



Operation manual

Variocool NRTL process thermostats

VC 1200 NRTL, VC 1200 W NRTL, VC 2000 NRTL, VC 2000 W NRTL, VC 5000 NRTL, VC 5000 W NRTL,
VC 10000 NRTL, VC 10000 W NRTL

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Translation of the original operation manual

Q5WT-E.13-002, 4, en_US 08/10/2023 © LAUDA 2023

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1 Safety

1.1 Safety notices



IMPORTANT

- Before using the device, please read the operating manual carefully.
- The information in this operating manual must be kept close at hand in the immediate vicinity of the device.
- Save the operating manual for later reference.
- This operating manual is part of the device. If the device is passed on, the operating manual must be kept with it.
- The operating manual is available on our homepage (www.lauda.de).



An overview of authorized personnel and protective equipment can be found in ↪ Chapter 1.12 "Personnel qualification" on page 12 and ↪ Chapter 1.13 "Personal protective equipment" on page 12.



Refer to ↪ Chapter 1.15 "Structure of warnings" on page 14 for more information on the general structure of warnings.

The "Safe State" of the constant temperature equipment in the event of overtemperature, low level or failure is defined as:

- Heating off.

Safety notices

- The devices can only be operated as intended under the conditions specified in this operating manual. Any other mode of operation is considered to be unintended use and could compromise the protection provided by the device.
- You, the user, must check the functionality of the safety fittings of the device. Observe the maintenance intervals.
- Transport the device carefully. The device must never be tilted or turned upside down.
- The device and the inside of the device could be damaged:
 - due to fall,
 - due to shock.
- The device may only be operated by trained personnel.
- Never put the device into operation if:
 - it is damaged,
 - it is leaking (for example, heat transfer liquid is escaping),
 - the mains cable and/or other cables are damaged.
- Do not install the device in areas with aggressive media.
- The installation surface must be sealed, level, non-slip and non-flammable. Do not place a table-top device on table edges.
- Keep the specified distance from other devices, objects or walls.
- Protect the device from dripping water or condensation.
- Do not store any liquids or flammable objects above the device.
- Do not handle flammable liquids in the immediate vicinity of the device.

- Do not place heavy parts on the device.
- The devices are intended for operation on grounded networks. Operation on IT networks, for example, is not permitted.
- Switch off the device and pull out the mains plug,
 - before starting service or repair work,
 - when moving the device,
 - when installing or removing interface modules or accessories.
- Do not operate the device without heat transfer liquid.
- Only skilled personnel are permitted to perform service and repair work.
- Drain the device completely before moving it.
- Do not make any technical modifications to the device.
- The devices are not designed for use in medical applications in accordance with DIN EN 60601-1 and IEC 601-1!
- Only connect hydraulically closed applications to the device.
- In pressure-sensitive applications (e.g. glass apparatus) with a maximum permissible working pressure below the maximum pressure of the device pump, a pressure relief device must be installed to protect against gage pressure.
- Parts of the device (e.g. pump, drain connectors) can assume surface temperatures of over 70°C at higher operating temperatures (possible risk of burns).
- After a power failure or when the device is switched off, parts of the device may become hotter for a short time.
- Use suitable hoses.
- Use hose clips to prevent the hoses from slipping off the hose nozzle.
- Check the hoses from time to time for possible material fatigue.
- Hoses containing hot heat transfer liquid and other hot parts may not come into contact with the mains cable.
- Do not operate the device if leaks have been detected. Ventilate the installation room immediately.
- The following actions may unintentionally restart the thermostat from standby,
 - previously activated timer operation,
 - 'Start' command over active interfaces on the device.
- Observe the permissible storage and operating temperatures of the device.
- The device may not be exposed to fire.
- The device may only be operated with the casing mounted.
- Bring the heat transfer liquid to room temperature before draining.
- When switching to another heat transfer liquid, clean the device intensively and empty it completely. We recommended that you flush out the device with the new heat transfer liquid.
- The penetration of secondary liquids into the device (e.g., through a defective heat exchanger provided by the customer) absolutely must be prevented.
- Observe all product safety labels/safety marks on the device.

Additional safety information for water-cooled devices

- Use suitable cooling water to prevent corrosion in the cooling water circuit.
- Secure the water cooling return hose in the outlet area to prevent the hose from jerking suddenly, even when pressure surges occur.

- Secure the water cooling return hose in the outlet area in such a way that hot cooling water cannot spray out.
- Avoid bending or squeezing the return hose of the water cooling system. Gage pressure can cause the cooling water hoses to rupture and hot cooling water to escape.
- In order to avoid damage caused by leakage of the cooling water system, it is recommended to install a leakage water detector with water shut-off.

Additional safety notices for process thermostats with water cooling

- Process thermostats with a cooling water connection (type W) always require a cooling water supply, even if the devices are only used for heating.

1.2 Testing in accordance with the Industrial Safety and Health Ordinance

Obligations of the operator

The national regulations for operation applicable in the country in which the system is installed must be complied with. In particular, the application of statutory regulations concerning operational safety must be observed.

1.3 EMC requirements

Table 1: Classification in accordance with EMC requirements

Device	Immunity requirements	Emissions class	Customer power supply
Variocool NRTL process thermostats	Table 2 in accordance with DIN EN 61326-1 (Industry)	Emissions Class B in accordance with CISPR 11	Only for EU Domestic connection value ≥ 100 A
Variocool NRTL process thermostats	Table 2 in accordance with DIN EN 61326-1 (Industry)	Emissions Class B in accordance with CISPR 11	Rest of the world (outside EU) No limitation

Instructions for Class A digital device, USA

"This equipment has been tested and found to comply with the limits for Class A digital device, pursuant to Part 15 of the FCC (Federal Communication Commission) Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense."

Instructions for Class A digital device, Canada

"This Class A digital apparatus complies with Canadian ICES-003" (ICES = Interference Causing Equipment Standards).

« Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada ».

1.4 Software versions

This operating manual is valid for devices with the following software versions or higher.

Software	Valid from version
Control system	1.39
Cooling system	1.19
Heating	1.16

1.5 Observing additional operating instructions

Interface modules

Additional interface modules can be fitted to the device. Before installing and using interface modules, always read and observe the operating manual accompanying the relevant interface module.

1.6 Limits of the device

1.6.1 Application limits

Intended use

- The process thermostat may only be used for the temperature control and circulation of non-flammable heat transfer liquid through a closed circuit. The heat transfer liquid is pumped through a hose to the external, closed application, where the heat energy is transferred. The heat transfer liquid then flows through a hose and back into the thermostat. A list of heat transfer liquids and hoses approved by LAUDA is included in this operating manual.

Reasonably foreseeable improper use

- Operation without heat transfer liquid
- Operation with heat transfer liquids, hoses or refrigerants other than those specified in the operating manual
- Operation with a glass reactor without gage pressure protection
- Operation in a non-closed hydraulic circuit
- Operation in a potentially explosive atmosphere
- Outdoor operation
- Connecting hoses incorrectly
- Setting an incorrect pump pressure
- Use for controlling the temperature of foodstuffs
- Use as a medical device

Type of energy supply

- Electrical energy (each device)
- Cooling water (required for water-cooled process thermostat)

Performance limits, operating values

- See ↪ Chapter 12 “Technical data” on page 114

1.6.2 Environmental and operating conditions

The device may only be used in the following areas:

- Production, quality assurance, research and development in an industrial environment
- Only used inside buildings
- Use up to a height of 2,000 m above sea level
- Ambient temperature from 5°C to 40°C

- Maximum relative humidity 80% at an ambient temperature of 31°C, relative humidity linearly decreasing to 50% at 40°C
- Fluctuations of the mains voltage up to $\pm 10\%$ of the nominal voltage
- Surge category II

1.6.3 Time limits

Service life	- The service life of the device is 10 years.
Maintenance intervals	- See ↗ Chapter 7.1 “Maintenance intervals” on page 98
Maximum operating time without interruption	- The device is designed for unattended continuous operation.

1.7 Prohibition of modifications to the device

Any technical modification of the device by the user is prohibited. Any damage resulting from unauthorized modification is not covered by customer service or the product warranty. Service work may only be performed by the LAUDA Service department or a service partner authorized by LAUDA.

1.8 Materials

All parts that come into contact with heat transfer liquid are manufactured from high-quality materials adapted to withstand the operating temperature. High-quality stainless steels, copper, brass and premium-quality heat-resistant plastics are used.

1.9 Fluorinated refrigerant

Refrigeration process thermostats are operated with fluorinated refrigerants. The designation and refrigerant charge are specified on the type plate.

1.10 Heat transfer liquid requirements

- Heat transfer liquids are used to control the temperature. Only LAUDA heat transfer liquids are approved for use in the device. LAUDA heat transfer liquids are liquids that have been tested and approved by LAUDA DR. R. WOBSER GMBH & CO. KG.
- The heat transfer liquids are suitable for a specific temperature range. This temperature range must correspond with the temperature range of your application.
- The use of heat transfer liquids poses a risk of injury from high and low temperatures if certain upper or lower temperature thresholds are exceeded.
- Risks in handling the heat transfer liquid are specified in the safety datasheet together with corresponding safety measures. The safety datasheet of the heat transfer liquid must therefore be observed in order to use the device as intended.

1.11 Hose requirements

The

- temperature,
- pressure and
- media resistance of the hoses must be suitable for the respective application.

Refer to Chapter ↗ Chapter 4.2 “Hoses” on page 23 for information on recommended hoses.

1.12 Personnel qualification

Operating personnel

Operating personnel are personnel who have been instructed on how to use the device as intended in line with the information in the operating manual.

Specialized personnel

Certain activities on the device must be performed by specialized personnel. Specialized personnel are personnel whose education, knowledge, and experience qualify them to assess the function and risks associated with the device and its use.

Always read the operating manual before operating the device.

1.13 Personal protective equipment



Protective gloves

Protective gloves must be worn for certain tasks. The protective gloves must comply with the standard DIN EN 374. The protective gloves must be chemically resistant.



Protective work clothing

Protective clothing must be worn for certain tasks. This protective clothing must meet the legal requirements for personal protective equipment. Protective clothing with long sleeves must be worn. Additionally safety shoes are required.



Safety glasses

Safety glasses must be worn for certain tasks. The safety glasses must comply with the standard DIN EN 166. The glasses must be tightly closed and equipped with side plates.

1.14 Safety fittings on the device

1.14.1 Overtemperature protection

The overtemperature protection is a safety fitting that prevents damage due to excessively high temperatures. All safety-related components on the device are shut down to prevent fire from posing a danger to the device and environment. An alarm signal also indicates that the overtemperature protection has been activated. The temperature at which the safety fitting triggers is fixed and cannot be changed.

1.14.2 Low-level protection

The low-level protection is a safety fitting that prevents damage to the device. If the heat transfer liquid level in the device falls below a specified level, a warning is issued initially. If the level drops further, an alarm is triggered and all safety-related components of the device are switched off.

Check the function of the low-level protection before using the device in extended, unattended continuous operation.

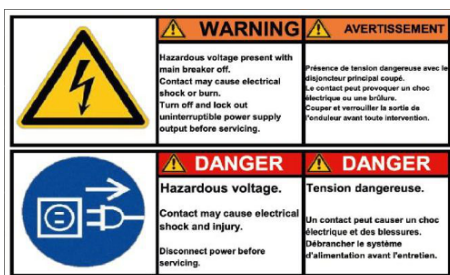
1.14.3 Product safety label

Hot



A "Hot surface" graphical symbol is affixed to the device. This symbol warns against hot surfaces on the device. These surfaces must not be touched during operation. These surfaces must be allowed to cool to room temperature before they can be touched during other operation phases such as servicing.

Parts that remain live after the main switch is turned off




Some components on the device remain live after the main switch is turned off. Before starting any service work, turn off the device at the main switch, secure against reactivation and disconnect from the power supply.

1.15 Structure of warnings


Dangerous

- A warning of "dangerous" indicates an **immediately dangerous** situation.
- If this warning is not observed, then **death** or **severe, irreversible injury** could occur.

 DANGER! Type and source	
	Consequences of not following instructions
	<ul style="list-style-type: none">● Measure 1● Measure...


Warning

- A warning of "warning" indicates a **possibly dangerous** situation.
- If this warning is not observed, then **death** or **severe, irreversible injury** could occur.

 WARNING! Type and source	
	Consequences of not following instructions
	<ul style="list-style-type: none">● Measure 1● Measure...


Caution

- A warning of "caution" indicates a **possibly dangerous** situation.
- If this warning is not observed, then **minor, reversible injury** could occur.

 CAUTION! Type and source	
	Consequences of not following instructions
	<ul style="list-style-type: none">● Measure 1● Measure...

Notice

A "notice" warns that dangers to property or the environment may exist.

 NOTICE! Type and source	
	Consequences of not following instructions
	<ul style="list-style-type: none">● Measure 1● Measure...

2 Unpacking



DANGER!
Transport damage

Electric shock

- Closely inspect the device for transport damage prior to commissioning!
- Never operate a device that has sustained transport damage!

Personnel: Operating personnel

Unpacking VC 1200 (W) NRTL and VC 2000 (W) NRTL

1. Unpack the device.



Keep the original packaging of the device for subsequent transportation.

2. Check the device and accessories for completeness and transport damage immediately after delivery.



If the device or accessories are damaged contrary to expectations, immediately inform the shipping company so that a damage report can be compiled and the transport damage inspected. Also notify the LAUDA Service department immediately. You will find the contact information here ↪ Chapter 11.5 “Contact LAUDA” on page 113.

Unpacking VC 5000 (W) NRTL and VC 10000 (W) NRTL

1. Remove the tightening straps.
2. Remove the cover (ramp).
3. Remove the protective carton.
4. Read and follow the instructions for unpacking and packing (LAUDA document number Q4DT-VT01-002).



Keep the original packaging of the device for subsequent transportation.

5. Check the device and accessories for completeness and transport damage immediately after delivery.



If the device or accessories are damaged contrary to expectations, immediately inform the shipping company so that a damage report can be compiled and the transport damage inspected. Also notify the LAUDA Service department immediately. You will find the contact information here ↪ Chapter 11.5 “Contact LAUDA” on page 113.

Table 2: Accessories included as standard

Device type	Designation	Quantity	Catalog number
	Mains cable (for devices with single-phase power supply)	1	
	Mains cable (for devices with three-phase power supply)	1	
VC 1200 (W) NRTL through VC 5000 (W) NRTL	Thermostatic circuit hose fittings (¾" hose nozzle with ¾" union nut)	2	EOA 004
VC 10000 (W) NRTL	Thermostatic circuit hose fittings (1" hose nozzle with 1¼ union nut")	2	EOA 003
Devices with water cooling	Cooling water circuit hose fittings (½" hose nozzle with ¾" screw cap)	2	EOA 001
All devices	Operating manual	1	--
All devices	Instructions for unpacking and packing	1	--

3 Device description

3.1 Structure

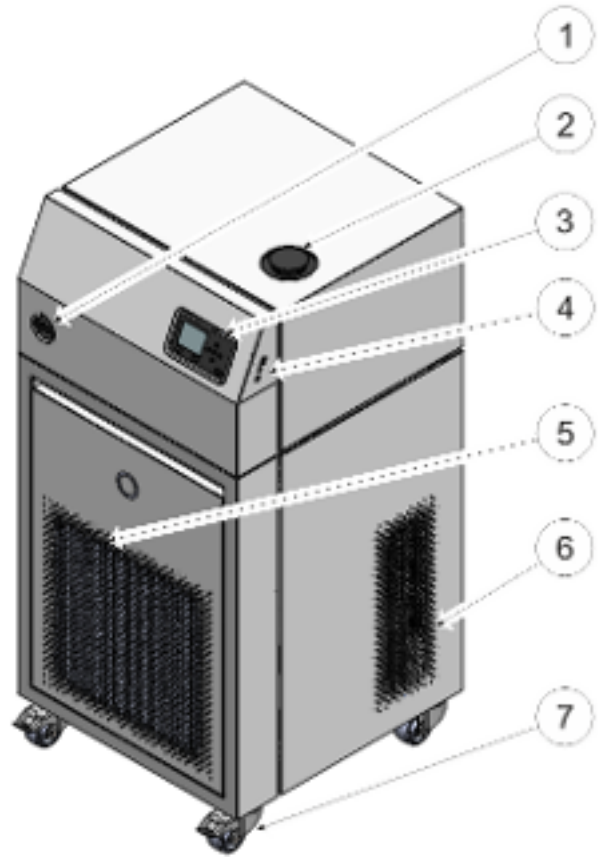


Fig. 1: VC 10000 NRTL

- 1 Mains switch
- 2 Filler nozzle with cover
- 3 Control panel
- 4 Interfaces
- 5 Front panel (ventilation openings only in case of air-cooled devices)
- 6 Ventilation openings (on both sides)
- 7 Four castors (front castors with locking brake)

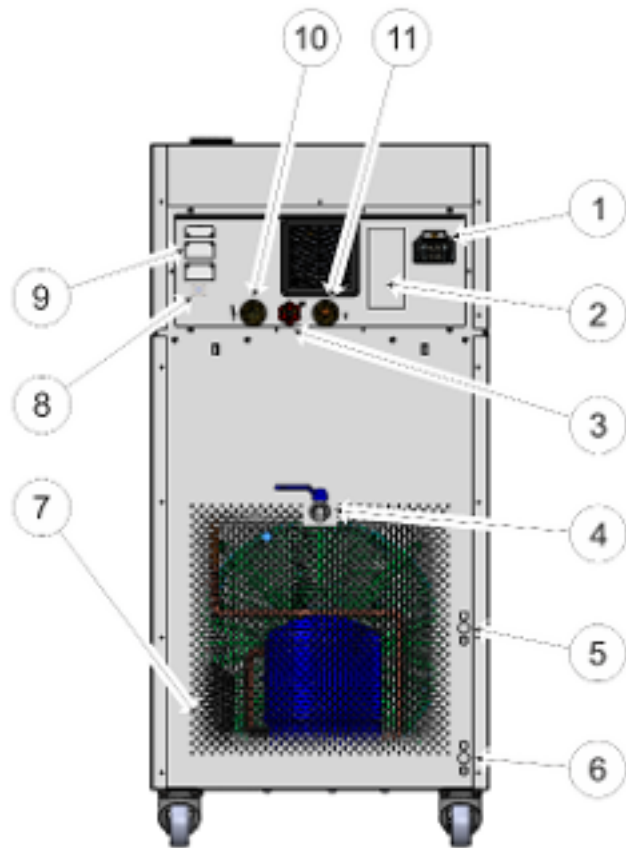


Fig. 2: Rear side of VC 10000 NRTL

- 1 Power supply
- 2 Type plate
- 3 Bypass adjusting wheel
- 4 Drain tap
- 5 Connecting sleeve for cooling water outlet (only available for water-cooled devices)
- 6 Connecting sleeve for cooling water inlet (only available for water-cooled devices)
- 7 Ventilation grid
- 8 Alarm output (interface 12N)
- 9 Module bays
- 10 Thermostatic circuit connecting sleeve at pressure side (outflow)
- 11 Thermostatic circuit connecting sleeve at inflow

3.2 Mains switch

The devices have a mains switch on the left side. This is designed either as a toggle switch or as a rotary switch. Position [0] switches the device off, position [I] switches it on.



Mains switch for single-phase devices

The toggle switch is also designed as a safety switch. If the current is too high, the toggle switch trips and disconnects the device from the mains supply. The device can be used again by switching the toggle switch to position [1]. If the safety switch trips again, contact the LAUDA Service department.



Mains switch for three-phase devices

The automatic fuse may only be switched on by a qualified electrician!

The rotary switch is not designed as a safety switch. The three-phase devices have a separate automatic fuse built in. If the automatic fuse trips, contact the LAUDA Service department.

3.3 Hydraulic circuit

Hydraulic circuit in Variocool NRTL

The Variocool NRTL process thermostat is a powerful device for the temperature control and circulation of heat transfer liquid with a medium active bath volume.

The powerful pressure pump in the device ensures the necessary flow. The pump always delivers the heat transfer liquid at its maximum pressure. The components of the external hydraulic circuit must be designed for this maximum pressure. If the maximum pressure of the pump must be lowered due to the use of pressure-sensitive components in the external circuit, adjust the built-in bypass accordingly.

In the event of a fault, large quantities of heat transfer liquid can flow back into the device from the external circuit. To avoid flooding the device, refer to the following section ↗ “External hydraulic circuit” on page 19.

The hydraulic circuit in the device consists of the following components:

- Bath boiler,
- Level sensor,
- Pump,
- Bypass,
- Heating unit and
- Evaporator.

External hydraulic circuit

External applications are connected to the device through hoses that are connected to the pump connectors.

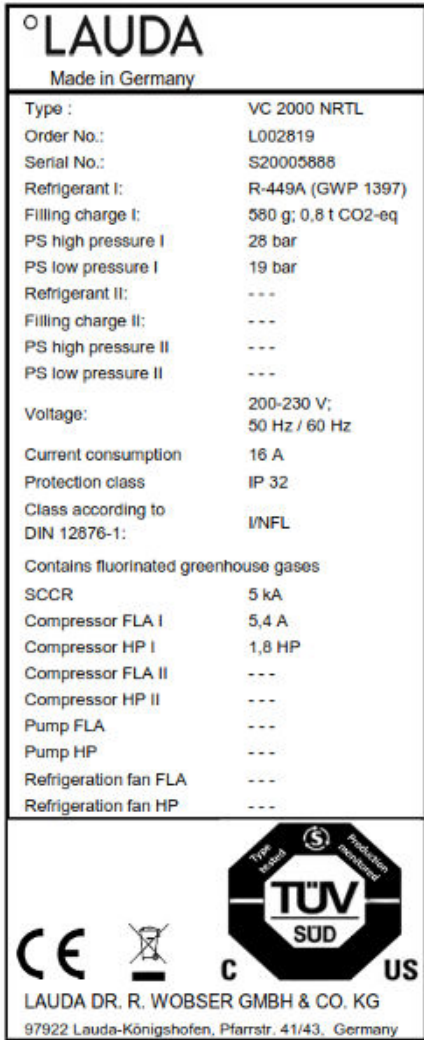
Only closed applications are compatible with Variocool NRTL devices as the pressure pump does not allow the level in the external volume to be checked.

In order not to flood the device at standstill, shut-off valves must be used for temperature control with quantities of liquid greater than the bath volume, which prevent heat transfer liquid from flowing back when the pump is stopped.

The external hydraulic circuit consists of the following components:

- hoses (minimum 1x pressure side, 1x inflow)
- external application
- shut-off valves, if necessary

3.4 Rating label



The serial number of a LAUDA device is composed as follows:

- The letter S,
- the year of manufacture (two-digit),
- and a 7-digit number, whereby the last digit represents the consecutive number of the device in the year of manufacture.

The specifications on the type plate are described in more detail in the following table. Certain specifications depend on the equipment installed.

Fig. 3: Type plate

Specification	Description
Type / Gerätetyp:	Type of the device
Order No. / Bestell Nr.:	Catalog number of the device
Serial No. / Serien Nr.:	Serial number of the device
Refrigerant / Kältemittel I:	Refrigerant used in refrigeration circuit 1 of the appliance for cooling. The global warming potential (GWP) of the refrigerant is given in brackets.
Filling charge / Füllmenge I:	Filling weight of the refrigerant and corresponding size of the CO ₂ equivalent in tonnes.
PS high pressure / Hochdruck I:	Maximum permissible working pressure on the high-pressure side of the refrigeration circuit (compression, condensation)
PS low pressure / Niederdruck I:	Maximum permissible working pressure on the low-pressure side of the refrigeration circuit (expansion, evaporation)

Specification	Description
Refrigerant / Kältemittel II:	Refrigerant used in refrigeration circuit 2 of the appliance for cooling. The global warming potential (GWP) of the refrigerant is given in brackets.
Filling charge / Füllmenge II:	Filling weight of the refrigerant and corresponding size of the CO ₂ equivalent in the second stage.
PS high pressure / Hochdruck II:	Maximum permissible working pressure on the high-pressure side of the refrigeration circuit (compression, condensation)
PS low pressure / Niederdruck II:	Maximum permissible working pressure on the low-pressure side of the refrigeration circuit (expansion, evaporation)
Voltage / Spannung:	Permissible power supply
Current consumption / Stromaufnahme:	Current consumption of the device
Protection class / Schutzart:	IP protection level of the device
Fuse / Sicherung:	Fuse used in device
Class according to DIN 12876-1:	According to DIN 12876-1, the device has the classification
SCCR (Short Circuit Current Rating):	Indicates the short circuit current according to NEC 110-10 or UL508A that the machine's components and assemblies can withstand.
Compressor FLA I:	Current consumption compressor I
Compressor HP I:	Power consumption compressor I
Compressor FLA II:	Current consumption compressor II
Compressor HP II:	Power consumption compressor II
Pump FLA:	Current consumption pump
Pump HP:	Power consumption pump
Refrigeration fan FLA:	Current consumption condenser fan
Refrigeration fan HP:	Power consumption condenser fan



In accordance with UL 1995 and CSA22.2 No236 for components of the device with a power rating of 0.75 HP or higher, the values for power- and current consumption must be specified on the type plate.

