

Technical information

Kröber O2



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1. Preliminary Remark

1.1 General

This Technical Information describes the **Kröber O2** oxygen concentrator.

It only applies in conjunction with the **Kröber O2** Instructions for Use.

The Kröber O2 is equipped with a humidifier on the unit side as standard. If desired, a humidifier close to the patient can also be selected as an option

The following minimum performance data apply to the **Kröber O2** oxygen concentrator:

minimum O2 concentration ± 3%			
until 2016-12	from 2017-01 until 2018-06	from 2018-07 until 2019-11	as of 2019-11
0.1 - 4.0 l/min. 95%	0.1 - 4.0 l/min. 95%	0.1 - 4.0 l/min. 95%	0.1 - 5.0 l/min. 93%
4.0 - 5.0 l/min. 85%	4.0 - 5.0 l/min. 90%	4.0 - 5.0 l/min. 93%	
5.0 - 6.0 l/min. 75%	5.0 - 6.0 l/min. 85%	5.0 - 6.0 l/min. 90%	
Oxygen concentration measurement is performed under the following operating conditions: Operating temperature: +5 to +40 °C Relative humidity: 15% - 93% (r.H. non-condensing) Air pressure: 700 to 1060 mbar			

These values must be measured and documented during maintenance.

Required test equipment: Oxygen meter
 Flowmeter measuring range 0-6 l/min

The setting values for various device parameters specified in this Technical Information are guide values and are used to optimize the device to the specified performance data.

The data read from the microprocessor are evaluation aids for the technician to analyze causes of any performance deviations.

1.2 Warranty

Deviating from our General Terms and Conditions, we grant an extended 30,000 operating hour warranty for our **Kröber O2** oxygen concentrator for all functional parts (e.g. compressor, control board, valve technology, etc.). The extended warranty is valid for a maximum of 5 years from the date of purchase.

Excluded from the warranty are filters and zeolites, damage due to improper handling and mechanical damage to parts (e.g. transport damage).

Our warranty services are limited to the free replacement of defective parts. The defective components must be presented to us for inspection. We will not bear any costs for travel and

working hours incurred on site. If devices are sent to us free of charge for warranty repair, we will also assume the labor costs for any warranty repairs.

1.3 Device identification

The year of manufacture of the Kröber O2 can be derived from the serial number. The silver type plate is located on the rear side above the coarse dust filter and has the following format



Here YYMM is the coding for year and month, e.g. 1912 in 1019126749 means December 2019.

Note that the prefix CC can be two to four digits, e.g. 16T20021234 and S4OX20017253.

2. Structure

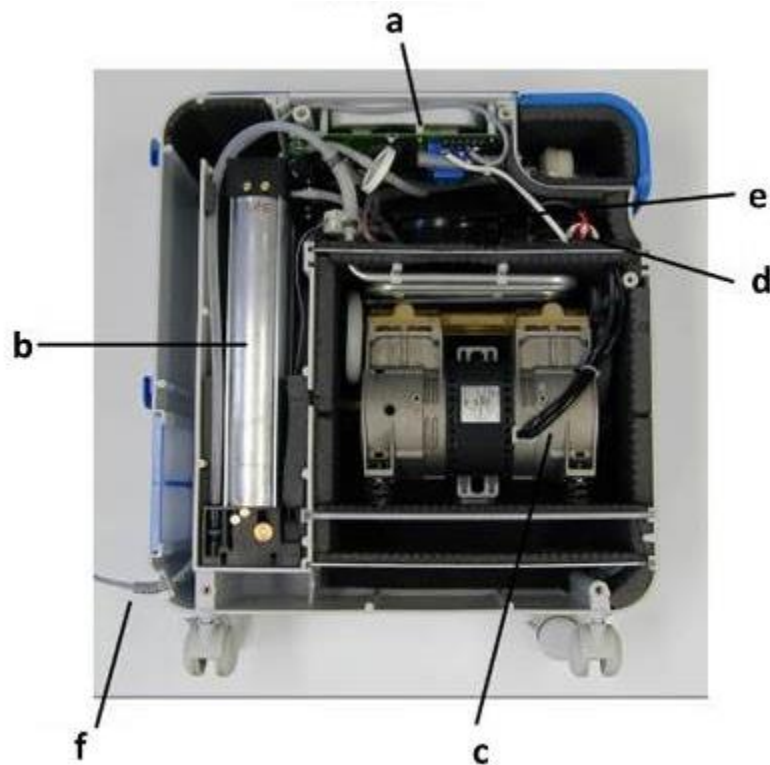
2.1 Version with Camozzi functional unit

In the opened device you can see the assemblies

- a. Control board
- b. Functional unit Camozzi
- c. Compressor
- d. Fan

and the components

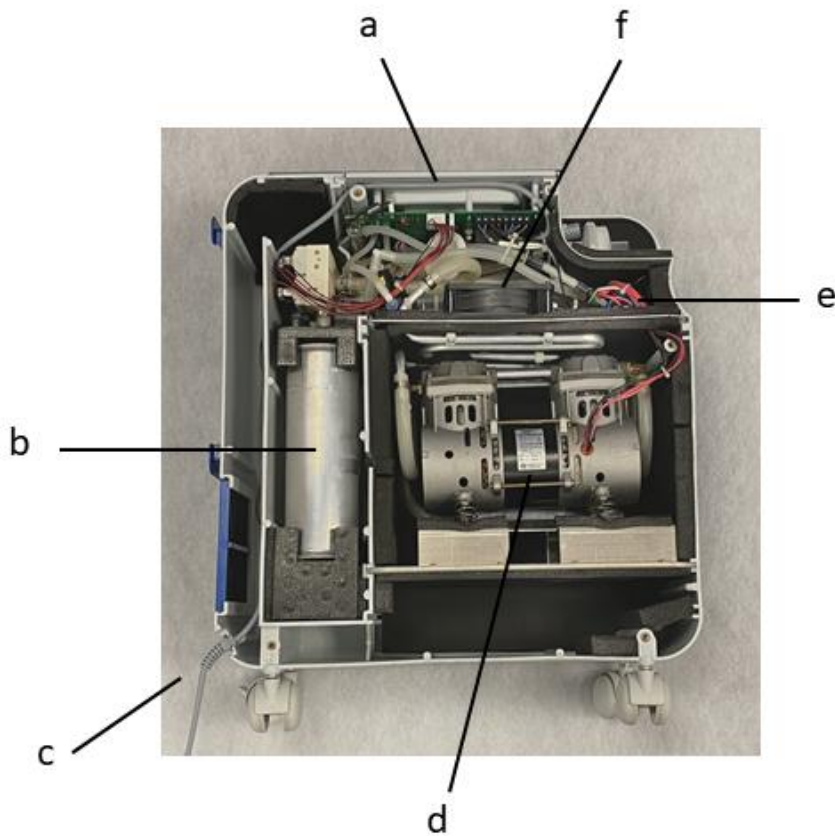
- e. Capacitor
- f. Power cable



2.2 Version with SMC functional unit

In the opened device you can see the assemblies and components

- a. Control board
- b. Functional unit SMC
- c. Power cable
- d. Compressor
- e. Capacitor
- f. Fan



3. Service work



WARNING! Danger due to electric current!

