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## Automotive | Hybrid & EV

### Lucas-Nuelle as part of the SkillsUSA



#### **Lucas-Nuelle as part of the SkillsUSA**

SkillsUSA is a partnership of students, teachers and industry working together to ensure America has a skilled workforce. SkillsUSA helps each student excel. We provide educational programs, events and competitions that support career and technical education (CTE) in the nation's classrooms.

SkillsUSA serves more than 335,000 students and instructors annually. This includes 19,500 instructors who join as professional members. Including alumni, SkillsUSA membership totals over 395,000. SkillsUSA has served more than 13.5 million annual members cumulatively since 1965.

Lucas-Nuelle is proud to be an official partner of the SkillsUSA and contribute its on part to improve the skilled automotive workforce.

# ASE L3 Trainer "Light Duty Hybrid/Electric Vehicle Specialist" at SkillsUSA



## ASE L3 Trainer "Light Duty Hybrid/Electric Vehicle Specialist" at SkillsUSA

We are proud to announce that LN and our unique trainer for the ASE L3 test was a very successful part of the SkillsUSA in Louisville, Kentucky.

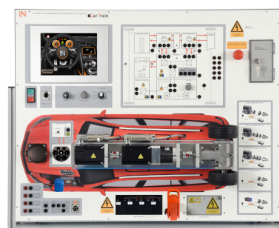
If we are talking about future mobility including hybrid and electric vehicles, then the USA is the place to be. There have been around 4 million hybrid and electric vehicles sold within the USA and sales are continuing to increase rapidly. With this demand for new technology and highly complex vehicles, it is crucial that current and future technicians are prepared for the challenge of diagnosing and repairing these vehicles.

Our trainer is one of the various automotive challenges of the SkillsUSA. The students have to show their knowledge and diagnostic skills about hybrid and electric vehicles on our trainer, which is completely aligned to the ASE L3 curriculum.

### List of articles:

Pos.	Product name	Bestell-Nr.	Anz.
1	<b>CarTrain "Hybrid and Electric Vehicles - ASE L3 Trainer"</b>	CO3221-6X8	1

Prepare your students for the ASE L3 test "Light Duty Hybrid/Electric Vehicle Specialist". All topics related to the New ASE L3 test are now covered by our newest Hybrid/Electric vehicle trainer. We offer a blending of comprehensive curriculum with practical tasks to make sure your students have the competencies and system understanding needed to succeed in this emerging, highly technical market. Allow your students to build confidence by knowing they can safely work on a state of the art real world system performing the procedures needed to work on hybrid/electric vehicles.



One of the key topics involved in modern automotive technology is the move towards electric drive power or electromobility. This is viewed as the innovation of the modern age and the drive system of the future, so developments continue to proceed at rapid rate. One key aspect of these developments involves the education and training of specialists and mechanics, who always need to have their fingers on the pulse of the latest technology to keep pace with ever-changing challenges. Lucas-Nuelle training systems represent an essential link between education and industry. Particularly in the sphere of hybrid and electrical vehicles the company's training system plays an exceptional role, since it embodies the perfect synergy between authentic practice, high safety requirements and targeted theory, all in conjunction will real diagnostic exercises.

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. This means that the training system gives rise to an absolutely safe working environment, enabling work to proceed with confidence. All the training content is in line with ASE L3 and frequently even exceeds those requirements. Trainees can become familiar with all the key theoretical background by means of an interactive e-learning course. The subjects can be organised into topic areas, including drive configurations, components of high-voltage systems, disconnection/isolation of HV systems, safe working with such systems, electrical fundamentals, charging of high-voltage batteries and diagnostics. Each of the theoretical sections is accompanied by practical exercises and tests of knowledge, which also help to advance vital diagnostic skills, skills which 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, even involving measurements on an actual HV system, yet nonetheless 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
- Upgrade of fault simulation (e.g. adjusted response to insulation faults)
- New LabSoft course with lots of new content
- New front panel design

**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
  - Illustration of the content of DGUV 200-005
  - No license model

