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Instruction Manual for LC2030 Workstation

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IMPORTANT INFORMATION

USAGE OF THIS DOKUMENT

The terms of all elements of LC2030 workstation are changed in Juli 2015 according to EN 62424. Following all changed terms are listed.

Element	New Term	Old Term
Pumps	M	P
Level switches	B	LS

USAGE OF THE WORKSTATION

When temperature is to be controlled, it is important, that the water level is above the medium level switch and the marking on the heating rod.

To prevent damage to the heating rod it is necessary to cool it down (i.e. leave it in the water tank) for at least 30 minutes.

Do not heat the water in the tank to more than 45°C.

The pumps must not run dry, i.e. without water.

Do not close the manual valves completely as this can damage the pumps.

M1 should not run while control valve V1 is closed.

The input signal FC1 and FC2 are analogue inputs and shall not exceed a maximum of 10V DC.

The input signals M1, M2, M3, M4 and TC1 are binary inputs with a maximum of 24V DC.

The lamps L1, L2 and L3 are binary inputs with a maximum of 24V DC.

Make sure, all level switch plugs and the temperature probe plug are fully connected.

INSTRUCTIONS FOR LC2030

The workstation LC2030 can be used to work on open-loop control tasks (binary) and closed-loop control tasks (analogue). The following closed-loop control systems are available:

- liquid level control
- flow control
- temperature control

The workstation is equipped with an adjustable pump and an adjustable valve for flow and level control and with a heating rod and a circulation pump for temperature control.

Floating switches and a pressure sensor give information about the level in on tank (container) C1. A Pt100 resistance thermometer and two flow meters measure temperature and flow rate. The P&I diagram is shown in Figure 1.

Figure 2-5 show all elements of the plant from different views.

