



HYBRID AND ELECTRIC VEHICLES

Automotive Training Systems

TRAINING SYSTEMS FOR ELECTRIC AND HYBRID VEHICLES





FACTS AND FIGURES

- Training based on DGUV 200-005
- Training as high-voltage technicians, Levels 2 and 3
- Training systems with genuine high-voltage circuitry
- Practical training in disconnection procedures
- For motor vehicle mechatronics specialists of all kinds
- Advanced training for technicians, master mechanics and engineers

ELECTROMOBILITY – THE WAVE OF THE FUTURE



Hybrid and electric vehicles are taking over the world. Electromobility now represents one of the most innovative and trailblazing areas of automotive technology. Toyota alone has already sold more than 7 million hybrid vehicles worldwide. Tomorrow's skilled automotive professionals need optimum training to meet the demands of this new technology.

The training systems that Lucas-Nuelle has developed for this field set new standards in functionality, educational value and user-friendliness. With clear, practically oriented explanations, they present the full spectrum of electromobility-related subjects, ranging from the principles of operation of electric drive systems and how they are controlled in motor vehicles to the various drive configurations used in hybrids and all-electric vehicles.

Along with technical content, there is a major focus on occupational safety and safe practices for working on high-voltage systems.

All Lucas-Nuelle training systems are developed to provide practical information specifically adapted to the target group. Since users can apply what they learn directly to their professional activity, they acquire the necessary technical skills for the job.

State-of-the-art training!



TRAILBLAZING: THE LN TRAINING CONCEPT



Real cars

- Toyota Prius
- BMW i3
- Audi Q5 hybrid
- and many more



CarTrain

- Electric vehicles
- High-voltage and air-conditioning systems



UniTrain

- Hybrid drives in vehicles
- Pilot lines
- Interlocks isolating units



UniTrain

- DC/DC conversion
- DC/AC conversion
- Working safely with high-voltage systems

For 40 years now, Lucas-Nuelle training systems have been assisting in education and training, and the company is synonymous with progressive and innovative learning. Each training system developed by engineers at Lucas-Nuelle GmbH fits seamlessly within the overall pedagogical framework and paves the way to a successful training program.

Whether you want to buy an individual training system or equip a complete lab for studying electromobility, we are passionate about meeting all your specific needs.

Real cars

Learning on a digitally networked training vehicle is the final stage of the Lucas-Nuelle training concept. Trainees are well-prepared for this challenge and apply their newly acquired

skills on a real car. This allows them to raise their skill level even further and develop their own working methods.

CarTrain

CarTrain gives trainees an effective and efficient learning environment. The hardware supports all the latest technologies and is combined with a multimedia LabSoft course on automotive technology. The operation of modern vehicle subassemblies is explained in a practical, hands-on fashion using genuine OEM components. Through realistic

fault simulation, trainees acquire basic diagnostic skills. Since it comes complete with a built-in measurement interface and all required components are already installed and configured, the system can be put into use immediately.

UniTrain

The UniTrain system introduces trainees to the world of automotive technology, covering all the required fundamentals in a simple and motivating way. The compact desktop lab is portable and can be used anywhere. By

building motivation and maximizing successful instruction, this multimedia platform guarantees effective and efficient learning.

UniTrain

The multimedia courses first explain the theoretical background and then help the trainees conduct experiments using hardware specific to each course. In addition, the intelligent measuring interface includes connections for analog and digital measurement and control. When combined with the virtual instruments of the system, the result is a high-quality laboratory instrument. Learning progress can be

monitored in troubleshooting exercises on the experiment hardware as well as by tests, all of which can be digitally documented. The electrical and electronic circuitry needed for the experiments is connected to the system by means of an "Experimenter" module. Access to the courses themselves and control of the virtual instruments and experiment hardware are provided by the LabSoft browser platform.

UNITRAIN – BASIC KNOWLEDGE TRAINING



UniTrain hybrid drives in motor vehicles

With this system, students can build their own electric motors, thereby developing the requisite system understanding.

