

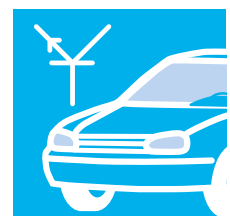
# Hybrid and Electric Vehicles

Unique Training Solutions for the World of Hybrid Vehicles



- Perfect synergy of theory and practice
- Independent learning on real components
- Highest safety standards
- Engineered in Germany

2<sup>nd</sup> Edition



# Interactive 360° Laboratory



Take a look at these training systems in action by scanning the QR code or visiting our website at [www.lucas-nuelle.com/automotive](http://www.lucas-nuelle.com/automotive) and choosing 360° Laboratory.







# Hybrid Vehicles Worldwide

## Hybrid vehicles

By the end of the year 2014 the European market registered a increase of the registrations of hybrid and pure electric vehicles by 37%. This trend continues steadily. With this demand for new technology and highly complex vehicles, it is crucial that current and future technicians are prepared for the challenge of diagnosing and repairing these vehicles.

### Make sure your auto program is up to date!

Lucas-Nuelle has a range of trainers that come ready to use in the classroom or laboratory. Our program is complete with the practical tasks and theoretical knowledge, all supplied with our blended learning curriculum software "Labsoft". These trainers give the students real knowledge and experience working with high voltage systems, all while being completely student safe and complying with all european safety standards.

### Manufactured to Automotive Industry Standards!

Lucas-Nuelle training systems are manufactured in our own state of the art factory located in Kerpen, Germany. The complexity and depth of our product range is managed by a highly-motivated team of customer oriented and experienced professionals and engineers. Our commitment to enterprise resource planning ensures that your order will always be delivered on time.



**Student learning on the advanced technology systems of today and the foreseeable future!**





*Sample of an Automotive Training Laboratory*

# Trail blazing: The LN Training Concept

For 40 years Lucas-Nülle training systems have been assisting education and training, and the company is synonymous with progressive and innovative training. Each training system developed by engineers at Lucas-Nülle GmbH is incorporated into the overall training concept and smoothes the way to a successful career. Whether you want to purchase an individual training system or a fully equipped lab for studying hybrid and electric vehicles, we are passionate about meeting all your needs.

## The LN Training Concept from Top to Bottom



### 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
- Battery isolating units



### UniTrain

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

## Real cars

**Learning to work on a genuine training vehicle** forms the final stage of the Lucas-Nülle training concept. Trainees are ideally prepared for the challenge of applying the skills they have learned to use on a real car. This means they can not only enhance their skills, but also develop their own working methods.

### CarTrain

CarTrain provides trainees with an effective and efficient learning platform. The hardware is based on the latest technology and is combined with a multimedia LabSoft course on automotive technology. The way that modern vehicles operate is conveyed in practical, hands-on fashion using **original components specific to various vehicles**. Thanks to the **realistic simulation of faults**, trainees can gain **elementary diagnostic skills**. The system can be put into use immediately. All the necessary components are already installed and configured. In order to carry out measurements, a **built-in measuring interface** is provided.

### UniTrain

The UniTrain-System represents an introduction to the world of vehicle mechanics and provides trainees with the necessary fundamental knowledge in a way that is simple and motivating. The system can be **put to use at any time**, in laboratories, classrooms or at home. The **multimedia training platform** ensures a high degree of motivation and the best chance of successful learning, guaranteeing effective and efficient learning.

In the **multimedia courses**, the **theoretical background** is explained and then **experiments** are carried out using **experiment hardware** which is specific to each course. In addition, the intelligent measuring interface includes analog and digital **inputs and outputs for measurement and control**. In combination with **virtual instruments** the whole system represents a high quality piece of lab equipment. Learning progress can be monitored in **troubleshooting** exercises on the course hardware as well as by tests, all of which can be digitally documented. The electrical and electronic circuitry needed for the experiments are connected to the system by means of an **“Experimenter”** module. Access to the courses themselves and control of the virtual instruments and experiment hardware is provided by the LabSoft browser platform.

## UniTrain "Hybrid Automotive Drives"

Students build functional electric motors and see how they operate with **safe low voltage** components to really understand electric motor concepts.