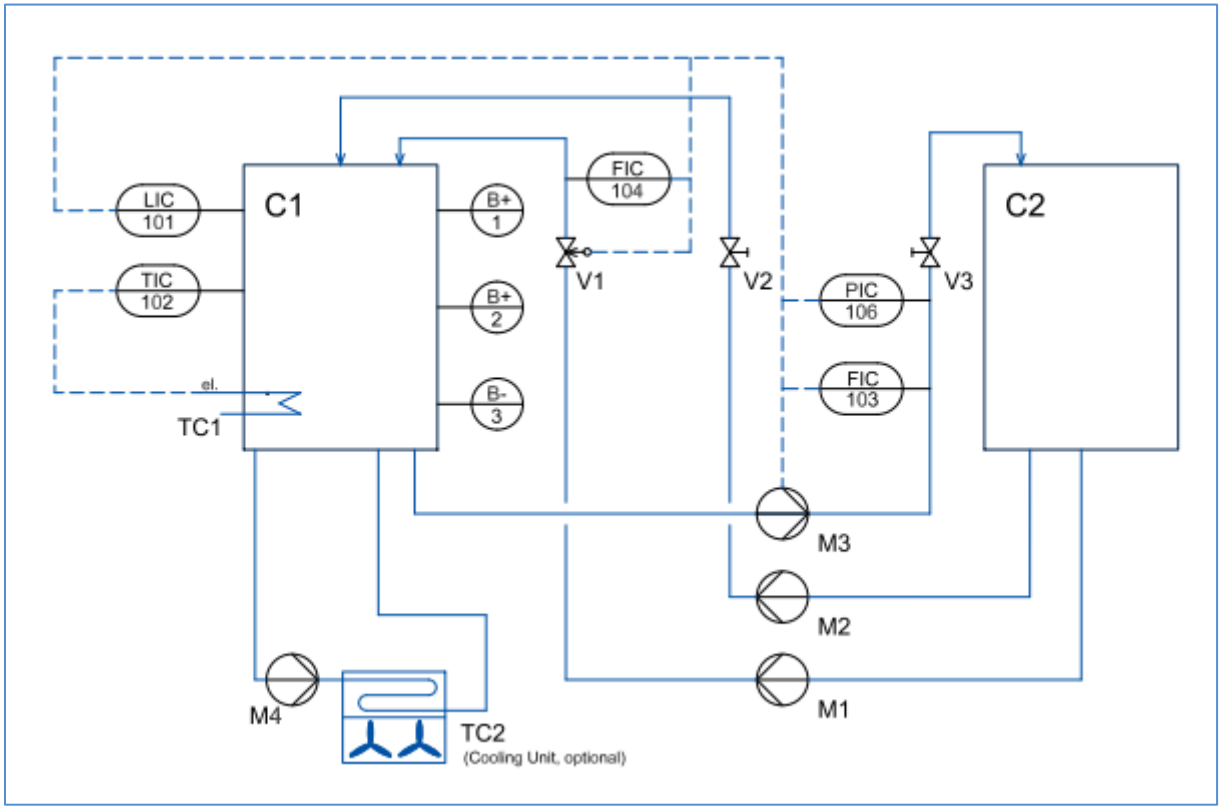

Figure 1: P&I diagram of LC2030 workstation

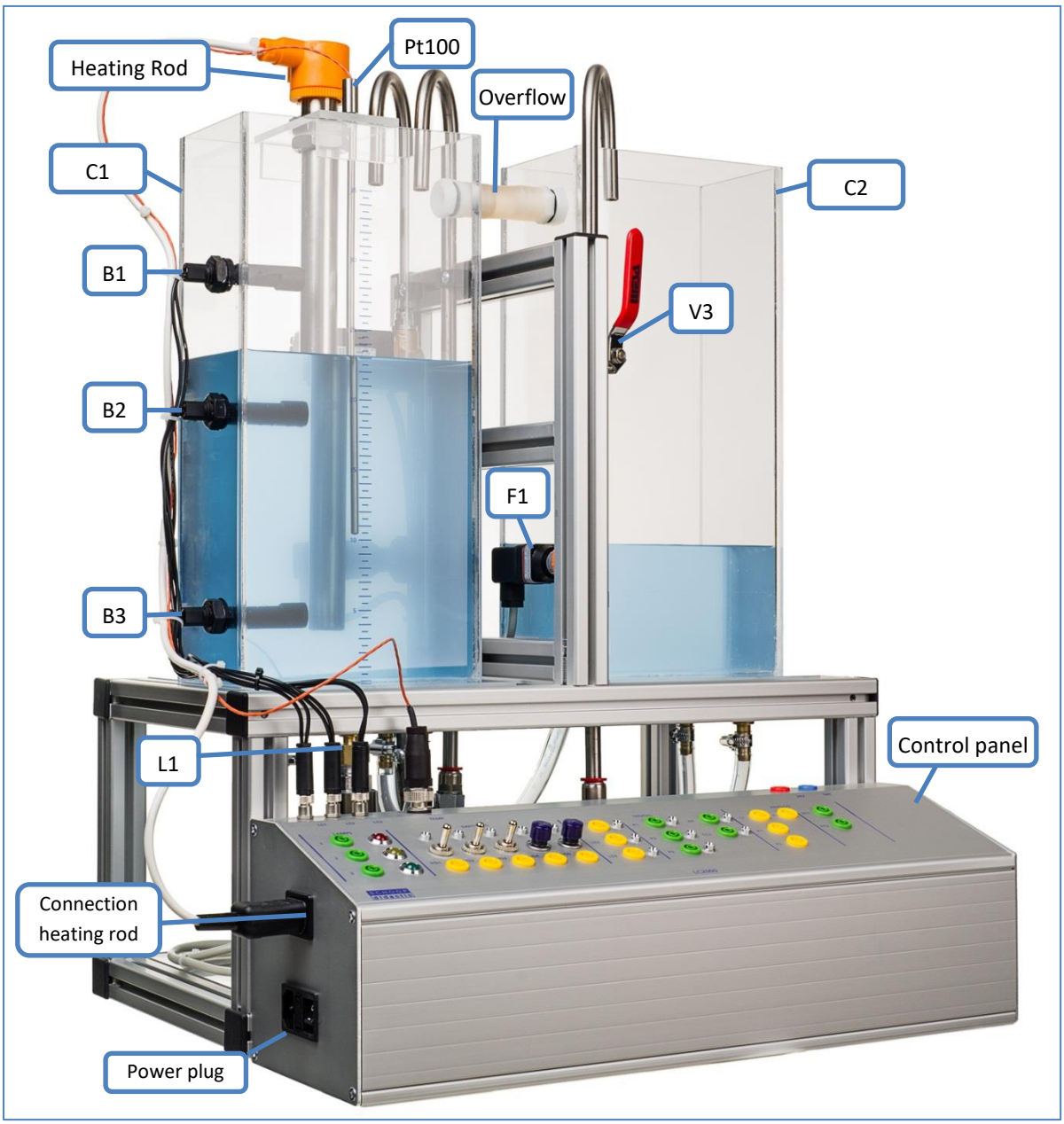

Figure 2: Front view

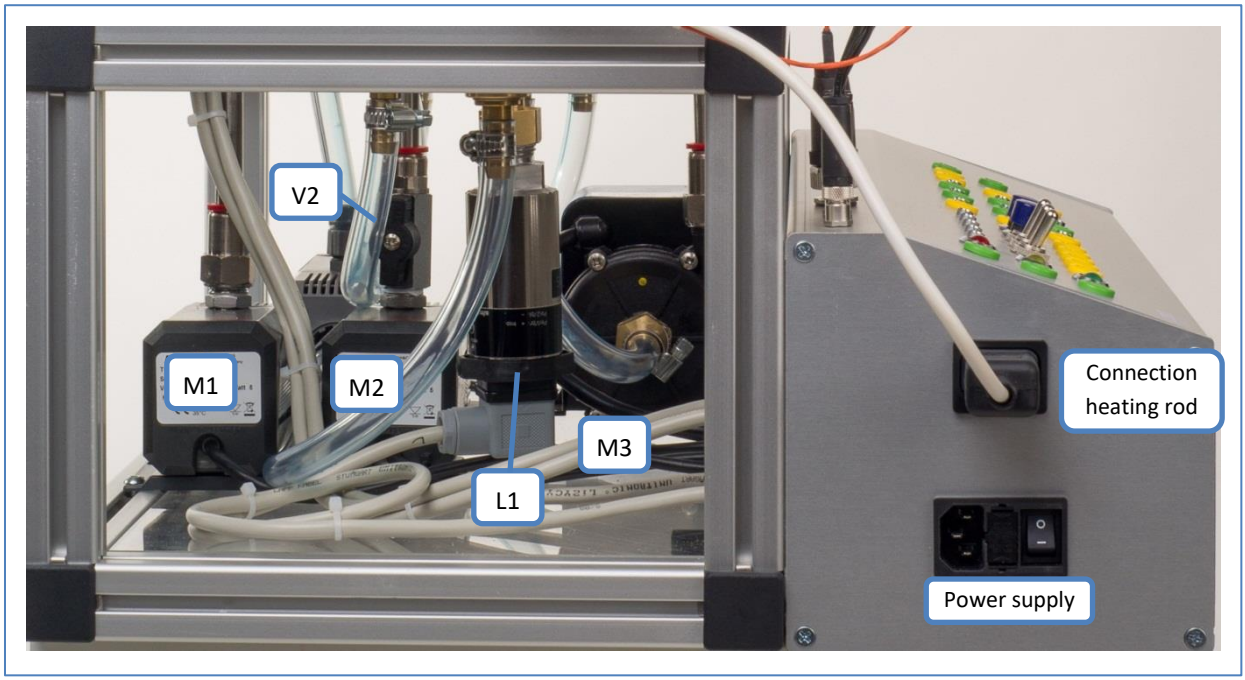

Figure 3: Left side view

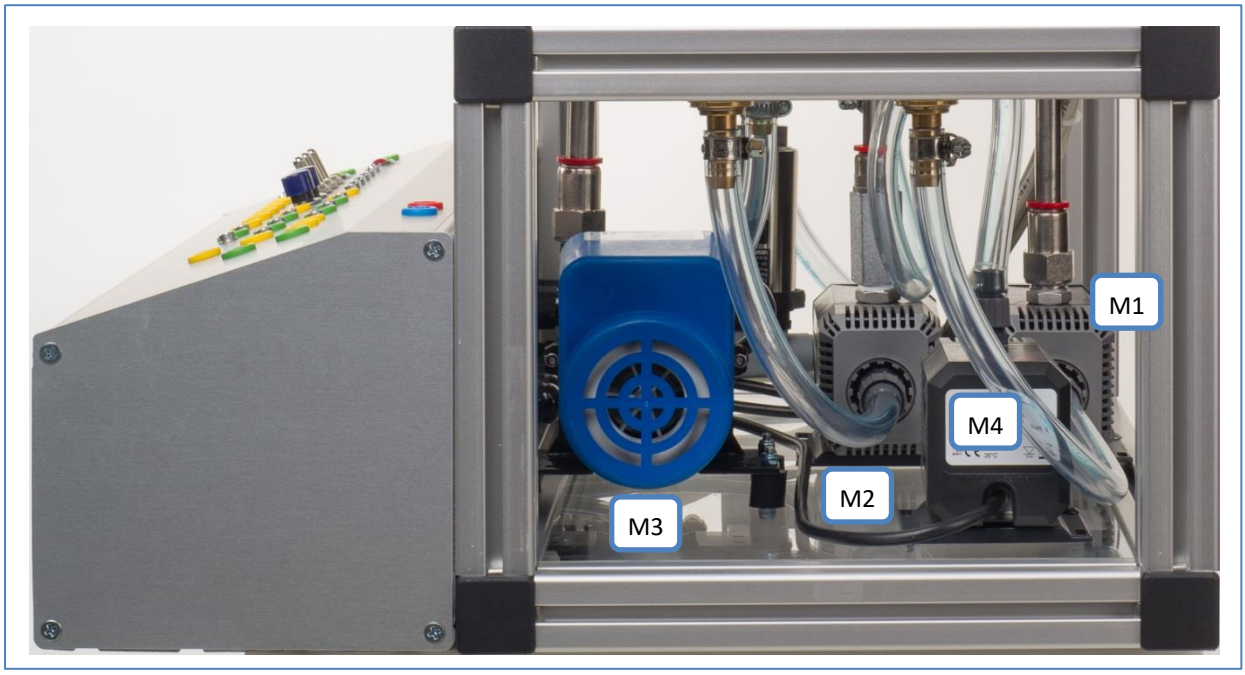

Figure 4:Right side view

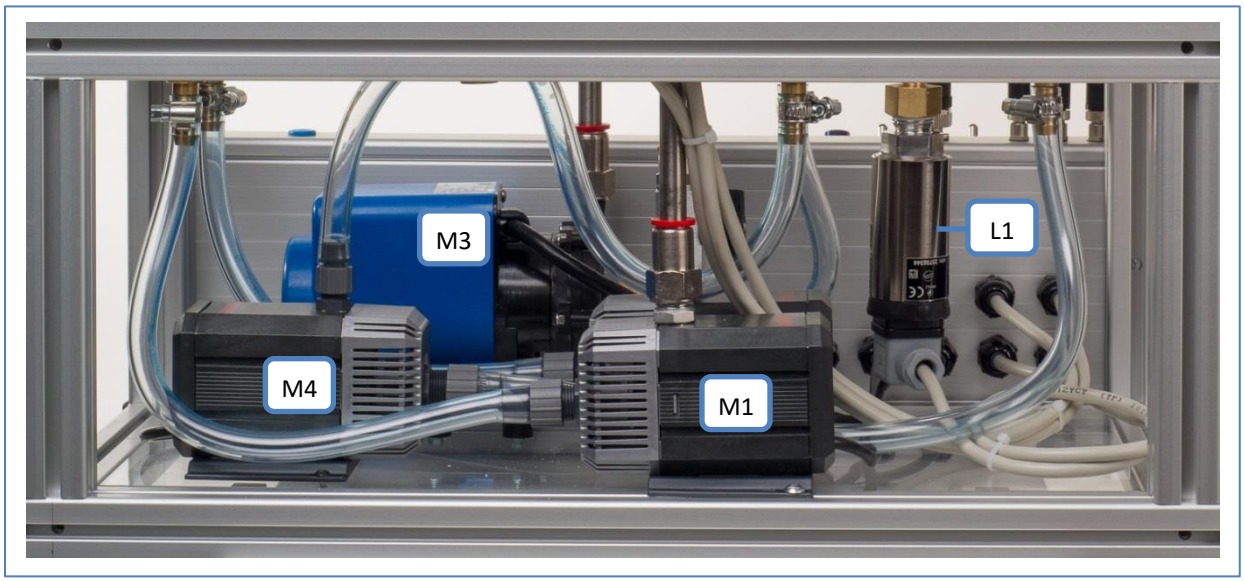

Figure 5 Back side view

Figure 6 Optional pressure control behind the pump M3

ELECTRICAL CONNECTION

POWER SUPPLY AND HEATING ROD

At the control panel´s left side the power plug for 230V AC, 50Hz and the connection for the heating rod are located.

Figure 7: Power supply and connection to heating rod

LEVEL SWITCHES AND TEMPERATURE SENSOR

Figure 8: Connection for level switches and Pt100

Figure 8 is showing the connection for level switches B1, B2 and B3, aswell as for temperature sensor T1.

For signals B1, B2 and B3 M8 sensor sockets are used. The temperature sensor has a M12 plug.

