

# HIGH VOLTAGE BATTERY SYSTEM EDUCATIONAL TRAINER

## USER MANUAL

**HYBBAT02**

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# 1. SAFETY REQUIREMENTS

## 1.1. General safety requirements

### Attention:

Before using the training board, take a look at the user manual.

Training equipment may only be used for the purpose of teaching the design, construction and operating principle of the vehicle.

The staff conducting the training (lecturer, teacher, instructor and others) must be familiar with the instructions for the training equipment, know the methods and principles of use, settings, control of the equipment, be able to switch off (stop) the training equipment in an emergency.

The training staff (lecturer, teacher, instructor and others) acquaint those working and learning with the training equipment with the work safety requirements.

When working with high voltage systems (hybrid power plants and electric vehicles), it is mandatory to comply with electrical safety requirements and use personal protective equipment against electric shock.

It is forbidden to work with educational equipment for children, unqualified staff.

It is forbidden to work with training equipment for persons under the influence of alcohol or other psychotropic substances. Failure to comply with the requirements of this clause will void the warranty and the manufacturer is not liable for any damage or personal injury.

It is forbidden for people who do not have the appropriate qualifications to open the electrical input boxes, connect or change anything there.

It is prohibited to improve, modify or otherwise change the design of training equipment without the written consent of the manufacturer. Changing the design of the equipment is only possible after consultation with the manufacturer.

Do not ignore the information on possible dangers provided by the warning signs on the training equipment. Beware of the hazards indicated on the warning signs.



The training equipment must be switched off completely during cleaning work.

It is forbidden to wash the training equipment with running water or any chemical cleaning agents.

It is forbidden to clean the electronic components of the training equipment with damp cloths.

The equipment must be completely switched off during maintenance and repair work on the training equipment.

It is forbidden to disconnect the power cords of the electrical elements of the training equipment. Careless or repeated disconnection of these wires will result in damage to the connectors and loss of contact. The desired electrical measurements can be performed at specially designed and installed banana-type connectors in the training equipment. Banana type connectors are resistant to multiple joints.

### **Before working with training equipment, check that:**

- Equipment is not mechanically damaged, broken;
- All protective shields are assembled;
- All components are available;
- The equipment components are free of foreign bodies;
- Undamaged power cords;
- Neat power supplies (battery or stand power supply);
- Power supplies are properly connected (e.g., battery terminals are screwed on, polarity is not mixed, proper power supply is used according to local electrical installation standards);
- The training equipment is properly constructed and locked (e.g., the equipment is placed on a sufficiently solid base,);
- During operation, the equipment will not pose any danger to those working with it and the surrounding staff;
- There are other factors not specified in the instructions that may endanger the health of personnel working with the equipment and others.

### **Observe during work with the equipment:**

- The noise emitted by the equipment is characteristic of such a work process (no extraneous sounds);
- Odour of glowing, burning objects;
- Power supplies are working properly;
- There are no factors or processes other than those specified in the instructions that could endanger the health of personnel working with the equipment or other persons.



## 1.2. Safety requirements for working with electric and hybrid car training equipment

Employees, lecturers, students, support and service personnel must be familiar with the requirements of the work instructions for work with electrical devices after listening to the instructions and must sign the work safety logs. Instruction of employees and other personnel is carried out in accordance with the normative legal acts, laws and by-laws in force in that state (country). The "Safety Regulations for the Operation of Electrical Equipment" are followed.

Only qualified persons may work with high-voltage components and circuits of electric vehicles (refer to the laws and regulations of your country).

Elements marked in orange (wires, connectors, control units, voltage converters, etc.) are constantly or periodically exposed to high voltages.

Follow the rules for safe work when operating stands.

### Warning:

- Before inspecting or servicing the circuits and components of the high voltage system, be sure to remove the maintenance connector (Service plug (fuse)) from the socket in the battery box of the high voltage battery (HV battery). This will turn off the high voltage circuit.
- Place the maintenance connection (Service plug (fuse)) safely out of the reach of other persons to prevent it from being accidentally connected by another person during maintenance and service work.
- Before working on high voltage components, take care of personal protective equipment and equipment: gloves, shoes, face shield, rubber mat, earthing circuit, etc.
- Take care of the safety of the work area around the high-voltage battery: the work area must be marked, a responsible employee must be appointed, and the work area must be fenced. When work is not in progress, high-voltage parts and components must be covered with insulating covers or shields to prevent them from touching them.

**CAUTION: HIGH VOLTAGE. DO NOT TOUCH DURING OPERATION.**

To draw the attention of other employees, set up an information warning sign.



OPERATION  
NOT TOUCH DURING  
HIGH VOLTAGE. DO  
CAUTION:

CAUTION:  
HIGH VOLTAGE. DO  
NOT TOUCH DURING  
OPERATION



The table must be printed, folded into a triangle (the bends are marked with a dotted line) and placed on the car.

Hybrid cars may not make any noise. The absence of noise does not mean that the car is switched off.

Always disconnect the negative terminal of the 12 V battery if necessary.

High voltage battery, connected with high voltage (marked in orange) wires to voltage converter, electric motor / generator, air conditioner pump. High voltage wires, regardless of their polarity, have orange insulation.

The high voltage battery is protected by a fuse. Voltage switching on and off is control

### Attention:

There may be residual voltage in the high voltage circuit after it has been switched off. Therefore, wait at least 10 minutes after switching off the system. During this time, it is forbidden to touch, disconnect, repair or inspect high-voltage wires.

Both positive and negative high voltage wires are separated from the car body. Therefore, there is no possibility of electric shock when touching the metal parts of the car.

When working with high voltage components, the battery must use protective equipment:

- glasses
- face shield
- rubber, latex gloves;
- protective clothing and apron;
- rubber boots:
- rubber mats.

All protective and working equipment must meet the requirements of electrical safety standards, be metrologically inspected and have valid metrological inspection documents.

When preparing to work with a hybrid / electric car, it is necessary to turn off the car by removing the negative terminal of the car's 12 V battery. Wait 2 minutes. Using protective equipment (gloves, work clothes, shoes, goggles, mats, etc.) disconnect the high voltage service connector (Service plug (fuse)): unlock the lever lock, lift the lever up and pull the entire service connector out of the socket.

When disconnecting high voltage cables, they must be insulated. This avoids short circuits, self-coupling and human protection. Use only fully insulated tools for this purpose.

After disconnecting the electrical components, make sure that there is no residual voltage.