3.5 Interfaces

Standard interfaces

- **USB interface for device** (type B). Software updates (updaters) are transferred to the device through this interface (not a process interface).
- The **USB interface for the host** (type A) enables the connection of a USB stick. This interface can be used for data imports and exports and software updates (not a process interface).
- The **Ethernet interface** enables connection to a control station or a PC. The interface offers the customer the opportunity to control and monitor the temperature control processes carried out by a LAUDA interface command set (process interface).

Optional interfaces

Various interface modules can be installed in the devices.

- The **analog module** (order no. LRZ 912) has a 6-pin socket with two inputs and two outputs. The inputs and outputs can be configured as a 0 – 20 mA, 4 – 20 mA or 0 – 10 V interface independently of one another. A voltage of 20 V applied to the socket supplies power to an external sensor with electronic evaluation unit.
- The **RS 232/485 interface module** (order no. LRZ 913) is available in a 9-pin SUB-D socket design Galvanically isolated by an optocoupler. When combined with the LAUDA interface command set, the module is compatible with the ECO, Variocool, Proline, Proline Kryomat, PRO, Integral XT and Integral T product lines. The RS-232 interface can be connected directly to the control station or PC using a 1:1 contact cable.
- The **contact module** (order no. LRZ 914) is available in a plug connector design according to NAMUR NE28. This contact module is identical to LRZ 915, but only has two sockets, each with one output and one input. The coupling socket (order no. EQD 047) and the coupling connector (order no. EQS 048) have a 3-pin design.
- The **contact module** (order no. LRZ 915) is available in a 15-pin SUB-D socket design. With three relay contact outputs (changeover contacts, maximum 30 V/0.2 A) and three binary inputs for control via external potential-free contacts.
- **Profibus module** (order no. LRZ 917). Profibus is a bus system used primarily in the chemical industry, which can connect a maximum of 256 devices at a high signal transmission rate.
- **EtherCAT module** (order no. LRZ 922) with M8 connection sockets. **EtherCAT module** (order no. LRZ 923) with connection via RJ45 sockets. EtherCAT is an Ethernet-based field bus with master/slave functionality.
- **Pt100 LiBus interface module** (order no. LRZ 918 for small module bay, order no. LRZ 925 for large module bay) with a LEMO socket (10S) for an additional external Pt100 temperature probe. The LiBus socket (70S) is used to connect components via the LAUDA device bus.

Refer to the operating manual accompanying the relevant LAUDA interface module for further information on connecting and using these interfaces.

4 Before starting up

4.1 Install device



WARNING!

Rolling away or overturning of the device due to incorrect handling

Impact, crushing

- Do not tilt the device.
- Position the device on an even, non-slip surface with a sufficient load carrying capacity.
- Actuate the castor brake when setting up the device.
- Do not place heavy parts on the device.

Installation conditions

- Irritant vapors may develop during the operation of the device, depending on the heat transfer liquid and working temperature used. Always ensure that the vapors are adequately extracted.
- Note the electromagnetic compatibility (EMC) requirements of the device .
- Do not cover the ventilation openings of the device.
- Further installation conditions apply to the devices. These conditions are specified in the technical data .

Personnel: Operating personnel

1. Position the device on a suitable, even foundation.



The devices can be moved. To do this, release the locking brakes on the castors by pushing the lever upwards.

2. Lock the castors of the device. To lock, press the lever on the castor downwards.
3. For applications above 70°C, apply the "Hot surface" warning sticker in a clearly visible place.



4.2 Hoses



CAUTION!

Risk of external hydraulic circuit bursting

Scalding, cold burns

- Use hoses with a greater compressive strength than the maximum possible pump pressure.



CAUTION!
Risk of heat transfer liquid escaping due to the use of unsuitable hoses

Scalding, cold burns

- The temperature and media resistance of the hoses must be suitable for the application.



CAUTION!
Contact with hot or cold hoses

Hot and cold burns

- Use insulated hoses for temperatures below 0 °C and above 70 °C.

Please note:

- When laying the water cooling and heat transfer liquid hoses, make sure that the hoses cannot be kinked or crushed.



The hoses described below can be used for all heat transfer liquids approved for the devices.

Table 3: Hoses

Type	Device Pump connection	Required accessories (nipple and screw cap provided on device by standard)	Maximum working pressure	Clearance width x outer diameter in mm	Tem- perature range in °C	Cat. No.
EPDM hose with fabric reinforcement	VC 1200 through VC 5000 (W) G $\frac{3}{4}$ (15), nipple $\frac{3}{4}$ "	Hose nozzle with screw cap EOA 004	10 bar	19 x 27	-40 – 100	RKJ 032
EPDM hose with fabric reinforcement	VC 7000 through VC 10000 (W) G1 $\frac{1}{4}$ 1(20), nipple 1"	Hose nozzle with screw cap EOA 003	10 bar	25 x 34	-40 – 100	RKJ 033

Table 4: Hose clips

Suitable for hose	Clear Ø in mm	Cat. No.
RKJ 112, RKJ 031	12 – 22	EZS 013
RKJ 032, RKJ 033	25 – 40	EZS 016

4.3 Connecting an external application



CAUTION!
Risk of external application bursting

Scalding, cold burns

- Adjust the pump pressure with the bypass.

Please note the following:

- Temperature control hoses: Always use the largest possible diameters and shortest possible hoses in the external circuit.
If the temperature control hose diameter is too narrow or the flow rate is too low, there may be a temperature gradient between the device and the external application. In this case, adjust the temperature accordingly.
- Secure the temperature control hoses using hose clips.
- If the external application is positioned higher than the device, there is a risk that the device will overflow. If in doubt, attach a shut-off valve on the pressure side between the pump connection and the lower connection of the application.
- If using a pressure-sensitive application (such as a glass reactor), use a pressure relief device.
- Depending on the type of application, a vent valve can significantly simplify the aeration process. The vent valve must be located at the highest point of the circuit.
- If external control is used, a Pt100 probe must be installed in the external application.
- Install a dirt trap if the circuit is not free of dirt.

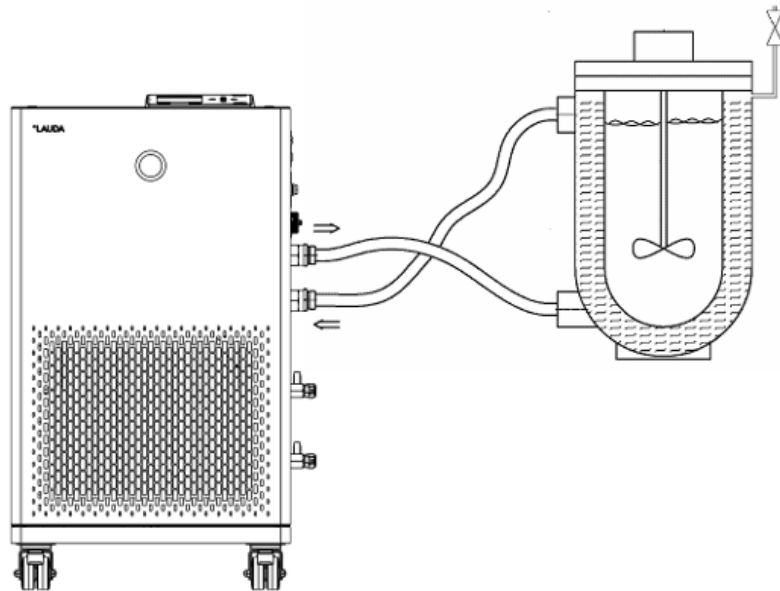


Fig. 4: Connection diagram with vent valve

The liquid must flow through the application from the bottom upward so that any gas/vapor bubbles can be removed from the system and undisturbed operation is possible. The thermostatic circuit connecting sleeve at the pressure side (outflow) must be attached to the bottom connection on the external application, and the thermostatic circuit connecting sleeve at the inflow to the top connection.

4.4 LAUDA heat transfer liquids



DANGER!
Use of unsuitable heat transfer liquid

Fire

- Select a heat transfer liquid with a temperature range suitable for the application.

Please note:

- If the heat transfer liquid reaches the lower limit of the temperature range, the temperature control properties can be expected to deteriorate as a result of the increase in viscosity. Therefore, only fully utilize this temperature range when absolutely necessary.
- Never use contaminated heat transfer liquid. Contamination in the pump housing can cause the pump to seize and the device to shut down.
- Observe the safety datasheet for the heat transfer liquid. You can request a copy of the safety datasheets at any time, if necessary.

Please note:

- When using Kryo 30:
The water content decreases during longer periods of operation at higher temperatures and the mixture becomes combustible (flash point 119°C). Check the mixing ratio using a hydrometer.
- When using Aqua 90:
Evaporation losses occur at higher temperatures.

Heat transfer liquid, water

- The proportion of alkaline earth ions in the water must be between 0.71 mmol/L and 1.42 mmol/L (equivalent of 4.0 and 8.0 °dH). Harder water leaves limescale deposits in the device.
- The pH value of the water must be between 6.0 and 8.5.
- Distilled, deionized and demineralized water are unsuitable due to their reactivity. High-purity water and distillates are suitable as a heat transfer liquid after 0.1 g of soda (Na₂CO₃, sodium carbonate) is added for every liter of water.
- Sea water is unsuitable due to its corrosive properties.
- Avoid chlorine content in the water at all costs. Do not add chlorine to the water. Cleaning agents and disinfectants, for example, contain chlorine.
- The water must be free of impurities. Water with iron content is unsuitable due to rust formation and untreated river water is unsuitable due to algae growth.
- The addition of ammonia is not permitted.

Table 5: Permissible heat transfer liquids for Variocool NRTL

Designation	Chemical characterization	Working temperature range in °C	Viscosity (kin) in mm ² /s at 20 °C	Viscosity (kin) in mm ² /s at temperature	Flash point in °C
Kryo 30	Monoethylene glycol/water mixture	-30 – 90	4	50 at -25 °C	119
Aqua 90 ¹	Decalcified water	5 – 90	1	---	---

Table 6: Heat transfer liquid order numbers

Designation	Container size		
	Cat. No.		
	5 L	10 L	20 L
Kryo 30	LZB 109	LZB 209	LZB 309
Aqua 90	LZB 120	LZB 220	LZB 320

4.5 Cooling water requirements

This section is relevant for:

- Water-cooled devices

! NOTICE!
Risk of cooling circuit leaking due to corrosion

Device damage

- Do not use corrosive cooling water.

Requirements

Cooling water is subject to specific purity requirements. A suitable procedure must be employed to purify the cooling water in line with the contamination in the water and maintain the water quality. Unsuitable cooling water may cause the condenser and the entire cooling water circuit to become blocked or damaged, or start to leak. The entire cooling circuit and cooling water circuit may sustain extensive consequential damage as a result.

- Free chlorine consisting of disinfectant, for example, and water containing chloride will cause pitting corrosion in the cooling water circuit.
- Distilled, deionized and demineralized water are unsuitable due to their reactivity and will cause corrosion in the cooling water circuit.
- Sea water is unsuitable due to its corrosive properties and will cause corrosion in the cooling water circuit.
- Iron particles and water containing iron will cause corrosion in the cooling water circuit.
- Hard water is unsuitable for cooling due to the high lime content and will lead to calcification of the cooling water circuit.
- Cooling water containing suspended matter is unsuitable.
- Untreated, unpurified water such as river water or cooling tower water is unsuitable due to its microbiological content (bacteria), which can settle inside the cooling water circuit.

Suitable cooling water quality

Data	Value	Unit
pH value	7.5 – 9.0	---
Hydrocarbonate [HCO ₃ ⁻]	70 – 300	mg/L
Chloride	< 50	mg/L
Sulfate [SO ₄ ²⁻]	< 70	mg/L
Ratio hydrogen carbonate [HCO ₃ ⁻] / sulfate [SO ₄ ²⁻]	> 1	---
Total water hardness	4.0 – 8.5	°dH
Electrical conductivity	30 – 500	µS/cm
Sulfite (SO ₃ ²⁻)	< 1	mg/L
Free chlorine gas (Cl ₂)	< 0.5	mg/L
Nitrate (NO ₃ ⁻)	< 100	mg/L
Ammonia (NH ₃)	Not permitted	---

Data	Value	Unit
Iron (Fe), dissolved	< 0.2	mg/L
Manganese (Mn), dissolved	< 0.05	mg/L
Aluminum (Al), dissolved	< 0.2	mg/L
Free aggressive carbon dioxide (CO ₂)	Not permitted	---
Hydrogen sulfide (H ₂ S)	Not permitted	---
Algae growth	Not permitted	---
Suspended matter	Not permitted	---

4.6 Connecting the cooling water

This section is relevant for:

- Water-cooled devices

Table 7: Cooling water data

Specification	Value
Maximum cooling water pressure	10 bar
Cooling water temperature	15 °C recommended, 10 to 30 °C permitted (in upper temperature range with reduced cooling output)

Please note:

- Connect the cooling water inlet and outlet according to the labeling on the device. The inlet and outlet of the cooling water supply may not be interchanged.
- The hoses used for the cooling water circuit must be suitable for the temperature range specified. Also observe the permitted hose diameter.
- Secure the hose nozzles or the coupling connectors to the hoses using hose clips.
- Secure the water cooling return hose in the outlet area to prevent the hose from jerking suddenly, even when pressure surges occur.
Secure the water cooling return hose in the outlet area in such a way that hot cooling water cannot spray out.
- Avoid kinking or crushing the hoses.
- We recommend using a leakage water detector with water shut-off function to prevent leakages from causing damage in the cooling water system.
- Only use cooling water that meets the quality requirements.
- If the condenser leaks, there is a danger that refrigerating machine oil or combustible/non-combustible refrigerant from the device's refrigerant circuit will mix with the cooling water. Observe the legal requirements and provisions of the water supply company applicable at the operation site.

4.7 Configuring interfaces



WARNING!

Touching pieces charged with voltage when installing the modules

Electric shock

- Disconnect the device before installing modules.

Personnel: Specialized personnel



Equipment connected to the low-voltage inputs and outputs must be safely insulated against dangerous contact voltages as per DIN EN 61140, for example, using double or reinforced insulation as per DIN EN 60730-1 or DIN 60950-1.



Refer to the separate operating manual accompanying the interface modules for further information on installing and operating these interface modules. Each respective operating manual must be observed in order to use the module as intended.

4.7.1 Configure potential-free contact (alarm output)

In the *Alarm output* menu, an option is always selected. The selected option is marked with a check mark. You can combine the other options.

A fault in the device can be an alarm or an error.

Table 8: Possible options

Options	Description
<i>Fault</i>	Signal transmission (e.g. for reverse flow protection, pilot lamp)
<i>Standby</i>	Switch the device to standby

Personnel: Operating personnel

1. Switch to the main menu.
2. Select the *Settings* → *Basic setting* → *Alarm output* menu item.
3. The following options are available:
 - *Fault*
 - *Standby*
4. Press the Enter key to confirm your selection.

4.7.2 Interface floating contact

- The contacts may be loaded with a maximum voltage of 30 V direct current (DC) and a maximum current of 0.2 A.

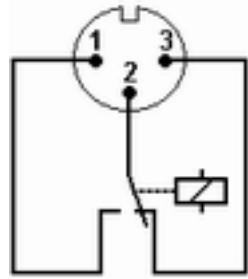


Fig. 5: Flange plug (front) in fault condition

View of the flange plug (front) or into the coupling socket on the soldering side.

Good condition

- Pin 1 and 2 are closed.
- During trouble-free operation, the alarm output is in good state.

Fault condition

- Pin 2 and 3 are closed.
- The alarm output is in fault condition:
 - If the device is switched off,
 - after switching on, if a fault (e.g. low level) is already present,
 - during operation, if a fault occurs, and
 - for each event configured in the *Alarm Output* menu.



You can find information on the settings for the alarm output in [Chapter 4.7.1](#) “Configure potential-free contact (alarm output)” on page 30.

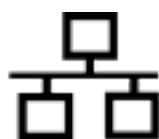
Please note the following:

- The equipment connected to the extra-low voltage inputs and outputs must be reliably isolated from voltages dangerous to the touch in accordance with DIN EN 61140. For example, by double or reinforced insulation according to DIN EN 60730-1 or DIN 60950-1.
- Only use protected connection lines. Connect the protective screen with the connector shell. Cover unused connectors with protective caps.

4.7.3 Configuring the Ethernet interface

Technical data of the Ethernet interface

Data	Value	Unit
Ethernet - standard	10/100	MBit



PC control

- The *PC control* menu item enables the device to be accessed by a PC or control station. You activate this function if you want to control or monitor the constant temperature equipment from an external control station.

Before the constant temperature equipment and control station can be operated together in a local network (LAN), the Ethernet interface must be configured.

The Ethernet interface can be configured in two different ways:

- | | |
|--|--|
| Automatically obtain LAN configuration | - In order for this to work, a DHCP server must be present in the local network (LAN). If communication is direct, the control station must support the auto IP standard. |
| Manually configure LAN configuration | - Manual configuration must be performed if a DHCP server is not available, auto IP standard is not supported or you wish to use the Ethernet interface with fixed IP addresses. |

Obtain LAN configuration automatically (DHCP client on)

1. Switch on the constant temperature equipment.
2. Press the [Enter key] to open the menu.
3. Select the menu items from *Setup* → *Basic setup* → *Ethernet* → *LAN configuration* → *DHCP client* using the cursor keys.
 - ▶ The options [Off] and [On] appear on the display.
4. Select the option [On] and press [OK] to confirm.
 - ▶ A check mark is set. The DHCP client is active. The Ethernet interface is configured automatically.
5. In the [PC control] menu, select the [on] entry.
 - ▶ A check mark is set. The control for the control station is activated.
6. If required, enter the port number in the [PC control] menu.

Specify LAN configuration manually (DHCP client off)

1. Switch on the constant temperature equipment.
2. Press the [Enter key] to open the menu.
3. Select the menu items → *Setup* → *Basic setup* → *Ethernet* → *LAN configuration* → *DHCP client*.
 - ▶ The options [Off] and [On] appear on the display.
4. Select the [Off] option and press the Enter key to confirm.
 - ▶ A check mark is set. The entry has been accepted.
5. Use the left arrow key to go back one menu level.
6. Scroll to the numerical values of the [Local IP address] menu item and press the Enter key.
 - ▶ The *Local IP address* menu opens.
7. Byte 1 is marked. Press the right arrow key.
 - ▶ The entry window opens. The area in which the numerical values can be entered is displayed.
8. Enter the numerical value for byte 1. Confirm the value with the Enter key [OK].



The numerical values are entered byte by byte. From top to bottom, from byte 1 to byte 4, for example 120.0.0.13 (Byte1.Byte2.Byte3.Byte4).

Press [ESC] to cancel the entry.

9. Enter the numerical values for byte 2, byte 3 and byte 4.
10. Once you have entered the numerical values, press the left arrow key.
 - ▶ You return to the *LAN configuration* menu.
11. Scroll to the numerical values of the [Local mask] menu item and press the Enter key.
 - ▶ The *Local mask* menu opens.
12. Enter the numerical values, as described in points 7 to 9.
13. Once you have entered the numerical values, press the left arrow key.
 - ▶ You return to the *LAN configuration* menu.
14. If required, also enter the numerical values for the [Gateway] and [DNS server].
15. Once you have entered the numerical values, press the left arrow key.
 - ▶ The entered numerical values of [Local IP address], [Local mask], [Gateway] and [DNS server] are displayed.
16. Press the [ANW.] softkey to accept the entered numerical values.
17. Press the left cursor key to move up one menu level and select the *PC control* menu item and press Enter.
18. Confirm the [PC control] entry once more.
19. Select the option [On] and confirm the entry.
 - ▶ The control for the control station is activated.



No settings are accepted if you leave the LAN configuration menu without first pressing the [ANW.] key.



Set the [DHCP client] from [off] to [on], all numerical values are reset to 0. 0. 0. 0.



If you have set up an Ethernet communication between the control station and the constant temperature equipment, it may take 1 or 2 minutes to establish the connection.

Checking the LAN network

1. Start the Windows command processor by entering `cmd.exe` on the PC with Microsoft Windows operating system.
 - ▶ The entry window will open.

2. There are two ways of checking:
 - Enter the ping command together with the IP address.
`ping xxx.xxx.xxx.xxx↵`
 For "XXX.XXX.XXX.XXX", put the IP address that was entered when the Ethernet interface was configured.
 Or
 - Enter the ping command together with the serial number of the thermostatic circulator (possible with software control system 1.36 or later).
`ping serial number↵`
 - ▶ If the Ethernet interface is configured and connected correctly, the interface will return four responses within a very short time. See Fig. 6.

```

Administrator: C:\Windows\system32\cmd.exe
Microsoft Windows [Version 6.1.7601]
Copyright (c) 2009 Microsoft Corporation. Alle Rechte vorbehalten.

C:\Users\Knoll>ping 172.17.20.22

Ping wird ausgeführt für 172.17.20.22 mit 32 Bytes Daten:
Antwort von 172.17.20.22: Bytes=32 Zeit<1ms TTL=64
Antwort von 172.17.20.22: Bytes=32 Zeit<1ms TTL=64
Antwort von 172.17.20.22: Bytes=32 Zeit<1ms TTL=64
Antwort von 172.17.20.22: Bytes=32 Zeit<1ms TTL=64

Ping-Statistik für 172.17.20.22:
    Pakete: Gesendet = 4, Empfangen = 4, Verloren = 0
    (0% Verlust),
    Ca. Zeitangaben in Millisek.:
    Minimum = 0ms, Maximum = 1ms, Mittelwert = 0ms

C:\Users\Knoll>
  
```

Fig. 6: Example for entering the ping command

Check the LAN network and the process interface

It is easy to check the connection to the interface with a PC and Microsoft Windows operating system.

- For Windows 3.11 with the program "Terminal".
- For Windows 95/98/NT/XP the program "HyperTerminal".
- For operating systems Windows Vista, Windows 7, Windows 8 and Windows 10 "HyperTerminal"* is not part of the operating system.



* Terminal programs are available on the Internet as freeware. These programs offer features similar to "HyperTerminal" (for example PuTTY or RealTerm). Search query "serial port terminal program".

Checking with RealTerm

1. Open the program "HyperTerminal" or the "terminal program" on a PC with Microsoft Windows operating system.
 - ▶ The entry window will open.