FUNCTIONS

LEVEL CONTROL

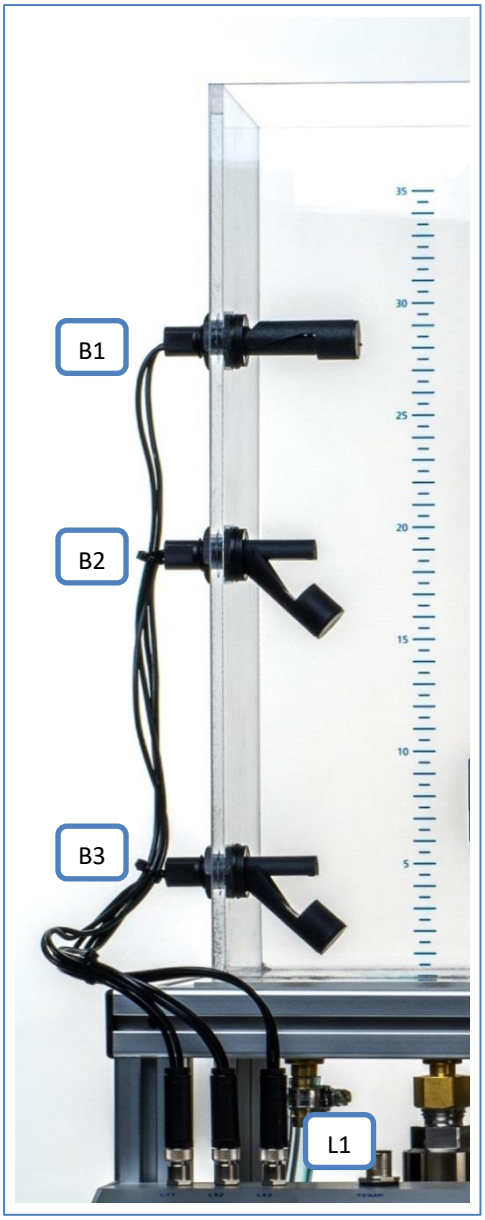

Figure 9: Level switch in tank (container) C1

The goal is to control the level in tank 1. Three binary level switches B1, B2 and B3 and an analogue pressure sensor (L1) detect the level. The level switches are connected to the control panel according to Figure 9. Pressure sensor L1 has a range of 0…45cm.

Tank 1 is filled by the pumps M1 and M2. M3 pumps the water into Tank 2. For level control the flow rate of the pump M3 is adjustable by an analog signal *FC1* (0...10V). To influence the control system it is possible to switch the pumps M1 and M2 on and off. With the control valve V1 and manual valve V2 each flow rate can be adjusted or influenced (see also Figure 3). The analog signal of the level in tank 1 is provided at socket *L1* in a range of 2..10V DC for 0..40cm.

Alternatively the level can be controlled using control valve V1. In this case the pump speed of pump M3 is a disturbance value.

FLOW RATE CONTROL F1

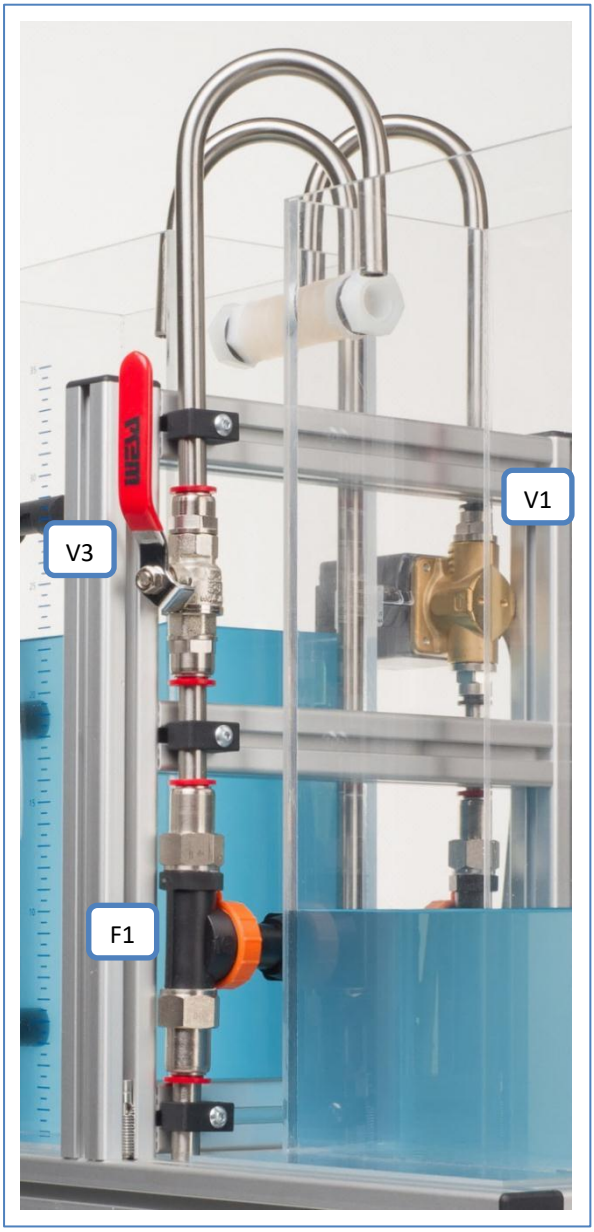

Figure 10: Flow sensor F1 and manual valve V3

The exercise is to control the flow rate from tank 1 to tank 2 using the rotational speed of pump M3. The flow rate is detected above pump M3. The flow control is influenced by the signal *FC1* when pump M3 is running. The analog signal of the flow rate is provided at socket *F1* in a range of 0..10V DC for 0.2 ... 6L/min.

By closing the valve, the flow rate can be varied.

FLOW RATE CONTROL F2

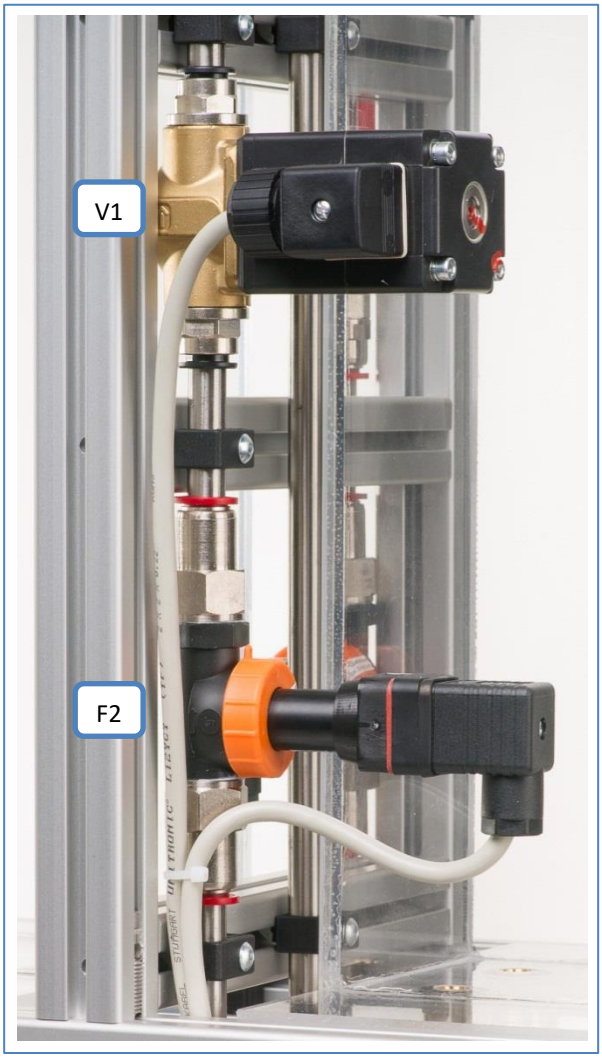

Figure 11: Flow rate sensor F2 und control valve V1

In this flow control the flow rate is adjusted using control valve V1. The sensor is located above pump M1. The flow rate is detected as a 0…10V for 5.5 … 10 L/minDC signal and provided at socket F2.