Training contents

- Design and operation of synchronous and asynchronous motors
- How inverters work
- Rectification of three-phase electricity
- Regenerative braking
- Energy-efficient drive systems
- Generating rotating electric fields
- LabSoft course software

Approx. 60 questions for testing knowledge

Order no. CO4204-6V



UniTrain DC /AC conversion

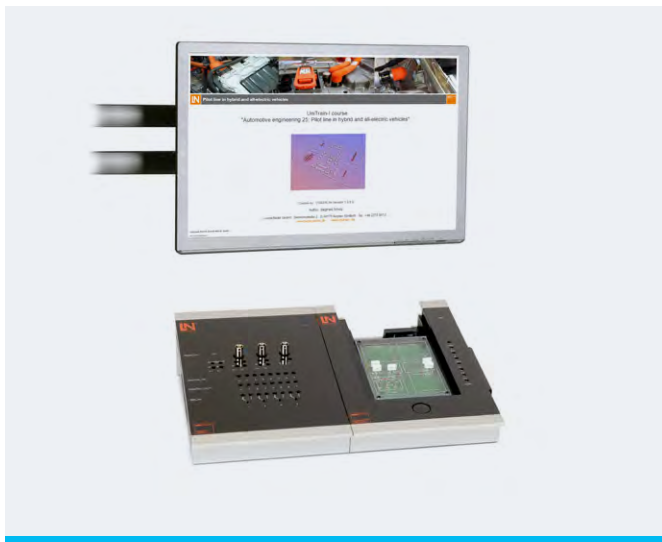
Batteries can only store and supply direct current. In order to drive an electric traction motor, however, an alternating current is required. This course uses numerous experiments to show how the current is converted.

Training contents

- Electrical induction
- Relationship between voltage and current
- Generation of pulse-width modulated voltage signals
- Conversion of DC voltage to AC
- Labsoft course software

Approx. 30 questions for testing knowledge

Order no. CO4204-6L



UniTrain electrical interlocks in electric and hybrid vehicles

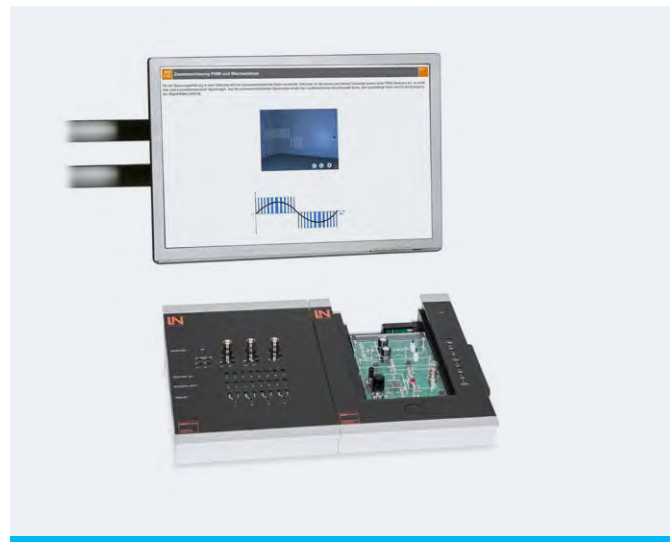
An interlock is a safety mechanism designed to ensure the safety of drivers and workshop mechanics dealing with electric vehicles. The interlock separates the high-voltage battery from the rest of the vehicle as soon as wires are improperly disconnected or in the event of a malfunction. Trainees learn about interlock systems through interactive experiments.

Training contents

- Electrical interlock circuitry
- Interlock signals
- Analytical measurement of an interlock
- Practical troubleshooting
- LabSoft course software

Approx. 40 questions for testing knowledge

Order no. CO4205-1H



UniTrain HV battery disconnect systems in hybrid and electric vehicles

This training system explains how the contactors for a high-voltage battery disconnection system operate. The system monitors the high-voltage installation and connects the battery only when a self-test confirms that it is safe to do so.

Training contents

- Design and function of battery disconnection unit
- How the contactors work
- Sequence of contactors in circuit
- Fault diagnostics – simulated faults can be activated
- Investigation by measurement
- Labsoft course software

Approx. 40 questions for testing knowledge

Order no. CO4205-1J

UNITRAIN – BASIC KNOWLEDGE TRAINING



UniTrain Safe Handling of HV systems

This training system focuses on safety when working on high-voltage systems and the dangers of electricity passing through the human body.