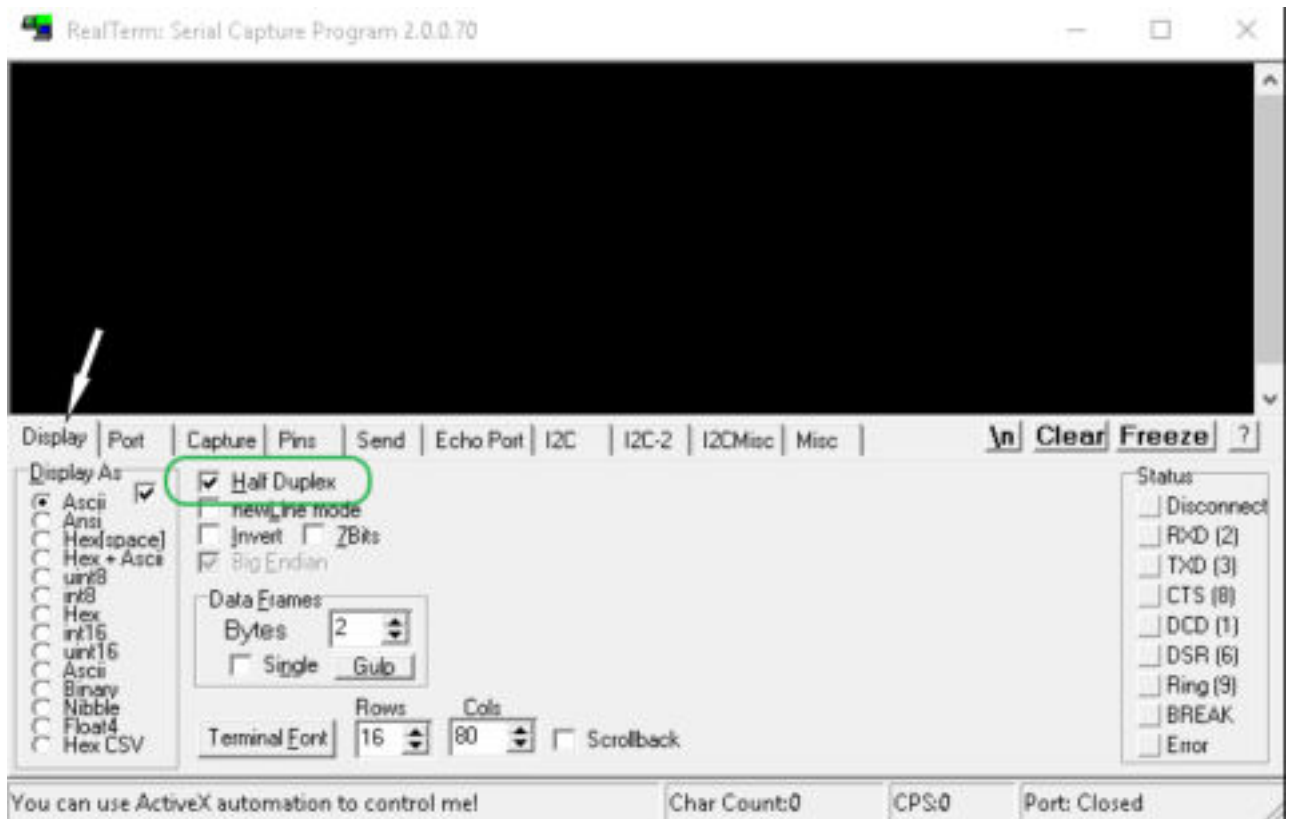


Fig. 7: "RealTerm" program

2. Place a checkmark under *Half Duplex* in the *Display* tab.

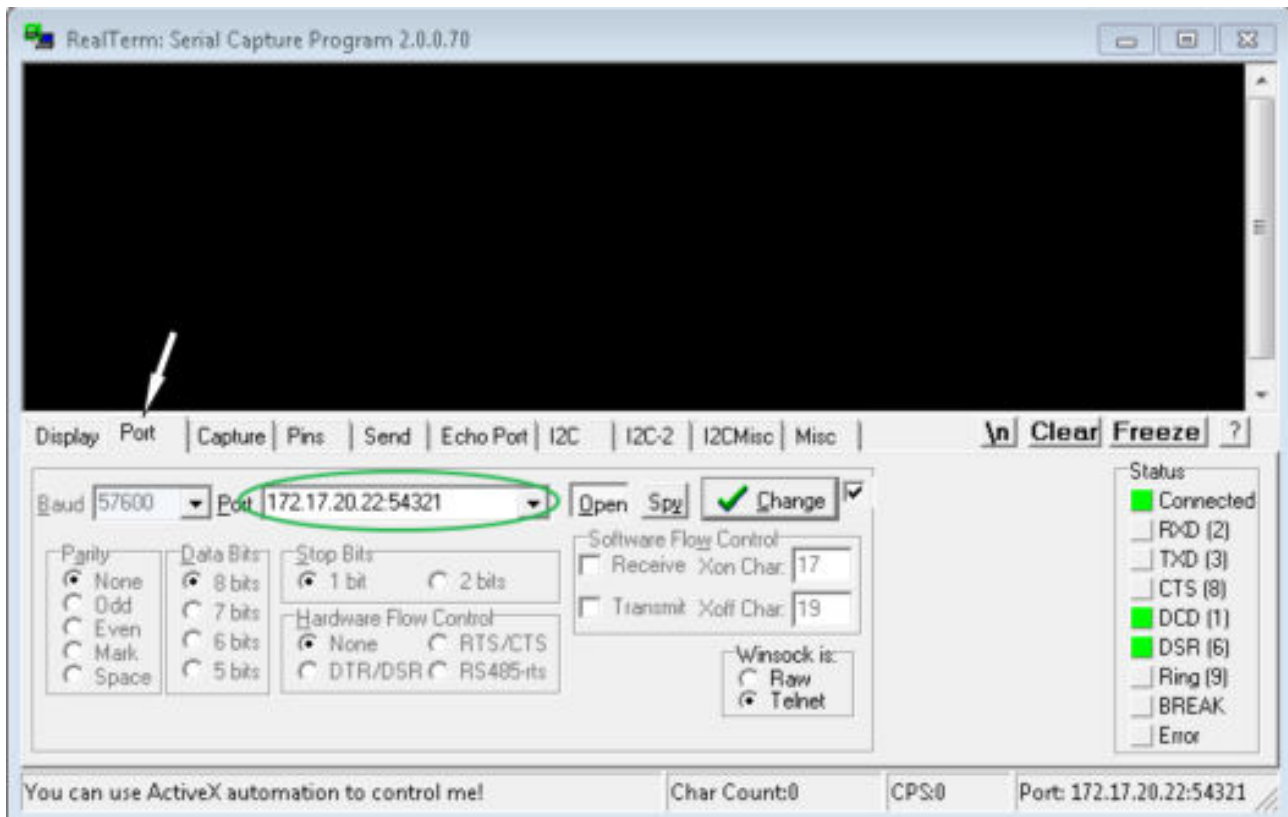


Fig. 8: Entry in the Port field

3. Enter the configured IP address and port number of the Ethernet interface on the constant temperature equipment in the *Port* tab. When you are doing this, be sure that the IP address and port number are separated by a colon.

You can enter the serial number of the constant temperature equipment instead of the IP address.

4. Then press the [Open] button.
5. Open the *Send* tab.
 - ▶ Now that the program has been configured, the actual test can begin.
6. Place a checkmark under *+CR* and *+LF*.

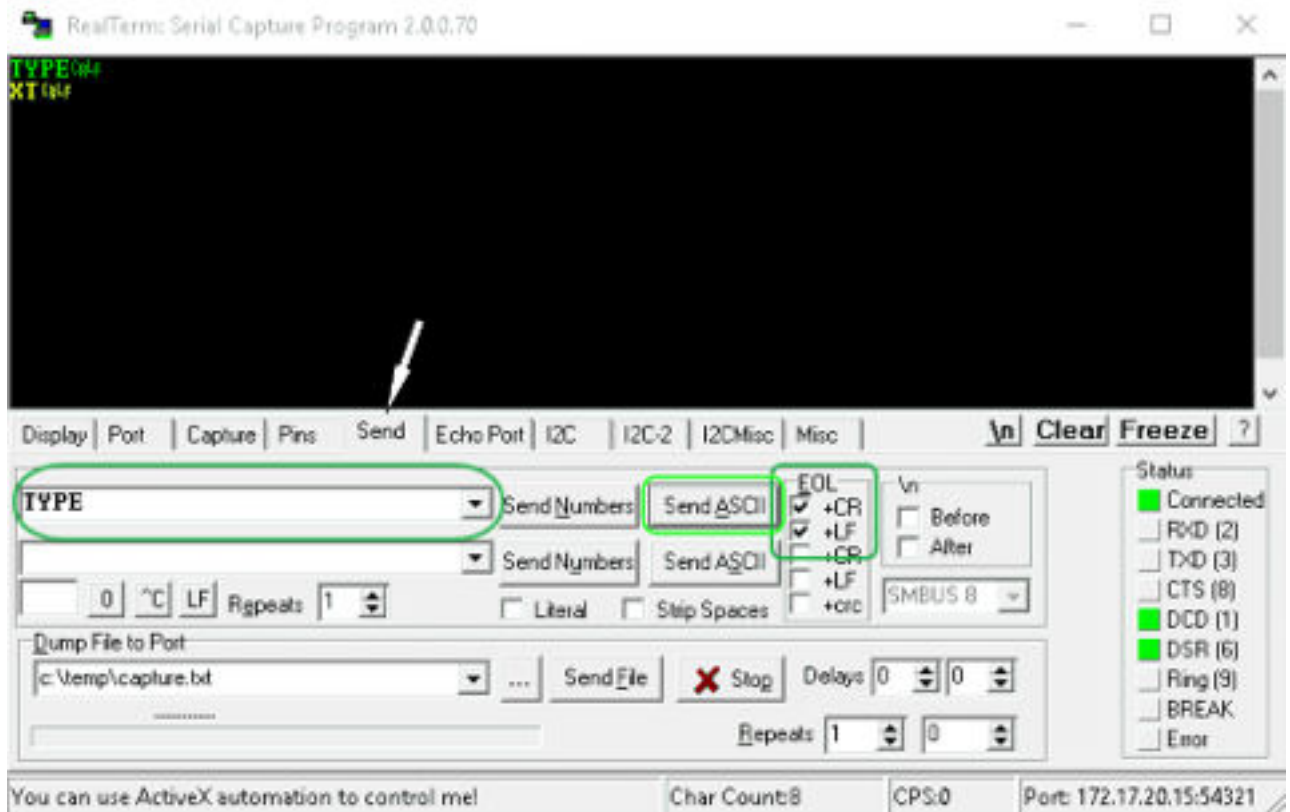


Fig. 9: Entries for the test

7. A command must be sent to the constant temperature equipment to test communication. For example, `TYPE`. Type the command and press [Send ASCII].
 - ▶ If the connection is operational, the constant temperature equipment acknowledges the command.

4.7.4 Data transfer rate

The data transfer rate cannot be precisely defined. It depends on a variety of different factors:

- Are the constant temperature equipment (with the Ethernet interface) and the control station/PC on the same network?
- Are the control station/PC and constant temperature equipment connected wirelessly (WiFi) or through a cable?
- What is the load on the network?

Generally commands can be sent to the constant temperature equipment every 500 ms. For WiFi connections the period could exceed 1 s. A new command can only be sent if the previous command has been acknowledged by the constant temperature equipment.

4.7.5 Protocol of the interface

Note the following instructions:

- The command from the computer must be made with a CR, CRLF, or LFCR.
- The response from the thermostatic circulator is always made with a CRLF.
- After each command sent to the thermostat, it is necessary to wait for the reply before sending another command. This ensures that the sequencing of inquiries and answers is clear.

CR = Carriage Return (Hex: 0D); LF = Line Feed (Hex: 0A)

Table 9: Example with set point transfer of 30.5 °C to the thermostatic circulator

Computer	Temperature control device
"OUT_SP_00_30.5"CRLF	➔
➔	"OK"CRLF

4.7.6 Read commands of the Ethernet interface

The interface recognizes the following read commands, which you can use to retrieve the operating data of the constant temperature equipment.

Table 10: Temperature

ID	Function	Unit, resolution	Command
2	Temperature set point	[°C]	IN_SP_00
3	Outflow temperature	[°C], 0.01°C	IN_PV_00
4	Outflow temperature	[°C], 0.001°C	IN_PV_10
5	Query of the controlled temperature (internal/external Pt/external analog/external serial)	[°C]	IN_PV_01
7	External temperature T_E (Pt100)	[°C]	IN_PV_03
8	External temperature T_E (analog input)	[°C]	IN_PV_04
14	External temperature T_E (Pt100)	[°C], 0.001°C	IN_PV_13
25	Overtemperature turn off point T_{Max}	[°C]	IN_SP_03
27	Limitation of outflow temperature T_{iH} (upper limit)	[°C]	IN_SP_04
29	Limitation of outflow temperature T_{iH} (lower limit)	[°C]	IN_SP_05

ID	Function	Unit, resolution	Command
33	Set temperature Tset in Safe Mode (safe set point in case of communication interruption).	[°C]	IN_SP_07
158	Actuating signal of master controller in case of external control	[°C]	IN_PV_11

Table 11: Fill level

ID	Function	Unit	Command
9	Level of the heat transfer liquid	[-]	IN_PV_05

Table 12: Actuating signal

ID	Function	Unit, resolution	Command
11	Controller actuating signal in per mille	[%], 0.1 %	IN_PV_06
13	Controller actuating signal in watts	[W]	IN_PV_08

Table 13: Cooling

ID	Function	Unit	Command
24	Cooling mode: 0 = Off / 1 = On / 2 = Automatic	[-]	IN_SP_02

Table 14: Safety

ID	Function	Unit	Command
35	Timeout communication via interface (1 - 99 seconds; 0 = Off)	[s]	IN_SP_08
73	Status of Safe Mode: 0 = Off / 1 = Active	[-]	IN_MODE_06

Table 15: Control parameters

ID	Function	Unit	Command
39	Control parameter Xp	[K]	IN_PAR_00
41	Control parameter Tn (181 = Off)	[s]	IN_PAR_01
43	Control parameter Tv	[s]	IN_PAR_02
45	Control parameter Td	[s]	IN_PAR_03
47	Control parameter KpE	[-]	IN_PAR_04
49	Control parameter TnE (response: XXXX; 9001 = Off)	[s]	IN_PAR_05
51	Control parameter TvE (response: XXXX; 5 = Off)	[s]	IN_PAR_06
53	Control parameter TdE (response: XXXX.X)	[s]	IN_PAR_07

ID	Function	Unit	Command
55	Correction limitation	[K]	IN_PAR_09
57	Control parameter XpF	[K]	IN_PAR_10
61	Control parameter Prop_E	[K]	IN_PAR_15

Table 16: Control

ID	Function	Unit	Command
59	Set point offset	[K]	IN_PAR_14
67	Control in control variable X: 0 = internal / 1 = external Pt / 2 = external analog / 3 = external serial / 5 = external Ethernet / 6 = external EtherCAT / 7 = external Pt second	[-]	IN_MODE_01
69	Offset source X for set point: 0 = normal / 1 = external Pt / 2 = external analog / 3 = external serial / 5 = external Ethernet / 6 = external EtherCAT / 7 = external Pt second	[-]	IN_MODE_04

Table 17: Rights

ID	Function	Unit	Command
63	Status of keyboard master: 0 = free / 1 = blocked	[-]	IN_MODE_00
65	Status of keyboard (remote control): 0 = free / 1 = blocked	[-]	IN_MODE_03

Table 18: Status

ID	Function	Unit	Command
75	Status of standby: 0 = Device is switched on / 1 = Device is switched off	[-]	IN_MODE_02
107	Device type (e.g.: "ECO", "INT" or "VC")	[-]	TYPE
130	Device status: 0 = OK / -1 = Fault	[-]	STATUS
131	<p>Fault diagnosis; a 7-digit answer in the format XXXXXXXX is output, whereby each digit X contains fault information (0 = no fault / 1 = fault).</p> <p>The following information is defined for the seven places of the answer format:</p> <ul style="list-style-type: none"> ■ 1. Character = error ■ 2. Character = alarm ■ 3. Character = warning ■ 4. Character = overtemperature ■ 5. Character = sublevel ■ 6. Character = 0 ■ 7. Character = external control value missing 	[-]	STAT

Table 19: Programmer

ID	Function	Unit	Command
77	Program used as a basis for further commands.	[-]	RMP_IN_04
88	Current segment number	[-]	RMP_IN_01
90	Number of preset program sequences	[-]	RMP_IN_02
92	Current program flow	[-]	RMP_IN_03
94	Currently running program (0 = no program currently running)	[-]	RMP_IN_05

Table 20: Contact input / output

ID	Function	Unit	Command
96	Contact input 1: = open / 1 = closed	[-]	IN_DI_01
98	Contact input 2: = open / 1 = closed	[-]	IN_DI_02
100	Contact input 3: = open / 1 = closed	[-]	IN_DI_03
102	Contact output 1: = open / 1 = closed	[-]	IN_DO_01
104	Contact output 2: = open / 1 = closed	[-]	IN_DO_02
106	Contact output 3: = open / 1 = closed	[-]	IN_DO_03

Table 21: SW version

ID	Function	Unit	Command
108	Control system	[-]	VERSION_R
109	Protection system	[-]	VERSION_S
110	Remote control (Command)	[-]	VERSION_B
111	Cooling system	[-]	VERSION_T
112	Analog interface module	[-]	VERSION_A
114	RS 232/485 interface module or Profibus / Profinet	[-]	VERSION_V
116	EtherCAT interface module	[-]	VERSION_Z
117	Contact interface module	[-]	VERSION_D
126	Heating system 0	[-]	VERSION_H_0
127	Heating system 1	[-]	VERSION_H_1
128	External Pt interface 0	[-]	VERSION_E
129	External Pt interface 1	[-]	VERSION_E_1

4.7.7 Write commands of the Ethernet interface

The interface module recognizes the following write commands, which you can use to transfer values to the constant temperature equipment.

The control station obtains operator privileges when sending a write command. This only works if the control station has not been locked by another control element → Chapter 6.12 “Operator and viewer” on page 86.



The constant temperature equipment confirms each write command with OK, e.g. the reply from the device address A015 is "A015_OK". In the event of an error, an error message is output as a reply, e.g. "A015_ERR_6", see .

Table 22: Temperature

ID	Function	Unit	Command
1	Temperature set point	[°C]	OUT_SP_00_XXX.XX
15	Actual value of external temperature (via interface)	[°C]	OUT_PV_05_XXX.XX
26	Limitation of outflow temperature TiH (upper limit)	[°C]	OUT_SP_04_XXX
28	Limitation of outflow temperature TiH (lower limit)	[°C]	OUT_SP_05_XXX
32	Temperature set point T_{set} in Safe Mode	[°C]	OUT_SP_07_XXX.XX

Table 23: Cooling

ID	Function	Unit	Command
23	Cooling mode: 0 = off / 1 = on / 2 = automatic	[-]	OUT_SP_02_XXX

Table 24: Safety

ID	Function	Unit	Command
34	Timeout communication via interface (1 – 99 seconds; 0 = Off)	[s]	OUT_SP_08_XX
72	Activating Safe Mode	[-]	OUT_MODE_06_1

Table 25: Control parameters

ID	Function	Unit	Command
38	Control parameter X_p	[-]	OUT_PAR_00_XX.X
40	Control parameter T_n (5 – 180 s; 181 = Off)	[s]	OUT_PAR_01_XXX
42	Control parameter T_v	[s]	OUT_PAR_02_XXX
44	Control parameter T_d	[s]	OUT_PAR_03_XX.X
46	Control parameter K_pE	[-]	OUT_PAR_04_XX.XX
48	Control parameter T_nE (0 – 9000 s; 9001 = Off)	[s]	OUT_PAR_05_XXXX
50	Control parameter T_vE (5 = Off)	[s]	OUT_PAR_06_XXXX
52	Control parameter T_dE	[s]	OUT_PAR_07_XXXX.X

ID	Function	Unit	Command
54	Correction limitation	[K]	OUT_PAR_09_XXX.X
56	Control parameter XpF	[-]	OUT_PAR_10_XX.X
60	Control parameter Prop_E	[K]	OUT_PAR_15_XXX

Table 26: Control

ID	Function	Unit	Command
58	Set point offset	[K]	OUT_PAR_14_XXX.X
66	Control in control variable X: 0 = internal / 1 = external Pt / 2 = external analog / 3 = external serial / 5 = external Ethernet / 6 = external EtherCAT / 7 = external Pt second (only for Integral)	[-]	OUT_MODE_01_X
68	Offset source X for set point: 0 = normal / 1 = external Pt / 2 = external analog / 3 = external serial / 5 = external Ethernet / 6 = external EtherCAT / 7 = external Pt second	[-]	OUT_MODE_04_X

Note (ID 66 and 68): If X = 3, the commands ID 66 and ID 68 cannot be executed in some constant temperature control devices until an external temperature specification has been received (via the command ID 15).

Table 27: Rights

ID	Function	Unit	Command
62	Master keyboard (equivalent to "KEY"): 0 = unlock / 1 = lock	[-]	OUT_MODE_00_X
64	Keyboard remote control unit (command): 0 = unlock / 1 = lock	[-]	OUT_MODE_03_X

Table 28: Status

ID	Function	Unit	Command
74	Switch the device on / off (standby)	[-]	START / STOP

Table 29: Programmer

ID	Function	Unit	Command
76	Select the program for the subsequent commands (X = 1 – 5). The default program is 5 when the constant temperature equipment is switched on. Caution! Executing this command may stop any programs that are currently running.	[-]	RMP_SELECT_X
78	Start programmer	[-]	RMP_START
79	Pause programmer	[-]	RMP_PAUSE
80	Continue programmer (after pause)	[-]	RMP_CONT
81	End programmer	[-]	RMP_STOP

4.7.8 Error messages for interface

The table lists the error messages of the interface modules.



The following information relates to the analog module RS 232/485 module and contact module, as well as the Ethernet interface.

Error	Description
ERR_2	Wrong entry (for example, buffer overflow)
ERR_3	Wrong command
ERR_5	Syntax error in value
ERR_6	Impermissible value
ERR_8	Module or value not available
ERR_30	Programmer, all segments occupied
ERR_31	Not possible to specify target value, analog target value input ON
ERR_32	$T_{iH} \leq T_{iL}$
ERR_33	External sensor missing
ERR_34	Analog value not present
ERR_35	Automatically configured
ERR_36	Not possible to specify target value, programmer is running or has been paused
ERR_37	Impossible to start the programmer, analog target value input is turned on

5 Commissioning

5.1 Establishing a mains connection



WARNING!
Contact with voltage conductors due to faulty mains cable

Electric shock

- The mains cable may not come into contact with hot heat transfer liquid and other hot parts, neither during operation nor after the device is switched off.



NOTICE!
Use of impermissible mains voltage or mains frequency

Device damage

- Compare the rating label with the available mains voltage and mains frequency.

Personnel: Operating personnel

Please note:

1. Only connect the device with a mains cable to a socket with a protective earth conductor (PE) and only use the installed mains cable for the power supply.
2. The mains switch disconnects the device from the power unit. The mains switch must be easy to identify and access.

The note only applies to devices in the USA and Canada

Note for electric installation on site

- We recommend LAUDA that a back-up fuse is installed on the installation side for three-phase devices: 25 A class cc low peak

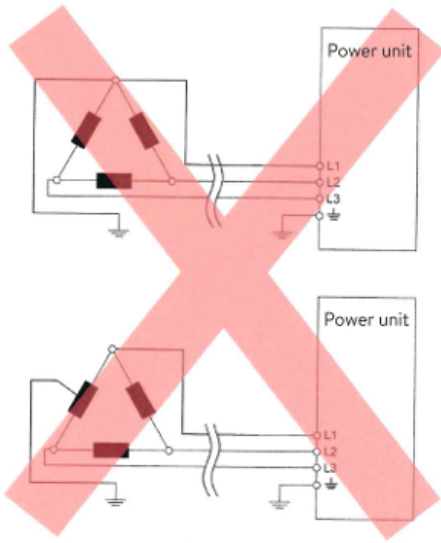


Fig. 10: Asymmetrically grounded delta network (without isolating transformer)

Notes for electric installation on site

- The fuse on the installation side must at least correspond to the maximum current consumption of the device (see type plate) and may not exceed the value permitted for the mains plug.
- Three-phase devices
 - Three-phase devices may only be operated on networks grounded at the neutral point, e.g. TN-C, TN-C-S or TN-S. For ungrounded networks (e.g. IT systems) or asymmetrically grounded networks, an isolating transformer must be connected upstream and the neutral point grounded. When selecting the isolating transformer, consider the maximum connected loads of the device.
 - Ensure correct rotating field! If the rotating field is incorrect, an error message is displayed and the device cannot be put into operation.

5.2 Switching on the machine for the first time

In Fig. 11, you can see the given sequence of entries which are necessary for safety reasons after each change of the heat transfer liquid and when switching on for the first time.

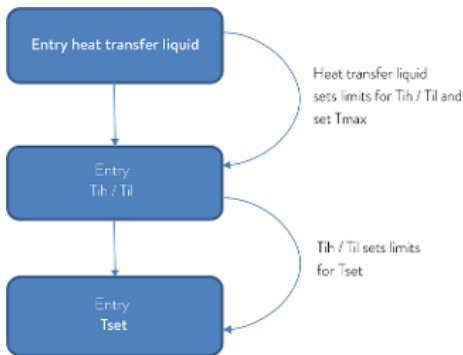


Fig. 11: Input sequence

Switch on the device



Fig. 12: Start screen

1. Switch on the device at the mains switch. A signal tone is emitted.
 - ▶ The menu for selecting the language then appears.



Fig. 13: Menu language

2. Use the up and down arrow keys to select the desired [menu language].
Press the [NEXT] softkey to confirm the selection.



You can change the menu language at any time via the menu.

- ▶ The menu for selecting the time zone then appears.
3. Use the up and down arrow keys to select the [time zone].
Press the [NEXT] softkey to confirm the selection.
 - ▶ The menu for selecting the heat transfer liquid then appears.
 4. Use the up and down arrow keys to select the [heat transfer liquid].
Press the [NEXT] softkey to confirm the selection.
 - ▶ After that, the "Filling mode" menu appears.

5.3 Setting the heat transfer liquid

In the menu of the device, set the heat transfer liquid used in the device. This process loads the values entered in the software into the controller of the device.

The entered values of the heat transfer liquid are:

- The flash point
- The viscosity
- The density
- The specific heat capacity
- The limit values of the working temperature range in the hydraulic circuit

If you set the heat transfer liquid to [Undefined], you can enter the properties of a new heat transfer liquid in the [Define heat transfer liquid] menu item.

Personnel: Operating personnel

1. Press the Enter key to open the menu.
2. Select the → Settings → Fluid → Select fluid menu items.
 - ▶ A list with the permitted heat transfer liquid for the device is displayed.
3. Scroll to mark a heat transfer liquid.



Press the [ESC] key to return to the basic window without making any changes.

4. Press [OK] to confirm the selection.
 - ▶ The option is marked with a check mark.
5. Under the → Display fluid properties menu item, you can display the properties of the heat transfer liquid.

5.4 Setting temperature limits Tih and Til


This function is used to set temperature limits Tih and Til. The temperature limits limit the set temperature. A warning is issued if the internal actual temperature is outside the temperature limits. These temperature limits should reflect the limits of your application. A tolerance of 2 K should also be added to the upper and lower temperature limits to compensate for overshooting by the control, in particular external controls. The working temperature range of the heat transfer liquid must also be taken into consideration when defining temperature limits.