**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.
  - The system is equipped with batteries connected in series, in order to clarify the principle behind series connection of the traction battery.
  - 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 screening of the wiring.
  - There are also externally accessible 4-mm measuring sockets directly connected to the inverter.
  - Measuring sockets for motor/generator 1 are provided in the form of 4-mm measuring sockets.
  - Measuring sockets for motor/generator 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.
  - Measuring sockets for demonstrating safety communication between the charging station and the vehicle via an interlock contact are also available in the form of 4-mm safety measuring sockets.
  - To aid faster understanding, the right-hand side of the front panel features a graphic representation of each drive configuration implemented in the system.
  - An emergency stop switch is also located on the front panel.
  - The system as a whole can be connected to a PC with the help of a USB cable. A built-in measuring instrument allows all measurements on the system to be recorded and sent to the computer via the USB link.
  - A lockable fault simulation switch box makes it possible to emulate an extensive variety of fault scenarios.
  - Measurements of insulation resistance can also be made using an instrument which is supplied with the training system.
  - HV system implemented as an IT network.
  - Two-voltage on-board power supply system
  - Charge enabling switch
  - Preparation for inductive charging

#### **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
- Function generator output
- Resolver reference signal

- Variable voltages and waveforms via function generator
- Variable signals via frequency generator
- Variable voltages via three-phase supply
- Variable voltage and phase-shift via extended three-phase supply

#### **Performing the following measurements:**

- Charging processes of the traction battery
- Discharging processes of the traction battery
- Voltage measurements on the traction battery
- Verifying voltage isolation
- DC link circuit voltage
- Insulation resistance measurement
- 3-phase measurement on motor/generator 1 (power and recuperation)
- 3-phase measurements on motor/generator 2 (power and recuperation)
- Sine and cosine voltages from resolver
- Measurement of equipotential bonding
- Shielding measurement
- CP contact in charging system
- Analysis voltage in charging system
- Charge voltage in plug-in system
- The maximum voltage amplitude is approx. 425 V AC and approx. 320V DC
- Charge system based on DIN IEC 61581-1

#### **Practical training contents:**

- Service 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 equalization 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 on a CD-ROM. The course is incorporated into the Labsoft training platform which also allows access to measuring instruments. In addition to imparting training content via text, images and animations, it also allows for monitoring of student progress and fault-finding experiments in the form of workshop job orders. Training contents are SCORM-compatible (HTML) and can be imported into training platforms of your own, such as Moodle.

- Smart grids
- Criteria for putting the test equipment into operation
- Selection and checking of the test equipment
- Drive concepts
- Drive configurations
- Drive variants
- Operating modes
- Health and safety while working
- Electrical hazards
- Passage of electricity through the human body

- Hazards due to AC
- Safety regulations
- HV battery
- Batteries made of nickel-metal hydrides
- Lithium-ion batteries
- Cooling of battery systems
- Meaning of "high voltage (HV)"
- Electricity "fueling" stations
- Working with high-voltage vehicles
- On-board power networks in high-voltage vehicles
- Intrinsically safe HV vehicles
- Safety concepts for high-voltage vehicles
- Vehicle-internal safety concepts
- Switch-on current and current limiting
- Serial hybrid drive with plug-in capability
- Parallel hybrid drive with plug-in capability
- Serial-parallel hybrid with plug-in capability
- Axle-split parallel hybrid
- Power-split hybrid drive
- Other drive configurations
- Hybrid driving
- Pure electric driving
- Generator operation
- Boosting
- Regenerative braking
- Electric drive systems for hybrid vehicles
- Electric vehicles
- Hydrogen-fueled electric vehicles
- Design of electrical machines
- Asynchronous machines
- Synchronous machines
- Control units for hybrid drives
- Rectifiers
- Inverters
- Regenerative braking and energy recovery
- Fault finding in traction motor circuits
- Fault finding in inverter circuits
- Fault finding in screening circuits
- Fault finding in equipotential bonding circuits
- Fault finding in battery circuits
- 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 120 V, 50-60 Hz
- Removeable connection cable with earthing pin plug
- Dimensions: 1000 x 800 x 220 mm (WxHxD)
- Weight: 72 kg approx.