Be sure to disconnect the power plug before opening the device.

After operation, increased surface temperatures may occur on components and parts.

3.1 Opening the Kröber O2



WARNING! Danger due to electric current!

Be sure to disconnect the power plug before opening the device.



NOTE!

To simplify work on the **Kröber O2**, it is advisable to place the device on a clean surface. Any humidifier that may be screwed on must be completely emptied or dismantled.



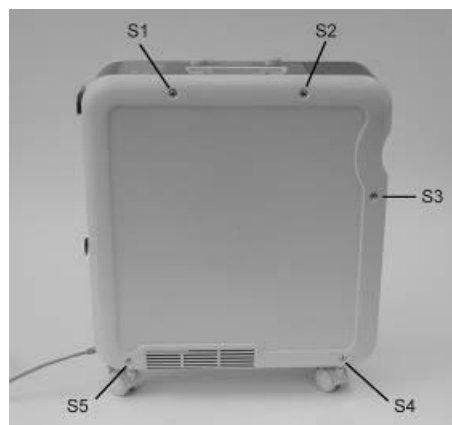
2. Unscrew 5 screws (S1 to S5).
3. Carefully remove the housing cover.
4. Remove the blue service flap and store it separately.
 - a. Control board
 - b. Functional unit

3.2 Closing the Kröber O2



Closing the **Kröber O2** is most easily done with a device placed on its side.

1. Carefully replace the gray housing cover and ensure that the cover is correctly latched.
2. Insert all housing screws; tighten screws S4 and S5; tighten all other screws lightly



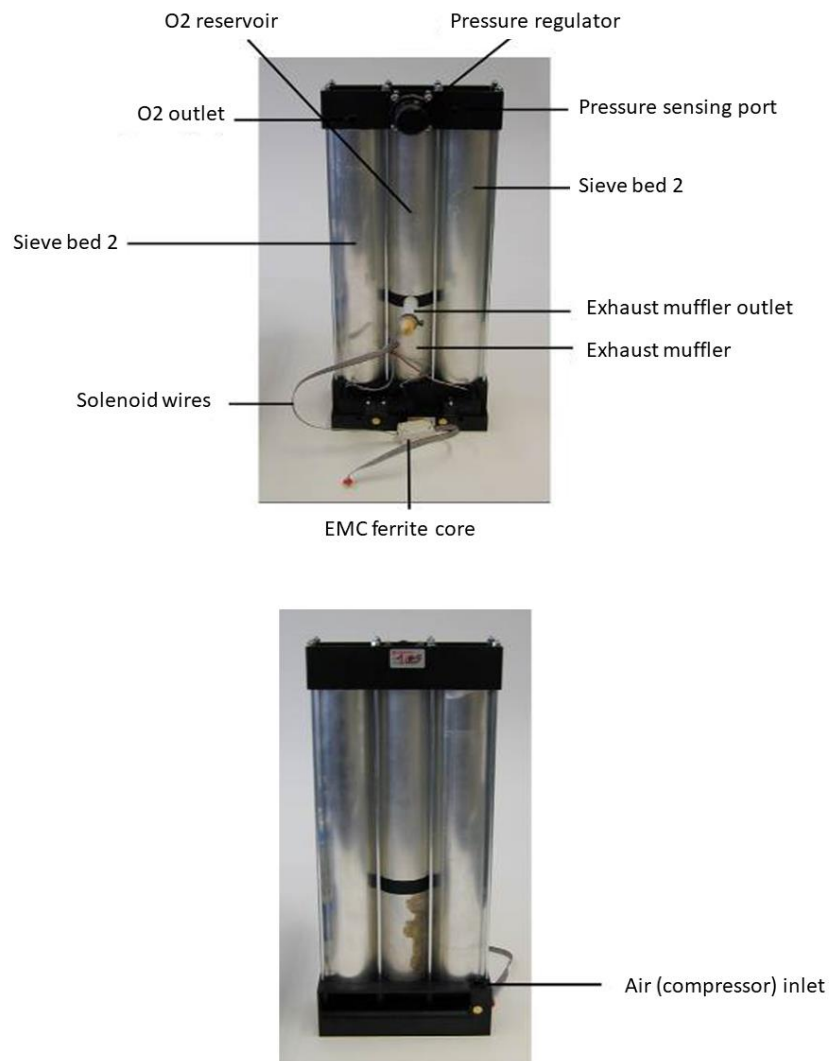
3. Carefully insert the blue service flap with the two lateral lugs into the corresponding bearings in the housing. To do this, stretch the housing open a little.



4. Hand-tighten all five housing screws.
5. Replace the coarse dust filter cover on the rear of the **Kröber O2**.

3.3 The functional units

3.3.1 The Camozzi functional unit



The Camozzi functional unit integrally includes the following components as a module:

- Molecular sieve 1 and 2
- Exhaust silencer
- Oxygen reservoir
- 3 Valves
- Pressure reducer

If a component is defective, the entire unit must/should be replaced.

3.3.2 Removing the Camozzi functional unit

1. Disconnect the red connector of the valve control line from the control board.



2. Loosen the cable tie on the EMC core with side cutters.



 **NOTE!**

It is normal that a slight popping noise may occur due to any excess pressure still present in the hose.

