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■ Non-public

Safety production training for high-voltage system of new energy vehicles

Overseas Business Division

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I. Voltage type

As specified in GB/T 2900.50 *Electrotechnical terminology - Generation transmission and distribution of electricity - General*, the voltage is classified as follows:

Voltage level	Voltage limit
Safety voltage	36V
Low voltage	≤1000VAC，≤1500VDC
High voltage	1kV～330kV
Ultrahigh voltage	330kV～1000kV
Extra-high voltage	≥1000kV

Foton power battery output voltage: DC450V~657V

I. Voltage type

As specified in GB 3805-83 *Safety voltage*, the voltage is divided into the following levels.

Voltage level	Voltage limit
Level 1	6V
Level 2	12V
Level 3	24 V
Level 4	36 V
Level 5	42 V

I. Voltage type

As specified in GB18384-2020 *Electric vehicles safety requirements*, the voltage is divided into the following levels.

Voltage level	Maximum operating voltage U	
	DC	AC (rms)
Level A	0≤U≤60	0≤U≤30
Level B	60≤U≤1500	30≤U≤1000

As for Foton's power electrical system except the LV electrical system, the voltage is far more than 10 times of the safety voltage limit.

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II. Terms and definitions

No.	Abbreviation	Chinese name	English name	Meaning
1.	PACK	Power battery pack	Power Battery Pack	Battery pack in the power battery system, and basic unit of the battery
2.	BDU	高压配电单元	Battery Distribution Unit	Battery power controller
3.	PEU	多合一控制器单元	Power Electronics Unit	Vehicle power controller
4.	MSD	手动维修断路器	Manual Service Disconnector	Switch for disconnecting the battery or battery pack from the external part
5.	EC	电平台	Electrical Chassis	A group of electrically connected conductive parts whose potential is used as a reference

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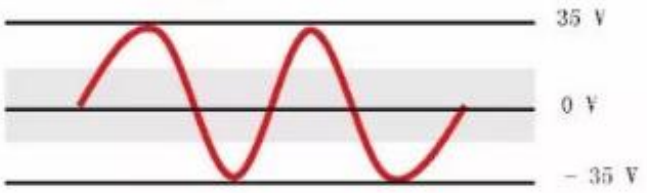
Reaction to and hazards of overcurrent in the human body

Alternating current is more dangerous than direct current. The hazards of alternating current are described below

Value of current flowing through the human body	Reaction of human body
3mA	You will have a preliminary feeling of electric shock
5mA	You will get an "electric shock" and feel tingling, but can still release yourself from the current conductor
10 mA	"Release threshold". You will suffer from contracture, and cannot release yourself from the power supply!
30 mA	Operating current of the residual current (or leakage) protector installed in the building
50mA	"Death threshold"
80mA	Muscle and heart flutters will be triggered