Training contents

- Fundamentals of safety when working with high-voltage vehicles
- Effects of faults encountered in practice
- Using a model to measure the current passing through a human body
- LabSoft course software

Approx. 40 questions for testing knowledge

Order no. CO4205-1M



UniTrain step-up converters and UniTrain step-down converters

The inverters in electric and hybrid vehicles – and in many other circuit applications as well – require various DC voltage levels. Here students study different ways to convert DC voltages.

Training contents

- 1 course on step-up conversion (from lower voltage to higher)
- 1 course on step-down conversion (from higher voltage to lower)
- Safe handling thanks to safety low voltage
- Practical experience of voltage conversion
- Function and design of DC-DC converters
- Measurement of input and output voltages
- Labsoft course software

Approx. 40 questions for testing knowledge

Order no. CO4205-1K/CO4205-1L



UniTrain fuel cells

Despite considerable technological advancements, internal combustion engines still produce large quantities of CO₂. That's why engineers must look for alternative drive concepts. One such concept involves the use of electric traction motors in combination with a fuel cell. This training system allows trainees to learn about this fascinating technology and gain an understanding of how it works.

Training contents

- Fuel cell application in motor vehicles
- Function of a fuel cell
- Design of a fuel cell
- Fundamentals of the chemical process
- Properties of fuel cells
- Recording characteristics
- Efficiency of a fuel cell
- LabSoft course software

Approx. 50 questions for testing knowledge

Order no. CO4204-6M



UniTrain Photovoltaics

The term photovoltaics refers to the direct conversion of (sun) light into electrical energy by means of solar cells. Accessory loads can use that energy to enhance driving comfort, e.g. by providing extra cooling for the passenger compartment in extremely bright sunshine. With our UniTrain photovoltaics system, students very quickly grasp the fundamentals of this technology.

Training contents

- Use of photovoltaic system in motor vehicles
- Design of a photovoltaic cell
- Open-circuit voltage
- Short-circuit current
- V-I characteristic
- Power of a photovoltaic cell
- Photovoltaic cells connected in series
- Photovoltaic cells connected in parallel
- Direct operation
- Storage operation
- LabSoft course software

Approx. 50 questions for testing knowledge

Order no. CO4204-6N

UNITRAIN – 48-VOLT ONBOARD SUBSYSTEM



The integration of the 48-volt onboard subsystem in combination with a lithium-ion battery requires a significant change in work routines. With a focus on how to handle this new technology safely, this package offers you practical, targeted work methods and essential diagnostic skills.

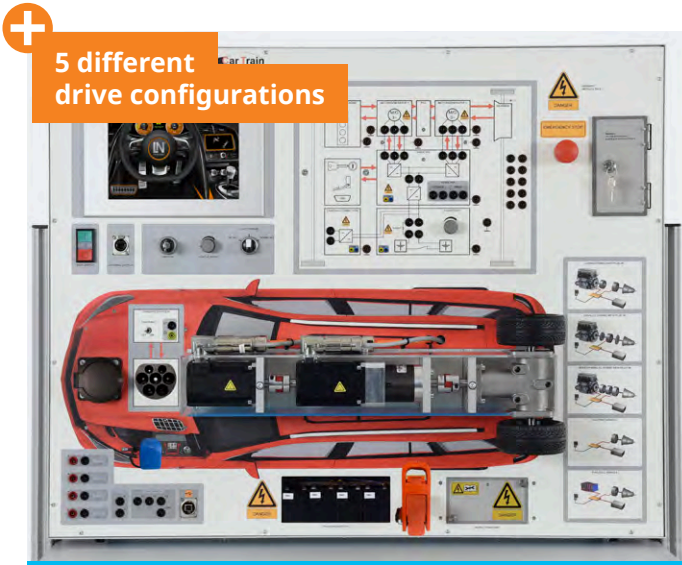
Training contents

- Benefits of a 48-V subsystem in an onboard network
- Design of a 48-V subsystem
- Possible electrical hazards
- Disconnection/isolation of a 48-V system using a tester
- Manual disconnection of a 48-V system
- Diagnostics in 48-V systems

Approx. 60 questions for testing knowledge

Order no. CO4205-1T

CARTRAIN – LEARNING DIAGNOSTIC SKILLS



CarTrain Hybrid and electric vehicles

This is the only electric vehicle training system that combines 5 different drive configurations and includes all the necessary terminals for making measurements on a high-voltage system.