Protective equipment must be used when working with high voltage circuits. Measure the voltage inside the electrical components before working on them. The devices must display 0 V. It is only possible to work with high-voltage circuit elements at least 10 minutes after the circuit has been switched off. There are capacitors in the system that need to be discharged (discharged).

## Attention!

Work safety instructions must be observed when working with high voltage circuits. Workers working on high-voltage circuits can be shocked by high-voltage electricity and injured by improper handling of measuring and repair equipment due to sparks. At the beginning of the work, it must be ensured that all repair and maintenance work is carried out only with the high-voltage lines disconnected.



## 2. GENERAL INFORMATION

### 2.1. Purpose of training equipment

Educational equipment is intended for educational activities. It is a visual tool for explaining and demonstrating the structure and operation of various automotive parts, assemblies, structures, systems. The equipment is used as a teaching and learning tool for monitoring and analysing work processes of various car systems. It is possible to carry out various measurements of the parameters of the systems installed in the training equipment, to carry out fault simulations, and to diagnose. Various laboratory tasks can be performed using the educational equipment. The equipment is prepared and manufactured in order to provide students with information about the structure of the unit, the system composition and the principle of operation as clearly and comfortably as possible.

The educational equipment is intended for the demonstration, teaching and learning of the structure, operating principle of the Toyota Prius hybrid car high voltage battery.

### 2.2. Training equipment parameters

Length	720 mm (28.346 in);
Width	310 mm (12.205 in);
Height	705 mm (27.76 in);
Weight about	20 kg (44.092 lb);
Energy sources	battery 12 V or household electrical network ~ 230 / 110 V AC 50 / 60 Hz

Educational equipment is made using elements of the car:

Manufacturer:	Toyota
Model:	Prius II
Year of production:	2009 – 2015
	high voltage battery pack 201,6 V DC

### 2.3. Transport and storage conditions

The training equipment is mounted on a dedicated stand, frame, platform or chassis. During transportation, it is mandatory to protect the equipment from falling, overturning, shocks, moisture, temperature effects, and vibrations.

When carrying out export or import procedures, it is mandatory to take into account the legal acts between the countries. Import-export procedures



and various taxes apply to various technical fluids, oils, batteries, tires and more.

Training equipment must be stored in a room with a minimum ambient temperature of at least + 10 °C. Relative humidity not more than 60 %.

Training equipment must not be exposed to direct sunlight. The equipment must be covered with protective equipment if the equipment is exposed to direct sunlight.

Unused educational equipment is stored completely switched off.

## 2.4. Maintenance and service

Training equipment is maintained as normal mechanical, hydraulic, pneumatic, electrical machines and systems. Educational equipment requires minimal maintenance and service.

It is necessary to control and ensure that all the components belonging to the educational equipment are present.

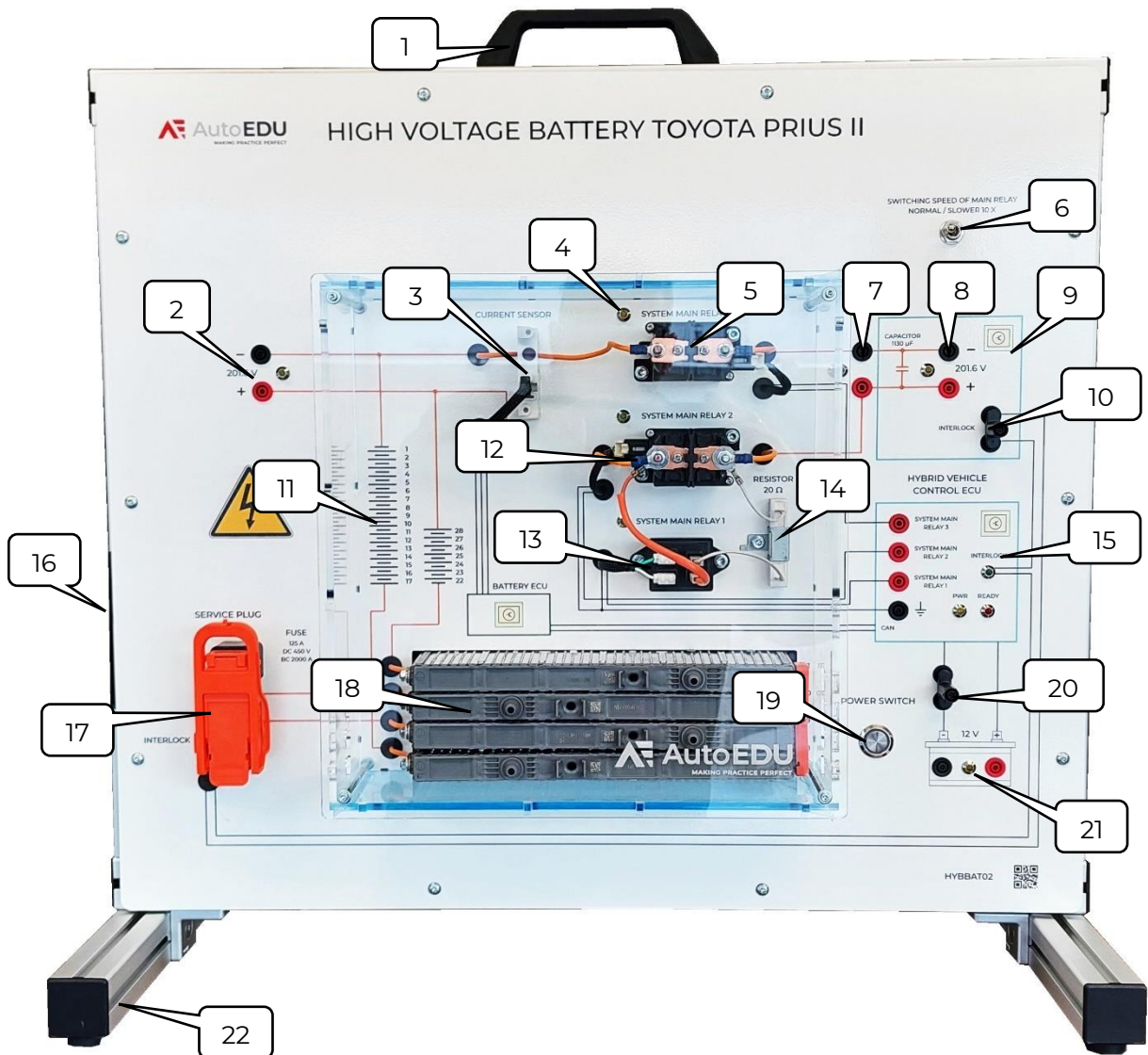
Damaged, broken parts, blown fuses, damaged connecting wires and other parts are replaced with new ones.