### Advantages:

- ✓ Construction and operation of synchronous and asynchronous motors
- ✓ Operation of invertors
- ✓ Rectification of three phase
- ✓ Energy regeneration
- ✓ Labsoft blended learning software



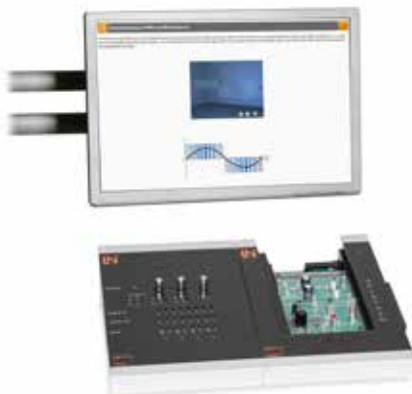
Article #: SO4204-6V

## UniTrain "DC/AC Conversion"

Because batteries can only supply direct current an inverter is required to turn the battery DC voltage into alternating current voltage that can be used by an electric motor. This difficult to understand concept is explained in an **easy to understand** way with the help of the hardware and theory course "DC/AC conversion".

### Advantages:

- ✓ Generation of an AC voltage
- ✓ Relationship between voltage and current
- ✓ PWM signals
- ✓ Labsoft blended learning software



Article #: SO4204-6L



## UniTrain “Electrical Interlock in Hybrid Vehicles”

The electrical interlock is one of the most important safety Advantages on modern electric vehicles. The interlock separates the high voltage battery from the rest of the vehicle in the event that a cable would be incorrectly disconnected Understanding this concept will help the technician diagnose faults or **may even save some one’s life**.

### Advantages:

- ✓ Operation and function of electrical interlock
- ✓ Measure and observe electrical interlock signal
- ✓ Diagnosis of the electrical interlock
- ✓ Labsoft blended learning software



Article #: CO4205-1H

## UniTrain “HV Battery Disconnect Systems in Hybrid Vehicles”

This training system focuses on the high voltage disconnection relays of the battery unit. The system monitors the hybrid system and only connects to the high voltage when it is considered “**safe and secure**”. The accompanying Labsoft course explains this complex system.

### Advantages:

- ✓ Operation and function of the disconnect relays
- ✓ Fault finding
- ✓ Perform the service disconnect
- ✓ Labsoft blended learning software



Article #: CO4205-1J

## UniTrain "Safe Handling of HV Systems"

This topic covers how high voltage interacts with the human body and what can be done to understand and minimize the risks to electric vehicle technicians and drivers.



### Advantages:

- ✓ Voltage pathways through the body
- ✓ High voltage safety concepts
- ✓ Safe low voltage operation
- ✓ Labsoft blended learning software

Article #: CO4205-1M

## UniTrain "Step-Up / Step-Down Converter"

The course "Step Up / Step Down Converter" teaches how electric vehicles can increase high voltage battery voltage to the sometimes much higher voltages required for the electric motor. It also shows how the high voltage can be reduced to low voltage to run the 12 volt battery and run the vehicle's electrical and electronics system.



### Advantages:

- ✓ 2 separate cards for step up and step down
- ✓ Safe low voltage operation
- ✓ Manual and automatic generation of the voltage
- ✓ Labsoft blended learning software

Article #: CO4205-1K/1L

## UniTrain "Fuel Cells in Automotive"

Motorized vehicles (cars, trucks) produce large quantities of CO<sub>2</sub>. Despite considerable advancements, the internal combustion engine still has very high CO<sub>2</sub> emission levels. It is therefore no surprise that engineers are seeking alternative drive concepts. In this training system students get to know and understand this fascinating technology. One interesting drive concept involves the use of electrical drive motors in conjunction with a fuel cell.

### Advantages:

- ✓ Fuel cell application in the motor vehicle
- ✓ Function of a fuel cell
- ✓ Design of a fuel cell
- ✓ Fundamentals of the chemical process
- ✓ Properties of fuel cells
- ✓ Recording characteristics
- ✓ Labsoft blended learning software



Article #: SO4204-6M

## UniTrain "Photovoltaics in Automotive "

The term photovoltaics means a direct conversion of sunlight into electrical energy by means of solar cells. The energy obtained in this manner can be supplied to ancillary consumers to enhance driving comfort, e.g. to additionally cool a vehicle's interior in extremely bright sunshine. With our UniTrain-I Photovoltaics System students very quickly grasp the fundamentals of this technology.