Setting Tih and Til



Fig. 14: Define temperature limits

1. Press the Enter key to open the menu.
2. Select the menu items → Setup → Temperature limits → Lo.limit (Til) or → Up.limit (Tih).
 - ▶ The entry window appears. The cursor flashes under the value. The upper and lower temperature range is displayed.
3. Change the value with the arrow keys.

 By pressing the [ESC] key, you return to the higher-level menu without making any changes.
4. Press the Enter [OK] key.
 - ▶ The value is accepted.

5.5 Input window and entering set temperatures

The display settings are configured in the input windows. There are two variants of input windows.

Input window for selecting options



Fig. 15: Selecting options

- The check mark indicates the active option.
- You can navigate in the options using the [up] and [down] arrow keys.
- The selected option is highlighted in color.
- Press the [ESC] softkey to exit the menu by pressing Change and/or without changing the input window.
- Press [OK] to accept the selected option.

Input window for a numerical value



Fig. 16: Setpoint

- The input value is displayed in enlarged font. The cursor below the value flashes.
- You can change the value using the [up] and [down] arrow buttons. If you keep one of the two arrow keys pressed longer, the change will be accelerated.
- By pressing the [left] or [right] arrow key, you can also select individual numbers and change them with the [up] and [down] arrow keys.
- Using the [+/-] softkey, you can change the sign of the value.
- The displayed *Max:* and *Min:* values specify the limits for the entered value.
- Press the [ESC] softkey to return to the previous screen without saving any changes.
- Press [OK] to accept the value set.

Entering set temperature

1. Press the Enter key to open the menu.
2. Select the → *Set temperature* menu item.
3. Press the Enter key.
 - ▶ The input window appears. The cursor below the temperature value flashes. The upper and lower temperature ranges are displayed.
4. Change the value with the arrow keys.



Press the [ESC] key to return to the previous menu without making any changes.

5. Press [OK] to confirm the new value.
 - ▶ The new value is active.

5.6 Operating the device with the operating unit

5.6.1 Home window, navigation and softkeys

After switching on the device and executing the settings, the "simple" home window (without status bar) is displayed. The softkey bar is hidden in the simple home window after about 10 seconds without a key being pressed. The press of any key displays it again. Only then have the softkeys regained their function.

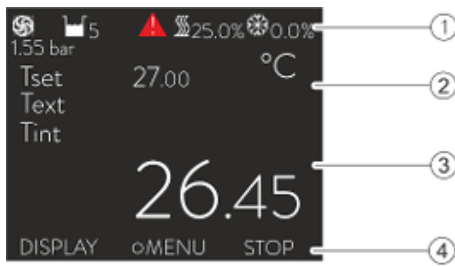


Fig. 17: Home window with status bar and softkey bar

- 1 Status bar
- 2 Display of the external temperature T_{ext} and/or internal temperature T_{int} and set temperature T_{set} .
- 3 Large display of the value to which the device regulates the temperature.
- 4 The softkey assignments are displayed in the softkey bar.

The softkeys are special keys that can be pressed at any time, but can assume different functions depending on the context. The respective function is shown in the display at the assigned position.

Status bar

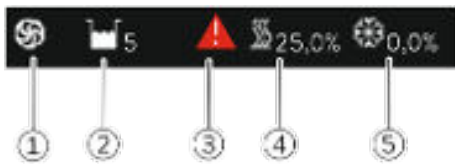


Fig. 18: Status bar from the expanded home window

- 1 The pump symbol rotates while the pump is running. Since there is only one pump level for the Variocool NRTL devices, no number is displayed.
- 2 Display of the filling level of the heat transfer liquid in the device
- 3 A yellow or red warning triangle indicates error, alarm or warning messages.
- 4 The heating heats with the displayed percentual capacity.
- 5 The refrigerating machine cools with the displayed percentual capacity.

Entry key and arrow keys

- To access the main menu from the home window, press the Enter key.
- Navigating with the four arrow keys
 - You can scroll up and down in the menu using the arrow keys.
 - If you are in the main menu, pressing the right arrow key [$\>$] (several times) or the [MENU] softkey takes you deeper into the menu.
 - If you are in a submenu, you can return to the home window by pressing the left arrow key [\leftarrow] several times.

Symbols in the menu

Symbol	Description
	The triangle indicates that there is a submenu.
	The padlock indicates that this menu cannot be changed.

Functions of the softkeys

The softkey bar is located at the bottom of the display. Depending on the context, the softkeys are assigned several different functions.

You can select the following functions with the softkeys:

- With [DISPLAY], you can switch through the various windows.
 - "Simple" home window (without status bar)
 - "Expanded" home window (with status bar)
 - Graphic window
 - List with Errors and code number
 - List with Warnings and code number
 - List with Alarms and code number
- Press [ESC] to leave the menu or an input window and return to the home window.

- Press [MENU] to
 - access the main menu and
 - confirm the selected menu command that will bring you into the submenu or to an input window.
- Press [OK] to
 - confirm an option in a selection window and
 - confirm a numerical value in an input window.
- Press [CHANGE] to
 - change a device parameter (e.g., set temperature)
- Press [SELECT] to
 - select an element from a selection list.
- Press [START] or [STOP] to switch between the two operating modes *Standby* and *Operation*.
- Press [+/-] to enter negative values into an input window.
- Depending on the context, further functions are assigned to the soft-keys (e.g. NEW/CLEAR in the programmer editor).

5.6.2 Menu structure

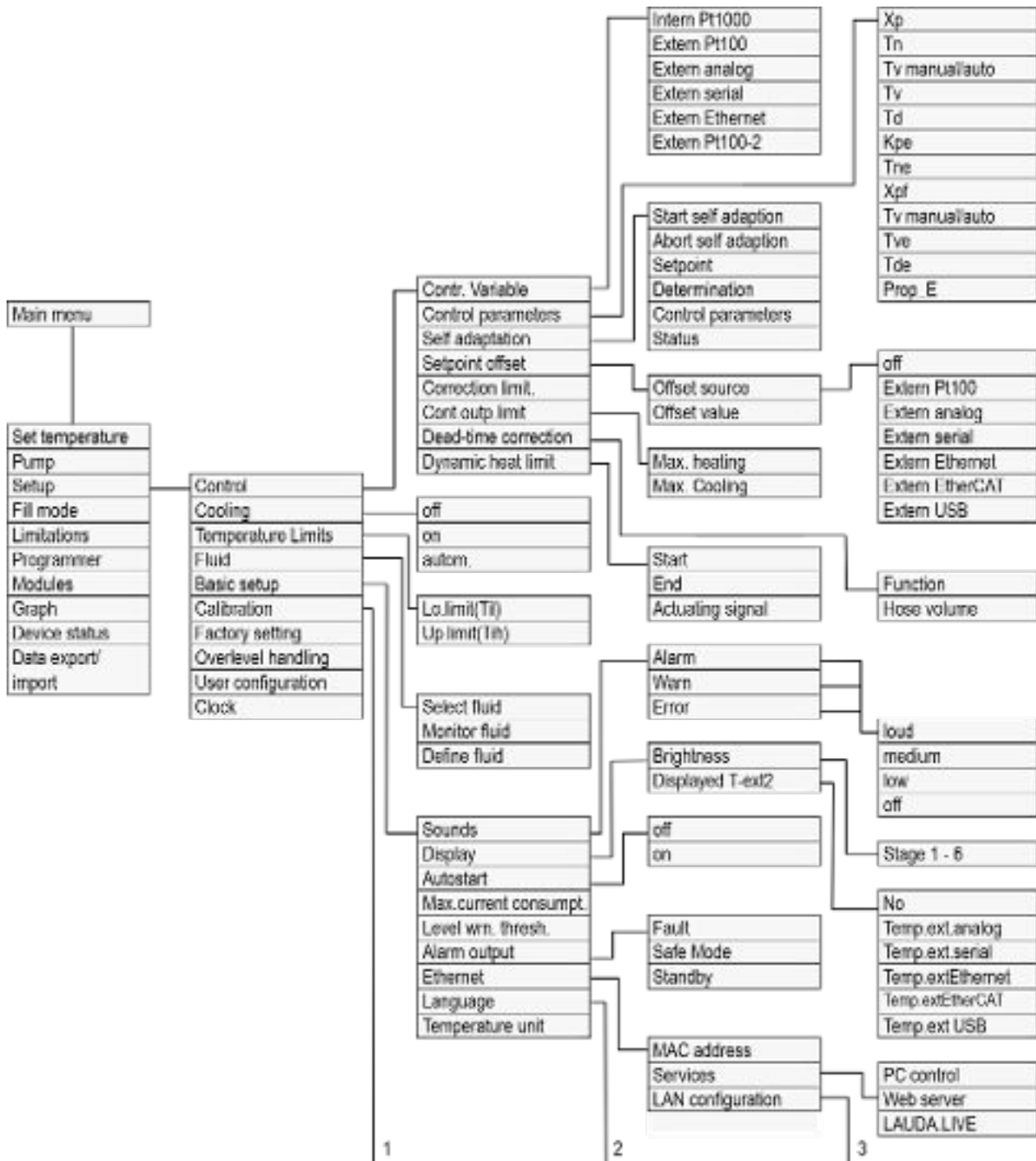


Fig. 19: Menu structure of Variocool NRTL

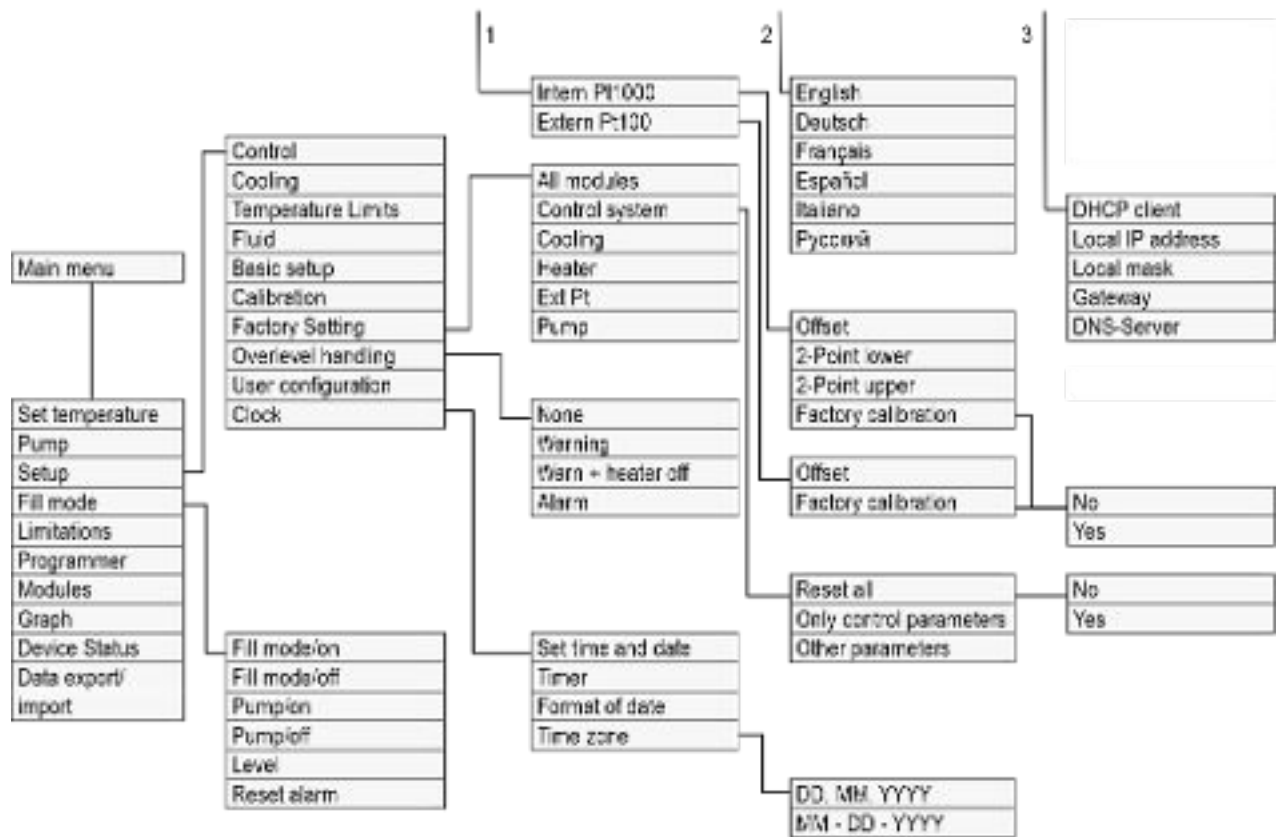


Fig. 20: Menu structure of Variocool NRTL, 2

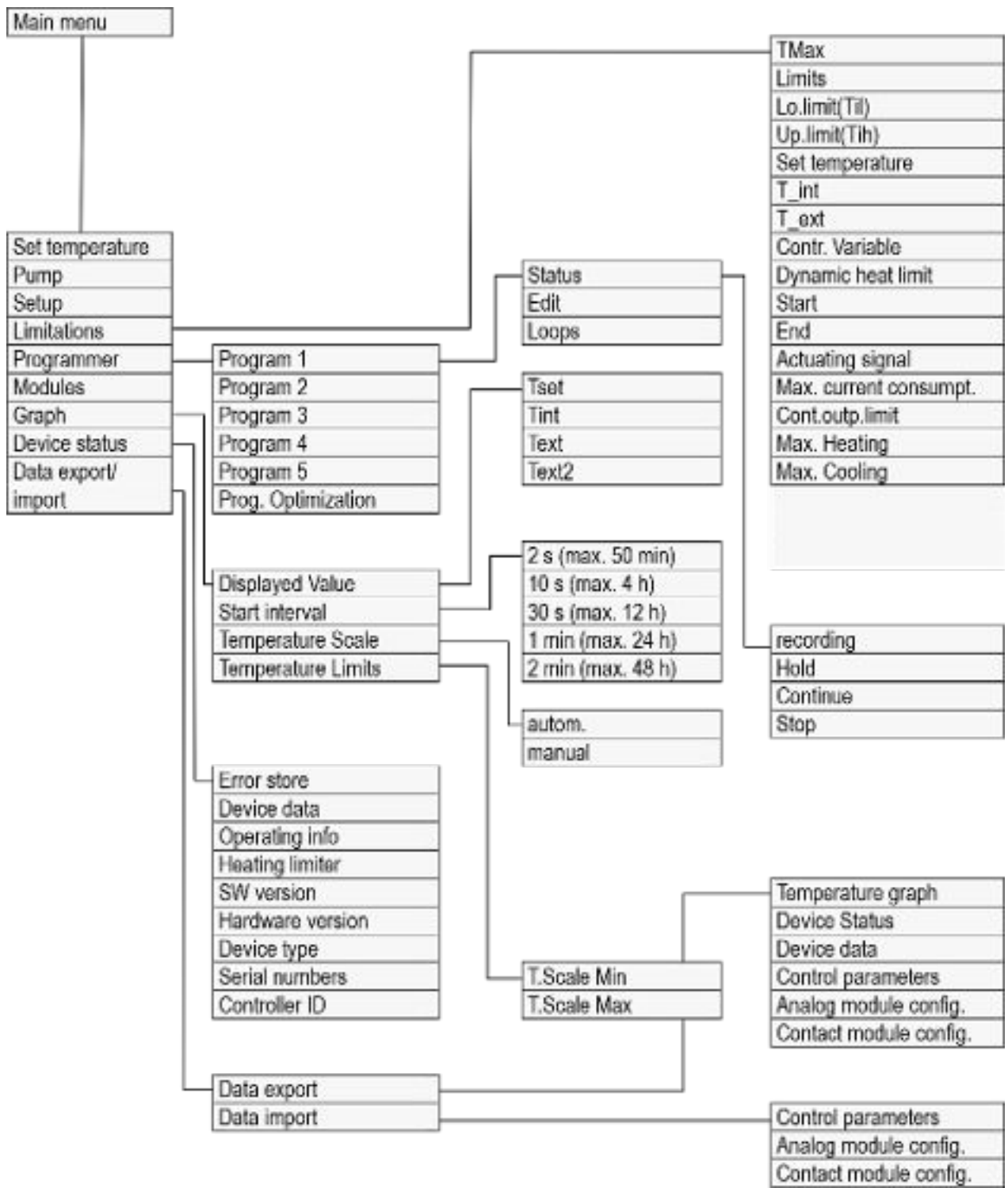


Fig. 21: Menu structure of Variocool NRTL, 3

5.6.3 Graph window

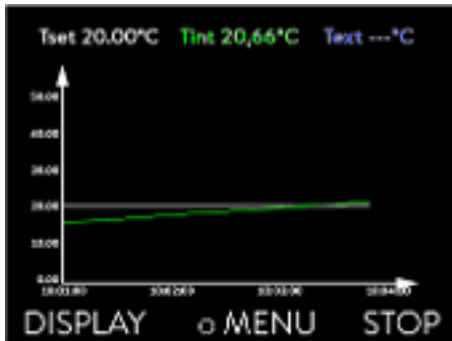


Fig. 22: Graph window

Edit the graphic window

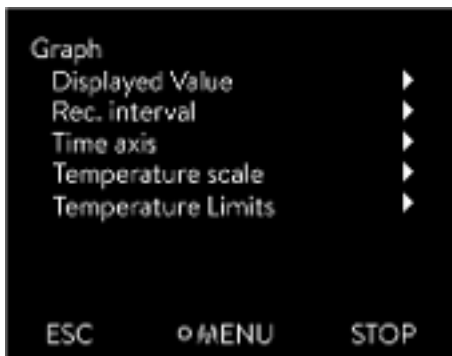


Fig. 23: Graphic menu

The display offers you the possibility to display temperature curves graphically.

The graphics window can be accessed via the [Display] softkey in the home window of the display.

- T_{set} indicates the set temperature (gray).
- T_{int} indicates the internal temperature (green) of the heat transfer liquid in the device.
- T_{ext} indicates the external temperature (dark blue) of the heat transfer liquid in the application.
- Use the arrow keys to scroll the graphic in any direction.

1. Press the Enter key to open the menu.
2. Select the → Graphic menu item.
 - ▶ The Graphic submenu opens.

In this submenu, you can adapt the graphics window to your requirements.

- [Display measurement values]: T_{set} , T_{int} , T_{ext} and T_{ext2} .
Here you can define which temperatures are displayed in the graph.
- [Sample time]: 2 s (maximum 50 min), 10 s (maximum 4 h), 30 s (maximum 12 h), 1 min (maximum 24 h) or 2 min (maximum 48 h).
Here you can define the time interval at which new temperature values are measured.
- [Time Axis]: auto, 9 min, 45 min, 2 h15 min, 4 h30 min, 9 h, 24 h or 48 h.
Here you can define the time range displayed in the visible graph window (corresponds to scaling of x axis).
- [Temperature scale]: automatic or manual.
Here you can define which temperature range is displayed in the visible graph window.
 - [Autom.]: The size of the visible graphic area automatically adapts to the changing temperature curves.
 - If the setting is selected automatically, the following menu item (Temperature limits) is not visible.
- [Temperature limits]: T.scale Min and T.scale Max.
Here you can manually define which time range is displayed in the visible graph window.

5.6.4 Operate the device using the Command Touch unit

The device can also be operated with the Command Touch remote control (accessory).



Do not switch on the device at the main switch until all hydraulic connections for the application have been fully established and all measures for safe commissioning have been implemented.

5.7 Basic settings

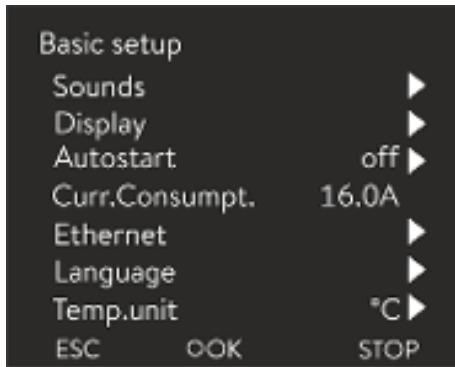


Fig. 24: Basic settings menu

Adjusting the volume of the sounds

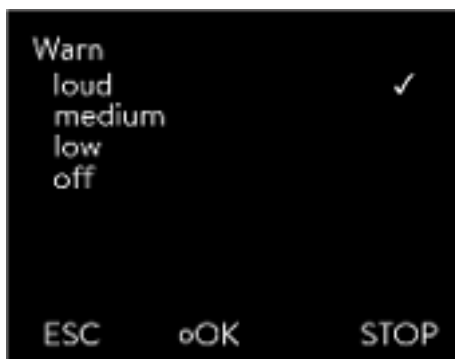


Fig. 25: Adjusting volume

Set the brightness of the display

Personnel: Operating personnel

1. Press the Enter key to open the menu.
2. Select the menu items → Setup → Basic setup.

The basic settings are described on the following pages.

The device indicates alarms, warnings and errors both visually and acoustically.

In the menu, you can adjust the volume of the sounds for:

- Alarm
- Warning
- Error

The volume settings are:

- loud
- medium
- low
- off

1. In the Basic setup menu select the menu item → Sounds.
 - ▶ A list containing the sounds opens.
2. Select the sound that you wish to change using the arrow keys.
3. Press the Enter key to confirm your selection.
 - ▶ A list containing the volume settings opens.
4. Select a volume setting using the arrow keys.
5. Press the Enter key to confirm your selection.
 - ▶ The new setting is active.

The display brightness can be set manually.



Fig. 26: Adjusting brightness

Displayed temperatures in the display

1. In the Basic setup menu select the menu item *Display* → *Brightness*.
 - ▶ A list containing the settings opens.
2. The following options are available in the window:
 - You can select the brightness manually with entries [Level 1 - 6]. The brightness intensifies from [Level 1].
 - ▶ The new setting is valid with immediate effect.

In the [Displayed T-ext2] menu you can select via which interface a **second** external temperature value is read into your device. The newly selected temperature value is displayed in the home window and in the graphic window.

1. In the Basic setup menu select the menu item → *Display* → *Displayed T-ext2*.
 - ▶ A list containing the settings opens.
2. Select the external temperature with the arrow keys, which you would also like to be displayed.
 - ▶ The measuring channels are displayed which are installed in the device.
3. Press the Enter key to confirm your selection.
 - ▶ The new setting is active.

Automatic start after power failure

After a power failure and restoration of the power supply, the device **does not** resume operation (default setting). However, you can set the device to automatically resume operation after the power is restored.

1. In the [Basic setup] menu, select the menu item → *Autostart*.
 - ▶ A list containing the settings opens.
2. Select one of the following options:
 - With [Off], the device is set to standby operating mode after a power failure and when the power supply is restored.
 - With [On], the device is set automatically continue after a power failure and when the power supply is restored.



Automatic running of the device may result in unattended operation.

3. Press the Enter key to confirm your selection.
 - ▶ The new setting is active.

Limiting the current consumption

The fuse on the installation side must at least correspond to the maximum current consumption of the device (see rating label). If the mains fuse is lower, you must reduce the maximum current consumption of the device. The heating output will be reduced accordingly. When setting the current consumption, consider whether other applications may be connected to a fuse together with your device.

Personnel: General personnel Specialized personnel

1. In the [Basic settings] menu select the menu item → *Max.current consumption*.
 - ▶ An entry window opens for a numerical value. The cursor flashes under the numerical value. The upper and lower entry range is displayed.
2. Change the value with the arrow keys.



By pressing the [ESC] key, you return to the [Basic settings] menu without making any changes.

3. Press [OK] to confirm the new value.
 - ▶ The new value is active.



The reduction of the maximum current consumption of the device reduces the heating power and thus influences the control characteristics, where applicable.

Selecting the menu language



Fig. 27: Select language

The menu languages English, German, French, Spanish, and Italian are available for the device display.

1. In the [Basic setup] menu select the menu item → *Language*.
 - ▶ A list containing the languages opens.
2. Select your language using the arrow keys.
3. Press the Enter key to confirm your selection.
 - ▶ The new setting is valid with immediate effect.

Select temperature unit

In the [Temp. unit] menu you can select in which unit the temperature value is displayed. In general, this setting is valid for all windows in the display.

1. In the [Basic setup] menu select the menu item → *Temp. unit*.
 - ▶ A list of the options opens.
2. Select one of the following options:
 - With [°C] all temperatures are displayed in °Celsius.
 - With [°F] all temperatures are displayed in °Fahrenheit.

3. Press the Enter key to confirm your selection.
 - ▶ The new setting is valid with immediate effect.

5.8 Tmax

On all Variocool NRTL, the Tmax value is permanently set to 90°C. This value cannot be modified.

5.9 Setting the pump pressure

The pump pressure can be set for devices with a bypass via a control valve on the back of the device. The pump pressure can therefore be set individually for pressure-sensitive external consuming units.

Open the bypass adjusting wheel on the back of the device to the full extent before switching the device on. Turn the wheel counterclockwise to do this.

Personnel: Operating personnel



CAUTION!
Bursting of external consuming unit due to excess pressure

Scalding, frostbite, cuts

- If using a pressure-sensitive consuming unit (such as a glass reactor), use a pressure relief device.



CAUTION!
Bursting of the external application due to overpressure

Scalding, frostbite, impacts

- For applications with a maximum permissible working pressure that is less than the maximum pressure of the pump, use a pressure relief device for protection. This pressure relief device must be installed in the outflow to the application.
- Set the maximum pump pressure as per your application.