### **WARNING:**

Personal protective equipment must always be used when removing and installing the service plug.

### 3. EDUCATIONAL EQUIPMENT

A general view and structure of the training equipment is presented in the illustrations below.



1. Transport handle
2. High voltage battery voltage measurement points
3. Current sensor
4. LED indicator
5. System main relay 3 (-)
6. Relay activation speed reduction switch
7. High voltage battery voltage measurement points (when the relays are on)
8. Voltage measurement points in the inverter (and capacitor)
9. Inverter



10. Inverter interlock (jumper)
11. High voltage battery modules (drawing)
12. System main relay 2 (+)
13. System main relay 1
14. System main resistor
15. Hybrid vehicle control ECU
16. Power supply connector
17. Service plug (and interlock)
18. High voltage battery modules
19. Power switch
20. 12 V battery disconnect terminal
21. 12 V battery
22. Stand legs

Note:

If you need to lay the stand horizontally on a table, remove the legs.



## 4. WORKING WITH EDUCATIONAL EQUIPMENT

A few notes on how to understand the structure and layout of the stand.

The transparent plastic covers the internal components of a real high-voltage battery.

High voltage battery voltage measurement points (on the left side of the transparent plastic) – allows you to measure the voltage in a high-voltage battery. A lit LED indicates that there is voltage at the contacts. The theoretical battery voltage of high-voltage batteries is 201.6 V DC. However, depending on the battery charge level, it may be lower or higher (190-260 V). The battery charge level cannot be changed on the stand.

### Warning:

These measurement contacts contain a high voltage of 201,6 V DC when the LED is illuminated.

High voltage is present at these measurement contacts even when the LED is not lit and the Service plug is unplugged. Measurement is made between these contacts and the corresponding contacts on the service key (136,8 V and 64,8 V DC).

High voltage battery voltage measurement points (on the right side of the transparent plastic, when the relays are on) – shows when high voltage is turned on and supplied from the battery. When the car is started (LED READY is lit), the relays are activated. When the car is turned off (LED READY turns off), the relays are deactivated. If the safety instructions are violated, the hybrid car's control unit turns off the relays and the voltage is cut off.

The drawn battery modules allow you to count the exact number of modules in a high-voltage battery pack. Four modules are installed to show the actual modules and the service plug connection.

The LEDs next to the system main relays indicate when the relays are on. The relays then supply high voltage to the inverter.

Relay activation speed reduction switch - slows down the activation time of the main system relays by 10 times. This allows you to visually monitor the activation moments and capture the sequence and moments of the activation of the main system relays.

Inverter – allows you to demonstrate when high voltage is supplied to the inverter from the battery. A lit LED indicates that there is voltage at the contacts.

Voltage measurement points in the inverter (and capacitor) – shows when the inverter (and capacitor) has high voltage. Even after disconnecting



the battery relays of the high-voltage batteries, high voltage remains in the inverter (its capacitor) for several minutes.

The inverter interlock jumper serves as a protection against the inverter cover being lifted. If the inverter cover is removed or closed improperly, the interlock circuit is open. When the inverter cover is opened, the interlock circuit is broken and this is a signal to the hybrid vehicle ECU that the high-voltage battery relays should not be connected or should be turned off if they were previously connected.

The other part of the Interlock is in the Service plug itself.

### Warning:

These measurement contacts contain a high voltage of 201,6 V DC when the LED is illuminated.

Hybrid vehicle control ECU – controls the battery relays of the hybrid vehicle's high-voltage batteries. This ECU collects information from the car's sensors and other control units and, according to a written program, controls and monitors the system main relay.

The LED informs about properly connected Interlocks (Interlock), connected 12 V battery (PWR) and turned on car ignition (Ready).

The system main relay control voltages can be measured at the contacts located here.

Power switch – performs the function of turning the car on and off. Works like an ignition switch.

12 V battery – replaces the car's 12 V battery. If there is no household electrical network, a 12 V battery can be connected to these contacts to power the stand.

Sound signal – sounds if the high-voltage battery service plug is disconnected in the wrong order. In a real car, there is no sound signal informing about incorrect disconnection.



A brief description of the main components of a high-voltage battery.

### **Hybrid Vehicle ECU control**

The HV ECU detects the amount of effort applied to the accelerator pedal in accordance with the signals provided by the accelerator pedal position sensor. The HV ECU receives the vehicle speed signals from the speed sensor (resolver) in the MG1 (Motor Generator 1) and MG2 (Motor Generator 2), and detects the shift position signal from the shift position sensor. The HV ECU determines the driving conditions of the vehicle in accordance with these pieces of information, and optimally controls the motive forces of MG1, MG2, and the engine. Furthermore, the HV ECU optimally controls the output and torque of these motive forces in order to realize lower fuel consumption and cleaner exhaust emissions.

The battery ECU constantly monitors the SOC (state of charge) of the HV battery, and transmits the SOC to the HV ECU. When the SOC is below the lower level, the HV ECU increases the power output of the engine to operate MG1, which charges the HV battery. When the engine is stopped, MG1 operates to start the engine; then, the engine operates MG1 to charge the HV battery.

If the SOC is low, or the temperature of the HV battery, MG1 or MG2 is higher than the specified value, the HV ECU restricts the motive force applied to the drive wheels until it is restored to the normal value. A temperature sensor that is built into MG2 directly detects the temperature of MG2. The HV ECU calculates the temperature of MG1.

### **Inverter control**

In accordance with the signals provided by the HV ECU, the inverter converts a direct current from HV battery into an alternating current for MG1 and MG2, or vice versa. In addition, the inverter supplies the alternating current from MG1 power to the alternating current for MG2. However, when electricity is supplied from MG1 to MG2, the electricity is converted into DC inside the inverter.

The HV ECU transmits a signal to the power transistor in the inverter for switching the U, V and W phase of the stator coil of MG1 and MG2, based on the rotor position information sent from MG1 and MG2 and the SOC of the HV battery sent from the battery ECU. When shutting down the current to MG1 and MG2 a signal is sent to the inverter from the HV ECU.

### **Battery ECU control**

The battery ECU detects the SOC, temperature, leak, and the voltage of the HV battery, and sends this information to the HV ECU.



The battery ECU detects the temperature of the battery via the temperature sensor located in the HV battery, and operates a cooling fan to control the temperature.

The battery ECU constantly monitors the items listed below and transmits their information to the HV ECU.