### Advantages:

- ✓ Use of a photovoltaic system on a motor vehicle
- ✓ Design of a photovoltaic cell
- ✓ Open-circuit voltage
- ✓ Short-circuit current
- ✓ V-I characteristic
- ✓ Power of a photovoltaic cell
- ✓ Series-connected photovoltaic cells
- ✓ Parallel-connected photovoltaic cells
- ✓ Direct and storage operation
- ✓ Labsoft blended learning software



Article #: SO4204-6N





Article #: CO3221-6K

## CarTrain "Hybrid and All Electric Vehicle Technology Trainer"

The only electric vehicle trainer on the market that combines the 5 different possible hybrid or electric vehicle configurations that use industry level voltages. Coverage includes the Toyota Prius series-parallel hybrid and the Tesla pure electric arrangements.

The integrated touch screen display can be easily changed to explain the various driving modes and energy flow.

The system uses actual voltage levels to ensure the student is confident and prepared to work on these vehicles safely.

### Advantages:

- ✓ Touch screen displays the energy flow
- ✓ Over 20 measuring points using certified safe connections
- ✓ Industry level voltages – over 300 volts
- ✓ Able to perform the high voltage isolation procedure just like on real vehicles
- ✓ Fault switches for troubleshooting
- ✓ Labsoft blended learning software



Article #: CO3301-6A

## CarTrain "Charging Station"

Our system teaches the students the communication and charging process of the high voltage battery vehicle is carried out.

### Advantages:

- ✓ Real charging station
- ✓ Possible to use on real vehicles
- ✓ Monitoring of the charging process
- ✓ Safety concepts
- ✓ Analysis of the communication protocol between the vehicle and the charging station
- ✓ Socket and cable provided for all vehicles

# CarTrain

## CarTrain "High Voltage and Air Conditioning Training System"

This trainer provides a **unique opportunity** to understand how an A/C system is integrated into a HV vehicle.

Including a fully operative high voltage A/C system that allows students to perform actual diagnostic and service tasks.

Also included in this trainer is a fully operational hybrid drive and system overview

### Advantages:

- ✓ Industry level voltages – over 300 volts
- ✓ Variable modes of the inverter control
- ✓ Functional electrical interlock
- ✓ Touchless current measurement
- ✓ Fault switches
- ✓ Fully functioning high voltage A/C system
- ✓ View of vehicle battery with integrated A/C cooling system
- ✓ Labsoft blended learning software



Article #: CO3221-6P



Back view



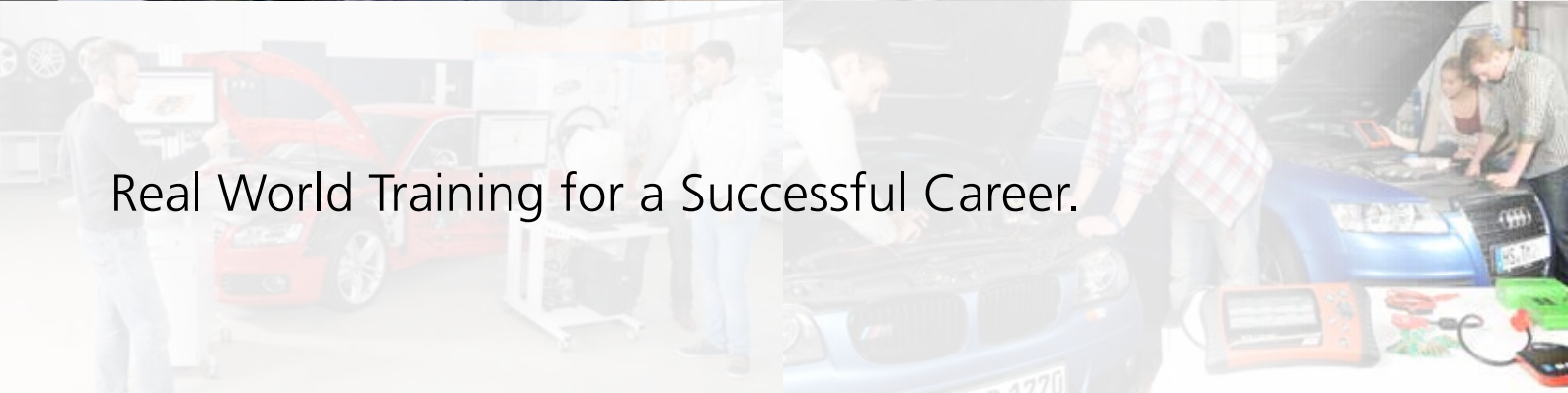
Front view



# Learning with a Training Vehicle



Real World Training for a Successful Career.