Additionally required:

Pos.	Product name	Bestell-Nr.	Anz.
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2 **Safety Zone for CarTrain/TruckTrain (Hybrid and Electric Vehicles)**

LM8671 1

This set gives you the option of setting up a complete safety zone for working with high-voltage hybrid and electric vehicles or their high-voltage batteries. Four securely free-standing poles with cordon straps allow you to set up a safety zone which meets the highest safety demands. Such a safety zone needs to be set up to secure high-voltage vehicles or their HV components and to protect trainees in laboratories or repair shops. For any work on a high-voltage battery it is essential for the area to be cordoned off. Setting up a safety zone is therefore an essential aspect of any training.



The cordon straps require no maintenance, are resistant to tearing and do not sag. This guarantees the highest level of safety and durability. The three magnetic roof pylons can be simply attached to the roof of a vehicle without any tools. Everything in the set is a certified and tested safety product.

3 **US Electric Service Gloves Class 0**

LM85708 1

The Class 0 electrical glove kit offers insulation protection up to 1000 VAC and 1500 VDC. Each glove is pre-tested and is valid for 12 months from the date indicated on the glove. Once they are put into service, they must be re-tested every six months. The kit contains goat leather protection gloves, class 0 rubber gloves and a canvas storage bag.



It meets and exceeds the standards for electric gloves:

- NFPA 70E
- CSA Z462
- ASTM D120
- ASTM F696
- Pre-tested - Ready to use
- Made in the United States
- Class 0

4 **Standard Group Lock Box for Lockout/Tagout (with 1 Padlock)**

LM8660 1

This lockable secure box gives you the option to keep keys and other items essential to security safe from unauthorised access. By using multiple padlocks (not included), it is even possible to arrange for multiple person protection. The box itself conforms to the highest standards of quality and can easily be moved thanks to its lightweight construction.



This box is ideal for preventing access to hybrid and electric vehicles in which the high-voltage system has been deactivated. Storing the key and the service/maintenance plug in here means that it is impossible for anyone to reactivate the HV system without authorization.



5 **Insulation Multimeter (1000V / 2GΩ, CAT III 1000 V, CAT IV 600 V)**

LM8310

1

The Insulation Multimeter combine a digital insulation tester with a full-featured, true RMS digital multimeter in a single, compact, handheld unit, which provides maximum versatility for both troubleshooting and preventative maintenance. Whether you work on motors, generators, cables, or switch gear, the Insulation Multimeter is ideally suited to help you with your tasks and at a cost that is far less than buying the two products.

Features

- Insulation test voltages 500 V, 1000 V
- Insulation test: 0.1 MΩ to 600 MΩ
- Auto discharge of capacitive voltage
- AC/DC Voltage
- DC millivolts
- AC/DC milliamps
- Resistance (0.1 Ω to 50 MΩ)
- Continuity
- Three-year warranty
- Remote probe, test leads, alligator clips
- Rugged, utility hard case
- Auto power off to save battery power
- True RMS
- Large display with backlight
- Live circuit detection prevents insulation test if voltage > 30 V is detected for added user protection




CAT Classes:

- 2000 m CAT III 1000 V
- CAT IV 600 V
- 3000 m CAT II 1000 V
- CAT III 600 V

Includes:

- Remote probe
- Test leads
- Alligator clips
- Hard case
- Four AA alkaline batteries
- Quick reference guide
- CD rom with manual

**Additionally recommended:**

Pos.	Product name	Bestell-Nr.	Anz.
6	<b>Fiber Pole for High Voltage Systems</b>	LM8673	1
	Fiberglass pole (1,65 m) suitable for rescuing persons from the danger area in the event of electrical accidents. For indoor and outdoor use, but not for rainfall. One-piece rescue pole. Glass fibre / polyester resin tube with hand limiting disc. Bridging-safe and permanently mounted rescue hook. Rescue of persons up to a weight of 150 kg (330 lbs). Torque test (hook): 30 Nm. Supplied with wall bracket.		

This set provides the optimum safety equipment for any work on a hybrid or electric vehicle. All products meet the highest quality requirements and all important international standards.