- Detects the HV battery temperature via the temperature sensor in the HV battery.
- Detects the leak in the VH battery via the leak detection circuit in the HV battery.
- Detects the voltage of the HV battery via the voltage detection circuit in the HV battery.
- Detects the amperage via the current sensor.

The HV battery calculates the SOC by estimating the charging and discharging amperage.

#### SOC control

While the vehicle is in motion, the HV battery undergoes repetitive charging / discharging cycles, as it becomes discharged by the MG2 during acceleration and charged by the regenerative brake during deceleration. The battery Ecu calculates the SOC based on charging / discharging levels detected by the current sensor, and transmits the calculated SOC value to the HV ECU. The HV ECU performs the charging / discharging control based on the received value in order to steady the SOC at its target level anytime.

## **HV Battery**

### General

The Prius has adopted sealed nickel hydride (Ni-MH) batteries for the HV battery. This HV battery has a high-power density, it is lightweight, and it offers longevity to match the characteristics of the THS-II system. Because the THS-II system effects charge / discharge control to maintain the HV battery at a constant level of SOC (State Of Charge) while the vehicle is operating normally, it does not rely on the use of external recharges.

The HV battery, battery ECU, and SMR (System Main Relay) are enclosed in a signal case and placed in the luggage compartment behind the rear seat to make more effective use of vehicle space.

A service plug that shuts off the circuit is provided in the middle of the 28 modules (Between No. 19 module and No.20 module). Before servicing any portion of the high-voltage circuit, make sure to remove the service plug.

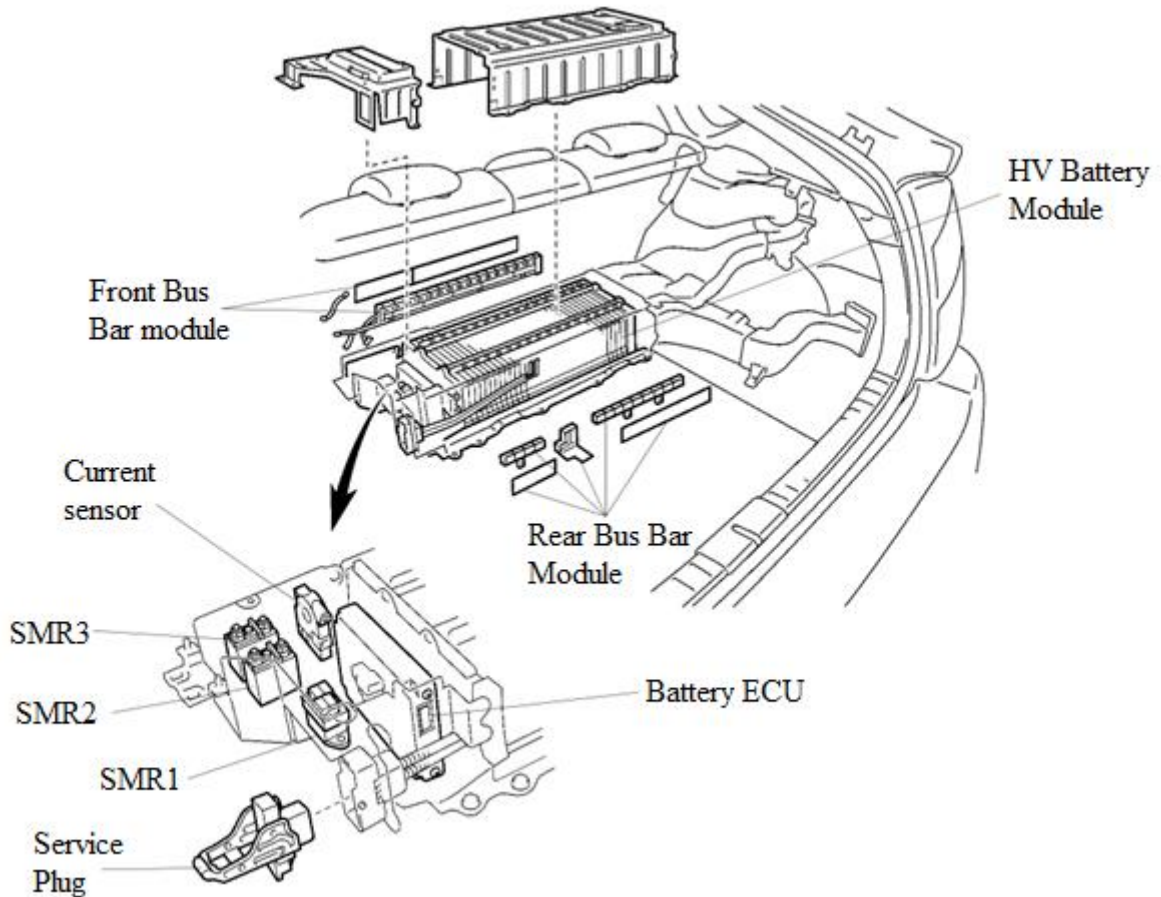
To ensure the HV battery's performance considering the heat that is generated in the HV battery during charging and discharging, the battery ECU controls the operation of the cooling fan.

The HV battery Prius consists of 168 cells ( $\{1.2 \text{ V} \times 6 \text{ cells}\} \times 28 \text{ modules}$ ) with a nominal voltage of 201.6 V. A compact and lightweight battery configuration has been achieved through these internal improvements.



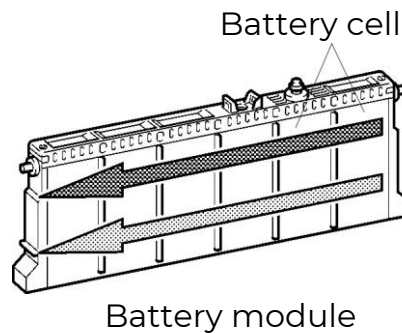
On the Prius, the connection between the cells of the HV battery consists of one spot. The internal resistance of the battery has been reduced by this improvement.

