush, Gas Analysis

- **Security issues**



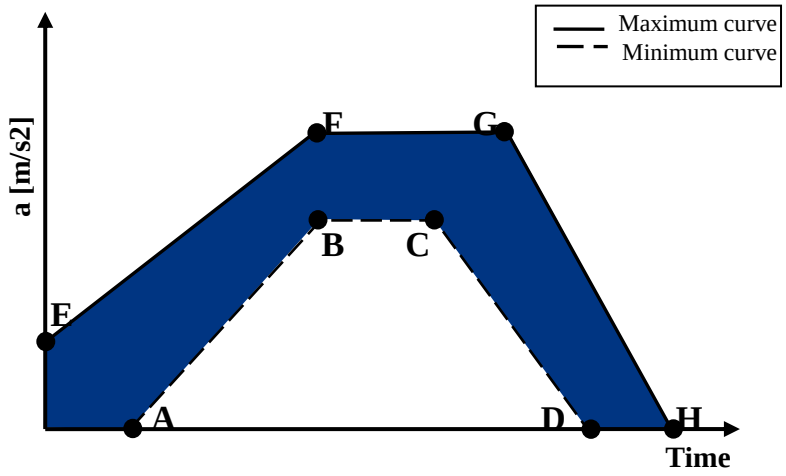

Tests for Electrical Energy Storages

Test Requirements

Vibration

Frequency [Hz]	Acceleration [m/s^2]
7 - 18	10
18 - 30	gradually reduced from 10 to 2
30 - 50	2

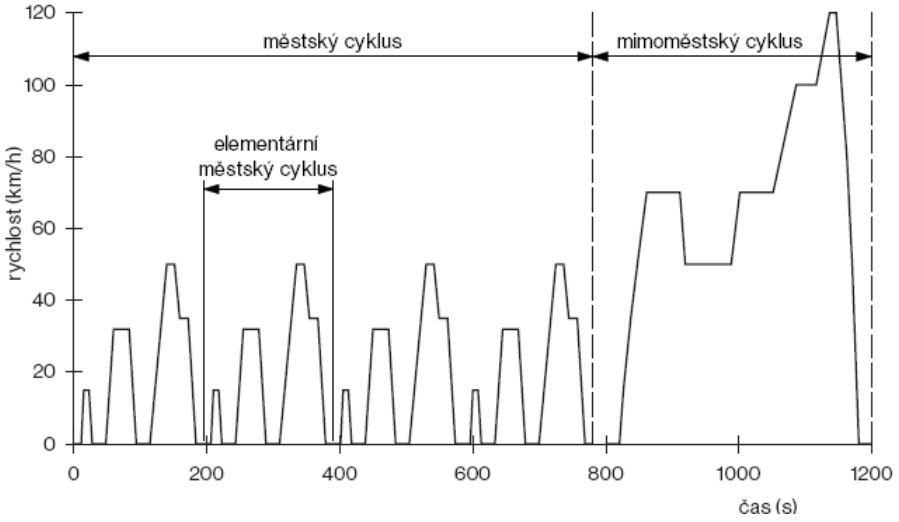
Mechanical Shock

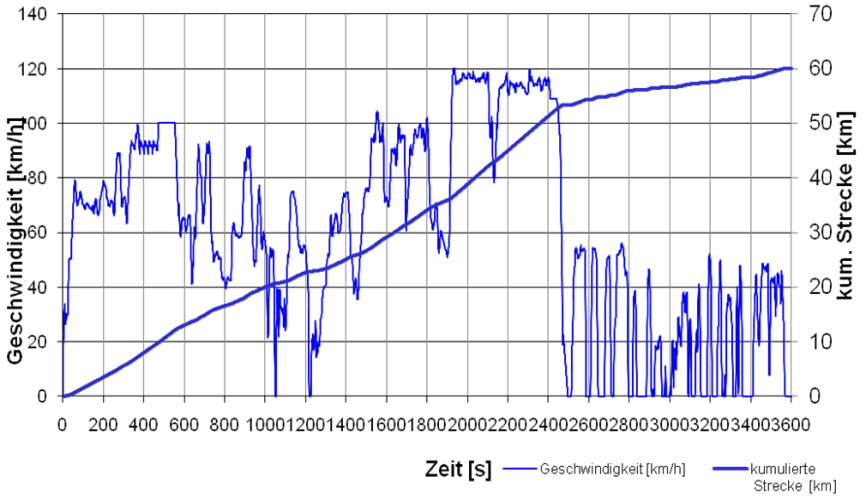


Point	Time [ms]	Acceleration [g]	
		Longitudinal	Transverse
A	20	0	0
B	50	20	8
C	65	20	8
D	100	0	0
E	0	10	4.5
F	50	28	15
G	80	28	15
H	120	0	0