PRESSURE CONTROL

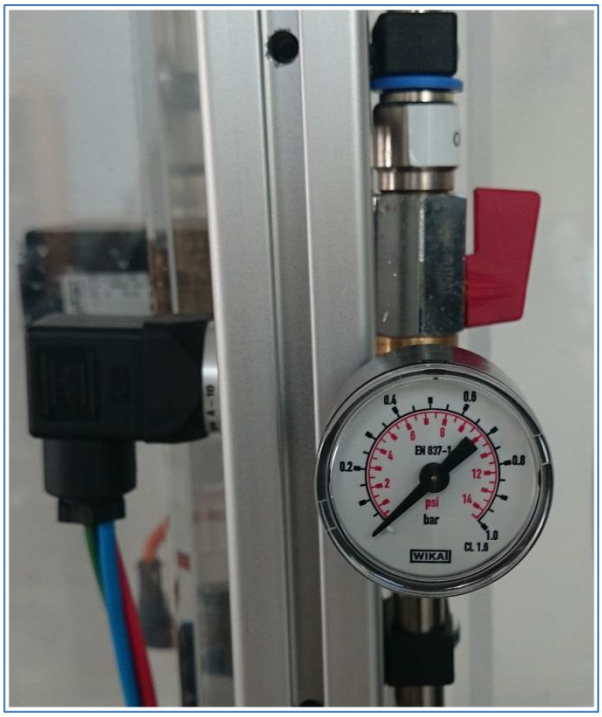

Figure 12: Manometer and pressure sensor

The goal is to control the pressure in the pipe above pump M3. The pressure control consists of a manual valve, a manometer and the sensor. The signal is detected with a 4-20mA sensor, which is converted into 2-10V and provided at socket P1.

Pump M3 is used for the pressure control. A maximum pressure of 0.4bar is possible.

VALVE 4 (V4)

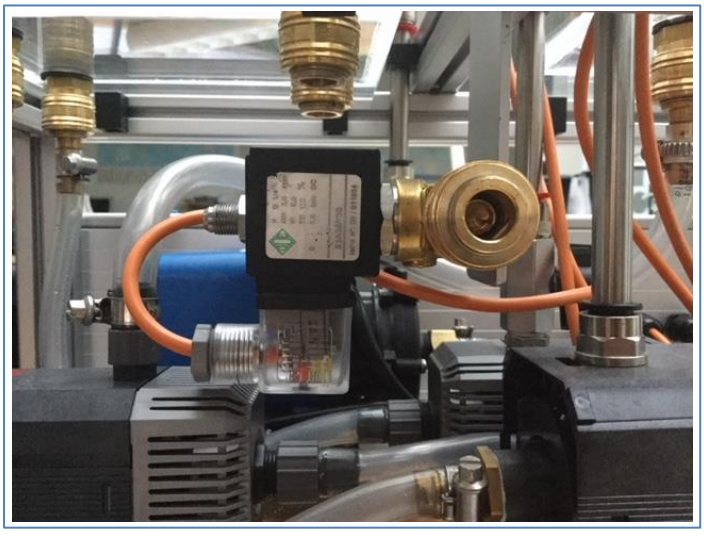

Figure 13 Valve 4

With valve 4 you can run the container B1 empty.

Valve 4 (V4) is installed behind the M3 pump.

Behind the valve there is a quick coupling on which you have to plug the drain hose if you want to empty the container B1 via the valve.

To drain faster, you can close the valve behind the pressure gauge, open V4 and turn on the M3 pump.

You can open the valve via the binary output Y1 (24V).

TEMPERATURE CONTROL

The task is to control the temperature in tank 1 using the heating rod. The analog signal of the temperature is detected by the Pt100 and provided at socket *T1* in a range of 0..10V DC for -30.0 ... 70.0°C. If the sensor is not connected a disturbance signal of 22.5V is transmitted.

The heating rod has to be connected to the 230V socket at the left side of the control panel (Figure 2), the Pt100 thermometer to the socket „*Temp*.“ on the top of the control panel as shown in Figure 8.

To prevent damage to the heating rod and the workstation, it is only possible to switch on the heater, when the water level in tank 1 is above B2. All level switches need to be connected. If the level is dropping the heating rod will automatically be turned off.

Switch on the pump M4 to mix the water in tank 1. This ensures an equal temperature distribution in the tank.