3. Press the edge of the plug-in connection at the air inlet of the functional unit down evenly and pull out the hose.



4. Press the edge of the plug-in connection on the gas outlet of the functional unit evenly and pull out the hose.



5. Lift the functional unit halfway straight up



6. Press the edge of the push-in connector on the pressure outlet for the pressure sensor evenly and pull out the hose.



7. Remove the functional unit completely.

3.3.3 Installation of the Camozzi functional unit

1. Remove the three protective caps from the inputs and outputs of the functional unit.
2. Insert the plug-in hose for the pressure sensor into the connection on the functional unit as far as it will go.



3. Carefully insert the functional unit into the shaft.



4. When inserting, make sure that the exhaust silencer is correctly inserted into the corresponding housing gap.



5. In the correct end position, the discharge silencer is directly in front of the compressor.



6. In the correct end position, the head of the functional unit is caught by a stop (see circle).



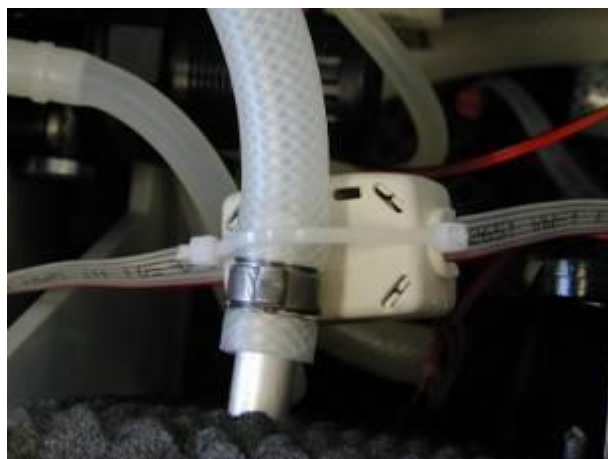
7. Reconnect the plug-in hose of the product gas outlet as far as it will go.



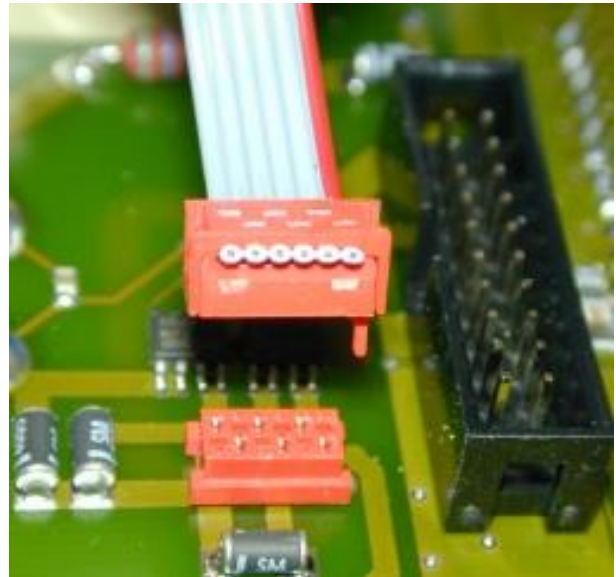
8. Insert the plug-in hose into the air inlet of the functional unit as far as it will go.



9. Attach EMC core to cooling coil output hose with a cable tie.



10. Plug the red connector of the valve control line onto the connector of the control board. Observe the polarity. The pin must point to the black tub connector.

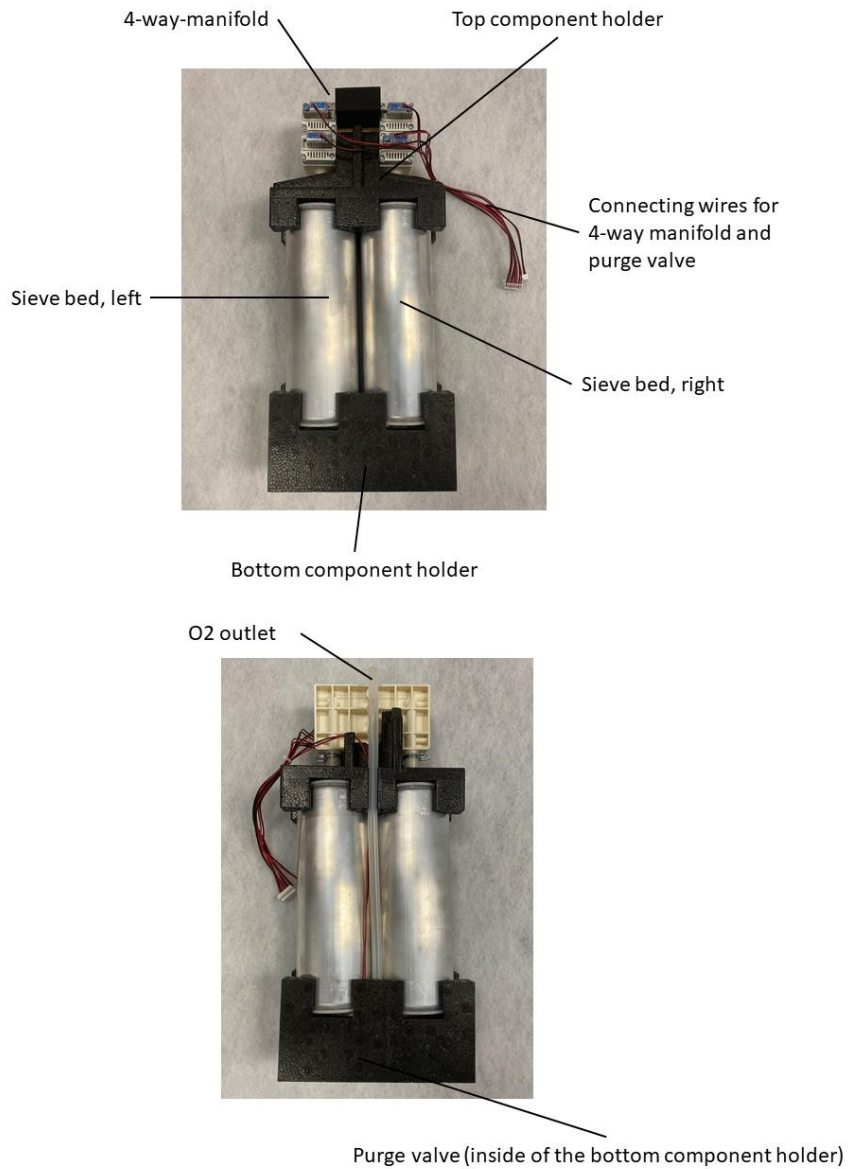


11. Push the plug on with feeling as far as it will go.



12. Check tubing and cabling for correct, pinch-free routing

3.3.4 The SMC functional unit



The SMC functional unit contains - discretely interconnected - the following components:

- Molecular sieve right and left
- the 4-fold valve block
- the flush valve

3.3.5 Removing the SMC functional unit

1. The following tools are required for simple removal:
 - Combination pliers
 - Telephone pliers with curved tips



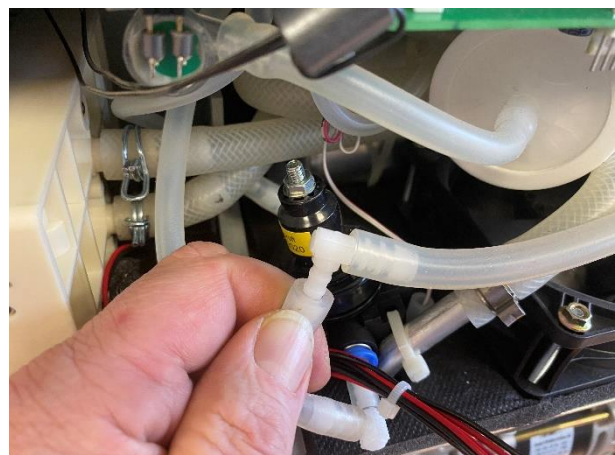
2. Pull off both the 8-pin and the 2-pin connector downwards. Moderate force is required for this.



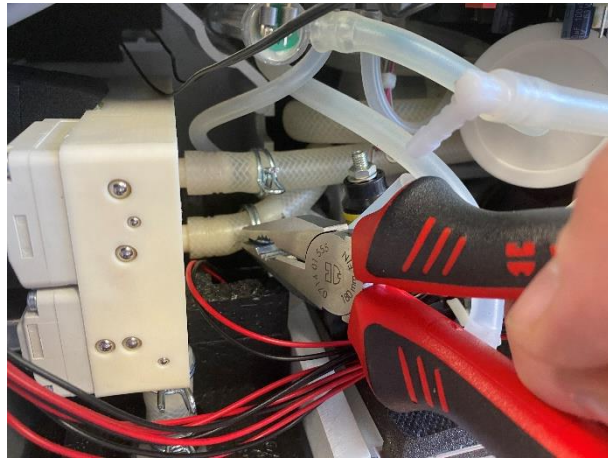
 **NOTE!**

It is normal that a slight popping noise may occur due to any excess pressure still present in the hose.

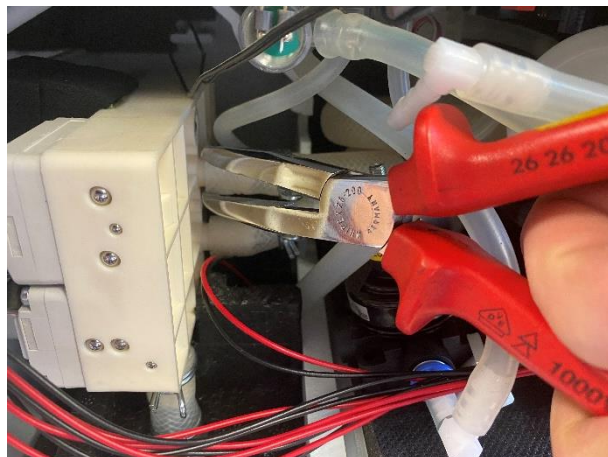
3. Pull the O2 output hose of the functional unit off the L-connector by hand.



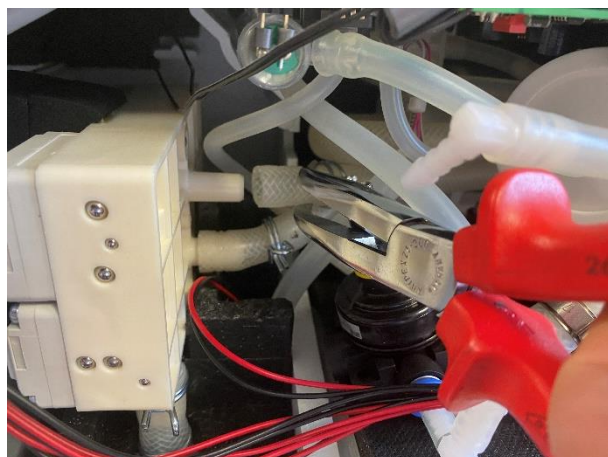
4. Compress the upper and lower clamps on the compressed air inlet and outlet of the 4-way valve block with a pair of combination pliers and slide them to the right onto the hose. Thus release the locking device.



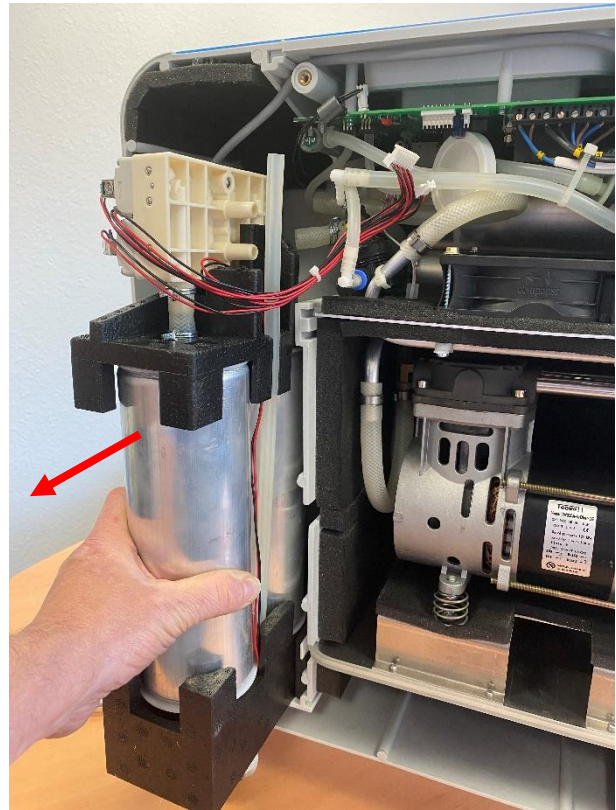
5. Grasp both hoses one after the other with the bent telephone pliers and lever them to the right against the housing.