# Real Training Vehicles

## Hybrid and Electrical Cutaway Training Vehicles

Lucas-Nuelle not only offers conventional vehicles with internal combustion engines, but now is able to deliver hybrid and electric vehicles that have been prepared especially for training in a safe transparent way. The vehicles are equipped with a fully operational HV system which has been designed for use in schools and training centers.

Due to safety concerns, built in faults cannot be integrated into the HV system of these vehicles, but extensive work has been done to the body and interior of these vehicles to allow all of the inner workings and important HV components to be easily visible and identified by students.

### Advantages:

- ✓ Practical hands-on training on authentic motor vehicles and automotive components
- ✓ Vehicles are fully operational
- ✓ Fault simulation (due to safety reasons, only on low voltage circuits)
- ✓ Fault switch box and breakout box for the combustion engine
- ✓ Investigation of the electrical and mechanical components
- ✓ Real HV system designed for extra safety
- ✓ All important HV components are fully visible
- ✓ Number of hybrid and electrical vehicles available

Article #: LM8249003



Sample: Cutaway Training Vehicle BMW i3

# LabSoft – The Multimedia Training Platform

## Benefits of LabSoft

LabSoft forms the link between the experiment hardware and an educational multimedia course. Users are guided step by step through the program and learn the various skills on their own initiative

### • Graphics and animation

Every one of the multimedia courses has been developed with a host of graphics and animations. This means that even complex and intricate system functionality can be explained in a simple and easily understood way.

### • Navigation

The built-in navigation window on the left provides direct access to all LabSoft courses installed on the computer. The open tree structure allows you to open the course at any location.

### • Simulation or real mode

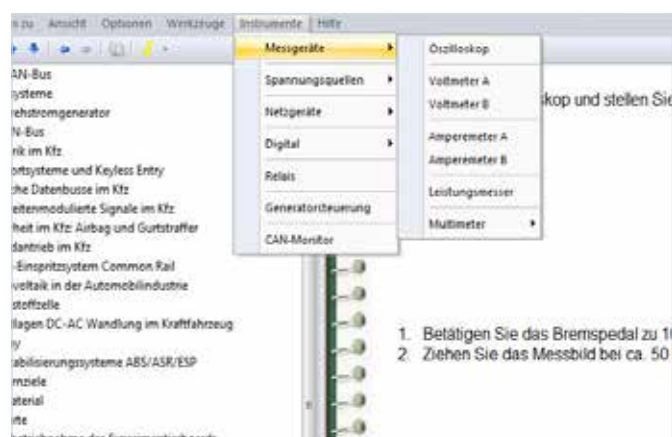
In order to prepare students for practical lessons even better, it is possible to operate LabSoft in simulation mode without the hardware connected. This means that the theoretical basics can be learned earlier, leaving more time for experiments in the laboratory.

### • Freedom of language

LabSoft provides for all the languages implemented in HTML. You can even switch from one language to another, in order to learn the basis for foreign terminology, for instance.



## Virtual Instruments



The "Instruments" menu gives you full access to all virtual instruments and power supplies.

## Saving



Measurement results can be saved by dragging and dropping them into the placeholders provided in the courses themselves.



## Network LabSoft

You can install LabSoft locally on your own computer or in a network. In order to facilitate incorporating courses into modern learning management systems (LMS), LabSoft courses are developed in accordance with international standards (SCORM).

## Software-based learning platform

Continuous communication between the experiment hardware and the multimedia course ensures that the learning proceeds in optimum fashion.