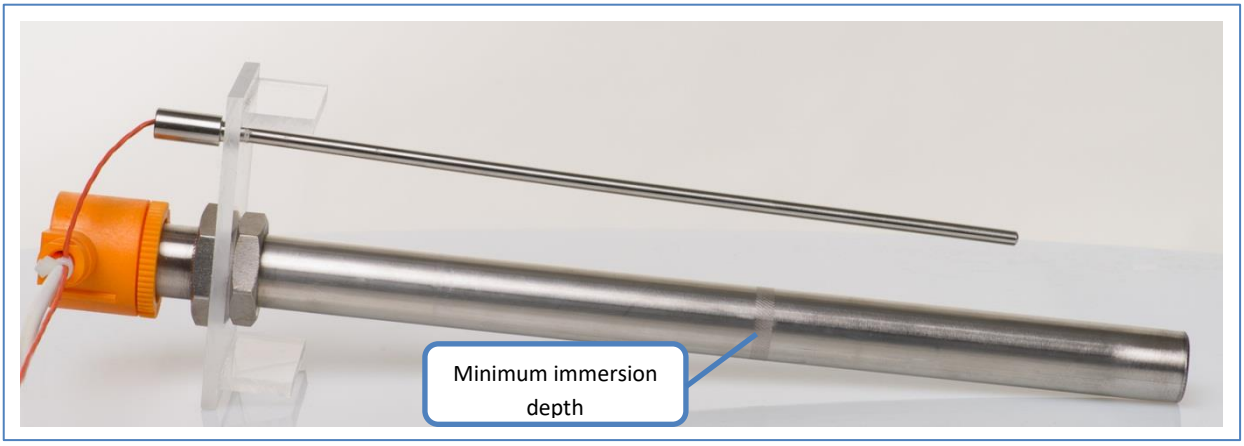

Figure 14: Heating rod with Pt100-thermometer

DESCRIPTION OF THE CONTROL PANEL

The workstation's control panel (Figure 15) provides all signals for level, flow rate, temperature and level switches, it is possible to control the pumps and the heater. On the control panel are also switches and lamps that can be used for various tasks (e.g. traffic light).

The control panel also provides a 24V DC supply for process hardware (e.g. I/O boards 4488 and 8816).

The analog signals level, flow rate and temperature are provided as 0(2)...10V DC on top of the control panel, the control signal for the pump M3 also has to be in a range of 0...10V DC.

The heating rod socket , the power inlet and the main switch can be found on the left side of the control panel. There is a fuse inside the power switch, in case of damage it has to be replaced by a 250VAC 6.3A medium time lag fuse (20mm x 5mm).

Figure 15 Control panel lid

SENSOR CONNECTIONS

Connector for B1, B2, B3:	M8-Socket
Pt100-Thermometer connector:	M12-Sensor plug
Connector for signals:	4mm-Sockets

LAMPS

These lamps can be used for different tasks: e.g. to show a status or alarms. The lamps need a 24V DC input signal, which has to be connected to the socket.

LAMPS		
LAMP1	Red LED	24V DC
LAMP2	Yellow LED	24V DC
LAMP3	Green LED	24V DC

SWITCHES

By operation of the switches 24V DC are provided on the corresponding socket. Connect the sockets directly to the pumps, lamps or the heating rod with a 4mm-banana-plug.

SWITCHES		
HS1	Standard switch, 24V DC	24V DC
HS2	Standard switch, 24V DC	24V DC
HS3	Standard switch, 24V DC	24V DC
HS4	Push button, 24V DC	24V DC
HS5	Push button, 24V DC	24VDC

BINARY SIGNALS (DIGITAL)

There are three binary (24V DC) signals (empty, medium/heater minimum and full) and an analogue 2...10V DC signal to give information about the water level in tank 1.

Furthermore pumps and heating rod are switched on here.

Binary Inputs		
B1	Level switch, signal „tank 1 full“	24V DC
B2	Level switch, signal „minimum water level for use of heating rod“	24V DC
B3	Level switch, signal „tank 1 empty“	24V DC

Binary Outputs		
M1	Pump M1	24V DC
M2	Pump M2	24V DC
M3	Pump M3	24V DC
M4	Pump M4	24V DC
TC1	Heating rod	24VDC

Pump M4 is a circulation pump for tank 1. This pump should be turned on while temperature control is active.

TC1 switches on the heating rod (if the level is above level switch B2). The heating rod must be immersed a least to the marking (Figure 14).

ANALOGUE SIGNALS

Here all analogue signals may be connected to further hardware.

Analogue inputs			
L1	Level	2…10V DC	0…45 cm
F1	Flow rate M3	0…10V DC	0.2…6 L/min
F2	Flow rate M1	0…10V DC	0.5…10 L/min
T1	Temperature	0…10V DC	-30…70 °C
P1	Pressure	2…10V DC	0…1bar

Analogue outputs			
FC1	Controller Output pump M3	0…10V DC	0…100%
FC2	Controller Output control valve V1	0…10V DC	0…100 %

Information for signal range in WinErs:

The pressure/level sensor provides a 4...20mA signal for a level of 0...40mbar/0...45cm. This signal is converted to a 2...10V DC signal. For exact level information an individual calibration is necessary.

The 0...10V DC temperature signal corresponds to a range from -30 to 70 °C.

The 0...10V DC flow rate signal F1 corresponds to a range from 0.0 to 6.0 L/min. The 0...10V DC flow rate signal F2 corresponds to a range from 0.0 to 2.0 L/min.

N.B.: Due to technical requirements a minmum flow rate for M3 is necessary. The consequence is, that the flow rate is not influenced in the lower range of the signal FC1, even at 0V DC.

VOLTAGE SUPPLY (E.G. FOR CONNECTION OF PROCESS INTERFACE ELECTRONIC)

Spannungsversorgung		
24V	Positive pole	24V DC
GND	Reference Potential, Ground	0V DC

CONNEXTION COOLER FOR TEMPEARTURE CONTROL

Figure 16 Cooling unit for LC2030

The cooler can optionally be used in the temperature control to cool the temperature of the water more quickly. It has a quick coupling and a hose which can be plugged into a quick coupling. The cooler is installed as shown in Fig. 1 (R & I flow chart) in the circuit of pump M4. In addition, the two built-in fans can be switched on by connecting 24V to the two sockets.

Pull the hose from the inlet of the M4 pump out of the quick coupling.

Figure 17 Hose for connecting the cooler

Insert the hose into the quick coupling of the cooler and the hose on the radiator into the free quick coupling on the container.