Example: 25 V eff - AC



Example: 60 V - DC

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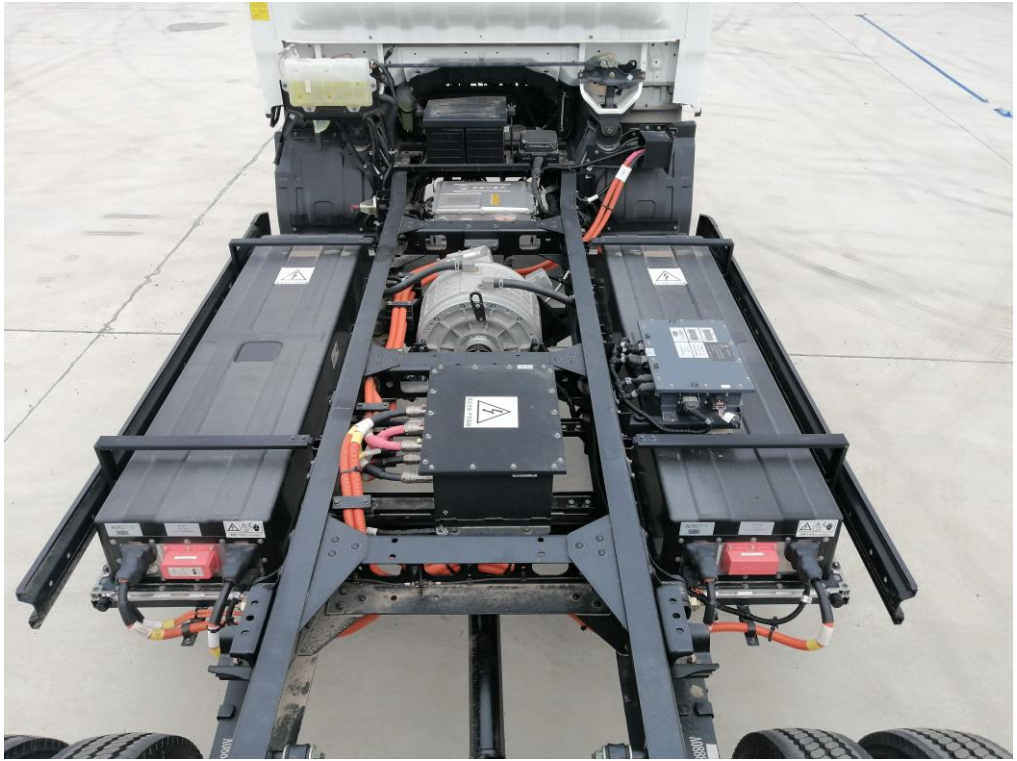