6. This disconnects both hoses from the 4-way valve block.

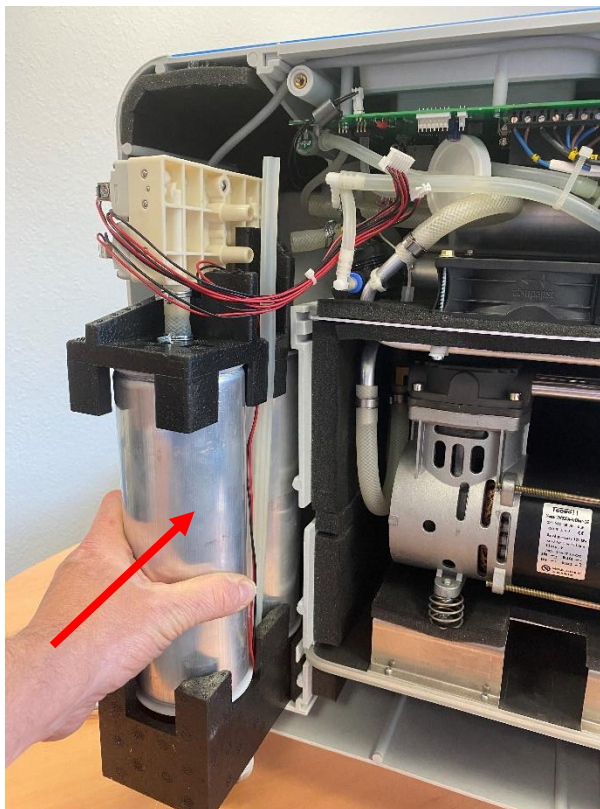


7. Before pulling out, make sure that the individual components are only plugged in and not screwed together. Therefore, grasp the entire unit with both hands at the top and bottom. Pull out the functional unit.



3.3.6 Installation of the SMC functional unit

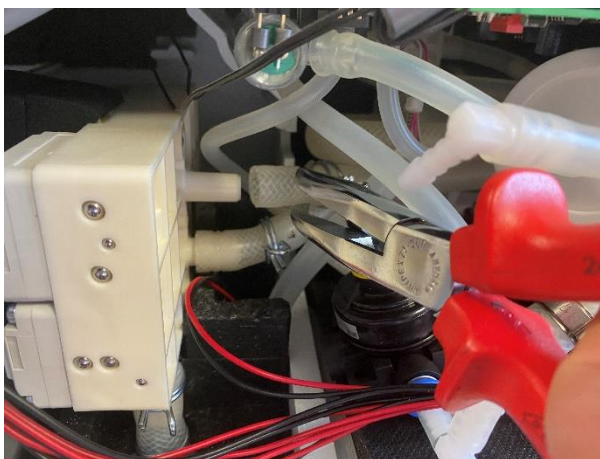
1. Carefully insert the functional unit into the shaft and push it through to the end. When doing so, push any hoses present from the interior to the side to allow a free path.



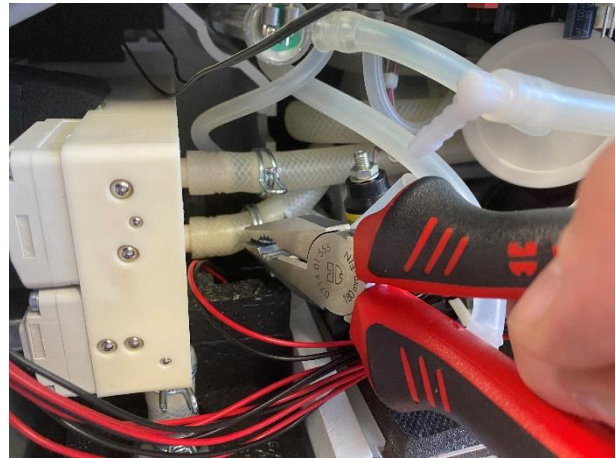
2. Place both pressure hoses on the connection pieces one after the other using pliers and push them through as far as they will go. Apply only moderate force so that the hoses are not damaged by the pliers.

 **NOTE!**

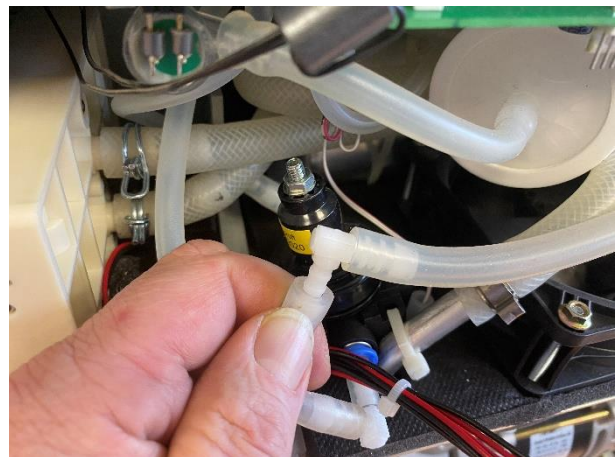
The upper hose comes from the cooling coil, the lower hose connects the discharge silencer located in the compressor compartment.



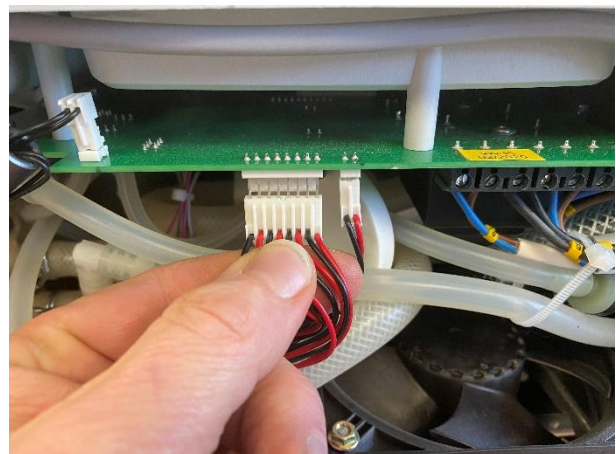
3. Use the combination pliers to spread both hose clamps and push them back over the connection pieces.



4. Push the O2 output of the functional unit onto the angle connector.



5. Place both electrical 8-pin and 2-pin connectors on the connector strips on the control board. Make sure that the corrugated side faces outwards. Push the connectors onto the bar all the way to the end.