## LabSoft functions

- HTML-based multimedia courses
- All languages supported in HTML
- Animations and graphics
- Theory and laboratory experiments as part of a single training module
- Documentation of results
- Questions for testing knowledge
- Access to all virtual instruments
- Logging in with user data
- Choice of language
- Selection of courses
- Individual learning progress can be saved

## Set-up animations



**Set-up animations** explain how experiments are carried out step by step.

## Knowledge Test



**Built-in tests of knowledge** keep a constant check on the knowledge gained by users. Both users themselves and their teachers can monitor how much has been learned.

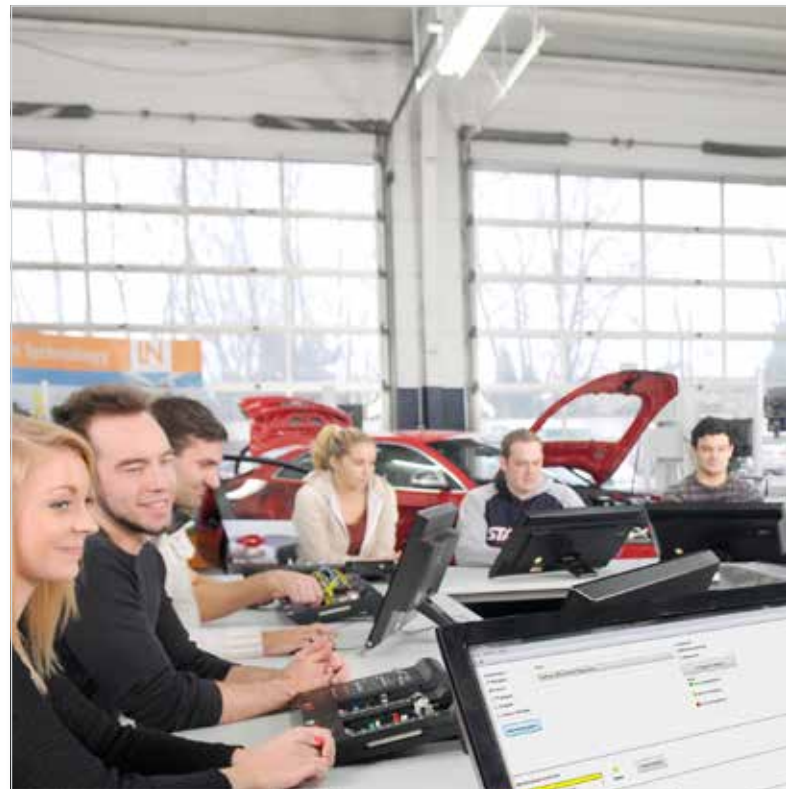


# LabSoft Classroom Manager 4.0

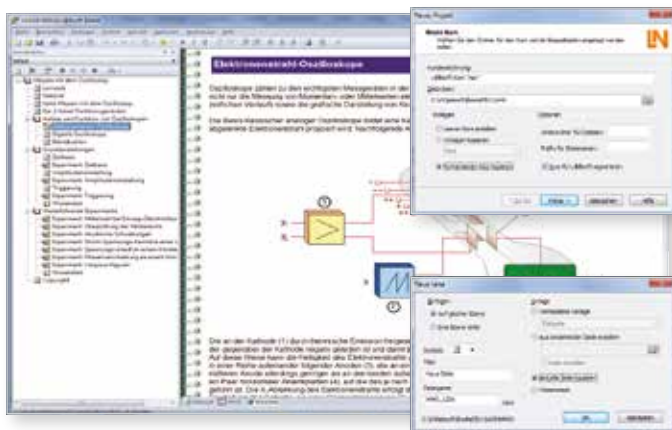
## Administration, Customization, Monitoring, Evaluation

### Benefits of LabSoft Classroom Managers 4.0

- **Optimum use of resources**  
Use Classroom Manager to get the best out of the educational concept behind Lucas-Nülle training systems.
- **Minimization of administration work**  
Save time and paper by electronically administering all LabSoft courses and all trainees in LabSoft Manager. Organize contents, users and groups of users.
- **Continually maximize successful learning**  
Use LabSoft Editor to personally customize LabSoft courses to the individual needs of students. Devise your own questions, experiments, measuring exercises and even your own courses, which are then instantly available to trainees themselves.
- **Monitoring learning progress at all times**  
You can use TestCreator to set up your own tests with just a few clicks of the mouse. Utilize pre-prepared questions and measuring exercises to test your students' knowledge and skills.
- **Keep everything in view at all times**  
Access learning progress and test reports with the help of LabSoft Reporter. Easily understood selection functionality quickly leads you to the information you want.



