


SI 2172

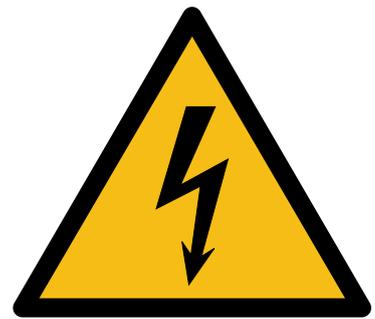
For technical personnel only!

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SERVICE INFORMATION

HIGH VOLTAGE – WORKING ON ELECTRIC VEHICLES SAFELY

THE 5 RULES OF ELECTRICAL ENGINEERING



1. SAFELY ISOLATE FROM THE SUPPLY VOLTAGE

Prerequisites / preparatory work:

- The skilled worker performing the work must have the 2S* qualification at a minimum.
- Cordon off and mark the work area.
- Ensure that all necessary work equipment is provided: PPE, measuring instruments, technical information from manufacturers, etc.

Safely isolate from the supply voltage in accordance with DGUV* (disconnect):

- Make sure that the battery charging plug is disconnected from the vehicle.
- Check the vehicle and high-voltage system for obvious damage.
- Switch off the ignition and keep the ignition key out of the wireless range in a secure location to prevent unauthorised access.
- Check and put on protective / insulating gloves (pursuant to EN 60903*, EN 61482-1*).
- Disconnect the 12 / 24-volt battery.
- For further steps, follow manufacturer's instructions.



2. SECURE AGAINST RENEWED SWITCH-ON

- Store the service / maintenance plug in a secure location to prevent unauthorised access.

Alternatively: prevent the battery main switch or low-voltage isolating plug from being switched back on using a lockable cover cap or padlock.

- According to the manufacturer's instructions, wait until the DC-link capacitors have discharged in the inverter. If unspecified, wait at least 10 minutes.
- For further steps, follow manufacturer's instructions.





3. ENSURE SAFE ISOLATION FROM THE SUPPLY VOLTAGE

- Check the safe isolation from the supply voltage using a suitable testing instrument, e.g. a two-pole voltage tester.
- The absence of voltage to the high-voltage system must be verified on all conductive components that could be live. Follow manufacturer's instructions!
- Document the safe isolation from the supply voltage.



DANGER

The system must be considered live until safe isolation from the supply voltage has been verified! Even after disconnection, energy is still present within the high-voltage battery.

4. EARTHING AND SHORT-CIRCUITING – NOT WITH HIGH VOLTAGE!

High-voltage vehicles have a so-called IT system (French: Isolé Terre = isolated earth), i.e. they are insulated against earth potential. The earthing of active parts does not reduce the risk.

(Rechargeable) batteries in battery electric vehicles (BEVs), hybrid vehicles and vehicles with fuel cells must not be short-circuited or earthed! Short-circuiting can result in damage, fire or bursting of the battery.



5. COVER / BLOCK OFF

If work on live high-voltage components is required:

- The skilled worker performing the work must have a 3S* qualification.
- Cover the components that are not affected and are live, e.g. use insulating covers as specified in DIN EN 61112*, VDE 0682-511*.





MEASURING THE POTENTIAL EQUALISATION

All high-voltage components are connected to one another and with the vehicle body (earth) through potential equalisation lines. This compensates for differences in potential among the high-voltage components. If there is a fault in the insulation, this prevents an electric shock when touching the vehicle's body or the housing of the high-voltage components.

A suitable measuring instrument which can be used to measure very small resistances in the milliohm range is required for the line test. A commercially available multimeter is not capable of this.

- Measure the resistance between all exposed conductive parts and the electrical vehicle earth.
- Test current: at least 200 mA
- Set-point value: less than 100 mΩ (according to ECE-R 100*), follow manufacturer's instructions

CHECKING THE INSULATION RESISTANCE

The insulation resistance is measured to check whether components are sufficiently insulated or whether there are any leaks in the insulation. To do this, the measuring instrument builds up a high voltage to detect potential leakage current. The insulation resistance is the test voltage divided by the total current. This is given in megaohm (MΩ) or higher units.

A "normal" multimeter is not suitable.

Only measure when disconnected from the supply voltage!

- Preparations: see manufacturer documentation!
- Set the appropriate measuring range on the measuring instrument (manufacturer documentation).
- Measure the insulation resistance:
 - 1st measurement between high-voltage positive (+) and the vehicle earth,
 - 2nd measurement between high-voltage negative (-) and the vehicle earth, each in both directions (reverse polarity).

Never measure high-voltage positive (+) to high-voltage negative (-)!



- The measuring instrument builds up the test voltage. The insulation resistance determined provides information about the insulation strength. Set-point value: at least 100 Ω / VDC (direct current) and 500 Ω / VAC (alternating current), see manufacturer documentation
- If the value is too low, this may indicate damaged cable insulation or leakage currents.

RESTARTING

After completing all work:

- Remove tools, auxiliaries and other equipment from the work and danger zones.
- Undo the steps prescribed by the safety rules by working in reverse order.
- Restore the intended safe operating state in accordance with the manufacturer's instructions.
- Read out fault code memory.



DANGER

Defective or damaged high-voltage cables must not be repaired. They must be completely replaced.



You can find further information on high voltage on our website.