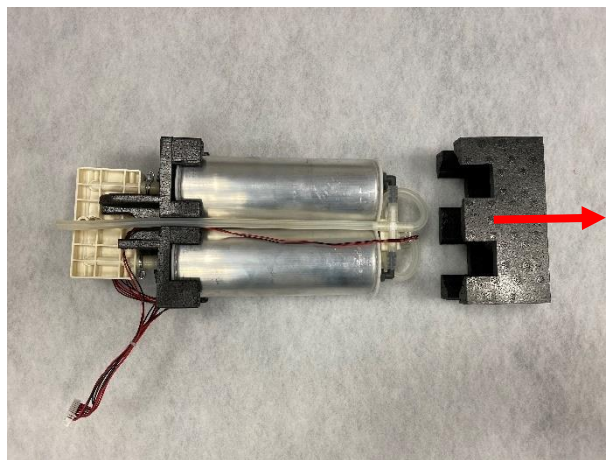
3.3.7 Replacing the molecular sieves

Notice!

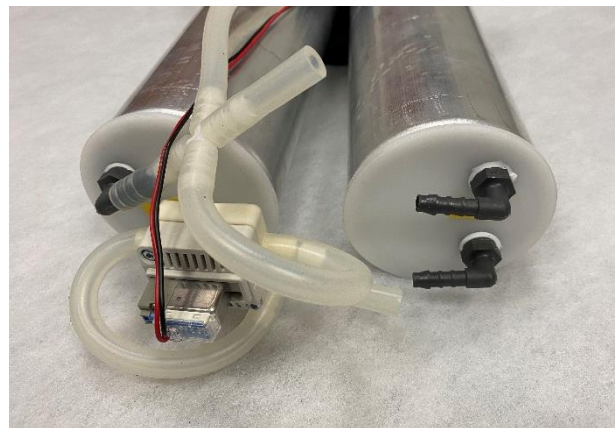
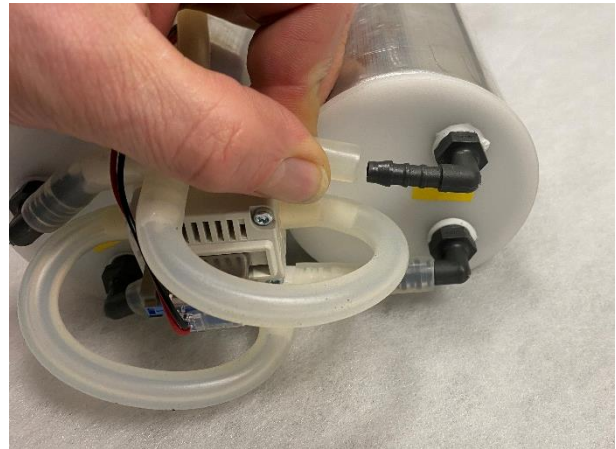
Molecular sieves should only be exchanged in pairs!

There is both a left and a right molecular sieve which must be exchanged functionally identical!

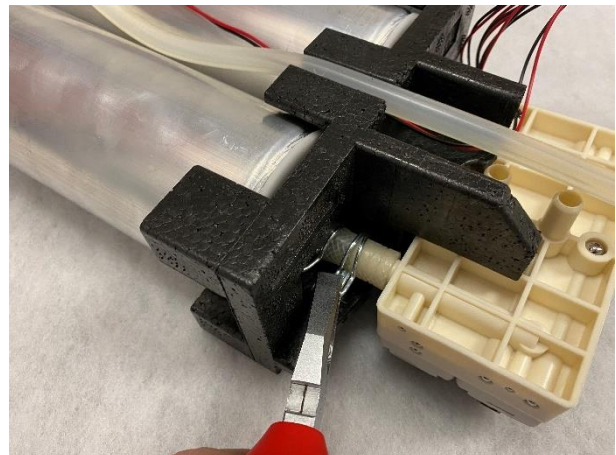
1. Removing the SMC functional unit (see 3.3.5)
2. Insert the plug-in hose for the pressure sensor into the connection on the functional unit as far as it will go.



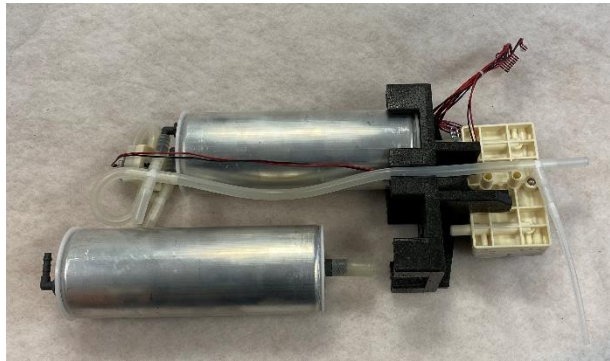
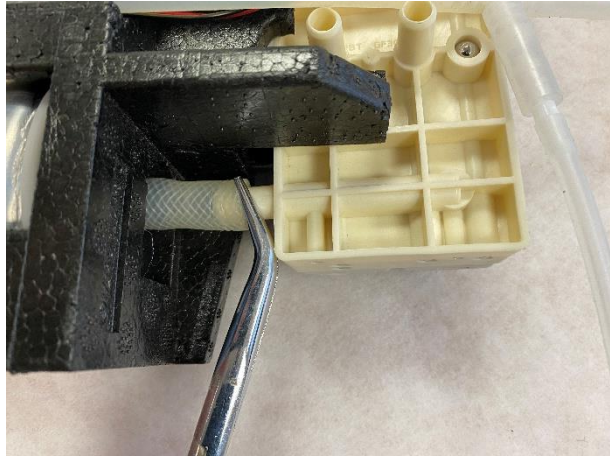
3. Pull off the two lower silicone tubes one after the other from a molecular sieve



4. Unfasten the clamp at the 4-way-manifold and move in into the direction of the sieve bed








5. Pull off the 4-way-manifold from the sieve bed.



6. Replace this sieve bed by a new one. Pay attention to the correct marking L or R.
7. Re-install all tubings and clamps and on this part in reverse order
8. Start the whole procedure for the other side

3.4 Control board

Variant	Introduction	Change history	
1	as of 2005	Initial design, 6-fold connection strip Long sensor	
2	from 2007	with additional temperature fuse. 8-fold connection strip 2 pressure sensors	
3	from 2014	with optocoupler for USB	
4/5	from 2018	with additional alarm LED and modified LCD symbolism with external loudspeaker fuse changed from 2.5ATT to 3.15 AT	
6	from 2019	with additional pin header for connecting the SMC function unit	

3.4.1 Removal of the control board



Attention!

