Item No.: CO3221-6X

CarTrain "Hybrid and Electric Vehicles"

Trainees work directly on a real high-voltage system, which has nevertheless been adapted with special safety features so that it can be used without any prior qualifications. Thus this training system provides a safe work environment and allows students and trainees to fully focus on the task at hand. All the content is based on the world wide existing curriculums like DGUV 200-005 , IMI EV Qualifications or ASE L3. Trainees can become familiar with all the key theoretical background by means of an interactive e-learning course. Each of the theoretical sections is accompanied by practical exercises and tests of knowledge, which also help to advance vital diagnostic skills. These skills are further boosted by the built-in diagnostic system and the scrupulously selected fault scenarios. This is the only training system which gives students the opportunity to develop various diagnostic strategies involving measurements on an actual HV system with real HV voltages under the most stringent safety conditions.

Special features of the training system:

- High-speed CAN as communication bus integrated into the HV system control.
  - Communication between HV charging system, HV battery and inverter.
  - Voltage values read out as CAN messages.
- 12V battery integrated into the disconnection and isolation process
  - Incl. fast-action battery terminal for tool-free disconnection of the negative pole
- Real fault codes for all diagnostics cases
- Extended interlock (service maintenance plug, HV measurement point)
- Real service maintenance plug
- Complete preload sequence for booting up HV system
- Active discharge - function for rapid shut-down of the HV system
- Reworked user interface with new "Virtual Cockpit"
  - With power meter
  - READY display
- Extended tester functionality incl. tester-guided disconnection and isolation
- Display of the actual values in the tester:
  - Voltage of the link circuit, traction battery
  - Illustration of the switch-on process (preload phase)
  - Status polling of HV relay
  - Status polling of interlock
  - Voltage of PP contact
  - Status polling of charging process

Includes:

- "CarTrain Hybrid and all-electric vehicles" training course
- USB-ethernet network adapter
- 5 Overlay masks for various drive systems
- Operating instructions
- Interactive training course on data media

Integrated brand-independent drive concepts:

- Serial hybrid drive with plug-in capability
- Parallel hybrid drive with plug-in capability
- Serial-parallel hybrid with plug-in capability
- All-electric vehicles
- Fuel-cell vehicles

Set-up of the training system

- On the front there are two motor-generator units and two transmission systems which transfer drive power to the two wheels on the rear axle.
- Different overlay masks are used to depict the various types of drive and vehicle. In addition to the graphic representation of the relevant block circuit diagrams, direct measurements covering individual electrical components and the flows of energy between them can be made with the aid of the diagrams themselves.
- A capacitive colour touch panel, 10.4 inch, offers a view of the instrument cluster for the vehicle in question.
- The touch panel can also be used to invoke the built-in engine tester.
- Also on the colour touch panel, force and energy dynamics can be shown as animations which are based on the original vehicles themselves.
- A potentiometer can be used to reset the speed of the vehicle as required.
- Another potentiometer enables the energy available from the HV battery to be adjusted between 0% and 100%.
- The driving profile is changed between uphill, level and downhill road conditions using a switch.
- The vehicle is started using a 3-stage ignition switch.
- A service maintenance plug (incl. interlock contact) is located on the front panel in order to de-energise the high-voltage system.
- Measurement sockets to enable verification that the system is de-energised (voltage free) are located behind a lockable cover (incl. interlock contact).
- There are also externally accessible 4-mm measuring sockets directly connected to the resolver. Sine and cosine voltages from the resolver can thus be measured directly.
- 4-mm measuring sockets are also accessible for equipotential bonding.
- Other 4-mm safety measuring sockets are provided in order to measure shielding of the wiring.
- There are also externally accessible 4-mm measuring sockets directly connected to the inverter.
- Measuring sockets for motor/generator 1 and 2 are provided in the form of 4-mm measuring sockets.
- A fully functional type 2 charge terminal for connection to a charging station conforming to IEC 61851-1 is also installed.
- A lockable fault simulation switch box makes it possible to emulate an extensive variety of fault scenarios.
- HV system implemented as an IT network.
- Two-voltage on-board power supply system
- Charge enabling switch
- Charge system based on DIN IEC 61581-1

Integrated WiFi measurement interface:

- Connection via USB port or via wireless WLAN
- 4-channel oscilloscope with trigger, cursor and freeze function
    - Four floating voltage inputs for voltages up to 500 V AC/DC
- Voltmeter
- Ammeter
- Student specific saving of measurement results inside the E-learning course
    - Saving per copy & paste - function

Practical training contents:

- Servicing work
    - Correct selection and testing of suitable instruments and testing equipment
    - How to use service information
    - Carrying out service work on HV systems

    - Checking charging device
    - Charging of high-voltage battery
- Repair work
    - Measurement at potential equalisation conductors
    - Disconnection and isolation of a HV system
        - Manual disconnection and isolation
        - Tester-guided disconnection and isolation
        - Securing against reactivation
        - Verification of isolated status (absence of voltage)
    - Putting a HV system into initial operation
    - Measurement of insulation resistance
    - Measurement of the shielding
    - Measuring the temperature (traction battery, E-machine)
- Diagnostics work
    - Fault localization on a HV system
        - Fault finding on electric motor
        - Fault finding on the inverter
        - Fault finding on the connection lines
    - Measurement of the equipotential bonding
    - How to use the diagnostic device
    - Read-out and deletion of fault memory
    - Measurement on the CAN bus

Course contents:

An interactive course is supplied, which contains the following topics:

- Criteria for putting the test equipment into operation
- Selection and checking of the test equipment
- Drive concepts
- Health and safety while working
- Electrical hazards
- Safety regulations
- HV battery
- Working with high-voltage vehicles
- Safety concepts for high-voltage vehicles
- Hybrid driving
- Pure electric driving
- Generator operation
- Boosting
- Regenerative braking
- Asynchronous machines
- Synchronous machines
- Inverters
- Regenerative braking and energy recovery
- Operating principle for resolvers
- Operating principle for interlock contacts
- High speed - CAN bus
- Measurement of the CP signal of type2 charge connection during active charging process
- How to handle damaged HV vehicles
    - Safer handling by rescue services
    - Disconnection and isolation options for rescue services
    - Special hazards
    - Rescue scheme for rescue services

Dimensions and power supply

- Voltage supply AC 230 V, 50-60 Hz/3 A
- Dimensions: 1000 x 800 x 220 mm (WxHxD)
- Weight: 72 kg approx.