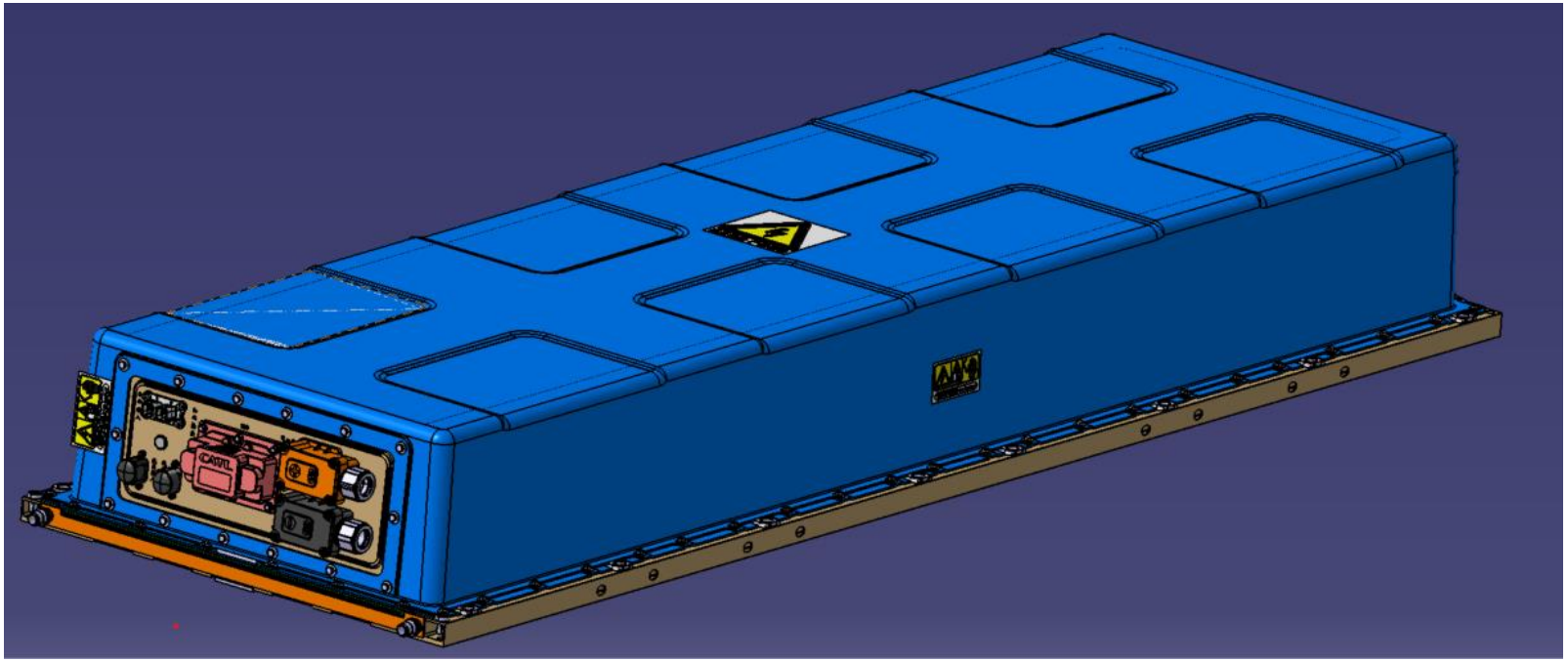
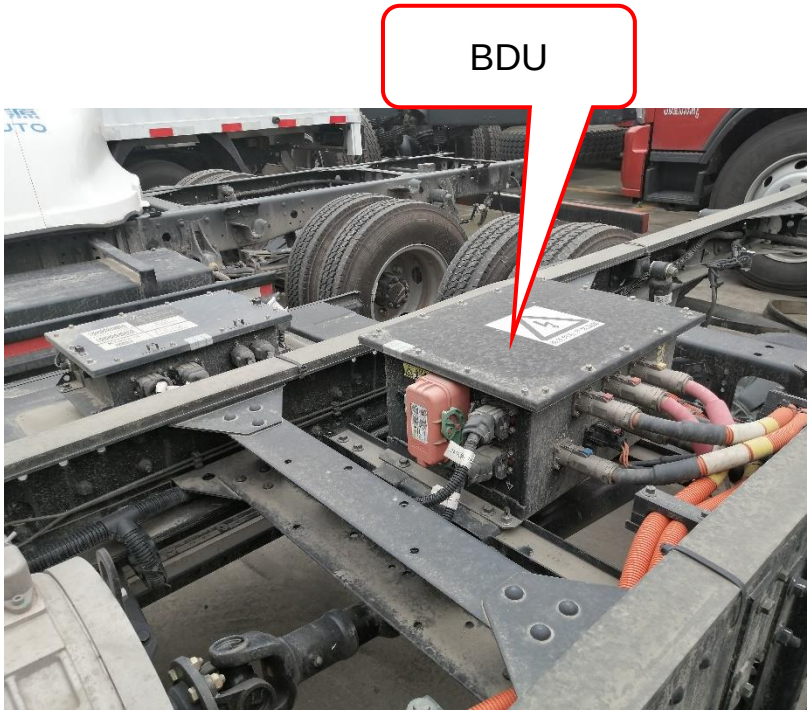
1. Vehicle overview