Range of Electric Vehicles

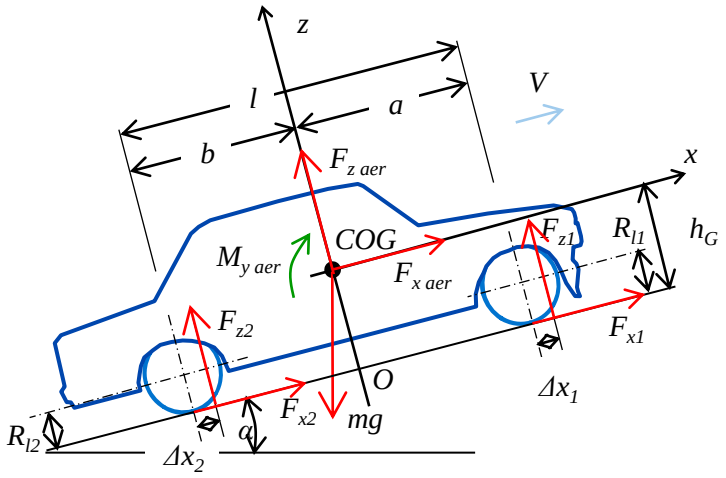
- Mandatory
  - NEDC
  - Vehicle dynamometer
- Consumer
  - TSECC (@-7, 23 and 30°C)
  - Vehicle Dynamometer
  - Simulation

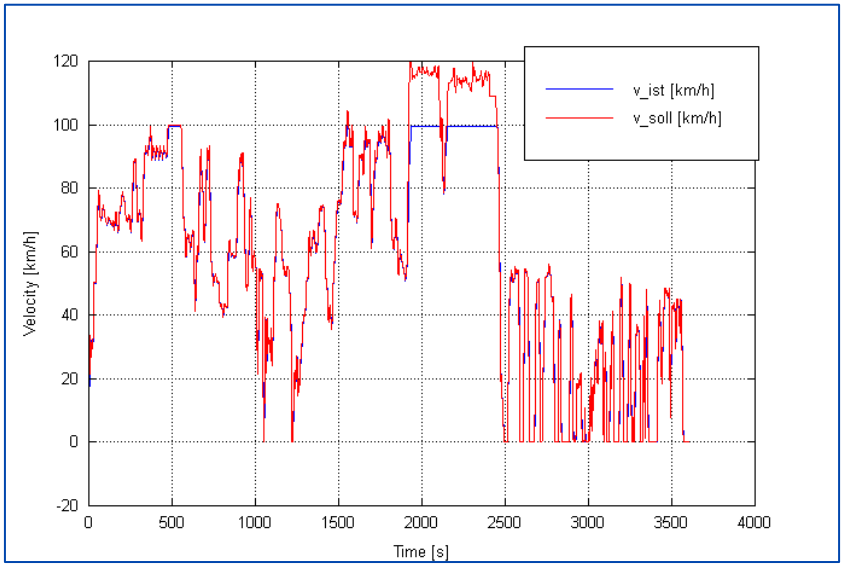


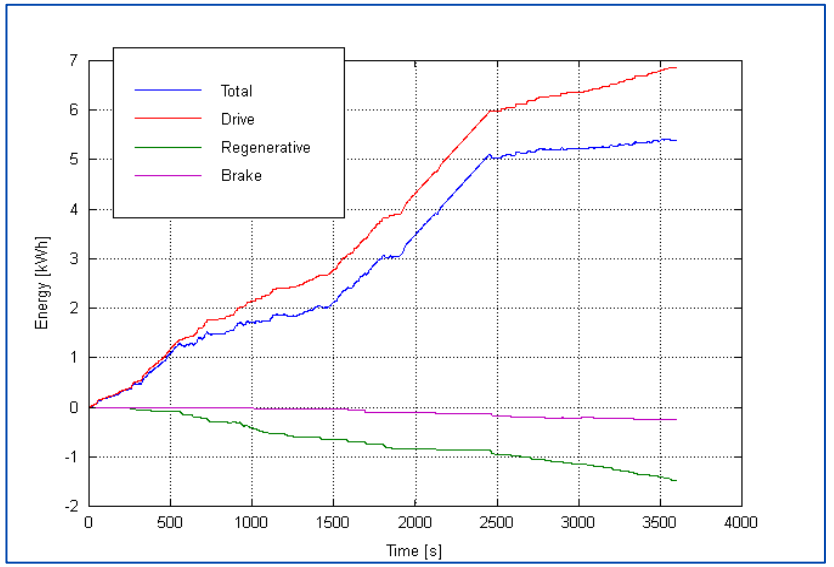


Simulation of Vehicle Range

- Model validation
  - Vehicle level
  - Component level
- Consumption of AUX devices
- Different simulation scenario
  - TSECC, NEDC, City, Real data, Aggressive driver, …