### Layout of Main Components



### HV Battery Module

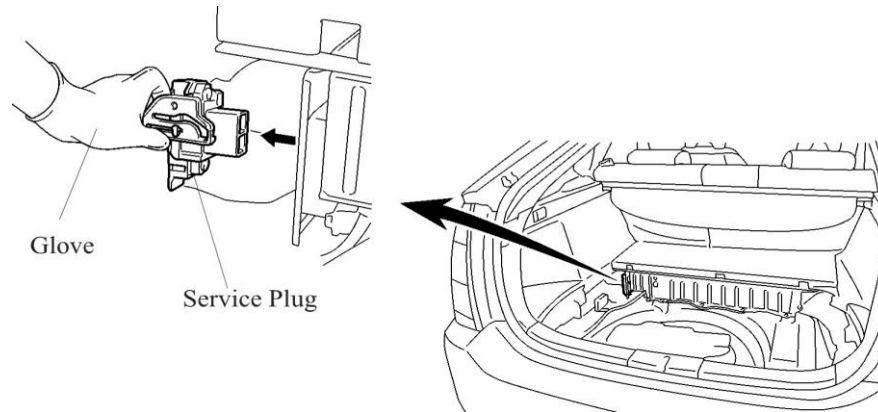
On the Prius, the connection between the cells of the HV battery consists of one spot at the upper part of the cells. With an additional connection at the lower part of the cells. The internal resistance of the battery has been reduced by this improvement.





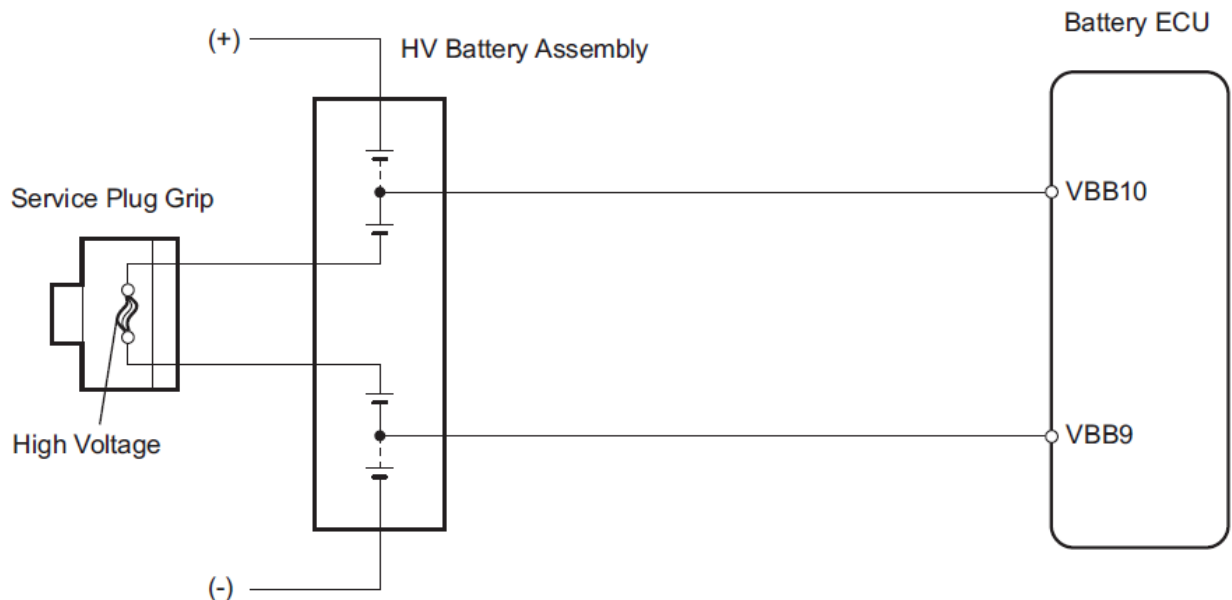
## Service Plug

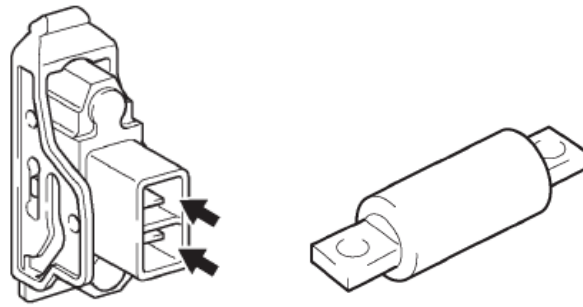
By removing the service plug before performing any inspection or service, the high-voltage circuit is shut off at the intermediate position of the HV battery, thus ensuring safety during service. The service plug assembly contains a lead switch for interlock. Lifting the clip lock up turns OFF the lead switch, which shuts off the SMR. However, to ensure safety, make sure to turn OFF the ignition switch before removing the service plug. The main fuse for the high-voltage circuit is provided inside of the service plug assembly.



### High voltage fuse

The high voltage fuse is located inside the service plug.