The set consists of the following items:

- Electrician's safety helmet
- Face Shield
- Balaclava
- Insulating stand mat 1000 x 1000 x 4 mm



#### **Electrician's safety helmet**

The helmet combines a very robust ABS shell, which provides excellent protection, with a particularly comfortable strap system. As a multi-standard product, the helmet complies with the following industry standards:

- EN397 - The European standard for safety helmets
- ANSI/ISEA Z89.1 - American National Standard for Industrial Headgear
- CSA Z94.1 - Protective headgear - Performance, selection, care and use
- GB2811- Chinese Standard for Industrial Headgear
- AS/NZS1801 - The Australian standard for industrial safety helmets

#### **Face shield (EN166, 170,GS-ET-29 class 2, ATPV 17cal/cm<sup>2</sup>)**

The protective screen can be easily attached to the helmet included in the set, providing excellent protection against all types of arcs and sparks. Furthermore, it complies with both US and EU standards.

- Injection Molded visor based on polycarbonate
- 2.6 mm thickness with anti-scratch outside coating
- Anti-fog coating inside
- Side panels, clear crown, transparent clear chin guard

#### **Balaclava**

The balaclava (size XL) is very comfortable to wear and offers additional protection. Furthermore, it is mandatory in various countries (e.g. USA).

- Complies w. ANSI /ISEA 125 Level 2 and Arc Flash PPE
- CAT category 2 with an arc capacity of 12 cal/cm<sup>2</sup>

#### **Insulating stand mat 1000 x 1000 x 4 mm**

Protective mats for electrical switch rooms, resistant to weather, ozone, light, acids, oil and fire (UL 94 V-0). The floor mat with a thickness of 3 mm has a dielectric strength of test voltage class 0 (1000 V), made of grey polymer (hardness approx. 65° Shore A), tensile strength > 10 N/mm, elongation at break > 600%, raised coarse material running surface (ribbed) for increased slip resistance, abrasion < 300 mm, temperature resistance from -30 °C to +70 °C. The floor mat is also nitrosamine- and PAH-free.

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## 8 Charging Station for PEV and PHEV

CO3221-6Q8

1

This charging station is extremely well suited to teaching trainees how HV battery charging works in a motor vehicle. The charging station can be used in conjunction with ASE L3 trainer as well as with the trainer for "Diagnostics and maintenance of a HV battery". The charging station is equipped with a type-1 socket with a corresponding charge controller, which monitors the communication with the vehicle in terms of charge parameters according to IEC 61851.

### Technical features

- Safety cover for the charging socket
- Contactor for disconnection of the charge terminal from the power grid
- Max. charge current 10 A
- Inputs and outputs: 4-mm safety sockets
- Internal auxiliary voltage 24V DC / 1A
- Voltage supply: 110-120V, 50/60Hz



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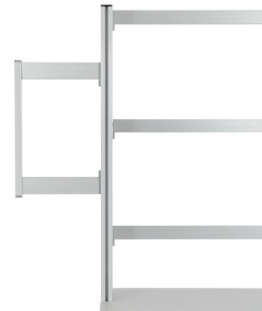
## 9 Sideways training panel frame extension

ST8003-1X

1

Extension module to accommodate training panels in DIN A4 format for mounting on the outside of aluminium profile uprights of benches, training panel frames or profile extensions. Aluminium profile rails with inward facing brushes allow for rapid and quiet swapping of training panels with no need for tools.

- Side section made of rectangular steel tubing (30x20x2 mm), grey (RAL 7047) powder-coated surface
- Two natural brushed aluminium profile rails (cross-struts) with two inward-facing brush strips
- Usable with any lab system featuring 4-groove aluminium profiles (10-mm grooves).
- Dimensions (WxH): 250 x 400 mm, 1 level



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## 10 ILA: "Hybrid/EV vehicle hazard management for emergency and recovery personnel"

SO2803-2X

1

This qualification is for training providers and employers to deliver to learners in the 16-18 and 19+ age groups. These learners will have an interest in gaining the knowledge to work safely around Electric/Hybrid vehicles during emergency and recovery situations.

It is therefore designed for those people who may encounter accident damaged or broken down electric/hybrid vehicles. It contains the knowledge required to work safely around a vehicle that may have or had damage to its high energy/electrical system.