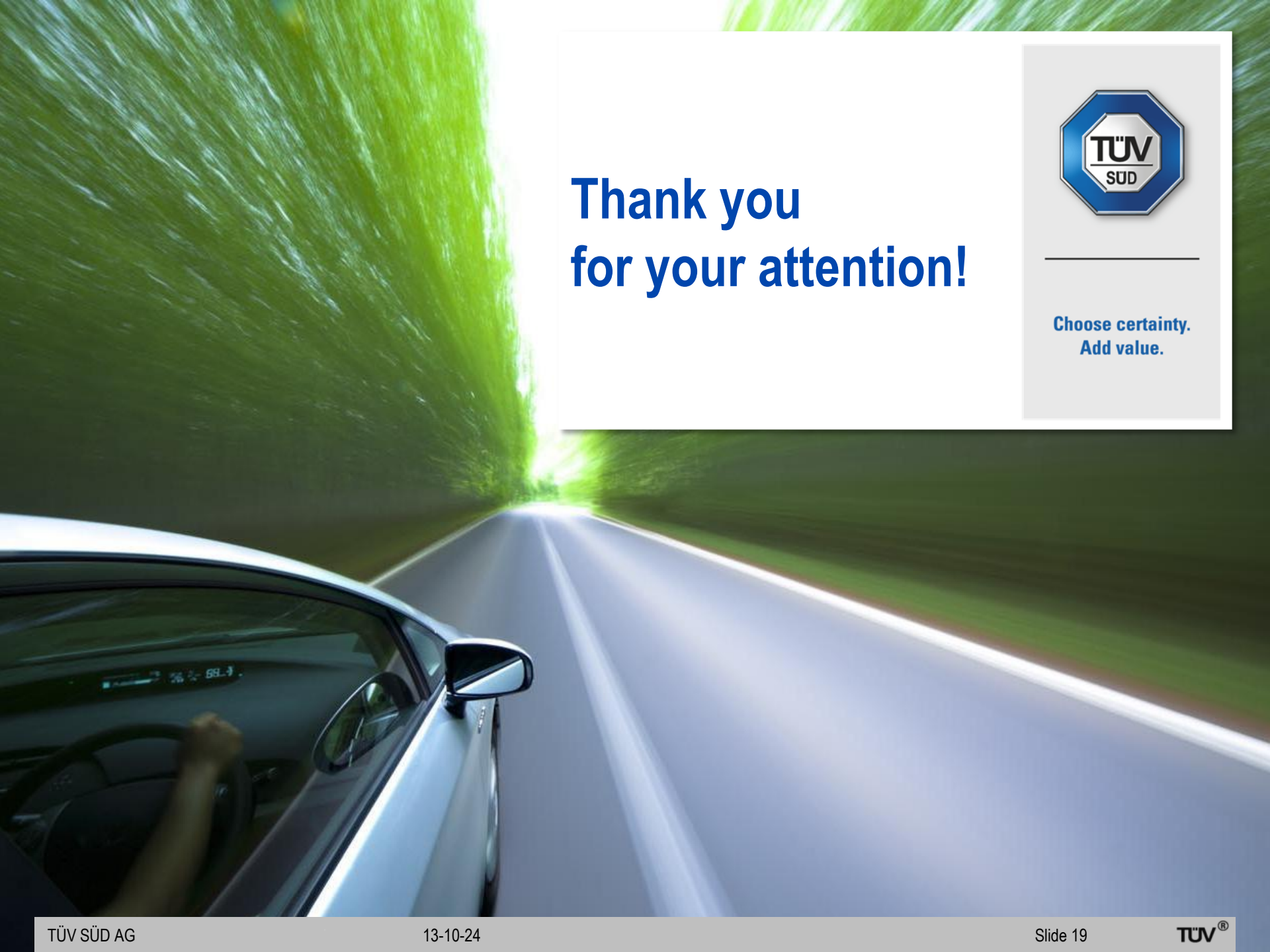


Conclusions

- EV testing
  - Mandatory requirements
  - Company internal testing requirements
  - Consumer tests

- ECE R 100.02
  - Vehicle homologation
  - Battery as component

- Range Evaluation
  - Temperature influence
  - Dynamometer/Simulation



Thank you for your attention!

Choose certainty.
Add value.