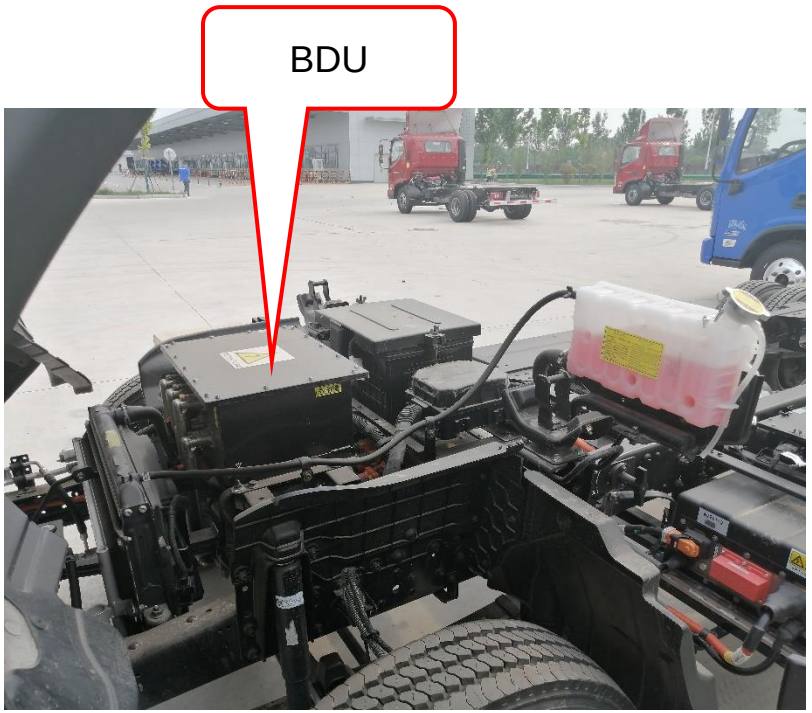


2. PACK

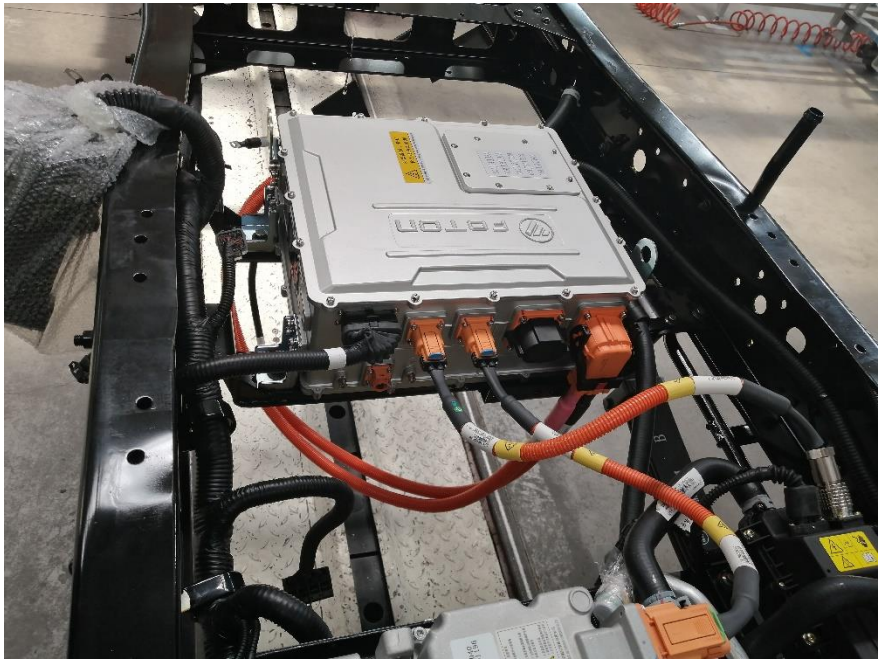


3. BDU

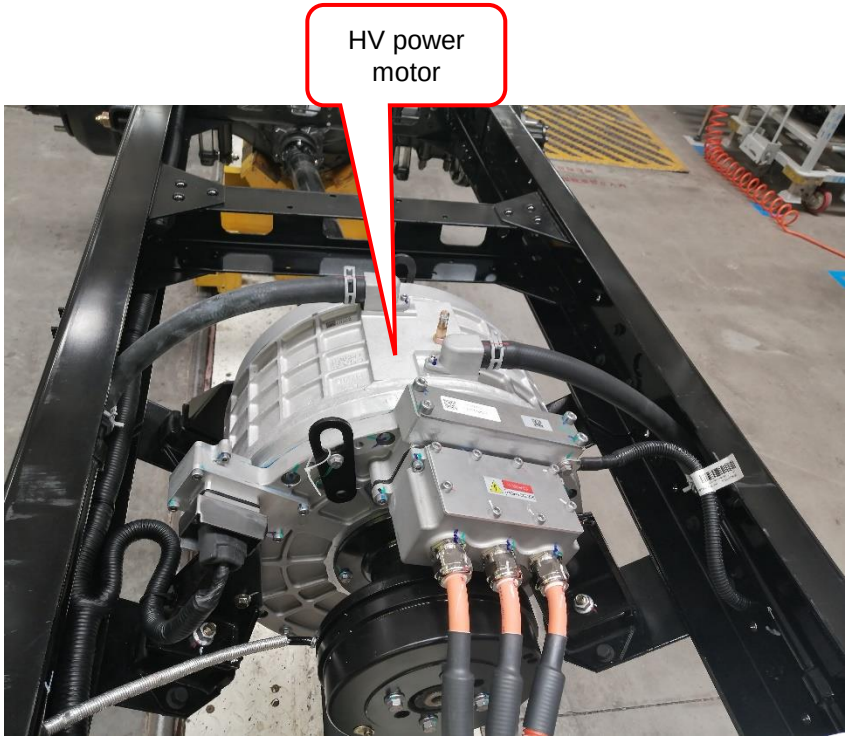


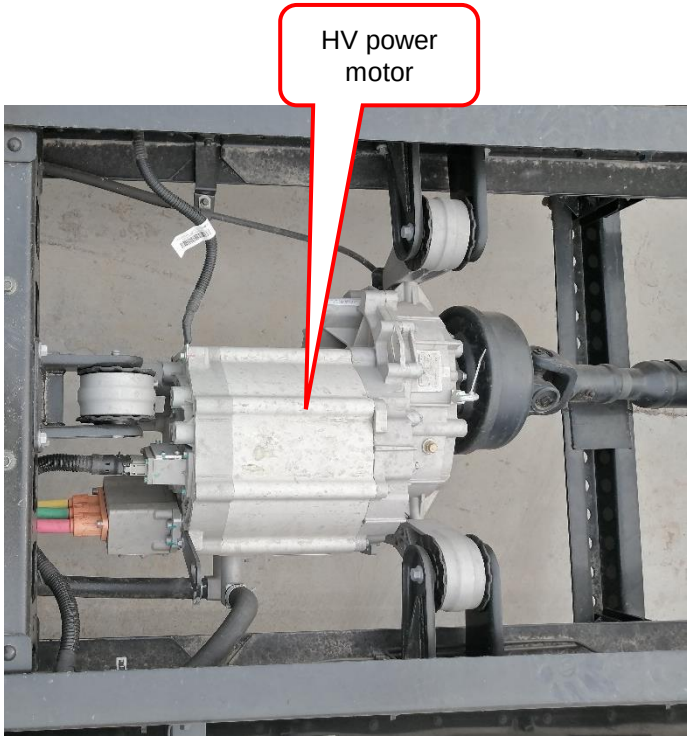


4. PEU

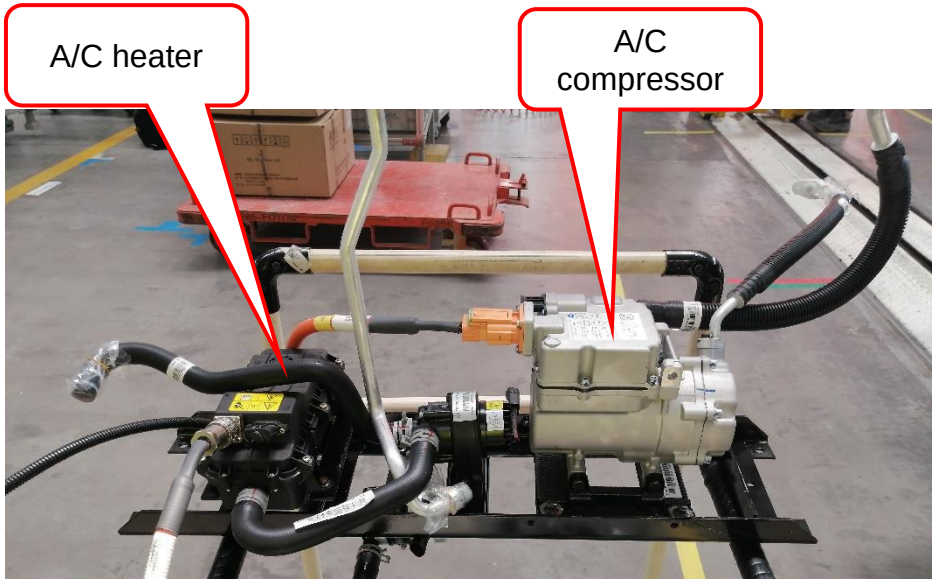


5. HV power motor

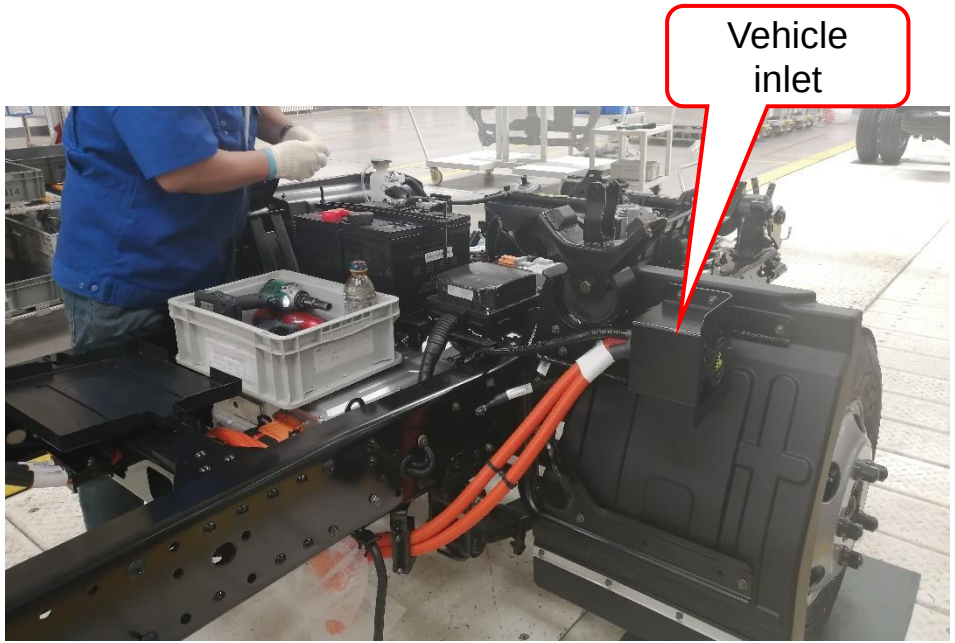




6. A/C accessory



7. Vehicle inlet



8. High voltage warning sign

As specified in 5.1.2.1 “High voltage marking requirements” of GB 18384-2020: the electrical energy storage system or generation device with Level B voltage shall be marked with the symbol in Fig. 1.