The control board contains sensitive electronic circuits. Compliance with ESD protection measures is mandatory!

1. Disconnect all strands at the terminal strip of the control board.

The strands are numbered in ascending order to avoid confusion. Thereby mean:

- No. 1 and 2: Mains cable
- No. 3 and 4: Temperature fuse
- No. 5 and 6: Compressor
- No. 7 and 8: Fan



2. Loosen the cable tie of the power cord.



3. Expose the control board by bending back the entire wiring harness and air supply hose.



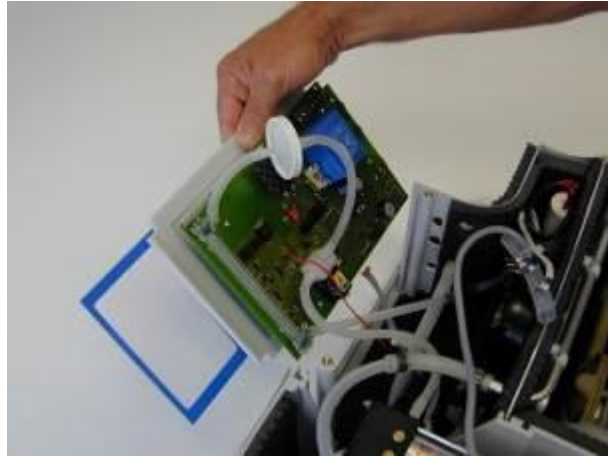
4. Pull out approx. half of the control board together with the housing insert and operating elements.



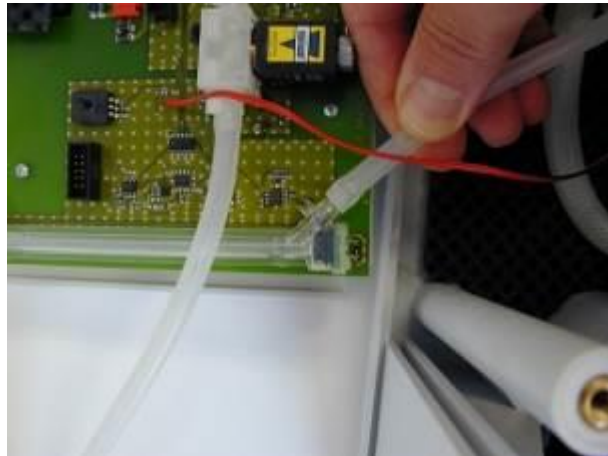
5. Pull off the connection hose from the pressure sensor



6. Pull out the control board completely, but do not put it down yet.



7. Pull off the silicone hose on the multifunction sensor.



8. Thread the temperature sensor out of the compressor compartment



9. Completely remove the printed circuit board together with the housing insert.



10. pull off the two operating elements upwards



11. Turn the circuit board over and loosen the 5 fastening screws.



12. Store the printed circuit board separately and ESD-protected.



3.4.2 Installation of the control board



Attention!

The control board contains sensitive electronic circuits. Compliance with ESD protection measures is mandatory!

Remove the printed circuit board from the transport packaging.



2. fasten the printed circuit board to the housing insert using 5 fastening screws.



3. turn over the printed circuit board and firmly attach the two control elements to the components.



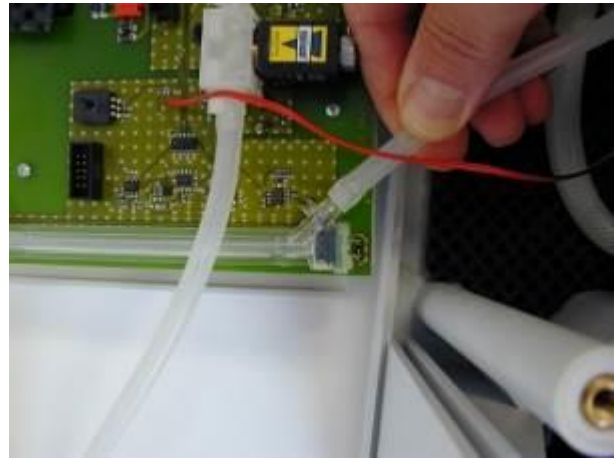
Unwind the temperature sensor line completely and thread it through the feedthrough into the compressor compartment.



Slide the control board together with the housing insert and the blue plexiglass cover halfway into the housing guides and hold it there.



Push the silicone hose onto the free outlet of the multifunction sensor.



Push the pressure measuring hose onto the pressure sensor.



Push in the control board with the operating unit completely flush.

 **NOTE!**

Make sure that the blue insert card with safety instructions is correctly seated!

Reattach the mains cable to the holding dome (see figure above right) using cable ties.



10. connect all wires to the terminal strip of the control board.

The strands are numbered in ascending order to avoid confusion. Thereby mean:

- No. 1 and 2: Mains cable
- No. 3 and 4: Temperature fuse
- No. 5 and 6: Compressor
- No. 7 and 8: Fan



3.5 The fan

3.5.1 The fan



3.5.1.1 Fan removal

1. Disconnect the two left connection cables (marked with 5 & 6 at PCB Vers. 1, from then on no. 7 & 8) of the fan at the terminal strip on the control board.



2. Loosen the cable tie on the wiring harness of the terminal strip, e.g. with a side cutter.



3. pull out the entire tray with fan and cooling coil up to halfway.
If necessary, detach EMC core from cooling coil input with cable tie beforehand.



NOTE!

If necessary, readjust the compressor cable and thus relieve the strain on it!



4. Loosen the four fan mounting screws from the cooling coil side.



5. The mounting screws do not need to be unscrewed all the way, just enough to clear the fan.



6. The fan can now be removed from the device.

3.5.1.2 Fan installation

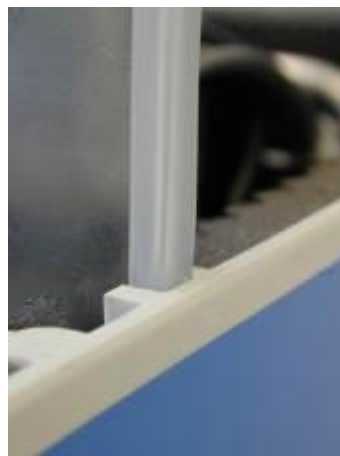
1. Install the fan so that the fan wheel or the airflow arrow points towards the sheet metal.