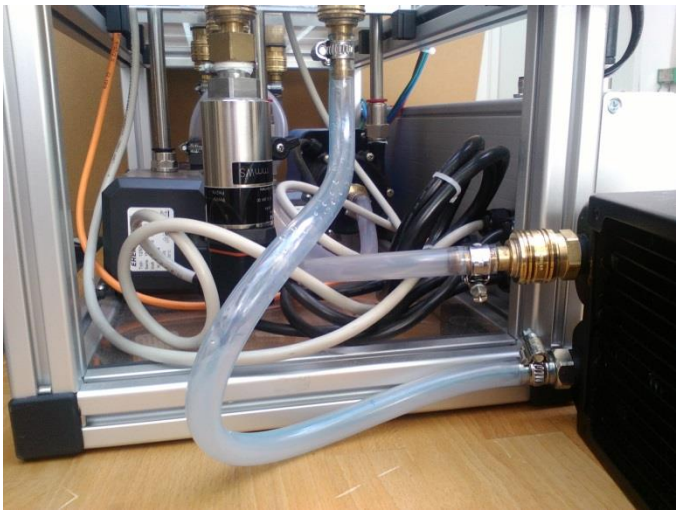

Figure 18 Physical connection of the cooler

You can use the fans for example by means of the HS1 switch, if you extend the jacks of the cooler with laboratory cables and connect the ground cable to the ground of the control panel and the 24V cable to the socket below the switch HS1. By pressing HS1, you can then switch the coolers on and off

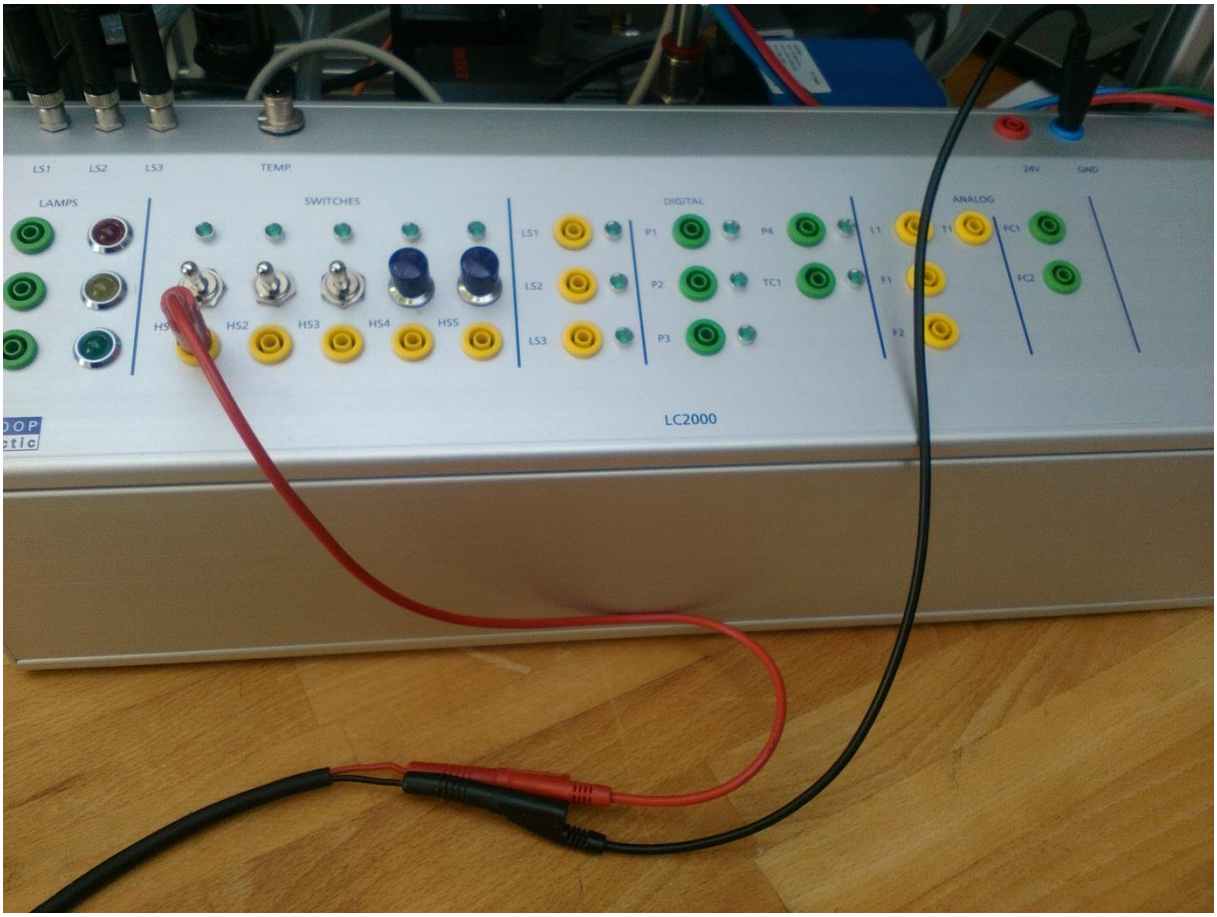

Figure 19 Electrical connection of the cooler

EMPTY WORKSTATION

To drain the water from the workstation, use the water hose in one of the hose couplings.

REPLACING THE FUSE

The fuse is situated inside the power switch, in case of damage it has to be replaced by a 250VAC 6.3A medium time lag fuse (20mm x 5mm).

Disconnect the power supply cable. Open the fuse cover carefully and exchange the fuse, then close the cover.

SOFTWARE LC2030-TRAINING, CONNECTING WORKSTATION - SOFTWARE

The I/O-Box 4488 is normally used to connect the LC2030 training software with the LC2030 practical training system.

For special applications, the software can also be connected to the system via other hardware interfaces. Please contact the manufacturer.

I/O BOARD 6288

The I/O Board 6288 is connected via USB. The necessary driver is automatically installed with LC2030-Training and WinErs laboratory version.

There are 8x binary inputs (24V), 8x binary outputs (24V), 6x analog inputs (0-10V) and 2x analog outputs (0-10V).

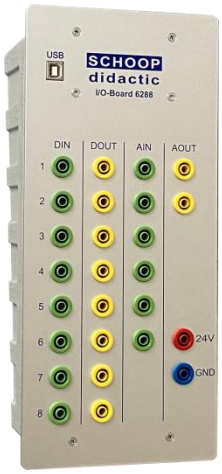

Figure 20 I/O Board 6288

I/O BOARD 8488

Beckhoff modules (Beckhoff) are installed on the I/O box 4488 for reading and outputting the signals and for communicating with the PC

There are 8x binary inputs (24V), 8x binary outputs (24V), 8x analog inputs (0-10V) and 4x analog outputs (0-10V).