High voltage warning sign

Other signs

9. High voltage warning sign

As specified in 5.1.2.2 “Marking requirements of wires with Level B voltage” of GB 18384-2020: the sheaths of cables and harnesses in the Level B voltage circuits shall be distinguished by orange, except those that need to meet the shielding requirements.

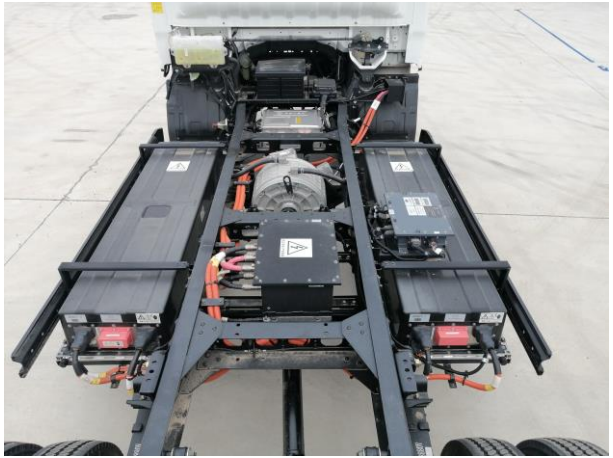
10. Potential equalization requirements (equipotential bonding)

As specified in 5.1.4.3 of GB 18384-2020: the exposed conductive parts for protection and direct contact with Level B voltage circuits shall be conductively connected to the electrical chassis, and the connection impedance shall not exceed 0.1 Ω. Equipotential bonding (also called connection) is to connect the exposed metal and conductive parts of the electrical devices and other devices on the vehicle with the frame, so as to reduce the potential difference between different components.