1. To increase the pressure in the consuming unit, turn the bypass adjusting wheel clockwise until the maximum permissible pressure for the external consuming unit is reached.



Monitor the pressure indication on the display.

5.10 Filling the device with heat transfer liquid



WARNING!
Overflow of heat transfer liquid

Electric shock

- Do not overfill the device. Observe the level display and the thermal volume expansion of the heat transfer liquid.



WARNING!
Spraying of heat transfer liquid

Electric shock

- Do not spray heat transfer liquid. Use a funnel for filling.



NOTICE!

LAUDA is not liable for damages resulting from the use of unsuitable heat transfer liquids.



Notes on filling

- Refilling during operation is possible.
- The device may overflow if the application is positioned higher than the device. In case of doubt, attach shut-off valve to the lower connection of the application.
- Only put the device into operation if liquid can flow through the consumer system. Therefore, open any shut-off valves attached to the application before filling or operating.
- Fill mode removes air bubbles from the thermostatic circuit while the heating and cooling unit are switched off. Observe the level indication and pressure indication until the level no longer drops, the pressure indication no longer rises, and the aeration symbol is no longer displayed for at least two minutes. Aeration takes a few minutes and can take more than an hour in unfavorable conditions with large-volume applications.
- An aeration valve placed at the highest point of the entire application can significantly improve the aeration process in closed circuits.

Filling an empty device

- Personnel: ■ Operating personnel
- Protective equipment: ■ Safety glasses
 ■ Protective gloves
 ■ Protective work clothing

1. Close the drain valve. by turning it clockwise.
2. Switch on the device.
 - ▶ If the tank has a level of 0, *filling mode* is activated immediately after the device is switched on.
3. Remove the tank lid. Use a funnel for filling, if required.
4. Carefully fill with heat transfer liquid. Check the level indicator to avoid overfilling the device. In addition, different signal tones will provide assistance during the process:
 - The alarm tone sounds from level 0 to level 2, due to a low level.
 - From level 2, the device emits an alarm tone at long intervals.
 - From level 4, the device emits an alarm tone at short intervals.
 - From level 5, a continuous signal tone is emitted to warn of the device being overfilled. Stop filling.
 - At level 6, the device has reached the **maximum filling level** and the device is about to overflow.



It is not possible to start a device that is overfilled. You must drain a quantity of heat transfer liquid from the device before you can start it again.

5. Close the tank lid.

Refilling the heat transfer liquid

Heat transfer liquid should be pumped into the application

1. If the device is partially filled, *Fill mode* can be manually started.
 → *Main menu* → *Pump* → *Fill mode* → *Start filling*.
2. Select the → *Pump* → *Fill mode* → *Start filling* → *Start pump* menu items.
 You might have to [delete the alarm] in the [Fill mode] menu.
 - ▶ Heat transfer liquid is pumped through the external application.
3. Fill up with heat transfer liquid until the desired liquid level is reached. Allow the pump to continue running during this time.
 The cooling unit is switched off. The outflow temperature can rise above the set temperature due to the heat input of the pump.
4. Press [Stop filling] to exit filling mode and stop the pump.
 With [Stop pump], the pump is stopped.



Do not mix different heat transfer liquids!

When refilling during operation, starting refilling mode is recommended, but not essential. To refill during operation, switch the device to stand-by, if necessary. To do this, press the [STOP] softkey.



If [Fill mode] is active, the device does not heat or cool. You can only start the device after you end [Fill mode].

6 Operation

6.1 General warnings



WARNING!
Splashing heat transfer liquid

Eye damage

- Always wear suitable safety glasses when working on the device.



CAUTION!
Touching hot/cold equipment parts and accessories

Hot and cold burns

- Never touch parts that are labeled with the warning symbol "Hot".



CAUTION!
Automatic device start with the timer

Scalding, cold burns, injury

- Before using the timer, ensure that all preparatory measures for intended use have been implemented!



CAUTION!
Risk of external application bursting

Scalding, cold burns

- Adjust the pump pressure with the bypass.

Please note:

- The device may only be moved once it has been drained. The device must be taken out of operation to do this.
- For pressure-sensitive applications (e.g. glass apparatus) with a maximum permissible working pressure below the maximum pressure of the pump, the hoses of the application must be laid in such a way that bending or squeezing is not possible. In addition, a separate safety valve must be installed to protect against operating errors.



NOTICE!
Frost damage or contamination of the heat exchanger

Damage to water-cooled devices

- Before decommissioning prior to transport, storage, maintenance or servicing, or to protect against frost damage, completely drain the cooling water circuit on the device.

6.2 Operating modes

The device supports two operating modes.

- In *Operation* mode, the components of the device are operational.
- In *Standby* mode, all device component are switched off. Power is only supplied to the display on the device. This operating mode is suitable for adjusting multiple settings, for example.



A program that has been started is paused in Standby mode. After activating Operation mode, the program must be resumed again manually.

6.3 Control parameters

The thermal mass and the thermal connection of the application to the thermostat may make it necessary to adjust the control parameters.



Only modify the control parameters if you possess adequate knowledge of control system engineering.

6.3.1 Control basics

Definition

A brief explanation of terms

Actuating signal	- Initial value of the controller to compensate for the difference between the actual value and target value (control deviation).
PID controller	- The PID controller operates with extreme speed and precision and consists of a P, I and D-component.
Proportional range X_p	- The proportional range X_p indicates the temperature range within which the proportional component (P-component) of the controller represents 0–100 % of the maximum actuating signal. If, for example, the preset X_p is 10 K and the control deviation is 2 K, the P-component is 20 % of the actuating signal. If the control deviation is 10 K or more, the P-component is 100 % of the actuating signal.
Adjustment time T_n	- The adjustment time is crucial for the I-component of the actuating signal. It specifies the interval at which an existing control deviation is integrated. The higher the T_n , the slower the control deviation is integrated and the more sluggish the control becomes. A small T_n makes the control more dynamic and eventually results in vibrations.
Hold-back time T_v	- The D-component of the actuating signal is formed from the hold-back time T_v . It influences the speed with which the actual value approaches the target value and counteracts the P-component and I-component. The greater the preset hold-back time T_v , the more intensively the output signal is attenuated. Rule of thumb: $T_v = T_n \times 0.75$.
Attenuation time T_d	- Attenuation time of the D-component. Rule of thumb: $T_d = T_v \times 0.15$.
Correction limitation	- Represents the maximum permitted deviation between the temperature at the pressure side pump outlet and the temperature at the external application.

Optimizing the hydraulic system

An important prerequisite for good control is the establishment of a good connection between the temperature control application and the constant temperature equipment.

- Use short hoses with a large cross section to reduce the flow resistance.
- Select the thinnest possible heat transfer liquid (viscosity below $30 \text{ mm}^2/\text{s}$) with the highest possible heating capacity. Precedence list: Water, water-glycol mixture, oils, fluorinated®.
- Set the bypass so that the volume flow of the heat transfer liquid is as high as possible.

Effects of viscosity on the heat transfer liquid

A control that is stable at low temperatures will usually be stable at high temperatures. Conversely, if a system is just about stable at high temperatures, it will most probably be unstable at lower temperatures, i.e. vibrate.

The viscosity of the heat transfer liquid changes drastically with the temperature. At low temperatures, liquids are more viscous. The control quality is therefore generally poorer at low temperatures. For this reason, the control setting should be towards the lower end of the temperature range.

Example of control setting

If the temperature range of an application is -20 – to 80 °C, for example, a control setting of -10 to 20 °C is most suitable.

Influence of control parameters on the control action



Fig. 28: Ideal setting

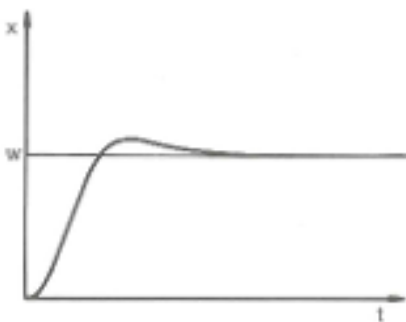


Fig. 29: Control parameter X_p too large

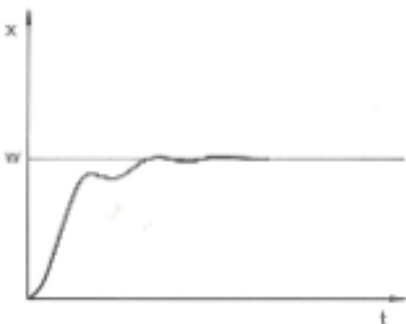


Fig. 30: Control parameter X_p too small

If the X_p parameter selected is too large, the actual value will reach the proportional range early and the P-component will be less than 100 % of the actuating signal. It takes longer to reach the target value and as a result, the simultaneously integrated I-component has more time to establish its actuating signal component. Once the target value is reached, the excessive addition of the I-component causes the value to overshoot the target value. If proportional range X_p is reduced, the P-component remains at 100 % for longer. Consequently, the actual value approaches the target value more quickly and the I-component has less time to integrate the system deviation. The overshoot is reduced.

If the proportional range selected is too small, the P-component of the actuating signal remains at 100 % for a long time. This value decreases even faster within the proportional range, i.e. the actuating signal decreases rapidly and the progress of the actual value towards the target value comes almost to a complete stop. The I-component, which only becomes effective now, causes the actual value to move slowly towards the target value.

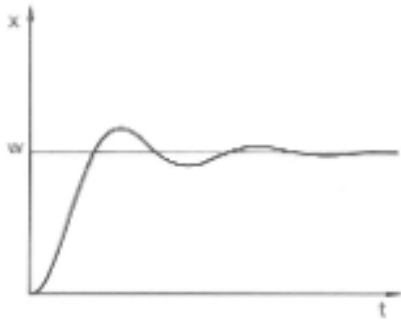


Fig. 31: Control parameters T_n and T_v too small

In the case shown here, the preset I component is too large (parameter T_n too small, T_n must be increased). The I-component integrates the control deviation until it becomes 0. If integration proceeds too rapidly, the actuating signal, i.e. the output signal of the controller, is too large. As a result, the actual value fluctuates (fading) around the target value. The hold-back time (parameter T_v) should be adapted using the formula: $T_v = T_n \times 0.75$.

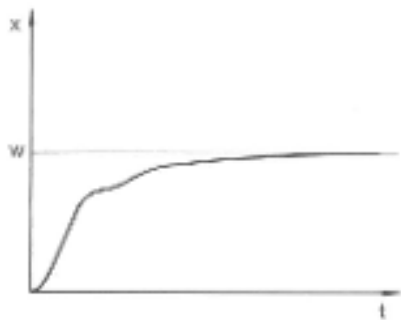


Fig. 32: Control parameters T_n and T_v too large

The actual value increases relatively sharply towards the specified target value. The proportional area settings seem to be correct. If the control deviation becomes smaller, the actual value approaches the target value much more slowly. The integration component (I-component) must compensate for the drastic reduction of the proportional component (P-component). In this case, the I-component is integrated too slowly. The parameter T_n , which specifies the integration interval, must therefore be reduced. The hold-back time (parameter T_v) should be adapted using the formula: $T_v = T_n \times 0.75$.

6.3.2 Overview of internal control parameters

The internal control compares the set temperature with the outflow temperature and calculates the actuating signal, i.e. the measurement used for heating or cooling.

Table 30: The following control parameters can be adapted for internal control:

Characteristics	Designation	Unit
X_p	Proportional range	K
T_n	Adjustment time	s
T_v	Hold-back time	s
T_d	Attenuation time	s



If T_v manual/auto is set to auto, T_v and T_d cannot be modified. In this case, they are derived with fixed factors of T_n .



The temperature limits T_{ih} and T_{il} also have an effect on the control.

6.3.3 Overview of external control parameters

- External control consists of a master controller (external controller) and a slave controller (internal controller). The temperature of the application to be temperature controlled is also required. In general this is determined with an external “Pt100 sensor”.
- The master controller compares the set temperature with the external temperature (application temperature) and, from these temperatures, calculates the set temperature (set_internal) for the slave controller (internal controller).
- The slave controller compares the set temperature (set_internal) with the outflow temperature and calculates the actuating signal, i.e. the measurement used for heating or cooling.

Table 31: The following control parameters can be adapted on the master controller (external controller):

Characteristics	Designation	Unit
Kpe	Amplification factor	-
Tne	Adjustment time	s
Tve	Hold-back time	s
Tde	Attenuation time	s
Prop_E	Proportional range	K

Table 32: The following control parameters can be adapted on the slave controller (internal controller):

Characteristics	Designation	Unit
Xpf	Proportional range	K



If Tv manual/auto is set to auto, Tv and Tde cannot be modified. In this case, they are derived with fixed factors of Tne.



The temperature limits Tih and Til also have an effect on the control.

Correction limitation

If a temperature jump is specified via set temperature T_{set} , the control may set an outflow temperature which is considerably higher (e.g. 50 K, possible with enamel reactors) than the temperature T_{ext} required in the external application. Therefore, there is a correction limitation that specifies the maximum permitted deviation between the temperature at the pump connection pressure side T_{int} and the temperature at the external application T_{ext} .

1. Press the [Enter key] to open the menu.
2. Select the menu items → Setup → Control → Correction limit..
 - ▶ An entry window opens for the numerical value.

3. Enter the value.
4. Confirm the new value with the [Enter key].
 - ▶ The new value has been accepted.

6.3.4 Activating the control variable

If you want the device to regulate to the internal control variable or an external control variable, you must set it accordingly. During setting, the old control variable with its set values is automatically deactivated. Only one control variable can be actively selected.

List of the possible control variables

- [Internal Pt1000]
- [External Pt100]
- [External analog]
- [External serial]
- [External USB]
- [External Ethernet]
- [External EtherCAT]

Personnel: Operating personnel

1. Press the Enter key to open the menu.
2. Select the → Settings → Control → Control variable menu items.
 - ▶ The selected option is marked with a check mark.
3. Scroll to another control variable and select it with the Enter key.
 - ▶ The new control variable is active with immediate effect.

6.3.5 Change control parameters

Personnel: Specialized personnel



Press the [ESC] soft key to return to the previous display without making any changes.



1. Press the Enter key to open the menu.
2. Select the menu items → Settings → Control → Control parameters.
 - ▶ If the control variable **extern** is active, the external control parameter is displayed on the display.
 - If the control variable **internal** is active, the internal control parameter is displayed on the display.
3. Scroll to another control parameter and select it with the Enter key.
 - ▶ An entry window opens. You can now change the numerical value. The displayed values *Max:* and *Min:* specify the limits for the value entry.

Fig. 33: Change control parameters


4. Press [OK] to confirm the new value.
 - ▶ The new value is active.

Enable control parameters for processing

- With *Tv manual/auto* you can define whether the control parameter *Tv* and *Td* or *Tve*, *Tde* and *Prop_E* are set manually or automatically. If the automatic setting is enabled, these control parameters are displayed with a lock and cannot be selected.

To be able to set these control parameters manually, change the control parameter *Tv manual/auto* to manual setting.

6.3.6 Manual optimization of control parameters

1. Select a control parameter set suitable for your application from  Table 33 "Proven control parameter settings" on page 71.
2. Start the constant temperature equipment and the application.
3. Wait until the temperature in the external application is within ± 3 K of the set temperature. The outflow temperature must not increase or decrease any further. Fluctuations in the outflow temperature are not a problem initially.

Adjust the slave controller (internal controller):

Tests have shown that a normal P controller is perfectly adequate as a slave controller.

1. "Immobilize" the master controller by setting K_{pe} to 0.1.
 - ▶ The master controller now only works very weakly.
2. If the outflow temperature fluctuates by $> \pm 0.1$ K, continue with point 4.
If not, decrease X_{pf} until the outflow temperature fluctuates ($> \pm 0.1$ K).
3. Slowly increase X_{pf} until the fluctuations stop. Continue to increase X_{pf} by approx. 20% (safety margin).
4. If $X_{pf} < 10$ - Good outflow control circuit/hydraulics
If X_{pf} is 10 – 15 - Fair outflow control circuit/hydraulics
If $X_{pf} > 15$ - Poor outflow control circuit/hydraulics



If the quality of the outflow control circuit (hydraulics) is poor, the quality of the external control will also suffer considerably!

Set the master controller (external controller):

Experience has shown that it takes much longer to set the master controller than the internal controller for a pure outflow temperature control. Several days may be required for a problematic control circuit.

1. First configure the default setting for T_{ne} :
 - For smaller reactors with a content of < 5 liters - $T_{ne} = 300$ s
 - For medium-sized reactors with a content of 10 – 30 liters - $T_{ne} = 500$ s
 - For larger reactors with a content of > 80 liters - $T_{ne} = 800 - 1000$ s
2. Adjust the set point by 5°C (5 K set point increase), record the outflow temperature and external temperature for a sufficiently long period (approx. 20 – 40 min.).
3. If the external temperature fluctuates (> 0.1 K), reduce K_{pe} until the fluctuations stop. Always wait a sufficiently long time between changes (at least 2 fluctuation cycles).
4. +20 K set point increase, wait for the transient process, -20 K set point decrease, wait for the transient process.
5. Assess the transient processes:
 - If an overshoot should be reduced, slowly increase T_{ve} (up to approx. 90% of T_{ne})
 - If an overshoot should be increased, reduce T_{ve} (up to approx. 60% of T_{ne})
 - Then adjust T_{de} : $T_{de} = 20\%$ of T_{ve}
 - After each change, continue with ↪ Step 4 on page 71: Implement and evaluate ± 20 K set point increases.
6. If the transient process takes too long overall,
 - T_{ne} can be reduced.
 - Also reduce a percentage of T_{ve} and T_{de} .
 - Increase K_{pe} to 150 – 200% so that the system fluctuates.
 - Then continue with ↪ Step 3 on page 71.
7. If the tendency to fluctuate increases without the overshoot being reduced to an acceptable level,
 - a) K_{pe} can be reduced easily, continue with ↪ Step 4 on page 71,
 - b) If you intend to select a larger time constant, increase K_{pe} to 150 – 200% so that the system fluctuates. Then continue with ↪ Step 3 on page 71.

Table 33: Proven control parameter settings

Device	Example	K_{pe}	T_{ne}	T_{ve}	T_{de}	Prop_E	Xpf	Pump level
IN 150 XT	1	4.0	300	246	24.0	20	5.0	3
IN 250 XTW	2	1.5	300	246	24.0	20	7.0	1
	3	0.7	100	84	8.0	20	7.0	4
IN 750 XT	4	1.5	200	164	16.0	20	5.0	8

Device	Example	Kpe	Tne	Tve	Tde	Prop_E	Xpf	Pump level
IN 950 XTW	5	1.5	300	246	24.0	20	15.0	5
	6	0.4	70	61	7.0	20	12.0	6

Kryo 70 silicone oil is used in all examples.

In example 2, the pressure control with 1 bar is used on the constant temperature equipment.

Example 1

- Glass double-shell reactor with 4 liters of heat transfer liquid, reactor not insulated
- 2 metal corrugated hoses, each 1.5 m in length, D = 10 mm clear width

Example 2

- Glass double-shell reactor with 4 liters of heat transfer liquid, reactor not insulated
- 2 metal corrugated hoses, each 6 m in length, D = 10 mm clear width
- Pump with pressure control setting of P = 1 bar
- Bypass used

Example 3

- Application with low volume
- Application with low thermal capacity
- Hoses with low flow rate, D < 10 mm clear width

Example 4

- Metal double-shell reactor with 17 liters of heat transfer liquid
- 2 metal corrugated hoses, each 1.5 m in length, D = 20 mm clear width

Example 5

- Glass double-shell reactor with content of 4 liters, reactor not insulated
- 2 metal corrugated hoses, each 5 m in length, D = 10 mm clear width
- Bypass used

Example 6

- Application with low volume
- Application with low thermal capacity
- Hoses with low flow rate, D < 10 mm clear width
- Bypass used

6.4 Set the setpoint offset

It is possible to apply an offset value to the temperature measured by an external temperature probe and then process this temperature as a target value. The setpoint of the heat transfer liquid in the device can therefore be set, for example, to 15 K below the temperature in the application, measured by the external temperature probe.

Navigating to the settings

1. Press the [Enter key] to open the menu.
2. Select the menu items → *Settings* → *Control* → *Setpoint offset*.
3. Select one of the following options:
 - [Offset source] allows you to select the source used to measure the offset.
 - [Diff. set/actual value] allows you to enter the value for the setpoint offset.

Entering the offset value

1. Select the [Diff. set/actual] button in the setpoint offset menu.
 - ▶ The entry window appears. An offset value can be entered within the limits displayed.
2. Enter the setpoint offset.
3. Press the [Enter key] to confirm.
4. The software returns to the previous Setpoint offset menu.

Activating an offset source

You can activate or deactivate the value entered for the setpoint offset of a corresponding source using the options in the [Offset source] menu. [External Pt100], for example, allows you to activate the setpoint offset for the external temperature probe.

1. Select the [Offset source] button in the Setpoint offset menu.
2. Select one of the following options:
 - Select [Off] to deactivate the offset source.
Activate an offset source from the remaining options:
 - [Extern Pt100]
 - [Extern analog]
 - [Extern serial]
 - [Extern USB]
 - [Extern Ethernet]
 - [Extern EtherCAT]
 - [Extern Pt100-2]
3. Press the [Enter key] to confirm.
4. Press the [ESC] softkey to switch to the home window.

6.5 Limitation of heating and cooling

The maximum heating or cooling capacity can be limited using the controller output limit. The limit is set as a percentage of the maximum value.

The controller output limit for the heating capacity is designed to prevent excessive temperatures on the surface of the heater. Excessive heater temperatures may degrade the heat transfer liquid.

1. Press the [Enter key] to open the menu.
2. Select the → *Settings* → *Control* → *Controller output limit* menu items.
3. Select [Max. heating] and press [OK] to confirm.
 - ▶ An input window appears. The controller output limit can be set to a value within the limit values displayed.
4. Change the value accordingly.
5. Press the [OK] button to return to the previous screen with the new setting configured.
 - ▶ The new setting is active.

6.6 Cooling

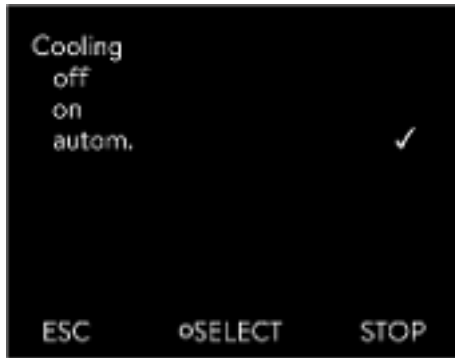


Fig. 34: Configuring cooling

The cooling unit of the devices is operated in the standard setting [autom.]. Depending on the temperature and operating status, the cooling unit is automatically switched on or off. You can switch the cooling unit on or off permanently via the menu. In the case of sensitive control processes, control fluctuations can be prevented by automatically switching the cooling unit on or off.

1. Press the Enter key to open the menu.
2. Select the menu items → Setup → Cooling.
3. Select one of the following options:
 - With the [autom.] setting, the cooling unit is switched automatically. When cooling capacity is required, the cooling unit switches on.
 - With [off], the cooling unit remains switched off.
 - With [on], the cooling unit cools permanently.
4. Press [OK] to confirm the selection.

6.7 Calibrating the temperature probe



A calibrated reference thermometer with the desired level of accuracy is necessary. Otherwise you should not change the calibration of your constant temperature equipment.

If, when checking the temperature in a steady state, you discover a constant temperature deviation of T_{int} or T_{ext} from the reference thermometer, this can be equaled out via the *Calibration* menu point.

With the menu point *Offset* (1-point comparison), the characteristic of the temperature switch is adjusted in parallel by the input value.

With the menu point *2-point calibration* (2-point comparison), the characteristic of the temperature switch is adjusted and the slope of the characteristic is changed.



It is possible to change the T_{int} and T_{ext} temperature values within a range of ± 3 K respectively.

Offset

- For calibration, the reference thermometer must be installed according to the specifications on the calibration certificate. The position of the reference thermometer on the pressure side between the connecting sleeve on the thermostatic circuit pressure side and the application should be as close as possible to the application to guarantee precision temperature control.
 - To measure the temperature, wait until the system is in a steady state.
1. Press the [Enter key] to open the menu.
 2. Select the menu items → Settings → Calibration → intern Pt1000 or → extern Pt100 → Offset.
 - ▶ The Input window opens.

2-point calibration

3. Enter the temperature value read from the reference thermometer into the entry window.
4. Press [OK] to confirm the new value.
 - ▶ The new value has been accepted.