This new version of CarTrain includes the following upgrades: The high-speed CAN communication bus is now directly integrated into the HV system's control system and a built-in touchscreen makes it easy for you to understand the various drive modes and energy flows.

The system operates on the same high voltage used in real vehicles. That means students can practice disconnecting a genuine high-voltage system.

Benefits

- Display of energy flow
- Over 30 measuring points in the high-voltage system
- Genuine high voltage
- Disconnection as in actual practice
- Fault simulation
- LabSoft course software

Approx. 263 questions for testing knowledge

Order no. CO3221-6X



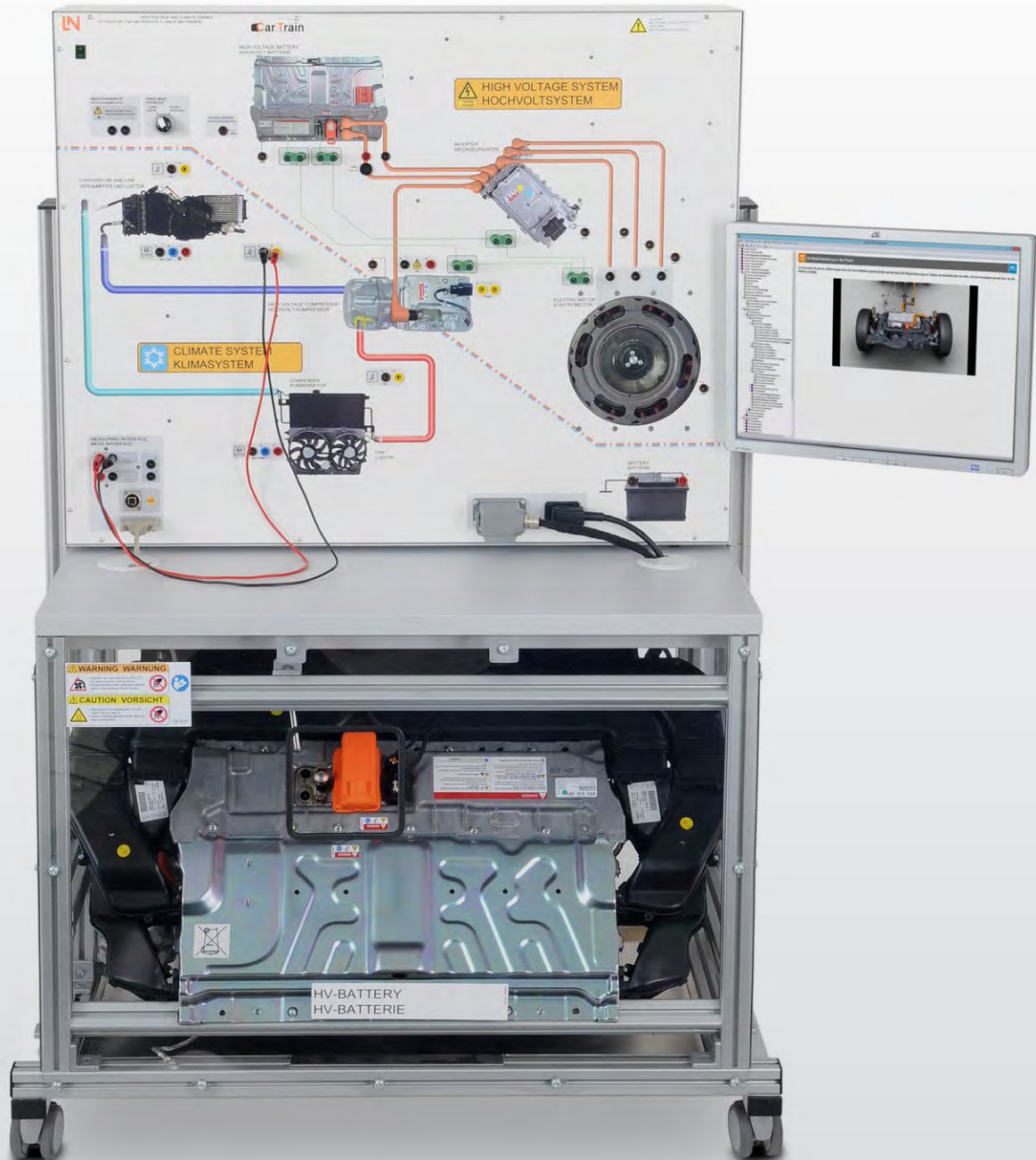
CarTrain charging station

Use the charging point to study the communication between a vehicle and the charging station itself while taking all necessary safety precautions.