11. Two whatevers

Whatever parts with high voltage warning signs are HV parts;

Whatever lines protected with orange bellows are HV lines.



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V. Personal protection

* Other unnecessary equipment

Insulation tools

Insulating pad

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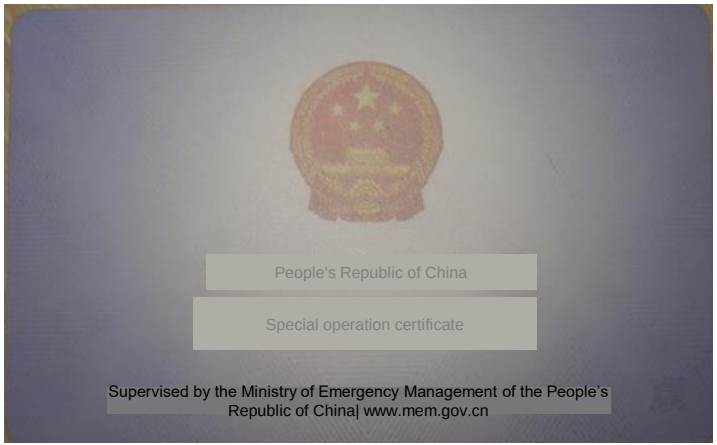
VI. Working conditions

1. Personnel engaged in HV electrical assembly or commissioning shall hold the "Special Operation Certificate", i.e. “Electrician Certificate” issued by the Ministry of Emergency Management of the People’s Republic of China;

2. Personnel shall have certain experience in automobile assembly or maintenance;

3. Personnel shall have the basic knowledge of the power electrical system;



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1. Operators must hold the nationally recognized Special Operation Certificate (operation type: electrical operation) and junior (or above) electrician certificate (professional qualification certificate), and the certificates must be within the validity period and reviewed on a regular basis.
2. Operators must wear PPE such as high-voltage insulating gloves, insulating shoes and goggles and use high-voltage insulating tools during operation.
3. Before operation, be sure to turn off the power switch, disconnect the manual service disconnect (MSD), and hang safety warning signs such as “No Operation Upon Start”and “Danger! Keep Away”.
4. When overhauling the HV system, it is necessary to observe the following principle: 1. Inspection (check the state of the vehicle, especially the state of the HV switch, ignition switch and gearshift switch); 2. Judgment (judge whether the part to be operated is live according to the state, or the power-on logic of the vehicle is changed to make the vehicle move suddenly); 3. Measurement (use a multimeter for measurement to ensure the safety after judgment); 4. Operation (perform the operation).

5. The HV system shall be tested and checked with the special diagnostic scan tool and adjusting instrument. In case of measurement with a multimeter, attention shall be paid to the range. Do not set the multimeter to the current position to measure the loop current, instead, use a clip-on ammeter.

6. As for the ECU and HV system components, do not disconnect the circuit or plug and unplug the terminal of the HV harness in the power-on state, so as not to damage the ECU and HV system components or affect the personal safety.

7. When opening the covers of the power battery, BCU and BDU for maintenance, care shall be taken to prevent entry of tools, bolts, nuts and liquids such as water, otherwise short circuits will occur, resulting in accidents.

8. After the operation, the HV and LV electrical components, systems and connectors shall be checked, and confirmed to be correct before power-on.

9. Do not operate the HV components within 15 min after HV power-off. Be sure to discharge the battery with a discharge tool and confirm that the voltage is safe before operation.

10. As for other matters not mentioned, the electrical operation requirements shall be followed.

THANKS