- For calibration, the reference thermometer must be installed in the inlet of the device according to the specifications on the calibration certificate.
 - The upper and lower temperature measurement points must be at least 40 K apart.
 - To measure the temperature, wait until the system is in a steady state.
1. Set a low T_{set} setpoint on the device.
 2. Wait until the setpoint and the temperature of the heat transfer liquid have equaled out.
 3. Press the [Enter key] to open the menu.
 4. Select the menu items → *Settings* → *Calibration* → *intern Pt1000* or → *extern Pt100* → *2-Point, bottom* .
 - ▶ The Input window opens.
 5. Enter the temperature value read from the reference thermometer into the entry window.
 6. Press [OK] to confirm the new value.
 - ▶ The lower value has been accepted.
 7. Set a high T_{set} setpoint on the device.
 8. Wait until the setpoint and the temperature of the heat transfer liquid have equaled out.
 9. Select the menu item [2-Point, top] in the *Calibration* menu.
 - ▶ The Input window opens.
 10. Enter the temperature value read from the reference thermometer into the entry window.
 11. Press [OK] to confirm the new value.
 - ▶ The upper value has been accepted. 2-point calibration has been completed.

Restore factory calibration

Use this menu item to restore the calibration configured in the factory.

1. Press the [Enter key] to open the menu.
2. Select the menu items → *Settings* → *Calibration* → *intern Pt1000* or → *extern Pt100* → *Factory calibration*.
3. Select the option [yes].
4. Press [OK] to confirm the selection.
 - ▶ This deletes the customer's calibration and restores the calibration as it was configured in the factory.

6.8 Restore the factory setting

Navigate to the Factory setting menu

1. Press the Enter key to open the menu.
2. Select the menu items → Setup → Factory setting.

Reset all modules

With the menu [All modules], the software settings of all modules of the device are reset to factory settings.

Further down in the Factory setting menu you can select and reset individual modules.

Reset control system

In the [Control system] menu, you can reset your specific settings to factory settings.

- Reset all
- Only control parameters
- Other parameters

Reset in the [Reset all] menu:

- Control
 - Control variable
 - Control parameters
- Temperature limits
- Basic settings
 - Sounds
 - Display
 - Autostart: On
 - Current consumption
 - Language
- Calibration
- Graphic display
- Home window
- Operating mode (operation)

Personnel: ■ Operating personnel

1. Select the [Reset all] menu item.
2. Select one of the following options:
 - By pressing the [no] key, you return to the higher-level menu without making any changes.
 - By pressing the [yes] key, the device is reset to factory settings when you confirm this action with the Enter key.
 - ▶ The complete device is reset to factory settings.

Select and reset individual control parameters

With the menu [Only control parameters] or [Other parameters], only the selected parameters are reset to factory settings.

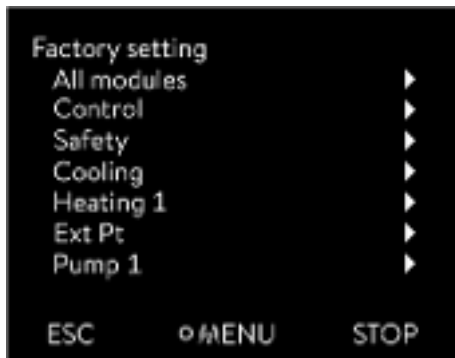


Fig. 35: Factory setting menu

Personnel: Operating personnel

1. Select the [Other parameters] menu item.
2. Select one of the following options:
 - By pressing the [no] key, you return to the higher-level menu without making any changes.
 - By pressing the [yes] key, the device is reset to factory settings when you confirm this action with the Enter key.
 - ▶ The parameters are reset to factory settings.

6.9 Viewing the device status

In the "Device status" menu and its submenus, you can display a lot of information and data about the device. No settings are possible in the entire "Device status" menu.

1. Press the Enter key to open the menu.
2. Select the → *Time* → *Device status* menu items.
 - ▶ A submenu opens.
3. These menu items are available:
 - Display error memory,
 - Display device data,
 - Display operating information,
 - Display heating restriction,
 - Display software version,
 - Display hardware version,
 - Display device type and
 - Display serial numbers.

Displaying the error memory

The device has an error memory for storing up to 140 warning, error and alarm messages that can be used to analyze errors.

1. Select the → *Error memory* menu item in the "Device status" menu.
2. You can navigate through the list using the up and down arrow buttons. The most recent message is in the top line.

The following information is displayed for each message:

- *No.* refers to consecutive numbers listed chronologically after the errors occur.
- The relevant module that triggered the message is displayed under *Source*.
- *Code* is the encoded description of the alarm, warning or error.
- *Type* specifies whether it is an alarm, warning or error.
- *Date* and *Time* display the exact time the message was issued.

The message marked above is explained in more detail at the bottom of the display.

Displaying device data

LAUDA Service uses this display for diagnostic purposes.

The device data is required for on-site service visits and telephone support.

1. Select the → *Device data* menu item in the "Device status" menu.
 - ▶ Various current values of the device are displayed (e.g., temperatures).

Displaying operating information

The "Operating information" menu item shows how long or how often components of the device have been in use.

The service life of the components listed below is displayed in hours unless otherwise stated.

- Heat transfer liquid (Fluid)
- Heating
- Pump
- Compressor
- Compressor duty cycle
 - The number of switching cycles (ON - OFF) is specified
- EEV 0
 - EEV is the electronic injection valve with the numbers; the opening of the valve is indicated in number of steps

Heating restriction

The submenu displays all current limits of the device. These limitations have been set by the user in other menus or have been activated by the instrument software based on the instrument configuration.

- Pump
- Current consumption
- Dynamic heating capacity restriction
- Upper limit value (Tih)
- Degassing mode
- Filling mode
- Actuating signal limit
- T_triac

Displaying software versions and hardware versions

The versions of the installed software and hardware are required for on-site service visits and telephone support.

1. Select the → *Software version* and/or → *Hardware version* menu item in the "Device status" menu.
 - ▶ The software versions installed on the device are displayed. The software versions of any connected interface modules are also displayed. The hardware version is not displayed for all modules. In the case of older modules, no hardware version can be recorded and displayed by the software. In such cases, "---" is displayed.

Displaying the device type

The device type is displayed in the "Device type" menu item.

Displaying serial numbers

The serial numbers are required for on-site service visits and telephone support.

1. Select the → *Serial numbers* menu item in the "Device status" menu.
 - ▶ The serial numbers of the device components are displayed.

6.10 Programmer

6.10.1 Basic information

The programmer allows you to execute and save a temperature-time program. A program consists of several temperature-time segments. A segment contains information on the final temperature of the segment, the duration, the temperature tolerance, the pump level and the switch position (off/on) of the contact. Ramps, temperature jumps and temperature maintenance phases are possible.



Fig. 36: Programmer

- Ramp

A ramp is defined by the specified duration between the start and the end of the segment, and by the destination temperature, i.e. the temperature at the end of the segment.
 - Temperature jump

If a time is not specified (time is 0), the end temperature is reached as quickly as possible.
 - Temperature maintenance phase

No temperature change (the temperatures at the start and the end of a segment have remained identical).
 - Pump level off or 0
 - Pump level [Off] can be selected within a segment. As a result, the program ends when this segment is reached, even though other segments follow in the program. The status of the thermostat is set to "Standby". When the program is started, a message appears indicating that the program will end at this segment.
 - Program optimization

Activating program optimization yields a very good control action in practice. With programs including both ramps and other types of segments, the actual temperature profile matches the target temperature profile more closely than programs without optimization. It reduces overshoots. There can only be significant undershooting at the ramp ends if the control parameters are very unfavorable. Deactivate optimization in this case.

Tolerances that are too small will impair the control result. Work without tolerances where possible.
 - Standby

If the device switches to standby while a program is running, the active program is automatically paused.
1. Press the Enter key to open the menu.
 2. Select the → *Programmer* → *Program X* menu item.
 - ▶ The submenu opens in the selected program.



Fig. 37: Program 1

3. The following options are available:
 - [Status]
 - Select the option [Start] to start the program.
 - Once the program has started, you can press [Hold] to pause it.
 - A paused program can be continued by pressing [Continue].
 - Select the option [Stop] to end the program.
 - [Edit]
 - [Loops]
 - Here you enter the number of repetitions of the selected program.
4. Select the → Edit menu item.
 - ▶ The program appears on the display and you can now edit it.

You can stop the programmer by pressing the [STOP] softkey. After pressing the [START] softkey, the programmer continues to run in the previously selected mode (pause or active mode).

i 100 temperature-time programs can be saved. A maximum of 250 freely programmable segments can be used per program.

i The programmer encoder can be controlled or modified using the timer.

Available settings

No.	Tend	hh	:mm	Tolerance
Start	30.00	---	---	0.1
1	50.00	0	20	0.0
2	50.00	0	20	0.0
3	70.00	0	20	0.1
4	60.00	0	30	0.0
5	30.00	0	0	0.0

Fig. 38: In the program editor

Setting	Description
No.	Program segment number
Tend	End temperature that should be reached
hh	Time in hours (hh) by which the specified temperature should be reached
:mm	Time in minutes (:mm) by which the specified temperature should be reached
Tolerance	Tolerance defines how close the temperature should be to the set temperature before the next segment is processed. 0.0 means that there is no tolerance. In other words, the program focuses on the next temperature when the specified time elapses, even if the starting temperature has not yet been reached.
Pump	In the case of Variocool NRTL, the pump is switched on or off. No pump levels can be set.
S1, S2, S3	The switching state (off or on) of a contact module (if installed) can be entered here. Contact modules are available as an accessory.

Examples of contact module functions

- Functions of the inputs
 - Set fault
 - Set standby
 - Control programmer
 - Control alternating operation (2 different set temperatures)
 - Regulate internal or external control
- Output functions
 - Signal various error states
 - Signal standby
 - Specify position with respect to a temperature window (inside or outside)
 - Specify programmer status
 - Signal refilling

Editing program examples

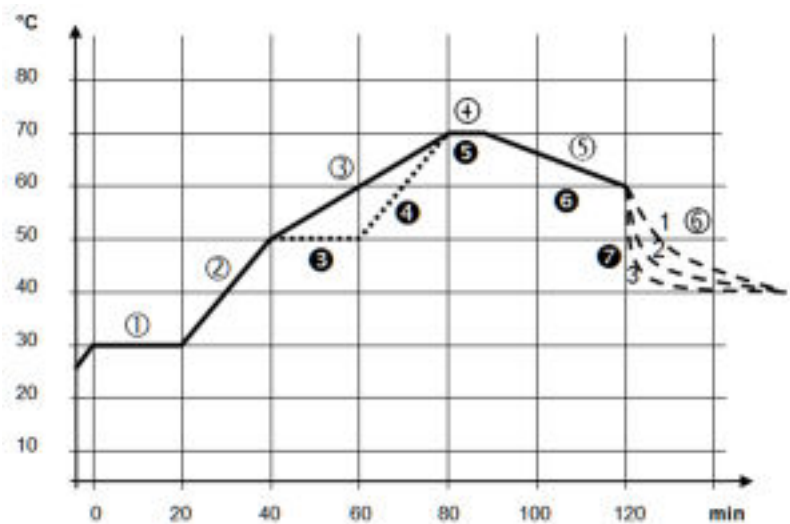


Fig. 39: Program example

The graph shows an example of a reprogrammed set temperature profile.

The cooling time in the graph varies between the device type, the application and other variables. In example segment number 2, 50 °C should be reached within 20 minutes.

The original values in the first table below (before) are represented by a solid line, while the values in the edited profile in the second table (after) are represented by a dashed line.

Start segment

Each program starts with the segment *Start*, which determines the temperature at which segment 1 continues the program. The temperature of the *Start* segment is reached as quickly as possible. It is not possible to specify a time limit for the *Start* segment. Without the *Start* segment, segment 1 would be different depending on the temperature of the heat transfer liquid at program start.

Table 34: Program example, before (—)

No.	Tend	hh	:mm	Tolerance	Pump	S1	S2	S3
Start	30.00	---	---	0.0	on	off	off	off
1	30.00	0	20	0.1	on	off	off	off
2	50.00	0	20	0.0	on	off	off	off
3	70.00	0	40	0.0	on	off	off	off
4	70.00	0	10	0.1	on	off	off	off
5	60.00	0	30	0.0	on	off	off	off
6	40.00	0	0	0.0	on	off	off	off

In the edited table, a new segment with the number 3 has been entered. In addition, the time for the segment with the number 4 has been changed and the pump has been switched off. For the segment with the number 5, the tolerance has been adjusted and the pump has been activated.

Table 35: Program example, after (- - - dashed line, edited)

No.	Tend	hh	:mm	Tolerance	Pump	S1	S2	S3
Start	30.00	---	---	0.0	on	off	off	off
1	30.00	0	20	0.1	on	off	off	off
2	50.00	0	20	0.0	on	off	off	off
3	50.00	0	20	0.1	on	off	off	off
4	70.00	0	20	0.0	off	off	off	off
5	70.00	0	10	0.8	on	off	off	off
6	60.00	0	30	0.0	on	off	off	off
7	30.00	0	0	0.0	on	off	off	off



In the **Pump** column of Variocool NRTL, [Off] or [On] can be entered.

Tolerance

Note the following and see Fig. 40:

- The Tolerance field ensures strict compliance with the residence time at a specific temperature, for example.
- The subsequent segment is only processed when the outflow temperature reaches the tolerance range (1) so the ramp in the second segment only starts after a delay (2), for example.

- Selecting a tolerance range that is too small can cause undesired delays. In extreme cases, it may not be possible to continue the program. The selected tolerance range should not be too small, **especially if the control is external**. A greater tolerance has been entered for segment 5 to guarantee adherence to the required time of 10 minutes, even with transient responses (3).
- A tolerance range should only be programmed for flat (slow) ramps, if appropriate. Steep ramps that come close to the maximum possible heating-up or cooling rates of the device may be severely delayed (4) if the tolerance range is too small (in segment 2 here).

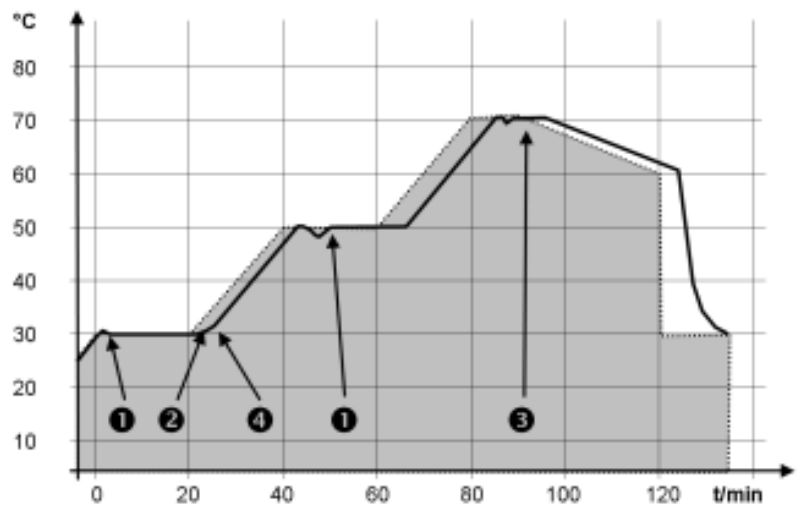


Fig. 40: Target/actual program process

The above graph of the edited process illustrates the possible delay in the development of the actual temperature (solid line) in relation to the set temperature of the programmer (gray area).

6.10.2 Set and process program

Please note:

- If a segment time > 999:59 h is included, this time must be distributed over several successive segments.

Start processing

No.	Tend	hh	:mm	Tolerance
Start	30.00	---	---	0.1
1	50.00	0	20	0.0
2	50.00	0	20	0.0
3	70.00	0	20	0.1
4	60.00	0	30	0.0
5	30.00	0	0	0.0

ESC ○ OK +/-

Fig. 41: Editing a program

1. Select the *Edit* menu item for the selected program.
 - ▶ You can edit the program.

Editing a program

Please note:

- If in the *hh* and *:mm* field the value "0" is entered, the temperature T_{end} will be started as quickly as possible.
- Changes to the pump level are entered in the respective segment (= program line).
- The default value of the contact module is *off*.

You have the following options in the selected program:

- By pressing the right arrow key 5 times you can display the columns Pump, S1, S2 and S3 of the program.
- Use the left arrow key to display the columns T_{end} , *hh*, *:mm* and Tolerance again.
- With the [up] and [down] arrow keys, you can navigate to the segments (lines) of a program.
- With the [OK] you select a value for editing.
- Use the [right] and [left] arrow keys to select individual digits of the value.
- With the [up] and [down] arrow keys, you can increase or reduce the selected digit.
- With the [ESC] softkey, you can deselect a selected value again.
- With the [OK] key, you confirm your change.
- You exit the program with the [ESC] softkey. The entered values are saved.

Add new segment

No.	T_{end}	hh	mm	Tolerance
Start	30,00	---	---	0,1
1	50,00	0	20	0,0
2	50,00	0	20	0,0
3	70,00	0	20	0,1
4	60,00	0	30	0,0
5	30,00	0	0	0,0

ESC ◯NEW DELETE

Fig. 42: Select program segment

Delete segment

1. Navigate to the segment under which the new segment should be added.
 2. In this segment, navigate to the column with the *No.*
 3. Press the [NEW] key.
 - ▶ A new segment is created.
-
1. Navigate to the segment that you want to delete.
 2. In this segment, navigate to the column with the *No.*
 3. Press the *DELETE* softkey.
 - ▶ The segment is deleted.

Editing a program currently running

Please note:

- No segments can be added or deleted in a currently running program.
 - In the running program, changes of the existing temperature values and segment durations are possible. The segment is continued as if the change had been effective since the beginning of the segment.
 - If the new segment time is shorter than the elapsed segment time, the program jumps to the next segment.
1. Select the *Edit* menu item for the running program.
 - ▶ You can edit the segments.

6.11 Setting the time, date, format and time zone

Setting the time format

The set time zone is used to convert between UTC (Universal Time Coordinated) and local time. After UTC, the internal real-time clock runs in the device. The conversion then leads to the automatic changeover from standard time to daylight saving time and vice versa since this is country-dependent. The leap years are independent of this setting as they are already included in UTC. These entries with fixed dates for the coming decades are also included for countries that base their time zone offset on religious specifications.

UTC is also needed to obtain the time from the network because the time and date of NTP time servers are always supplied in UTC only. For this to work at all, however, the LAUDA device must be assigned to an NTP time server via DHCP.

If DHCP is switched off and the IP address is permanently configured, automatic time tracking is not possible. (→ *Basic setting* → *Ethernet* → *LAN settings* → *DHCP client*)

Only change the time/date if you have previously set the time zone. Otherwise, the local time may change due to the changed time zone offset when the time zone is changed.

Setting the time format

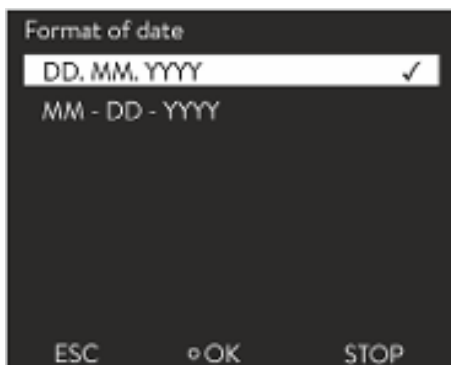


Fig. 43: Selecting options

Personnel: Operating personnel

You can display the date in two formats.

- The setting [DD.MM.YYYY] means the day, month and year is displayed in this order (European).
 - The setting [MM - DD - YYYY] means the day, month and year is displayed in this order (US English).
1. Press the Enter key to open the menu.
 2. Select the → *Time* → *Date format* menu items.
 - ▶ A list of settings opens.
 3. The following options are available in the window:
 - Format [DD.MM.YYYY]
 - Format [MM - DD - YYYY]
 - ▶ The new setting is active with immediate effect.

Setting the time and date

Personnel: Operating personnel

You can set the time and date.

1. Press the Enter key to open the menu.
2. Select the → *Time* → *Set time/date* menu items.
 - ▶ An input window opens.
3. Set the correct time and date.

Use the four arrow keys to navigate.

 - Use the right and left arrow keys to scroll to the corresponding position.
 - Use the up and down arrow keys to change the numerical value.
4. Press the input button to confirm your entry.
 - ▶ The new setting is active with immediate effect.

Setting the time zone

Personnel: Operating personnel

With the set time zone, the automatic changeover from daylight saving to standard time, correction of the date in a leap year, and so on takes place.

1. Press the Enter key to open the menu.
2. Select the → *Time* → *Time zone* menu items.
 - ▶ An input window opens.
3. Select your corresponding time zone.
4. Press the input button to confirm your entry.
 - ▶ The new setting is active with immediate effect.



The device obtains the time and date from the network if it is operated in the network (Ethernet) with a time server. This means that the user only needs to set the time zone.

6.12 Operator and viewer

Definition

Master - Operating unit on the LAUDA device

Command - Command Touch remote control (optional accessory with its own operating manual)

Operator - has read privileges and write privileges

Viewer - has read privileges only

The following operating units and interfaces are viewed:

- Master
- Command (optional accessory)
- Web server

- Control station/PC
 - connected to the constant temperature equipment via Ethernet interface, RS 232/485 interface (optional accessory), Profibus interface (optional accessory) or EtherCAT interface (optional accessory)
- Analog interface (optional accessory)
- Contact interface (optional accessory)



Allowing access to the device via the network

If you wish to have digital access to the device from the outside, this must be set in the device software beforehand.

Allowing access to the device

1. Press the [Enter key] to open the menu.
2. Select the menu items → Setup → Basic setup → Ethernet → PC control or → Web server.
 - ▶ The options [off] and [on] appear on the display.
3. Select the [on] option and press the Enter key to confirm.
 - ▶ A check mark is set. The entry has been accepted.

Range of functions of the operating units

- The full range of functions is available via the Master without restriction.
- Operation via the Command is reduced by the following functions:
 - Entry of TMax
 - Selection of the heat transfer liquid
- Operation via the Web server is reduced by the following functions:
 - Entry of TMax
 - Selection of the heat transfer liquid
 - Safety functions which require user presence at the device (e.g. menus for filling and draining)
- The control station is limited by the functionality of the interface and its protocol (command set).
- The analog interface and contact interface are restricted by their functionality and protocol.

Operator and viewer

Applies equally to Master, Command, Web server and Control station via

- Operator, once at maximum
 - The operator has all setting options available, both reading and writing, if included in the range of functions of the operating unit.
- Viewer, multiple times possible, only read privileges
 - All menus are accessible to the viewer, but no settings which change the function of the device can be made. Exceptions are entries which are necessary to log in as Operator.

The Master has Operator privileges in the set delivery condition.

If a user logs in via Web server or connects the Command operating unit, the Web server or Command has Viewer privileges.

An Operator is logged in and another operating unit requests Operator privileges (↳ “Requesting Operator privileges” on page 89). The first Operator becomes a Viewer after this Operator requests Operator privileges.

If an Operator is downgraded to Viewer, a pop-up window appears with a corresponding message.

The Master automatically becomes an Operator if a detachable control element with Operator privileges is removed.

Exception: A Command Touch with restricted user privileges. In this case, an error is first generated by the constant temperature equipment. The Master becomes the Operator again after it has been restarted (without Command).

Control station

The connection to the control station is actively monitored in the set delivery condition. If no command is received by the device via Ethernet for more than 15 seconds, an interruption of communication is detected. If connection to the control station is interrupted, the constant temperature equipment reacts according to the configuration .

The timeout can be set from one to 600 seconds. Use the command [OUT_SP_08_XX] via the interface for this purpose.

The function can also be executed for the Ethernet interface via the → Setup → Basic setup → Ethernet → Services → PC control → PC Timeout menu. This must be set before the start of communication.

If the monitoring of the control station is active, the Operator privileges are owned exclusively by the control station.

Neither Master, Command nor Web server can obtain Operator privileges.

Operation on the constant temperature equipment is therefore locked. If a timeout occurs during monitoring, the Operator privileges can be automatically transferred to the constant temperature equipment.

A timeout value of 0 must be set to deactivate the monitoring of the connection. The constant temperature equipment can be operated from the control station/PC or on the constant temperature equipment itself. The Operator privileges can be obtained on an alternating basis. In this case, there is no monitoring of the communication and a connection interruption is not detected.



The control station obtains Operator privileges for each write command of the control station, provided that the Operator privileges are not locked by another control element. If the control station sends write commands very frequently, operation can be made more difficult for another control element.

Cold start

The Master returns to the previous login level after the device has been switched off and on again. The same applies to the Command control element and the Web server.

An exception to this is the situation where the operating unit which last requested the Operator privileges is not connected. In this case, the Operator privileges automatically return to the Master when the device is switched on.

Status display

- If an operating unit has Viewer privileges, a lock symbol is displayed instead of the right-hand softkey or the Start/Stop button:
 - The right-hand softkey with the Start/Stop assignment is replaced by the assignment with the lock symbol in the Master.
 - The Start/Stop button is replaced by the lock symbol in the Command.
 - The Start/Stop button is replaced by the lock symbol in the Web server.
 - When operation is carried out using a control station, it is the responsibility of the user (customer) to display the status.

Requesting Operator privileges



Fig. 44: Operation on the device is locked

Locked Operator privileges

Operator privileges are requested by selecting the lock symbol:

- Press the right-hand soft key on the Master operating unit. A pop-up window appears with the query Yes/No.
- Press and hold down the Lock button on the Command remote control longer (> 0.5 s). A pop-up window appears with the query Yes/No.
- Click the Lock button in the Web server. A pop-up window appears with the query Yes/No.