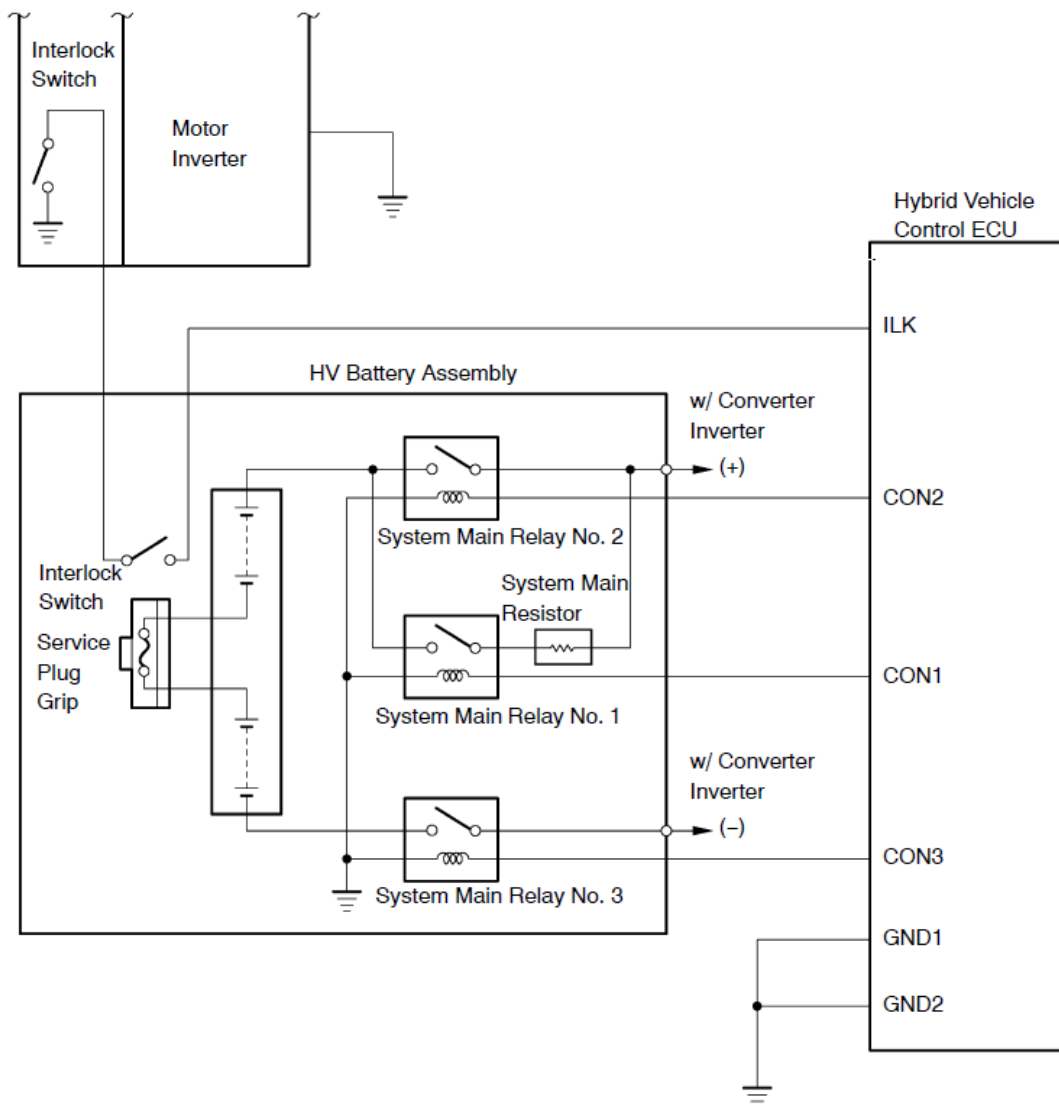




The standard resistance of the high voltage fuse must be below 1  $\Omega$ .

### Interlock

A short pin for the interlock switch is provided on the service plug grip and the inverter cover. Therefore, the interlock signal line circuit opens when the service plug grip or the inverter cover is removed.



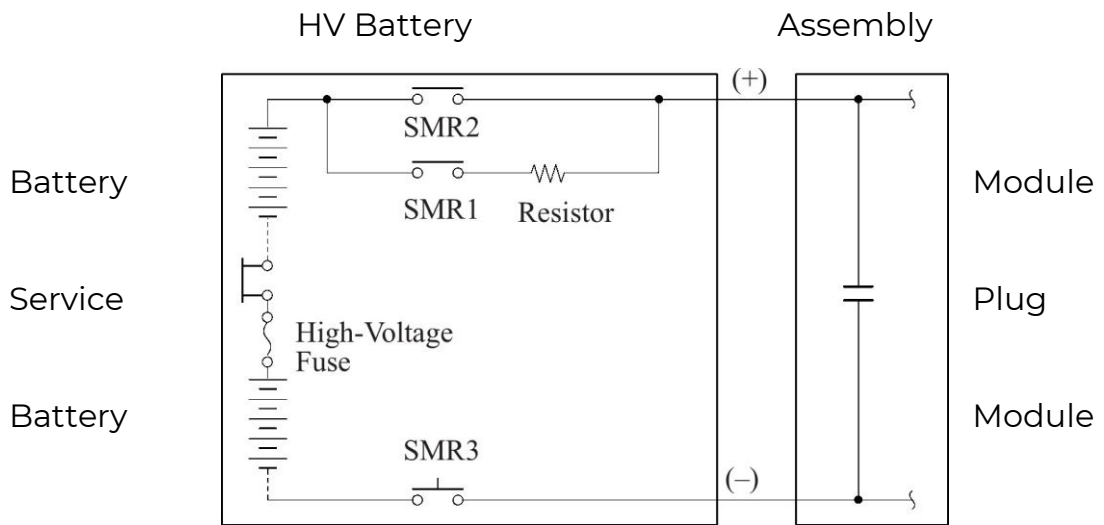


## SMR (System Main Relay) Control

### 1) General

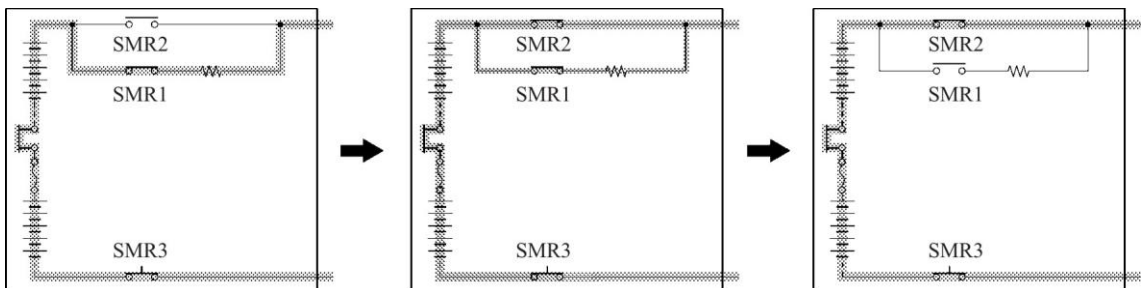
The SMR is a relay that connects and disconnects the power source of the high-voltage circuit upon receiving a command from the HV ECU. A total of 3 relays, one for the negative side, and two for the positive side, are provided to ensure proper operations.

System Diagram  
Inverter



### 2) Power is ON

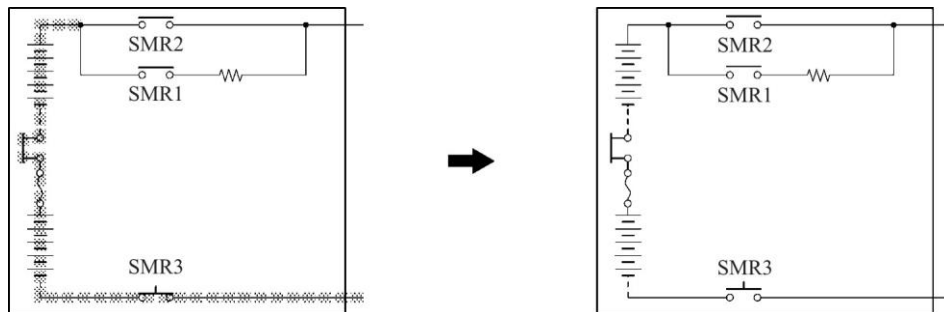
SMR1 and SMR3 turn ON when the circuit is connected; subsequently, SMR2 turns ON and SMR1 turns OFF. As the controlled current is initially allowed to pass through a resistor (standard resistance 18 – 22  $\Omega$ ) in this manner, the contact point in the circuit is protected from damage that could be caused by a rush current.