Benefits

- Analysis of an authentic high-voltage battery
- Can be used on real vehicles
- Monitoring of the charging process
- Safety concepts
- Analysis of the communication protocol between the vehicle and the charging station

Article no. CO3221-6Q



CarTrain High-voltage and air conditioning training system

Combined equipment for the topics of hybrid drive trains and high-voltage air conditioning in motor vehicles. Trainees can use this equipment to learn about the servicing, diagnostics and repair of high-voltage systems and air conditioning.

Benefits

- Genuine high voltage
- Simulation of various operating modes
- High-voltage air conditioning compressor
- Contactless measurement
- Fault simulation
- Fully functioning high-voltage vehicle air conditioning system made with original components
- High-voltage battery with original servicing and maintenance plug
- Interlock
- Original insulation monitor
- LabSoft course software

Approx. 72 questions for testing knowledge

Order no. CO3221-6P

CARTRAIN – DIAGNOSTICS AND MAINTENANCE OF HV BATTERIES



Working directly on a real high-voltage battery and inside it: The system is set up to be just like a high-voltage battery in a standard production vehicle. With this training system, trainees can make measurements and diagnoses inside the high-voltage battery, working down to the level of individual cells and even replacing them.

Comprehensive yet easy to use, the fault simulation system prepares students to handle a wide range of malfunctions. While working out the best way to diagnose problems for themselves, trainees gain skills to deal with today's automotive repair shop challenges.

Benefits

- Analysis of an authentic high-voltage battery
 - 16 lithium-ion cells
 - 8 temperature sensors
 - Cells and sensors can be dismantled
 - Air cooling
 - Interlock
- Disconnection of the high-voltage system
 - Disconnection via diagnostic tool
 - Disconnection by removal of service and maintenance plug
 - Disconnection for rescue personnel
- Measuring options
 - CAN bus interconnection of BMS 1-3
 - High-voltage battery disconnecting relay
 - High-voltage level and cell voltages
 - Interlock
- Charging infrastructure
 - AC charging Types 1 and 2
 - CCS DC charging

Order no. CO3221-6S

SETTING UP A SAFETY ZONE



When it comes to diagnostics on hybrid and electric vehicles, safety always comes first, especially when troubleshooting and repairing the battery itself.

In order to learn and apply the mandatory safety procedures correctly, the training system teaches the use of the comprehensive safety concept required for working on high-voltage batteries.

Training contents

- Personal protective equipment (PPE)
 - Practical use of PPE
 - Inspection of PPE
- Certified components
 - Suitable for use with vehicles
- Safety zones
 - Setting up a safety zone
 - Certified components
 - Suitable for use in workshops
- Classification of high-voltage batteries
 - Proper status
 - Critical status

DIAGNOSTICS ON HV BATTERIES



Safe training system



In combination with the personal protective equipment and the integrated high-voltage diagnostic unit, this very practically oriented training system supports in-depth diagnostics unlike any other. With safety clothing and equipment, plus the high-voltage diagnostic tester, the training system provides unique diagnostic range closely aligned to authentic practice.

In addition to the guided diagnostics, trainees can take various measurements directly on the training system itself.

Special training content includes measurements on the interlock system and also directly in the high-voltage battery's battery management system (BMS). Focus is placed on the HV system relay and switching the high-voltage system on and off.

Training contents

- Measurement of HV system voltage
- Measurements in the BMS
 - HV system relay
 - HV capacitors
 - High-speed CAN bus
 - Pre-load phase
 - Active/passive discharge
- Measurements on the interlock system
- Measurements on the temperature sensors
- Measurement of supply voltage

SIMULATION OF WORKSHOP-RELATED HV FAULTS



Troubleshooting specifically activated faults allows students to gain skills that they will need later in the repair shop.