Description:

Each operating unit with Operator privileges can disable the Operator privileges for other operating units/control stations (**lock**). In this case, no other operating unit/control station can obtain Operator privileges and it therefore remains a Viewer.

Locking of the Operator privileges in Command Touch:

- **User privileges** in addition to the Operator privileges and Viewer privileges are specifically available only in the Command Touch (see Command Touch operating manual).
If user privileges have been assigned/restricted via the Command operating unit (in the User configuration menu), all other operating units or the control station/PC become the viewer. Neither other operating units nor the control station can obtain Operator privileges. If an attempt is made to obtain Operator privileges, a message appears.
If a Command with restricted user privileges is disconnected from the constant temperature equipment, an error message is generated and the constant temperature equipment stops. The user must switch the device off and on again. The Master operating unit automatically becomes the Operator.

Locking of the Operator privileges in the control station

- If the monitoring of the control station is active, the Operator privileges are locked/owned exclusively by the control station.
No operating units can obtain Operator privileges. If an attempt is made to obtain Operator privileges, a message appears.
If the control station drops out, the constant temperature equipment is switched off and switched on again, an alarm is triggered or the control station monitoring is deactivated. Exclusive ownership is withdrawn from the control station.

Locking of the Operator privileges in the Master

- If a Safe Mode is triggered, the Operator privileges are transferred to the Master and locked/owned exclusively there. If the Safe Mode is deactivated, the exclusive ownership is withdrawn from the Master.

6.13 Web server LAUDA Command

The embedded Web server

The LAUDA device is equipped with an integrated Web server. The Web server is used to visualize device-internal and process-relevant data such as temperature, pressure and flow rate. The scope of the information displayed depends on the device, device type and installed accessories.

You can use the following software to access the Web server:

- **LAUDA Command app:**
Available in the app stores for mobile devices based on iOS and Android and in the Windows Store for Windows-based PC systems. The LAUDA Command app can also be downloaded from the LAUDA homepage for Windows-based PC systems. Open the LAUDA homepage, tap → *Services* → *Download center*. In the Download center, chose the [Software] option in the [Document type] drop-down list.
- **Web browser:**
Connection to the LAUDA device via a browser.

Requirements

- The LAUDA device and the PC/control station must be connected to the same network. The network settings can either be set automatically (*DHCP on*) or manually (*DHCP off*) on the device ↪ Chapter 4.7.3 “Configuring the Ethernet interface” on page 31.



Connection to the device via the LAUDA Command App

LAUDA recommends using the LAUDA Command app. If you use this app, state-of-the-art security mechanisms which offer a very high level of security against digital threats are automatically put in place. In addition to this, the App has an integrated search service for LAUDA devices in the local network, so that manual entry of a host name or IP address is no longer necessary.

Operating the device with the app

You are using the LAUDA Command app. This automatically searches for existing devices in the network. The devices found are displayed in a list. Select the required device. Connection to the device is established. If a connection to a device was established before closing the App, connection to this device is established when the App is started again.

Security with the web browser

The LAUDA device can be accessed with a web browser if users cannot use the LAUDA Command app for technical reasons or IT guidelines prohibit this.

You must install the LAUDA CA certificates (Root CA, Device CA) to obtain a high level of security when using a web browser.

You must carry out the following before using a web browser:

1. Download the CA certificates from the LAUDA homepage before connecting for the first time.
Open the LAUDA homepage, tap → *Services* → *Download center*.
2. In the Download center, chose the [Certificate] option in the [Document type] drop-down list.
 - ▶ A list of the certificates appears.
3. Tap the relevant certificate.
 - ▶ The download starts and a zip file is downloaded.
4. Install the certificates on all end devices which will be used later to access the LAUDA device.
5. Answer the question about whether you trust the LAUDA certificates with [Yes].
6. Compare the Common Name of the device certificate with the Controller ID of your LAUDA device during the initial connection setup.
 - ▶ The 24-character identification number is displayed. This can consist of the numbers 0-9 and the letters A-F. This is shown on the display in three number blocks (digits 1-8, 9-16 and 17-24).
7. Confirm the connection.



Fig. 45: Controller ID

Operating the device via the Web server

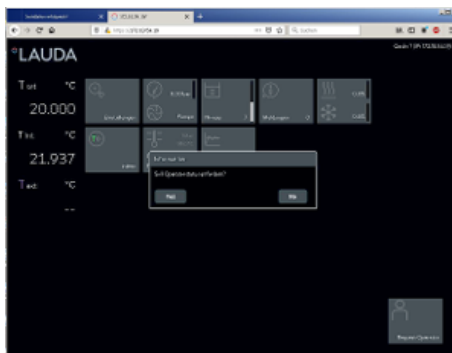


Fig. 46: Web server in the browser window

Operation of the LAUDA devices via the web server is carried out in the same way as operation via the operating unit on the device. If required, please refer to the respective descriptions of operation provided in this operating manual.

The operation of the device via the LAUDA Command App is very similar to the remote control Command Touch, whose operating instructions can be downloaded from our homepage. Open the LAUDA homepage, tap → *Services* → *Download center*. In the Download center, chose the [PRO] option in the [Product line] drop-down list.

You need the IP address or the serial number of the constant temperature equipment when you use the web browser. Enter the IP address or the serial number in the address line of the browser. Connection to the device is established.

Viewing the IP address

Select the menu items → *Setup* → *Basic setup* → *Ethernet* → *LAN configuration* → *Local IP address*.

Viewing the serial number

Select the menu items → *Device Status* → *Serial numbers*.

Cookies

Cookies must be activated if you use a web browser. The device creates a cookie with a connection-specific token which is generated during the initial mutual authentication. This information is lost if the cookie is rejected or deleted. Authentication must then be repeated the next time a connection is established.

Two-Factor Authentication (2FA) for increased security

Contact your network administrator if you require further assistance in implementing secure access.

Two-Factor Authentication is an authentication using a combination of two different and independent paths. The user is checked by the remote station and the remote station is checked by the user.

In the case of LAUDA, a user with automatically generated access data is created in the constant temperature equipment during the 2FA. The access data is stored in the App in the form of a token and as a cookie in the web browser. The token is valid for 6 months. In addition to this, all registered users (tokens) can be deleted via the Master on the constant temperature equipment. The user must repeat the 2FA in these cases.

The 2FA must be performed:

- At the first connection.
- When the token is no longer valid.
- When the cookie is no longer valid.
- If the cookie has been deleted in the browser or has not been saved.

The user is automatically prompted by the App or the web browser if a 2FA is necessary. A 6-digit one-time password is shown on the display of the constant temperature equipment when performing the 2FA. This is valid for 5 minutes. Type the code displayed in the Web client and confirm your entry. The connection is continued if authentication is successful. If an error occurs, check whether your entry was correct.

6.14 Cloud service LAUDA.LIVE



Fig. 47: Home window with cloud in the status bar

The LAUDA Variocool NRTL enables the communication of device data to the cloud-based service LAUDA.LIVE. The service provides various optional features and offers, such as remote maintenance.

Please contact LAUDA or visit our website for detailed information about LAUDA.LIVE and its services.

To implement the LAUDA.LIVE service, device data is exchanged with the LAUDA.LIVE cloud via an encrypted connection, enabling the LAUDA service to remotely maintain the constant temperature equipment.

Requirements

- The LAUDA Variocool NRTL has direct Internet access to LAUDA.LIVE via the Ethernet interface. It may be necessary to adapt the network settings and local network conditions ↪ Chapter 4.7.3 “Configuring the Ethernet interface” on page 31.
Note: The constant temperature equipment uses a dynamic IP address via DHCP by default. No further network settings are necessary provided that this is supported in the local network and Internet access is enabled.
- Users who cannot provide the constant temperature equipment with Internet/LAUDA.LIVE access via their local network for technical reasons or whose IT policies prohibit this can use a LAUDA wireless gateway as an alternative (please contact LAUDA for further information).



LAUDA.LIVE access and data transmission is disabled by default.

Allowing access to the LAUDA.LIVE cloud



Fig. 48: Services

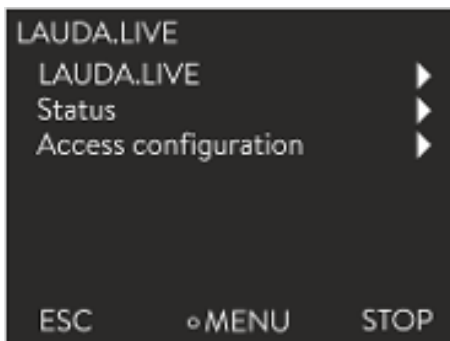


Fig. 49: LAUDA.LIVE menu

1. Press the Enter key to open the menu.
2. Select the menu items → *Setup* → *Basic setup* → *Ethernet* → *Services* → *LAUDA live* → *LAUDA live [off/on]*.
 - ▶ The options [off] and [on] appear on the display.
3. Select the [on] option and press the Enter key to confirm.
 - ▶ The entry has been accepted.

After switching on, the constant temperature equipment is registered and authenticated via an encrypted TLS connection using a device-specific X.509 certificate in LAUDA.LIVE. The connection can only be initiated on the device side for security reasons. A successful connection to LAUDA.LIVE is indicated in the same menu item under [Status]:

- connected - currently connected to LAUDA.LIVE
- connecting - connecting to LAUDA.LIVE
- off - switch off LAUDA.LIVE

If a connection to LAUDA.LIVE already exists, a cloud appears in the status bar of the home window.

Since LAUDA provides the user with full control over the data to be transferred, device data is not transferred until LAUDA.LIVE access has been configured.

Configuring LAUDA.LIVE access

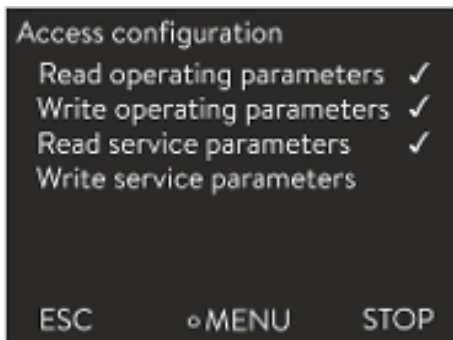


Fig. 50: Access configuration

1. Press the Enter key to open the menu.
2. Select the menu items *Setup* → *Basic setup* → *Ethernet* → *Services* → *LAUDA live* → *Access configuration*.
 - ▶ The following options appear on the display:
3. Select the desired option and press the Enter key to confirm.
 - ▶ A check mark is set. The entry has been accepted and the relevant option is enabled.



The Access configuration menu enables the user to independently define the data which may be transferred: [Op. param. readable] and [Service prm. readable].

A distinction is made between operating parameters (such as the set point/actual temperature (Tset/Tint/Text)) and the service parameters (internal device parameters). The operating parameters are essentially the parameters which are displayed to the user on the device display and can be modified by the user. In contrast, the service parameters are only available to the LAUDA Service.

Changing the data in the constant temperature equipment from the cloud, e.g. as part of remote maintenance by the LAUDA Service, is activated on the device side via [Op. param. writable] and [Service prm. writable].

In addition to measures provided in LAUDA.LIVE for authorizing access and changing device data, e.g. 2-factor authentication, the device-side access configuration is used by the user for basic restriction/control of the LAUDA.LIVE services.

6.15 Importing and exporting data

6.15.1 Importing data

Importing data from a USB stick

You can import the following data from a USB stick:

- Control parameters
- Analog module config.
- Contact module config.

If you have previously exported the control parameters, analog module configuration or contact module configuration of a device to a USB stick, you can use the USB stick to transfer them to another device.

Personnel: Operating personnel

1. Insert the USB stick in the USB host on the operating unit of the machine.
2. Press the Enter key to open the menu.
3. Select the → *Data export/import* → *Data import* menu items in the main menu.
 - ▶ The submenu opens.

- [Device data]
This data record is located in the subdirectory *DEV_DATA* and contains the file *DAT0.CSV* or several *.CSV* files with ascending numbering in the case of multiple exports.
All the existing measured values (temperatures, pressures, voltages, currents, and so on) are stored in this file as a snapshot of the system.
- [Control parameters]
This data record is located in the directory *LAUDA / USER* and contains the file *CTRLPARA.INI*. Only such a file can be exported. The file will be overwritten on re-export.
The file contains all the temperature control parameters as well as the temperature limits *Tih* and *Til*. The file is designed to transfer the settings of the control parameters from one device to another.
- [Analog module config.]
[Contact module config.]
These data records can only be exported if an analog module or contact module has been connected to the constant temperature equipment. The configuration is stored in the *LAUDA / USER* directory in the *ANACFG.INI* or *CONTCFG.INI* file. Only such a file can be exported in each case. This file will be overwritten on re-export. The file contains the complete configuration of the connected analog module or contact module. The file is designed to transfer the configuration from one constant temperature device to another.

Personnel: ■ Operating personnel

1. Insert the USB stick in the USB host on the operating unit of the machine.
2. Press the Enter key to open the menu.
3. Select the → *Data export/import* → *Data export* menu items in the main menu.
 - ▶ The submenu opens.
4. Select one of the following options:
 - n [Temperature graphic]
 - n [Device status]
 - n [Device data]
 - n [Control parameters]
 - [Analog module config.]
 - [Contact module config.]
5. Start the export by pressing the Enter key [OK].
Messages appear on the display during the export:
 - Data export to USB stick started.
 - Data export to USB stick has been successfully completed.
Confirm the message by pressing the Enter key [OK] once the data export has been completed.

If the data export was not successful, the message "Data export to USB stick failed" appears on the display. Press [OK] to confirm.

Check that the USB stick was inserted correctly and that there is enough free memory space (at least 1 MB).

Start the data export again.

7 Maintenance


7.1 Maintenance intervals

The maintenance intervals described in the following table must be observed. The following compulsory maintenance tasks must be performed before operating the device for prolonged periods.

Interval	Maintenance work
Weekly	Check the drain taps: <ul style="list-style-type: none"> ■ they must be set to the "closed" position and liquid must not escape. ■ The sealing caps must be fitted to the draining nozzles and tightened.
Monthly	Inspect the external condition of the device.
	Check the external hoses for material fatigue.
	Clean the air-cooled condenser.
	Clean the filter strainer.
	Check the function of the low-level protection.
Quarterly	Descale the cooling water circuit on water-cooled devices. (a shorter interval must be selected, depending on the water hardness and operating period)
Six monthly	Check the serviceability of the heat transfer liquid.


7.2 Cleaning the surfaces of the device

Personnel: ■ Operating personnel


WARNING!
 Risk of cleaning agent entering the device

Electric shock

- Only use a slightly damp cloth for cleaning.



NOTICE!
 Cleaning agents corrode surface structures

Damage to the device surfaces

- Do not use cleaning agents containing acetone, ethanol or other solvents for cleaning work.

1. Clean as follows:
 - Clean the control element using a wet cloth with a drop of washing-up liquid.
 - Clean painted sheet metal parts with a cloth and commercial industrial cleaner.

7.3 Check the heat transfer liquid

 WARNING! Contact with hot/cold heat transfer liquid	
	Scalding, cold burns
	<ul style="list-style-type: none"> Bring the heat transfer liquid to room temperature before starting work that may involve coming into contact with the liquid.


- Personnel: ■ Operating personnel
- Protective equipment: ■ Safety glasses
■ Protective gloves
■ Protective work clothing

The serviceability of the heat transfer liquid must be checked if necessary (e.g. if the operating mode is changed), but at least every six months. Continued use of the heat transfer liquid is only permitted following successful testing.

The heat transfer liquid must be tested as outlined in DIN 51529: Testing and assessment of used heat carrier media.

Source: VDI 3033; DIN 51529

7.4 Draining heat transfer liquid

 CAUTION! Contact with hot/cold heat transfer liquid	
	Scalding, cold burns
	<ul style="list-style-type: none"> Bring the heat transfer liquid to room temperature before starting work that may involve coming into contact with the liquid.

- Personnel: ■ Operating personnel
- Protective equipment: ■ Safety glasses
■ Protective gloves
■ Protective work clothing

1. Allow the device and heat transfer liquid to cool or warm up to room temperature.
2. Switch off the device and pull out the mains plug.
3. Screw a threaded sleeve with hose to the draining nozzle.
 - ▶ External thread on the draining nozzle on VC 10000 NRTL variants $\frac{3}{4}$ ", for all other VC NRTL variants $\frac{1}{2}$ ".

4. Place the hose in a suitable container to collect the heat transfer liquid.



It may be necessary to drain the device several times if the filling volume is high.

5. Release the return hose on the application.
6. Open the drain tap. Here, turn the tap counterclockwise.
7. Let the device run idle.
8. Remove the hoses from the external application. Empty the heat transfer liquid into a suitable container.
9. Close the drain tap after draining.



Observe the regulations for the disposal of used heat transfer liquid.



Depending on the consumption situation, the draining sequence may differ or contain additional steps.

7.5 Cleaning the thermostatic circuit



NOTICE! Internal icing

Device damage

- If water containing a cleaning agent (grease solvent) is used as a cleaning liquid, always make sure that the device is operated in fill mode (heating and cooling unit are deactivated).



In order to clean the internal thermostatic circuit, it must first be emptied.

Reasons for cleaning the thermostatic circuit may include, for example:

- During the inspection, you have determined that the heat transfer liquid was no longer suitable for use and drained it.
- You have drained the dirty heat transfer liquid and there are still residues of dirt in the thermostatic circuit.

- After the heat transfer liquid has been drained, residues remain in the device. These residues should be removed before placing the device into storage.
- If you wish to use a new heat transfer liquid and the device is operated above the thermal load limit of the old heat transfer liquid, deposits can form, especially on the heaters. These coatings reduce the performance of the device and decrease the service life of the device. Therefore, clean the device with an approved cleaning liquid or flush the device with the new heat transfer liquid before filling with heat transfer liquid for your application. Drain and dispose of the heat transfer liquid used for rinsing after the rinsing process.

- Personnel: ■ Operating personnel
- Protective equipment: ■ Safety glasses
- Protective gloves
- Protective work clothing

Suitable cleaning fluid	for heat transfer liquid
Water	Kryo 30

1. Connect a hose between the thermostatic circuit connecting sleeve at the pressure side and the thermostatic circuit connecting sleeve at the inflow (short-circuit hose).
2. Fill the device with a suitable cleaning fluid in fill mode.
3. Operate the device in fill mode for the duration of the cleaning.
4. Screw a threaded sleeve with hose to the draining nozzle.
 - ▶ External thread on the draining nozzle on VC 10000 NRTL variants $\frac{3}{4}$ ", for all other VC NRTL variants $\frac{1}{2}$ ".
5. Check the cleaning fluid for dirt or old heat transfer liquid.
 - ▶ If you detect dirt in the cleaning fluid, repeat points 2 to 3. Otherwise continue with point 5.
6. Remove the hose from the connecting sleeve of the thermostatic circuit.
7. Dry the internal thermostatic circuit in the device with compressed air. Here, allow the compressed air to flow into the device alternately via the thermostatic circuit connecting sleeve at the pressure side and the thermostatic circuit connecting sleeve at the inflow.
8. Remove the hose from the draining nozzle and close the drain tap.

7.6 Draining the cooling water circuit

This section is relevant for:

- Water-cooled devices

<p>! NOTICE! Frost damage or contamination of the heat exchanger</p>	
	Damage to water-cooled devices
	<ul style="list-style-type: none"> ● Before decommissioning prior to transport, storage, maintenance or servicing, or to protect against frost damage, completely drain the cooling water circuit on the device.

<p>! NOTICE! Splashed liquid</p>	
	Material damage from splashed liquid
	<ul style="list-style-type: none"> ● Use suitable collection containers that completely enclose the connecting sleeves.

- Personnel: ■ Operating personnel
- Protective equipment: ■ Safety glasses
■ Protective gloves
■ Protective work clothing

The device is now in standby mode.

1. Shut down cooling water supply.
2. Unscrew the hose from the cooling water outlet connecting sleeve on the device.
3. Press the Enter button to open the menu.
4. Select the menu items → *Pump* → *Water valve* → *open*.
 - ▶ The water valve opens.
5. Drain the cooling water circuit completely.
6. Unscrew the hose from the cooling water inlet connecting sleeve on the device.
7. Remove liquid residues from the cooling water circuit by introducing compressed air alternately through both connecting sleeves on the cooling water circuit.
 - ▶ Collect any residual liquid in a suitable container and dispose of.
8. Set the water valve to *auto* on the control menu (automatic). This is the default setting.

7.7 Cooling water circuit maintenance

This section is relevant for:

- Water-cooled devices

Cleaning filter strainer

The cooling water circuit and filter strainer must be cleaned regularly to maintain full cooling output.

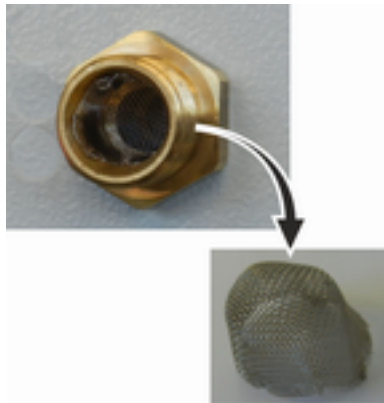


Fig. 52: Remove filter strainer

Descaling the cooling water circuit

- Personnel: ■ Operating personnel
- Protective equipment: ■ Safety glasses
 ■ Protective gloves
 ■ Protective work clothing

1. Switch machine off.
2. Shut down cooling water supply.
3. Unscrew the hose for the cooling water inlet from the device.
4. Remove the filter strainer from the water inlet. If necessary, use pointed pliers or large tweezers.
5. Clean the filter strainer.
6. Replace cleaned filter strainer and reconnect the hose.

Required equipment for descaling with a pump (drum pump):

- a container with approx 20 liter volume
- a pump
- Hoses between container and pump and between pump and cooling water circuit
- Hose between cooling water circuit and container

Required equipment for descaling with a funnel:

- Two containers with 10 to 20 liter volume
- A funnel
- Hose between funnel and cooling water circuit Place the funnel as high as possible, so that the device fills with descaler quickly
- Hose between cooling water circuit and container

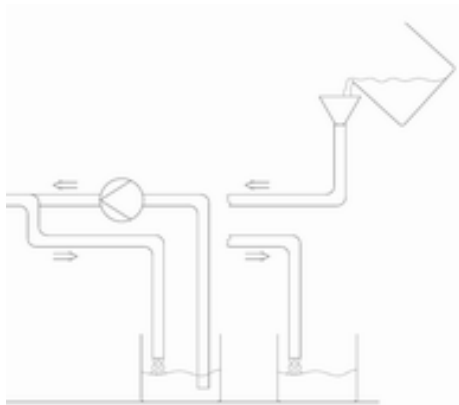


Fig. 53: Descaling

- Personnel: ■ Operating personnel
- Protective equipment: ■ Safety glasses
 ■ Protective gloves
 ■ Protective work clothing

1. Switch the device to standby
2. Press the Enter key to open the menu.
3. Select the menu items → *Fill mode* → *Water valve* → *open* on the operating unit.
 - ▶ The water valve opens.
4. Fill the device with descaler-water mixture via the hose on the cooling water inlet.
5. Recirculate the descaler/water mixture or refill continuously.
6. Leave the descaler-water mixture to work (see table below).
7. Flush the device thoroughly with clean water (see table below).
8. Drain cooling water circuit. Blow compressed air through the cooling water circuit.
9. Select the menu items → *Fill mode* → *Water valve* → *auto* (automatic) on the operating unit. This is the default setting.

Reaction time:	Continue pumping or refilling until the foaming reaction (usually at the beginning) has subsided. This usually takes 15 to 30 minutes.
Descaler:	Only permitted: LAUDA descaler with article number LZB 126 (5 kg pack). You must always follow the safety instructions and the instructions for use on the packaging when handling the chemical!
Flushing:	Let at least 30 liters of clean water run through the device.

7.8 Cleaning the air-cooled condenser

This section is relevant for:

- Air-cooled devices

Personnel: ■ Operating personnel

1. Switch off the device.
2. Carefully remove the front panel. Grasp the front panel at the recess, pull it towards you and lift it out of the guide.





The front panel is held in place by a magnetic catch.

3. Brush off or vacuum the condenser.
4. Install the front panel again with care.

7.9 Checking the low-level protection

An alarm signal sounds before the liquid level decreases so much that the heater is no longer covered completely with liquid. *Low level* appears on the display. The electronics system switches off the device components.


 WARNING! Contact with hot or cold heat transfer liquid	
	Scalding, cold burns
	<ul style="list-style-type: none"> ● Bring the heat transfer liquid to room temperature before draining.
 An alarm must sound as soon as the minimum level is reached.	

Personnel: Operating personnel

Protective equipment: Safety glasses
 Protective gloves
 Protective work clothing

1. Switch on the device and the pump. Set the set temperature to room temperature.
2. Watch the level indication on the display.
3. Lower the liquid level in the device. For this purpose, allow the heat transfer liquid to flow out into a suitable container via the open drain nozzle.
 - ▶ The display shows that the heat transfer liquid is sinking.
 - If the fill level falls to level 2, a warning is issued on the display.
 - If the liquid falls to level 0, the device switches off and the *Alarm* message appears on the display.
4. Close the drain tap.
5. Top up the heat transfer liquid.
 - ▶ The liquid level in the display rises.
6. Delete the fault in the device menu.