### 3) Power is OFF

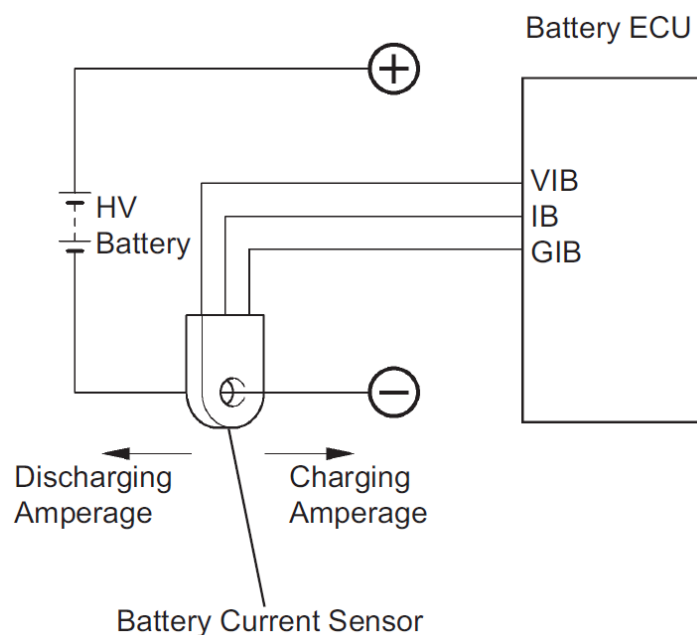
SMR2 and SMR3 turn OFF when the circuit is disconnected, in that order. Then, the HV ECU verifies that the respective relays have been properly turned off. Accordingly, the HV ECU is able to determine if SMR2 is stuck.



### Current sensor

The battery current sensor, which is mounted on the negative cable side of the HV battery assembly, detects the amperage that flows into the HV battery. The battery current sensor inputs a voltage (which varies between 0 to 5 V in proportion to the amperage) into the IB terminal of the battery ECU. An output voltage of the battery current sensor below 2.5 V indicates that the HV battery assembly is being charged, and above 2.5 V indicates that the HV battery assembly is being discharged.

The battery ECU determines the charging and discharging amperage of the HV battery assembly based on the signals that are input to its IB terminal, and calculates the SOC (state of charge) of the HV battery through the estimation of the amperage.



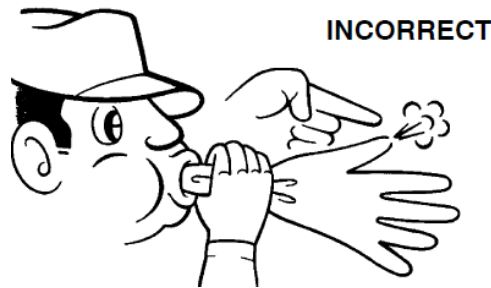


Steps to remove the service key plug

## ATTENTION

Always wear insulating gloves and safety glasses when working with high-voltage systems.

Check that the protective gloves are not damaged.



Keep the removed service plug in your pocket to prevent other technicians from reconnecting it while you are servicing the vehicle.

After removing the service plug grip, do not touch the high voltage connectors and terminals for 10 minutes.

### NOTICE:

After removing the service plug grip, do not operate the power switch as it may damage the hybrid vehicle control ECU (valid in a real car).

Before removing the service plug, it is necessary to turn off the hybrid vehicle by pressing the POWER SWITCH. READY should go out on the instrument panel.

### Note:

The equivalent of the READY inscription on the instrument panel is an LED (READY) installed in the hybrid car's control ECU.

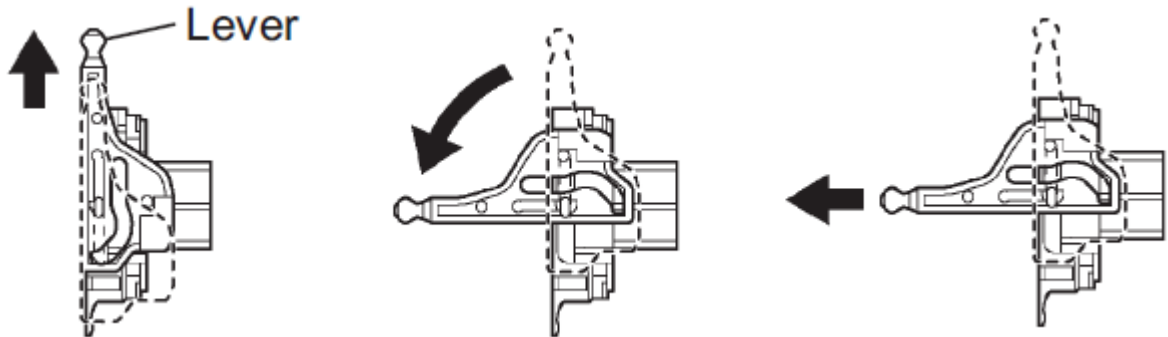
Wait 2 minutes.

Disconnect the negative terminal of the 12 V batteries (Remove the jumper from the circuit between the 12 V battery and the Hybrid vehicle control ECU).



Remove the service plug.

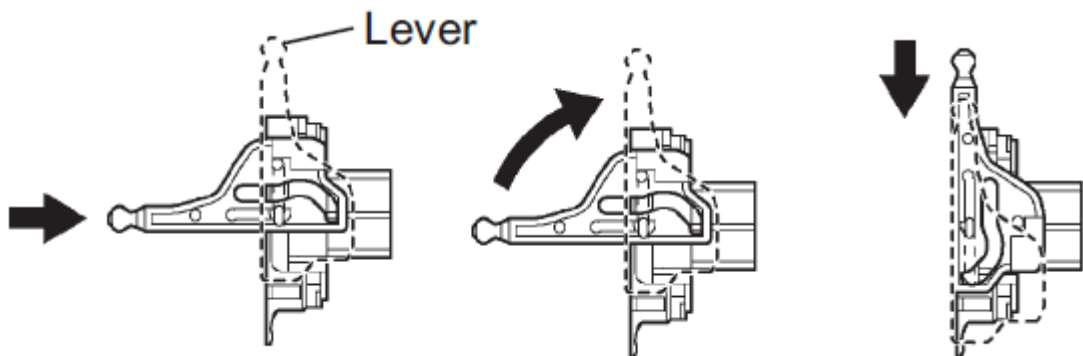
When removing the service plug, its handle is first lifted upwards, then swung back from the stand and pulled out of the socket.



Wait 10 minutes.

After removing the service plug only after 10 min. it is possible to start work with high-voltage electrical circuits. This time is required to discharge the high voltage capacitors.

Below is the sequence of service plug connection law.