The training system meets the highest safety standards. Trainees and the system itself are both protected in the event of operator error.

As soon as a diagnostic case from the digital course is opened, the associated fault is automatically activated.

Then it is up to the trainees to document their own diagnostic procedures in detail. The system makes it easy to evaluate the work later.

Diagnostic contents

- Over 50 different diagnostic cases
- BMS faults
 - Temperature sensors
 - CAN bus
 - HV system relay
 - Battery cooling
- Interlock faults
 - HV battery cover
 - Service and maintenance plug
- Disconnection faults
 - Procedure
- HV battery faults
 - Lithium-ion cells
 - Insulation resistance
 - Capacitors

LABSOFT – THE MULTIMEDIA LEARNING PLATFORM

Further information is available at
www.lucas-nuelle.com



FACTS AND FIGURES

- HTML-based multimedia courses
- All HTML-supported languages
- Animations and graphics
- Theory and diagnostic exercises in a single training unit
- Documentation of results
- Questions for testing knowledge
- Access to all virtual instruments
- Log-in with user data
- Selection of languages
- Selection of courses
- Saving of individual platform configurations

DIGITALLY NETWORKED TRAINING VEHICLES



Tested vehicles



Choose from four different cars. The cars chosen for these training systems are selected according to strict quality guidelines. This is how we guarantee you a high-quality product with excellent cost efficiency.

All cars are specially modified for optimal use within the framework of the training course. In addition to the display of the main systems in the vehicle, various breakout boxes are installed, along with more than 30 fault activation switches. Each vehicle also includes its original wiring diagrams, so students can perform diagnostics under practical conditions.

Hybrid powertrain

- VW Golf GTE (LM8296)
- Toyota Prius (LM8297)

Electric powertrain

- VW e-Golf (LM8295)
- BMW i3 (LM8298)

Order no. LM8295-98



The digitalization package – Digital diagnostics on a real vehicle

To take advantage of the full potential of a training vehicle, we recommend installing our digitalization package. This package equips the vehicle with a WiFi-capable measurement and diagnostics interface that allows you to activate simulated faults and transmit measurement results to the training platform. To save space, all the measuring instruments (4-channel oscilloscope, multimeters, current probe, etc.) are already integrated in the system and can be conveniently operated from the training platform.

Benefits

- Digitally networked training platform
- Interactive diagnostic course
- WiFi-capable measuring interface
- Includes non-contact current measuring probe
- WiFi-capable diagnostic interface
- OBD II breakout box

Order no. CO3223-7E



Measurement expansion package – Any number of trainees can work simultaneously

The measurement expansion package adds additional measuring stations to allow multiple trainees to take measurements and perform diagnostics on a single vehicle simultaneously. Up to six different signals are fed into the vehicle's signal interface and then made available at the students' workstations. Any number of measuring stations can be added as needed. In this way, a single vehicle can be used to train an entire group.

Benefits

- Built-in signal interface
- Includes 6 external measuring stations for students
- Parallel transmission of signals
- Custom extensibility
- Can be combined with training platform
- Built-in CAN interface

Order no. CO3223-7F



LABSOFT CLASSROOM MANAGER 5.0

Administration, customization, testing and evaluation



LabSoft Editor

Numerous wizards within the LabSoft Editor help you set up your own new courses and guide users step by step through the necessary procedures.



LabSoft Questioner

To generate questions, measuring exercises and tests, LabSoft Questioner provides many different kinds of questions. The exercises and questions can then be inserted into courses and tests.



LabSoft Manager

Manage your LabSoft courses, students and classes using the LabSoft Manager. This ensures that your students always have the right training content available.



LabSoft Reporter

LabSoft Reporter presents students' progress and test results. A wide range of assessment options for individual or class results in courses and tests enables fast, specifically targeted analysis.



LabSoft TestCreator

LabSoft TestCreator creates tests to assess students' knowledge and practical skills at the same time. Filter functions help you select test questions manually or automatically.

- Optimal use of resources
- Minimization of administrative work
- Maximization of learning success at all times
- Check on student progress at any time
- Everything always at your fingertips



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