#### LabSoft Editor



LabSoft Editor Advantages several wizards to help you devise your own new courses and guide trainees step by step through the necessary tests.

#### LabSoft Questioner



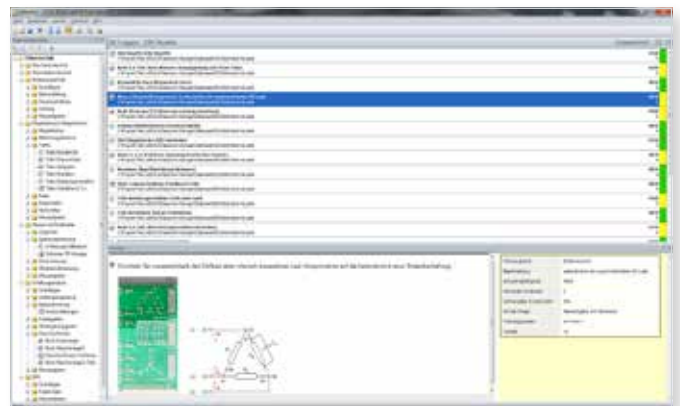
In order to create the questions, measuring exercises and tests, LabSoft Questioner has various types of question available. Exercises and questions can then be inserted into courses and tests.



### LabSoft TestCreator

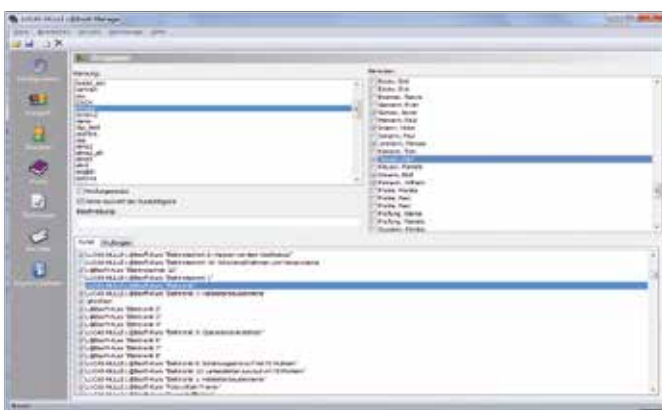
LabSoft TestCreator is used to put together tests, which can be used to check knowledge and practical skills at the same time. Filter functions help to select the questions either manually or automatically.

### LabSoft TestCreator



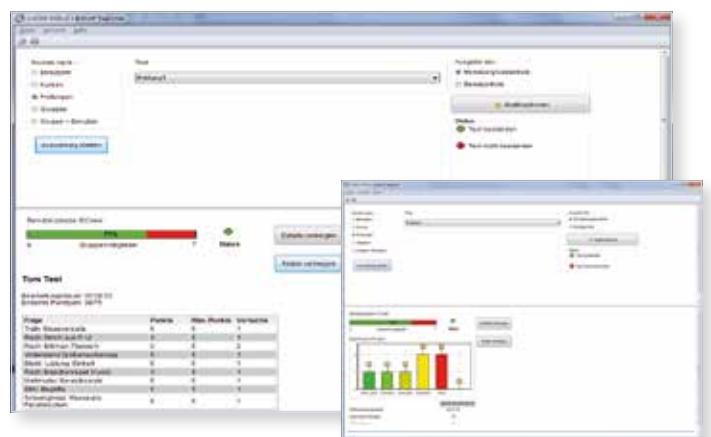
Use **TestCreator** to put together tests suitable for your own purposes in a matter of seconds.

### LabSoft Manager



Administer your LabSoft courses, students and student groups with **LabSoft Manager**. Then you can provide students with the right exercises for their needs at all times.

### LabSoft Reporter



**Progress and test results** can be displayed using **LabSoft Reporter**. This provides multiple ways of assessing results of courses and tests for individuals or groups allowing you to quickly and specifically monitor progress.

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