This Award sized qualification offers an introduction to this specialised industry sector which in addition to complimenting their current industry qualifications and experience, will enable them to continue to work safely within their role. These roles can include but are not exclusive to:

- Emergency services
- Roadside recovery operators

*Furthermore, this course can be used in connection with the CarTrains CO3221-6X and CO3221-6S. This makes it possible to offer the participants further practical content in which they can interact directly with a HV system designed for training purposes and train their handling skills.*



Accessories:

Pos.	Product name	Bestell-Nr.	Anz.
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11	<b>Mobile CarTrain/TruckTrain experiment trolley, 1070x1350x700mm</b>	ST7200-4K8	1
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The mobile aluminium-profile experiment trolley is specially designed to accommodate components of the CarTrain and TruckTrain system.

All the CarTrain and TruckTrain system components can be safely mounted in structured fashion for lessons from the front of a class or for students' own practicals. For students, this provides a modern, educationally designed workplace with a worktop and connections for multimedia.

It is supplied with one shelf, an angle bracket for attaching a PC and a under-table cabinet, suspended, 2 drawers + utensil drawer.



#### Table top + Shelf:

- 30-mm table top/25-mm shelf are made of highly compressed, multi-layer fine chipboard conforming to DIN EN 438-1
- Colour grey, RAL 7035, with 0.8-mm slightly textured laminate coating (Resopal) on both sides, conforming to DIN 16926
- Resistant to many chemicals and reagents including dilute acids and alkalis
- Resistant to heat, e.g. molten solder or heating at specific points such as by soldering tips or cigarette ends
- Table top 1000 x 700 x30 mm, Shelf 1000 x 525 x 25mm
- Frame with solid impact-resistant protective edging made of 3 mm thick RAL 7047 coloured plastic
- Coating and adhesive are PVC free
- Power strip with 6 outlet sockets mounted underneath the table top, lead and earthed plug

#### Frame:

- 2 extruded aluminium profiles with multiple grooves
- 8 equally sized grooves in extruded aluminium profiles (3 on each side and 1 each on the front and back)
- Grooves accommodate standard industrial mountings
- Base made of rectangular tubing with 4 swiveling double casters, 2 of which have brakes
- Table frame made of tough combination of rectangular tubing around the full perimeter
- Acid-resistant epoxy-resin coating, 80 µm thick (approx.), colour RAL 7047

#### Under-table cabinet:

- 1 utensil drawer, 2 drawers 2 HU
- Usable width 330mm, Usable depth: 480mm
- Central locking
- Metal drawers with surrounding row of slots
- Body made of 19mm-thick, highly-compressed, multi-layered fine chipboard with grade E1 plastic coating on both sides
- Dimensions: 430 x 590 x 290mm (WxHxD)

#### PC attachment bracket:

- With 3 screw-on rubber stoppers, dimensions 65x65x114 mm approx. (top fixing for PC)
- The height of the PC attachment bracket can be adjusted along the aluminium profiles
- For attachment to fastening materials included
- Acid-resistant epoxy-resin powder coating of thickness 80 µm approx., colour RAL 7047

#### Dimensions:

- Height of table top 800 mm
- Complete dimensions without training system: 1070 x 1350 x 700 (B x H x T)
- Complete dimensions with mounted training system: 1070 x 1650 x 700 (B x H x T)
- The mobile experiment stand will be delivered fully assembled

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12 **Monitor holder for flat screen monitor of weight up to 15kg / 33lbs** ST8010-4T

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Pivoting monitor holder for attachment to aluminium profiles of furniture in the SybaPro range. Allows a monitor to be placed in the optimum position so that work and experiments are less tiring.

- Pivoting arm with two-part joint
- Quick-lock for adjustment to any height on extruded aluminium profile
- VESA fastening 7.5 x 7.5 cm
- Includes VESA 75 (7.5x7.5) - VESA 100 (10x10) adapter
- 2 Cable clips
- Adequate carrying capacity 15 kg / 33 lbs
- TFT monitor can be turned parallel to the table edge
- Separation can be adjusted to anywhere between 105 and 480 mm



**Additionally included:**

Cable management set for installing cables along the profiles of the aluminium lab system furniture in the SybaPro range, consisting of:

- 3 Cross cable blocks for front and rear grooves of aluminium profile
- 3 Cross cable blocks for side grooves of aluminium profile
- 12 Cable ties
- 4 Aluminium cover profiles for covering and enabling wires to be run along the grooves of an aluminium profile
- Includes assembly instructions