7.10 Information on decommissioning

 NOTICE! Frost damage or contamination of the heat exchanger	
	Damage to water-cooled devices
	<ul style="list-style-type: none"> ● Before decommissioning prior to transport, storage, maintenance or servicing, or to protect against frost damage, completely drain the cooling water circuit on the device.

To avoid damage during storage or transport, all liquids must be drained completely from the device.

1. Drain the heat transfer liquid from the device ↪ Chapter 7.4 “Draining heat transfer liquid” on page 99.
2. Clean the internal thermostatic circuit.
3. Completely drain the cooling water circuit on water-cooled devices.
4. Observe the relevant temperature limits ↪ Chapter 12.1 “Dimensions, temperatures, filling quantities and other data” on page 114.

7.11 Notes on servicing and repairs



DANGER!
Contact with live or moving parts

Electric shock, impacts, cutting, crushing

- The device must be disconnected from the mains power supply before any kind of service or repair work is performed.
- Only specialist personnel authorized by LAUDA are permitted to perform service and repair work.



CAUTION!
Contact with hot or cold device parts, accessories and heat transfer liquid

Scalding, hot or cold burns

- Allow device parts, accessories and heat transfer liquid to reach room temperature before touching.

Note the following information about service and repair work:

- If you discover any damage to the device or device components, proceed as follows:
 - Switch off the device at the main switch.
 - Secure the device against accidental restart.
 - Pull out the mains plug.
- Repair and service work may only be performed by LAUDA Service or suitable specialist personnel working for a service partner authorized by LAUDA. You will find the contact information under ↪ Chapter 11.5 “Contact LAUDA” on page 113.


8 Faults

8.1 Alarms, errors and warnings

All alarms, error messages and warnings triggered on the device appear in text form on the display.

Procedure in event of alarm

Alarms affect safety. The components of the device, such as the pump, switch off. The device emits a signal tone. Once the cause of the fault has been eliminated, the alarm can be lifted with the enter button.


Refer to  Chapter 8.2 “Alarms” on page 107 for a list of alarms.

Procedure in event of warning

Warnings do not have a significant effect on safety. The device continues to operate. The device will make a continuous noise for a short period of time. Warnings are issued periodically. Once the cause of the fault has been eliminated, the warning can be lifted with the enter button.

Procedure in event of error

If an error occurs, the device emits a signal tone.

If this happens, switch off the device at the mains switch. If the error occurs again after switching on the unit, make a note of the error code and the corresponding description and contact LAUDA Service for Constant Temperature Equipment. You will find the contact information here  Chapter 11.5 “Contact LAUDA” on page 113.



Errors are displayed with an appropriate description and an error code in the form of a consecutive number.

8.2 Alarms

Code	Message	Description
1	Low-level pump	Pump detects low level
2	Low level	Float detects low level
3	Overtemperature	Overtemperature ($T > T_{max}$)
4	---	---
5	Verb. Command	The Command Touch remote control was withdrawn during operation.
6	---	---
7	No water	No cooling water connected
8	---	---
9	T ext Pt100	External actual value of Pt100 is not available
10	T ext analog	External actual value of analog signal is not available
11	T ext serial	External actual value of serial interface is not available

Code	Message	Description
12	Analog input 1	Analog module: Current input 1, interruption.
13	Analog input 2	Analog module: Current input 2, interruption.
14	High level	Float detects high level
15	Digital input	Fault on the digital input/switching contact
16	Refilling	The level of the heat transfer liquid is too low.
19	Gage pressure	Gage pressure at inlet
20	T ext Ethernet	The external actual value of the Ethernet module is not present
21	T ext USB	The external actual value of the USB port is not present
22	Communication interrupted	Communication interrupted on the interface module
23	T ext EtherCAT	The external actual value of the EtherCAT module is not present
24	---	---

8.3 Troubleshooting

Before informing the LAUDA Service department ↪ Chapter 11.5 “Contact LAUDA” on page 113, please check whether you can resolve the problem with the following instructions.

Table 36: Process thermostat

Fault	Cause ⇒ Possible remedy
The device cools very slowly or not at all.	<ul style="list-style-type: none"> ■ The cooling unit (Smart Cool) is switched off ⇒ Switch on the cooling unit. ■ The controller output limit is active ⇒ Switch off the controller output limit. ■ The condenser is contaminated ⇒ Clean the condenser ↪ Chapter 7.8 “Cleaning the air-cooled condenser” on page 104. ■ The temperature limit value Til is too high ⇒ Reduce the temperature limit value Til.
The device heats only very slightly or not at all.	<ul style="list-style-type: none"> ■ The controller output limit is active ⇒ Switch off the controller output limit. ■ The temperature limit value Til is too low ⇒ Increase the temperature limit value Til. ■ The dynamic heating capacity restriction is active ⇒ Switch off the dynamic heating capacity restriction.
The cooling unit is in operation for a few minutes, even though no cooling is necessary.	<ul style="list-style-type: none"> ■ Normal function (protection function), no remedy necessary

Fault	Cause ⇒ Possible remedy
Display: Overtemperature protection.	<p>If the temperature exceeds 90 °C, overtemperature alarm 3 is triggered and a two-tone acoustic signal sounds. The heaters, cooling system and pump are switched off as a result of this alarm.</p> <p>Troubleshooting:</p> <ul style="list-style-type: none"> ■ Turn off the device at the main switch. ■ Allow the device to cool to below 90° C (> 20 minutes). ■ Switch on the device. ■ Press the OK key to acknowledge the alarm.
Display: Level too high (Threat of excess level in expansion vessel). Display: Level too high (Excess level in expansion vessel).	<ul style="list-style-type: none"> ■ Heating increases the volume ■ The heat transfer liquid has absorbed moisture from the ambient air
Display: Gage pressure (Outflow pressure too high).	<ul style="list-style-type: none"> ■ The maximum pressure is too low ⇒ Increase the maximum pressure.

9 Disposal

9.1 Disposing of packaging

The following applies for EU member states: Disposal of the packaging must proceed according to regulation 94/62/EC.

9.2 Disposing of refrigerant

Disposal of refrigerant must proceed according to regulation 2015/2067/EU in combination with regulation 517/2014/EU.



CAUTION!
Uncontrolled escape of refrigerant

Impacts, cutting

- Only specialized personnel are permitted to perform disposal work.



NOTICE!
Uncontrolled escape of refrigerant

Environment

- Never dispose of a cooling circuit that is still pressurized.
- Only specialized personnel are permitted to perform disposal work.



The type and refrigerant charge are printed on the rating label.

Have repair and disposal carried out only by a refrigeration technician.

9.3 Device disposal



The following applies for EU member states: The device must be disposed of according to Directive 2012/19/EU (WEEE Waste of Electrical and Electronic Equipment).

10 Accessories

The following electrical accessories are available for Variocool NRTL devices.

Table 37: Large module bay (51 mm x 27 mm)

Accessories	Catalog number
Analog interface module	LRZ 912
RS 232/485-interface module	LRZ 913
Contact interface module with 1 input and 1 output	LRZ 914
Contact interface module with 3 inputs and 3 outputs	LRZ 915
Profibus interface module	LRZ 917
External Pt100/LiBus module	LRZ 925

Table 38: Small module bay (51 mm x 17 mm)

Accessories	Catalog number
External Pt100/LiBus module	LRZ 918

Table 39: Remote control

Accessories	Catalog number
Command Touch remote control unit (only functional in combination with LRZ 918 or LRZ 925)	LRT 923

Table 40: Connecting plug

Accessories	Catalog number
External temperature probe with socket and shielded connection cable	ETP 059
Coupling connector, 6-pin for analog inputs/outputs	EQS 057
Connecting plug SUB-D, 9-pin	EQM 042
RS 232 cable (length: 2 m) for PC	EKS 037
RS 232 cable (length: 5 m) for PC	EKS 057
3-pin coupling connector for contact input	EQS 048
3-pin coupling socket for contact output	EQD 047

Please also refer to our accessory brochures for further accessories.

11 General

11.1 Copyright

This manual is protected by copyright and only meant for internal use by purchasers.

The relinquishment of this manual to third parties, copying in any way whatsoever – even in the form of excerpts – and the utilization and/or conveyance of its content are not allowed, except for internal purposes, without written approval from the manufacturer.

Violation of this may obligate the violator to the payment of damages. Other claims reserved.

We point out that the designations and brand names of the respective companies used in the manual are generally subject to trademark, brand and patent protection.

11.2 Technical changes

The manufacturer reserves the right to make technical modifications to the device.

11.3 Warranty conditions

LAUDA offers a standard 12 month manufacturer's warranty on Variocool NRTL process thermostats from the date of purchase.

11.4 License texts

You can obtain the license texts for the software used in the device from the English version of our LAUDA website.

1. Enter the following into your browser's address line: <https://www.lauda.de/en/> and confirm your entry.
2. Click → *Services* → *Download center*.
3. In the Download center, chose the [English] option in the [Language] drop-down list.
 - ▶ A long list of files with multiple formats appears.
4. Now also filter the [Software] entry in the [Document type] drop-down list.
 - ▶ The list is now more clear.
5. Search for the following software files:
 - Lizenztexte_µTZ.txt
 - Lizenztexte_Qt.txt
 - GUF-Yocto-31.2-r8616-0.tar.zipClick on the relevant file line to start the download.
 - ▶ The file starts downloading.

11.5 Contact LAUDA

Contact the LAUDA Service department in the following cases:

- Troubleshooting
- Technical questions
- Ordering accessories and spare parts

Please contact our sales department for questions relating to your specific application.

Contact information

LAUDA Service

Phone: +49 (0)9343 503-350

Email: service@lauda.de

12 Technical data

12.1 Dimensions, temperatures, filling quantities and other data

Table 41: Shared device data

Specification	Value	Unit
Display type	TFT, white font on black background	---
Display size	3.5	Inches
Display resolution	320 x 240	Pixels
Setting resolution	0.01	°C
Display resolution	0.01	°C
Entry	via eight keys	---
Installation and use	Indoors	---
Maximum height of installation above sea level	up to 2,000	m
Relative humidity	Maximum relative air humidity 80 % at ambient temperature of 31 °C and up to 40 °C, 50 % with linear decrease	---
Ambient temperature range	5 – 40	°C
IP protection level	IP 32	---
Mains voltage fluctuations	Permissible up to ±10% of the nominal voltage	---
Protection class for electrical equipment DIN EN 61 140 (VDE 0140-1)	1	---
Class division according to DIN 12 876-1		
- Class designation	III	---
- Identification code	NFL (suitable for non-flammable liquids)	---
Storage temperature range	5 – 43°C; for water-cooled units, the condenser must be completely empty	°C
Transportation temperature range	-20 – 43	°C



The noise level of the various devices was measured according to the guidelines included in DIN EN ISO 11200 and the basic standards cited therein. The measured values correspond to the operating conditions that occur during typical device operation.

Table 42: Variocool NRTL

Specification	Unit	VC 1200 (W) NRTL		VC 2000 (W) NRTL		VC 5000 (W) NRTL		VC 10000 (W) NRTL	
ACC area*	°C	-20 – 80		-20 – 80		-20 – 80		-20 – 80	
Temperature stability ②	K	±0.05		±0.05		±0.1		±0.1	
Device dimensions width x depth x height	mm	450 x 550 x 825		450 x 550 x 825		550 x 650 x 1065		650 x 675 x 1350	
Filling volume									
- minimum	L	9		9		14		52	
- maximum	L	14		14		24		65	
Connector thread (outer) inlet/outlet	---	G¾"		G¾"		G¾"		G1¼"	
Distance between device and environ- ment									
Heat discharge		Air	Water	Air	Water	Air	Water	Air	Water
- Front	cm	20	20	20	20	50	20	50	20
- Back	cm	20	20	20	20	50	20	50	20
- Right	cm	20	0	20	0	20	0	20	0
- Left	cm	20	0	20	0	20	0	20	0



*ACC area (Active Cooling Control) according to DIN 12876 is the working temperature range during operation with an active refrigerating machine.

② - Measured value determined according to standard DIN 12876-2 (12/2001)

Table 43: Pump data

Specification	Unit	VC 1200 (W) NRTL	VC 2000 (W) NRTL	VC 5000 (W) NRTL	VC 10000 (W) NRTL
Pump data at 50 Hz					
- Maximum discharge pressure	bar	3.1	3.1	5.3	5.3
- Maximum flow rate	l/min	37	37	56	63
Pump data at 60 Hz					
- Maximum discharge pressure	bar	4.1	4.1	7.3	7.3
- Maximum flow rate	l/min	44	44	65	75

Table 44: Variocool 1200 / 2000 NRTL

Specification	Unit	VC 1200 NRTL	VC 1200 W NRTL	VC 2000 NRTL	VC 2000 W NRTL
Sound pressure level ③	dB(A)	59	59	60	59
Weight	kg	65	64	72	71

Table 45: Variocool 5000 / 10000 NRTL

Specification	Unit	VC 5000 NRTL	VC 5000 W NRTL	VC 10000 NRTL	VC 10000 W NRTL
Sound pressure level ③	dB(A)	70	68	74	72
Weight	kg	118	117	156	154

③ - Sound pressure level according to EN 11201 for operating position in front of device at a distance of 1 m.

12.2 Heating output

Table 46: Variocool NRTL

Table 1	Unit	VC 1200 (W) NRTL	VC 2000 (W) NRTL	VC 5000 (W) NRTL	VC 10000 (W) NRTL
Heating output 200 – 230 V, 50 Hz/60 Hz	kW	1.9...2.5	1.9...2.5	---	---
400 V; 3/PE~50 Hz	kW	---	---	7.5	15.8
460 V; 3/PE~60 Hz	kW	---	---	10	17.0
Current consumption	A	16.0	16.0	16.0	25.0

12.3 Cooling output



Measuring the performance data according to DIN 12876

The cooling capacity is measured at fixed temperatures of the heat transfer liquid. Ethanol is used as the standard heat transfer liquid, thermal oil is used for temperatures above 20 °C. The ambient temperature for the measurement of air-cooled devices is 20 °C. For the measurement of water-cooled devices the cooling water temperature is 15 °C as well as the cooling water differential pressure 3 bar.

Table 47: Variocool NRTL

Air-cooled	Unit	VC 1200 NRTL		VC 2000 NRTL		VC 5000 NRTL		VC 10000 NRTL	
		50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz
Cooling output									
At 80°C ①	KW	1.40	1.55	2.85	3.00	6.25	6.15	12.10	12.10
At 20 °C ②	KW	1.55	1.65	2.15	2.20	5.00	5.60	9.15	9.90
At 10 °C ②	KW	1.15	1.25	1.60	1.65	3.60	4.00	6.90	7.60
At 0°C ②	KW	0.75	0.80	1.10	1.15	2.35	2.65	4.95	5.40
At -10 °C ②	KW	0.45	0.45	0.65	0.70	1.30	1.50	3.00	3.60
At -20 °C ②	KW	0.18	0.14	0.29	0.34	0.50	0.55	1.60	1.60
Cooling of the refrigerating machine	---	Air		Air		Air		Air	

Water-cooled	Unit	VC 1200 W NRTL		VC 2000 W NRTL		VC 5000 W NRTL		VC 10000 W NRTL	
		50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz	50 Hz	60 Hz
Cooling output									
At 80°C ①	KW	1.50	1.55	2.70	2.75	6.50	7.00	13.10	14.30
At 20 °C ②	KW	1.70	1.85	2.20	2.40	5.90	6.70	10.80	11.90
At 10 °C ②	KW	1.15	1.25	1.65	1.80	4.00	4.50	7.85	8.55
At 0°C ②	KW	0.70	0.80	1.10	1.20	2.60	2.90	5.50	6.00
At -10 °C ②	KW	0.38	0.40	0.65	0.70	1.50	1.60	3.50	3.90
At -20 °C ②	KW	0.12	0.10	0.30	0.35	0.60	0.70	2.00	2.10
Cooling of the refrigerating machine	---	Water		Water		Water		Water	
Connector thread for the cooling water (outer)	Inches	G¾"		G¾"		G¾"		G¾"	

Water-cooled	Unit	VC 1200 W NRTL	VC 2000 W NRTL	VC 5000 W NRTL	VC 10000 W NRTL
Differential pressure of cooling water	bar	1 - 6	1 - 6	3 - 6	3 - 6
Maximum pressure of cooling water	bar	10	10	10	10
Maximum cooling water consumption at 3 bar and 15 °C	L/min	4	4.5	17	24

① - Measured with Kryo 30

② - Measured with ethanol

12.4 Refrigerant and filling weight

Devices containing semi-halogenated refrigerant

The device contains fluorinated greenhouse gases.

Table 48: Variocool NRTL

	Unit	VC 1200 (W) NRTL	VC 2000 (W) NRTL	VC 5000 (W) NRTL	VC 10000 (W) NRTL
Refrigerant	---	R-449A	R-449A	R-449A	R-452A
Maximum filling weight	kg	0.5	0.58	1.1	2.0
GWP _(100a) *	---	1397	1397	1397	2140
CO ₂ equivalent	t	0.7	0.8	1.5	4.3



Global Warming Potential (GWP), CO₂ comparison = 1.0

* Time frame 100 years - according to IPCC IV

13 EC Declaration of Conformity and NRTL certificate

13.1 EC Declaration of Conformity

EC DECLARATION OF CONFORMITY

Manufacturer: LAUDA DR. R. WOBSE R GMBH & CO. KG
Laudaplatz 1, 97922 Lauda-Königshofen, Germany

We hereby declare under our sole responsibility that the machines described below

Product Line: Variocool **Serial number:** from 5200000001

Types: 1200 (W) NRTL, 2000 (W) NRTL, 5000 (W) NRTL, 10000 (W) NRTL

comply with all relevant provisions of the EC Directives listed below due to their design and type of construction in the version brought on the market by us:

Machinery Directive	2006/42/EC
EMC Directive	2014/30/EU
RoHS Directive	2011/65/EU in connection with (EU) 2015/863

The equipment is not covered by the Pressure Equipment Directive 2014/68/EU, as the maximum classification of the equipment is Category 1 and it is covered by the Machinery Directive.

The protective objectives of the Machinery Directive with regard to electrical safety are complied with in accordance with Annex I Paragraph 1.5.1 in conformity with the Low Voltage Directive 2014/35/EU.

Applied harmonized standards:

- EN 12100:2011 (ISO 12100:2010)
- EN 61326-1:2013 (IEC 61326-1:2012)
- EN 61326-3-1:2018 (IEC 61326-3-1:2017)
- EN 378-2:2018
- EN 61010-1:2011 (IEC 61010-1:2010 + Cor.:2011)
- EN 61010-2-010:2015

Authorized representative for the composition of the technical documentation:

Daniel Petersam, Manager Design OEM

Lauda-Königshofen, 13.10.2021


Dr. Alexander Dinger, Director Quality Management

*FAHRENHEIT, *CELSIUS, *LAUDA.

Document number: Q5WA-QA13-015-EN Version 02

Fig. 54: EG Declaration of Conformity VC NRTL

ZERTIFIKAT ◆ CERTIFICATE ◆ 認證證書 ◆ CERTIFICADO ◆ CERTIFICAT



CERTIFICATE

No. U8 019054 0008 Rev. 00

Holder of Certificate: LAUDA
DR. R. WOBSE GMBH & CO. KG
Pfarrstraße 41/43
97922 Lauda-Königshofen
GERMANY

Certification Mark:



Product: Temperature controller
Process Temperature Controllers

This product was voluntarily tested to the relevant safety requirements referenced on this certificate. It can be marked with the certification mark above. The mark must not be altered in any way. This product certification system operated by TÜV SÜD America Inc. most closely resembles system 3 as defined in ISO/IEC 17067. Certification is based on the TÜV SÜD "Testing and Certification Regulations". TÜV SÜD America Inc. is an OSHA recognized NRTL and a Standards Council of Canada accredited Certification body.

Test report no.: 72153929-000

Date, 2020-08-17

(Richard A Grumski)



Fig. 55: Certificate VC NRTL U8, page 1

ZERTIFIKAT ◆ CERTIFICATE ◆ 認證書 ◆ CERTIFICADO ◆ CERTIFICAT



CERTIFICATE

No. U8 019054 0008 Rev. 00

Model(s):

VC 10000 NRTL	VC10000 W NRTL
VC 5000 NRTL	VC 5000 W NRTL
VC 2000 NRTL	VC 2000 W NRTL
VC 1200 NRTL	VC 1200 W NRTL

Brand Name:

LAUDA

Tested according to:

CSA C22.2 No. 236:2015
UL 1995:2015

Production Facility(ies):

019054

Parameters:

	VC 10000 NRTL VC10000 W NRTL	VC 5000 NRTL VC 5000 W NRTL	VC 2000 NRTL VC 2000 W NRTL VC 1200 NRTL VC 1200 W NRTL
Input Current	400 V AC; 460 V AC (3 phase)	400 V AC; 460 V AC (3 phase)	200-230 V AC (1 phase)
Frequency	50 Hz; 60 Hz	50 Hz; 60 Hz	50/60 Hz
Input Current	25 A	16 A	16 A
Enclosure Type:	12	12	12
SCCR	5kA	5kA	5kA
Protection Class	IP32	IP32	IP32

Fig. 56: Certificate VC NRTL U8, page 2

14 Product Returns and Clearance Declaration

Product Returns

Would you like to return a LAUDA product you have purchased to LAUDA? For the return of goods, e.g. for repair or due to a complaint, you will need the approval of LAUDA in the form of a *Return Material Authorization (RMA)* or *processing number*. You can obtain the RMA number from our customer service department at +49 (0) 9343 503 350 or by email service@lauda.de.

Return address

LAUDA DR. R. WOBSEER GMBH & CO. KG

Laudaplatz 1

97922 Lauda-Königshofen

Deutschland/Germany

Clearly label your shipment with the RMA number. Please also enclose this fully completed declaration.

RMA number	Product serial number
Customer/operator	Contact name
Contact email	Contact telephone
Zip code	Place
Street & house number	
Additional explanations	

Clearance Declaration

The customer/operator hereby confirms that the product returned under the above-mentioned RMA number has been carefully emptied and cleaned, that any connections have been sealed to the farthest possible extent, and that there are no explosive, flammable, environmentally hazardous, biohazardous, toxic, radioactive or other hazardous substances in or on the product.

Place, date	Name in block letters	Signature

15 Glossary

Auto IP	Auto IP is a standardized procedure where two or more participants agree on the same network configuration.
DHCP Client (Dynamic Host Configuration Protocol Client)	A DHCP client facilitates the automatic integration of an Ethernet interface in an existing network. As a result, the interface does not have to be manually integrated in the existing network.
DNS server (Domain Name Service Server)	The Domain Name Service is a database where mainly information on names and IP addresses of the computer are stored. A DNS can, for example, disperse a web address or URL (Uniform Resource Locator) to an IP address. The Ethernet interface specifies the IP address of the DNS server present in the connected network.
Gateway	Various networks are connected with one another via a gateway. Here, an IP address is given that can be used to reach a gateway in a local network.
IP address (Internet Protocol Address)	Each device within a data network requires an address, so that it can be clearly identified. This is the only way to ensure that e.g. the data flow is received by the correct device. When an Internet page is opened, the browser always transfers the IP address of your device. This is the only way that the web server can know where to send the required data packet. The Internet Protocol (IP) is a widely adopted network standard that stipulates how information can be exchanged.
IP version	Provides information about the Internet standard: IPv4 or IPv6. A well-known example of an IP address is 192.168.0.1. This address is structured according to the IPv4 standard: Four numbers between 0 and 255, whereby a period separates the numbers from one another. However, this system only allows a limited number of combinations, which is why there are IP addresses structured according to the standard in version 6 (IPv6). They consist of eight blocks of characters that can contain both numbers and letters as shown in this example: fe80:0010:0000:0000:0000:0000:0000:0001. Because this can seem rather confusing, a long string of zeros can be replaced by a colon. The IPv6 address from the example would therefore appear in a shortened form as follows: fe80:0010::1.
Local IP address	The local IP address is an address for the Ethernet interface in the local network. The Ethernet interface in the local network can be reached using this address. If the DHCP client is deactivated, the local IP address and the local mask must be manually configured. For manual configuration start by contacting your IT department.
Local mask	Local (subnet) masks are used to flexibly adapt the rigid class division of IP addresses in networks and computers to actual conditions.
MAC (Media Access Control)	Media Access Control is an almost unique global hardware address which can be used to clearly identify the device in an Ethernet network.
NTP (Network Time Protocol)	Network time protocol is a standard for synchronizing the time and date in networks.
Port	Port is a number that is used to establish a connection between two network participants. The port is a part of the network address. The port for the Ethernet interface can be taken from the approved "dynamic ports" range. This lies between 49152 and 65535.

Process Interface

A process interface on the LAUDA constant temperature equipment is the interface that makes it possible to control or monitor the constant temperature equipment via Ethernet using LAUDA interface command sets.

TCP (Transmission Control Protocol)

This network protocol define how data is exchanged between network components.

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