The I/O box is connected to the PC via ethernet cable. On the box, the BK9050 bus coupler is available via which the connection is established. The TCP/IP Modbus protocol is used for communication. The PC connection can be established via fixed IP address, a DHCP server or a TCP Modbus gateway (Schoop company).

Figure 21 IO board 8488

CONNECTION VIA FIXED IP ADRESS (STANDARD)

The BK9050 bus coupler of the 8488 I/O board is set to the address 172.16.17.1 and the subnet mask 255.255.0.0. For communication with the PC, the IP address of the PC must be set to 172.16.17.2 or higher and the subnet mask to 255.255.0.0.

The I/O selection in the LC2030 training course software is set to I/O 8488 and a fixed IP address.

The two blue DIP switches on the bus coupler must be set to off (0) (Figure 22).

Figure 22 Bus controller BK9050

CONNECTION VIA FIXED IP ADRESS (MANUAL)

If you want to work with a different IP address, you must change the IP address in the I/O board and adapt the driver of the LC2030 Training software.

The procedure for this is described in the LC2030 Training Help.

CONNECTION VIA DHCP

For address setting via a DHCP server, blue DIP switch 1 must be set to off (0) and blue DIP switch 2 to on (1). Only the first of the red DIP switches may be set to on (1). This automatically gives the bus coupler the name BK9050-1, with the 1 resulting from the address selector switches 1 to 8 of the BK9050.

The LC2030-Training software is set (I/O selection) in such a way that it communicates with the I/O board with the settings specified above (IP address, number of signals).

If you want to change from DHCP to fixed IP or vice versa, you can use the blue DIP switch no. 2 on the bus coupler (Figure 22). Disconnect the device from the power supply and set the DIP switch to the desired position. Restore the power supply. Wait until the LEDs stop flashing. Disconnect the power supply and restore it after a short wait.

CONNECTION VIA GATEWAY

The I/O Board 8488 can also be used via an additional gateway. The gateway is a hardware module that can be integrated into an existing network with multiple operator stations (LC2030 Training software). The gateway regulates the rights for the system. The blue DIP switch no. 2 on the bus coupler must be set to off (Figure 22).

SIGNAL ASSIGNMENT TO IO/BOARDS 6288 AND 8488

I/O-Board	LC2030	Signal description
Analogue Inputs		
AIN1	L1	Level
AIN2	F1	Temperature
AIN3	F2	Flow rate, control pump
AIN4	T1	Flow rate, control valve
AIN5	P1	Pressure, control pump
AIN6	/	Free
Analogue Outputs		
AOUT1	FC1	Controller Output for pump M3
AOUT2	FC2	Controller Output for control valve
AOUT3	/	Free
AOUT4	/	Free
Binary Inputs		
DIN1	B1	Upper level switch
DIN2	B2	Mid level switch
DIN3	B3	Lower level switch
DIN4	HS1	Standard switch HS1
DIN5	HS2	Standard switch HS2
DIN6	HS3	Standard switch HS3
DIN7	HS4	Push button HS4
DIN8	HS5	Push button HS5
Binary Outputs		
DOUT1	M1	Pump 1
DOUT2	M2	Pump 2
DOUT3	M3	Pump 3
DOUT4	M4	Pump 4, Circulating pump
DOUT5	TC1	Heating rod
DOUT6	LAMP1	Lamp 1
DOUT7	LAMP2	Lamp 2
DOUT8	LAMP3	Lamp 3

OPERATION WITH CC-BOARD

The CC board can be connected to the system instead of the I/O board. It is used for manual operation and monitoring of the system.

Abbildung 1 CC-Board 1122

The CC-Board has

- A voltage display with associated analog input,
- A potentiometer connected to an analog output
- Two binary inputs with status LEDs,
- Two binary outputs, one with switch, one with button,
- A voltage connection consisting of 24V connection and ground.

First, the voltage connection is connected to the power supply of the system via the red 24V and the blue GND socket.

Subsequently, the binary inputs of the system can be tested. The switch or button can be connected to the LEDs P1, P2 and P3 or to the pumps M1 to M4 and the heating element TC1 (Attention, the heating element has 100% power and it continues heating when it has been switched off. The temperature should not exceed 40°C, the heating element only works when the float switch B2 is closed).

The binary inputs can be connected to the switches and buttons of the system (HS1 to HS5) or the float switches (B1 to B3). The status on/off is indicated by the LEDs. Via the potentiometer (analog output) the speed of the pump or the valve position can be controlled (FC1, FC2).

With the help of the voltage display, the sensors for level (L1), temperature (T1), flow (F1 and F2) and pressure (P1) can be read. The displayed voltage can be converted into the physical value of the sensor. For this, the 2-10V output signal must be converted to the sensor.

	Description	Range
L1	Level	0.0 – 40.0 cm
F1	Flow rate at adjustable pump	0.0 – 10.0 L/min
F2	Flow rate at adjustable valve	0.0 – 10.0 L/min
T1	Temperature	-30.0 – 70.0 °C
P1	Pressure	0.0 – 0.6 bar

WATER FILTER, ALGAE FORMATION , CLEANING

You should use soft water or deionised water. The quality of the water can be improved by first filtering it through a water filter (available at the drugstore, e.g. Brita Marella water filter). The main task of a table-top water filter is to reduce carbonate hardness (lime) and filter suspended solids. In addition, odour- and taste-impairing substances such as chlorine and heavy metals such as lead and copper, which may occur in the home, are reduced.

A hygiene cleaner can be used against algae formation (available at the drugstore, e.g. "DanKlorix"). The monthly dosage is between 1-2 ml per container.

The cover made of imitation leather (order no. LC2030-AH) available for the LC2030 practical course unit is also effective against algae formation and soiling.

The water should be removed from the unit if the unit is not used for a longer period of time. For this purpose, the hoses can be disconnected and emptied using the hand couplings on the containers.

Simply use a damp cloth to clean the containers.

TECHNICAL DATA, MANUFACTURER / DISTRIBUTER:

Dimension	
Width	530 mm
Height	720 mm
Depth	450 mm

Weight: ca. 26,0 kg

Operating Voltage: 230V AC

MANUFACTURER / DISTRIBUTOR:

Manufacturer / Distributor:

Ingenieurbüro Dr.-Ing. Schoop GmbH
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