



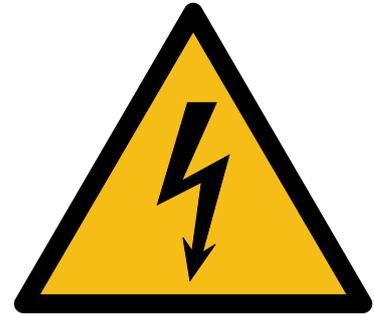
SI 2171

For technical personnel only!

1/4

SERVICE INFORMATION

HIGH VOLTAGE – QUALIFICATIONS AND EQUIPMENT



DANGERS WHEN WORKING WITH HIGH VOLTAGE

Depending on the specific current strength and the duration of exposure, contact with live high-voltage components can be fatal.

The dangers of working with high-voltage components are:

- Muscle contractions
- Breathing problems
- Electric current flowing through the body (cardiac arrest, ventricular fibrillation)
- Electric arcs (“flashover”)
- Secondary accidents (falls, cuts, ...)



DANGER

People with active medical implants must not work on high-voltage systems.



QUALIFICATIONS AND PERMITTED ACTIVITIES*

To protect workshop employees, the German Social Accident Insurance (DGUV)* stipulates the following qualifications for persons who carry out work on series production vehicles equipped with high-voltage systems and associated components.

S

“SENSIBILISIERTE PERSON” (A PERSON WHO HAS BEEN INSTRUCTED REGARDING THE INTENDED USE RELATING TO THE OPERATION OF HV VEHICLES AND COMPONENTS)

- Operation of vehicles equipped with high-voltage systems
- Maintenance and upkeep according to the operating manual for the vehicle
- Use of known filling connections (e.g. for engine oil, coolant, windscreen washer fluid)
- Interior and exterior cleaning:

When performing cleaning work, the bonnet, service flaps and covers must be closed as high-voltage components are located behind them.

There is a danger to personnel if high-voltage components are damaged by improper cleaning, e.g. by high water pressure or aggressive detergents.

1S

“FACHKUNDIG UNTERWIESENE PERSON” (FUP; A PERSON WHO HAS RECEIVED EXPERT INSTRUCTION BY AN FHV)

- General work is permitted, e.g. work on the body, changing oil and wheels, work on the braking system, work on the conventional on-board power supply system (up to 30 V AC and 60 V DC) after having been instructed on the specific vehicle type.
The instruction must be documented.
- A level 2S “Fachkundige Person” must be present on site during the work.

Persons with this qualification are not permitted to isolate the supply voltage! (“Keep away from orange components!”) The supply voltage is only allowed to be isolated under the supervision of a level 2S “Fachkundige Person” (FHV).

2S

“FACHKUNDIGE PERSON” (FHV; A PERSON WHO POSSESSES THE EXPERTISE AND SPECIALIST KNOWLEDGE NECESSARY TO PERFORM A SPECIAL TASK ON A HIGH-VOLTAGE SYSTEM) FOR WORK ON DE-ENERGISED HIGH-VOLTAGE SYSTEMS

- Measurement, repair, replacement and testing of de-energised high-voltage components.
- Providing the instruction for a level 1S “Fachkundig unterwiesene Person” (FuP).
The instruction must be documented.
- Guiding and managing a level 1S “Fachkundig unterwiesene Person” (FuP).

Automotive mechatronics fitters that have been trained according to the German Vocational Education and Training Ordinance 2013 (“Ausbildungsverordnung 2013”) have already achieved qualification level 2S.

3S

“FACHKUNDIGE PERSON” (A PERSON WHO POSSESSES THE EXPERTISE AND SPECIALIST KNOWLEDGE NECESSARY TO PERFORM A SPECIAL TASK ON A HIGH-VOLTAGE SYSTEM) FOR WORK ON LIVE HIGH-VOLTAGE COMPONENTS

- Minimum qualification: level 2S “Fachkundige Person” (FHV).
- Measurement, repair, replacement and testing of live high-voltage components.
- Replacement of battery cells and work on damaged vehicles where the supply voltage is not guaranteed to be safely isolated.
- As a rule, a 2nd person is required for this. Minimum qualification: level 1S “Fachkundig unterwiesene Person” (FuP) trained in first aid.

The qualifications do not expire. Regular further training is recommended.

Separate qualification levels of E, 1E, 2E and 3E apply for Research and Development employees.



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3/4

SAFETY FIRST

PERSONAL PROTECTIVE EQUIPMENT (PPE) – MINIMUM EQUIPMENT REQUIRED

01



02



03



01 Safety goggles according to EN 166*/EN 170* or helmet with face protection according to IEC 61482-1-2*

02 Safety shoes with electrically insulating sole according to EN 20345*

03 Rubber gloves according to EN 60903*/EN 61482-1* – always check the tightness of the gloves before starting any work!

RECOMMENDED AUXILIARIES

04



05



06



04 Barrier posts with safety chain according to EN 50110*

05 Warning notices and signs according to ISO EN DIN 4844D-W008/DIN 4844D-P010*

06 Insulated rescue pole according to DIN VDE 0681*



RECOMMENDED TOOLS

07



08



09



07 Padlock for service connector (depends on the vehicle)

08 2-pole voltage tester for DC and AC voltage up to 1,000 V according to DIN EN 61243-3* (VDE 0682-401*)

09 Measuring instruments for insulation and potential equalisation according to UNECE R 100*

10 High-voltage-resistant tool according to IEC 60900

10



FURTHER INFORMATION, STANDARDS AND LEGISLATION*

- DGUV Information 209-093 “Training for work on vehicles with high voltage systems” (successor to DGUV Information 200-005, formerly BGI/GUV-I 8686)
- DGUV Information 204-003 “First aid – Finding a person”
- Directive ECE R100 of the European Union on the safety requirements specific to the electric power train of road vehicles
- VDA brochure “Accident Assistance and Recovery of Vehicles with High-Voltage or 48-Volt Systems”
- DIN VDE 0100-410:2018-10 “Low-voltage electrical installations - Part 4-41: Protection for safety”
- DIN EN 61140 (VDE 0140-1) “Protection against electric shock”

Disclaimer

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*) This information sheet predominantly considers German and European standards. Please note: The relevant applicable statutory provisions and safety provisions may differ between countries.

All content, including pictures and diagrams, is subject to change.



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