Inserting the service plug into the socket

Connect the negative terminal of the 12 V batteries.

Turn on the stand by pressing the POWER SWITCH. READY should go out on the instrument panel.

Note:

The equivalent of the READY inscription on the instrument panel is an LED (READY) installed in the hybrid car's control ECU.



## Toyota safety instructions

### PRECAUTIONS FOR HIGH VOLTAGE CIRCUIT INSPECTION AND SERVICE

(a) Engineer must undergo special training to be able to perform high voltage system inspection and servicing.

(b) All high voltage wire harness connectors are colored orange. The HV battery and other high voltage components have “High Voltage” caution labels. Do not carelessly touch these wires and components

(c) Before inspecting or servicing the high voltage system, be sure to follow safety measures, such as wearing insulated gloves and removing the service plug to prevent electrocution. Carry the removed service plug in your pocket to prevent other technicians from reinstalling it while you are the servicing vehicle.

(d) After removing the service plug, wait 10 minutes before touching any of the high voltage connectors and terminals.

#### HINT:

10 minutes are required to discharge the high voltage condenser inside the inverter.

(e) Be sure to install the service plug before starting the hybrid system. Starting the hybrid system with the service plug removed may damage the vehicle.

(f) Before wearing insulated gloves, make sure that they are not cracked, ruptured, torn, or damaged in any way. Do not wear wet insulated gloves.

(g) When servicing the vehicle, do not carry metal objects like mechanical pencils or scales that can be dropped accidentally and cause a short circuit.

(h) Before touching a bare high voltage terminal, wear insulated gloves and use an electrical tester to ensure that the terminal is not charged with electricity (approximately 0 V).

(i) After disconnecting or exposing a high voltage connector or terminal, insulate it immediately using insulation tape.

(j) The screw of a high voltage terminal should be tightened firmly to the specified torque. Both insufficient and excessive torque can cause failure.

(k) Use the “CAUTION: HIGH VOLTAGE. DO NOT TOUCH DURING OPERATION” sign to notify other engineers that a high voltage system is being inspected and/or repaired.

(l) Do not place the battery upside down while removing and installing it.

(m) After servicing the high voltage system and before reinstalling the service plug, check again that you have not left a part or tool inside, that the high voltage terminal screws are firmly tightened, and that the connectors are correctly connected.



## PRECAUTIONS FOR INSPECTING HYBRID BATTERY SYSTEM

(a) Before inspecting the high-voltage system, take safety precautions to prevent electrical shocks, such as wearing insulated gloves and removing the service plug grip. After removing the service plug grip, put it in your pocket to prevent other technicians from reconnecting it while you are servicing the high-voltage system.

### NOTICE:

Turning the power switch ON (READY) with the service plug grip removed could cause a malfunction. Therefore, do not turn the power switch ON (READY) unless instructed by the repair manual.

(b) After disconnecting the service plug grip, wait for at least 10 minutes before touching any of the high voltage connectors or terminals.

### HINT:

At least 10 minutes are required to discharge the high-voltage condenser inside the inverter.

(c) Since liquid leakage may occur, wear protective goggles when checking inside the HV battery.

(d) Wear insulated gloves, turn the power switch OFF, and disconnect the negative terminal of the auxiliary battery before touching any of the orange-colored wires of the high-voltage system.

(e) Turn the power switch OFF before performing a resistance check.

(f) Turn the power switch OFF before disconnecting or reconnecting any connector.

(g) To install the service plug grip, the lever must be flipped and locked downward. Once it is locked in place, it turns the interlock switch ON. Make sure to lock it securely because if you leave it unlocked, the system will output a DTC related to the interlock switch system.



## 5. WARRANTY CONDITIONS

Educational equipment is a complex engineering product that meets the high standards of modern technology. The equipment is made of high quality, using modern materials and technologies.

Educational equipment is granted \_\_\_\_ months. warranty, unless otherwise stipulated in the sales contract. The guarantee starts counting from the day the invoice is issued.

The warranty for educational equipment is cancelled if:

- Non-original parts are used;
- Low-quality fuel is used;
- The wrong power source is used;
- When connecting the power source, the polarity was mixed;
- Technical fluids of the wrong quality are used and/or there are not enough of them;
- The design of the equipment has been changed;
- Equipment damaged during transportation or improper storage;
- The equipment was damaged due to illegal actions of individuals (vandalism, hooliganism, theft);
- Safe work instructions were not followed during work;
- Failures of household electrical networks, voltage fluctuations;
- Aggressive chemical cleaning agents were used to clean the equipment;
- Any equipment damage or loss occurred, defined as a case of *Force Majeure*;
- Educational equipment is broken or otherwise damaged;
- If foreign objects or liquids get into the educational equipment;
- Using incomplete equipment.

The warranty does not apply to equipment wearing parts, fuses, operating fluids, fuel, seals, filters, liners, belts, bearings, etc.

Warranty repairs are carried out at technical service companies authorized by the manufacturer. Defective equipment units are repaired or replaced with new ones free of charge during the warranty period. The decision on the replacement or repair of parts is made by technicians of authorized companies. Replaced parts become the property of the service point.

After warranty repair, the warranty period is not extended and remains valid until the end of the scheduled period.



The costs related to the disassembly, disassembly, packaging and transportation of the equipment to the authorized warranty service company are not reimbursed to the Customer.

The Customer must cover all expenses incurred by technicians coming to the Customer (transportation, accommodation, etc.) to carry out warranty maintenance work on the educational equipment, when the warranty period of the equipment has not yet expired, but at least one case has been identified that voids the warranty for the educational equipment.

The manufacturer reserves the right to change the design, appearance and equipment of the training equipment.

The warranty conditions are valid only when the educational equipment is used according to the purpose specified in the instructions and in compliance with all work safety instructions.

When applying for a guarantee, the customer must have all the documents for the purchase of the educational equipment: purchase receipt, invoice - receipt, acceptance - transfer deed.

### **Attention:**

If the educational equipment breaks down, a "Warranty maintenance voucher" is filled out. The completed document is sent to the manufacturer of the educational equipment.



## Warranty service voucher

Name of educational equipment	_____
Product number	_____
Date of sale	_____
Owner of educational equipment	_____
Trade partner/representative	_____

### Description of performed works

Date	Description of the failure and its elimination process	Technician / Signature
	_____ _____ _____ _____ _____	
	_____ _____ _____ _____ _____	
	_____ _____ _____ _____ _____	
	_____ _____ _____ _____ _____	
	_____ _____ _____ _____ _____	





## CONTACTS

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