2. Tighten the four fastening screws hand-tight.



3. Press the fan panel back evenly into the grooves as far as it will go. Make sure that the silicone profiles are guided along.



4. If necessary, readjust the position of the compressor lines.

5. If necessary, reattach the EMC core to the silicone hose of the cooler outlet with a cable tie.



6. Screw the marked wires of the fan into the terminal strip (pos. 5 & 6 or 7&8).

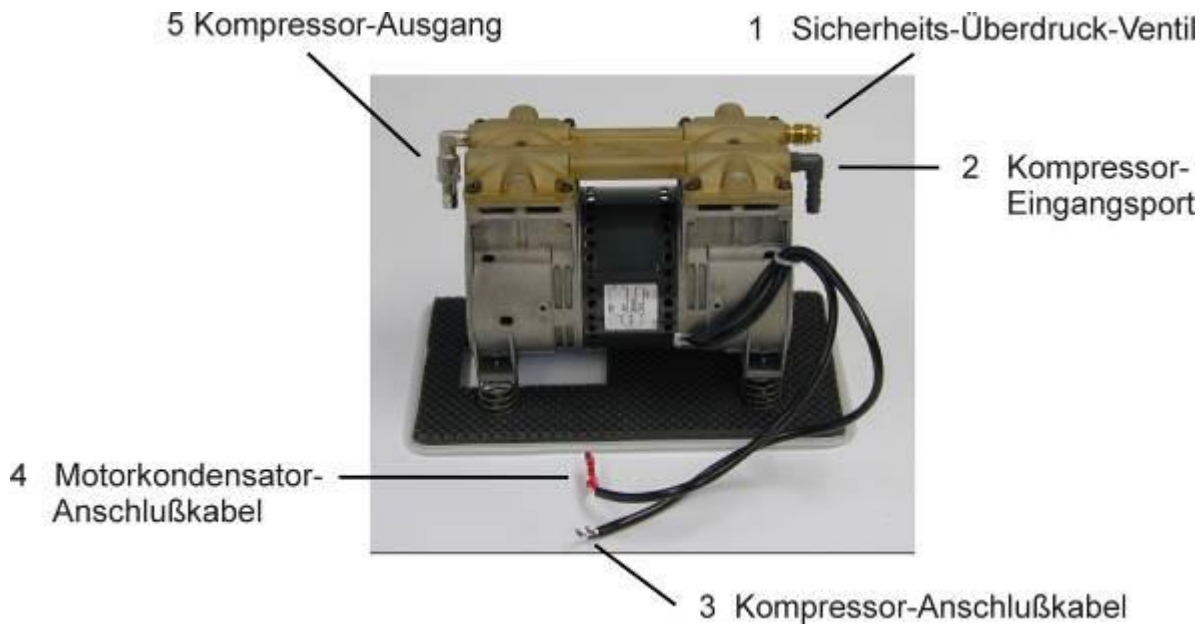


7. Tying the cable harness together with a cable tie including the protective hose



3.6 The compressor

3.6.1 The compressor model Gardner Denver



3.6.1.1 Compressor removal

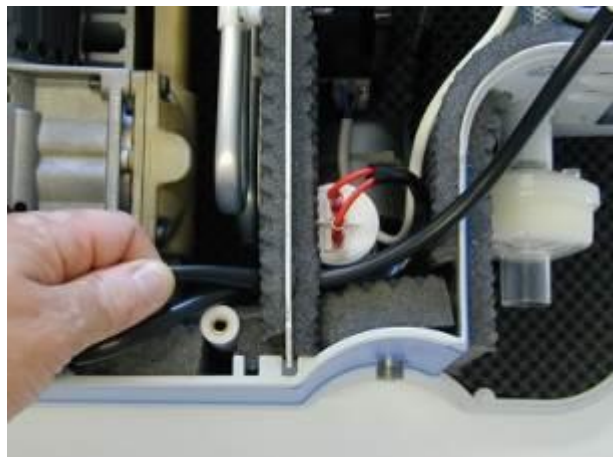
1. Disconnect strands no. 5 and 6 of the compressor at the terminal strip of the control board.



2. Loosen the cable tie on the cable harness.



3. Pull the compressor cable through the grommet of the fan plate.



4. Disconnect the motor capacitor connection cable from the capacitor.
5. Pull the connection cable back through the grommet.



6. Pull the compressor together with the retaining plate approx. 50% out of the guide and hold it in this position.

7. Using a screwdriver or similar, open the clamp on the compressor compressed air outlet and pull the hose off the nozzle.



8. Also disconnect the hose from the compressor inlet.



9. Pull the compressor together with the retaining plate out of the guide.

3.6.1.2 Compressor installation

1. Thread the compressor together with the retaining plate into the guide and allow it to submerge by approx. 50%.
2. Guide the clamp over the pressure output hose of the compressor.
3. Guide the pressure outlet hose over the stainless steel nozzle.
4. Secure the connection by pressing the ear clamp together.
5. Guide the air inlet hose over the gray plastic grommet.



6. Allow the compressor and retaining plate to slide in the guide as far as it will go.

NOTE!

Ensure that the side rubbers are guided correctly and without twisting!



7. Guide the compressor connection line through the grommet.
8. Also lead the motor capacitor connecting cable through the grommet.

NOTE!

*Due to the cable lugs, it is necessary to pass them **SINGLE** through the grommet.*

9. Connect capacitor with motor capacitor connection cable.

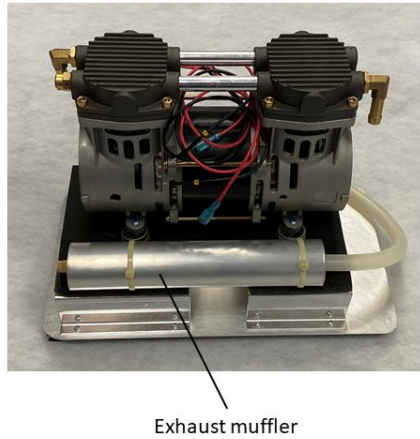
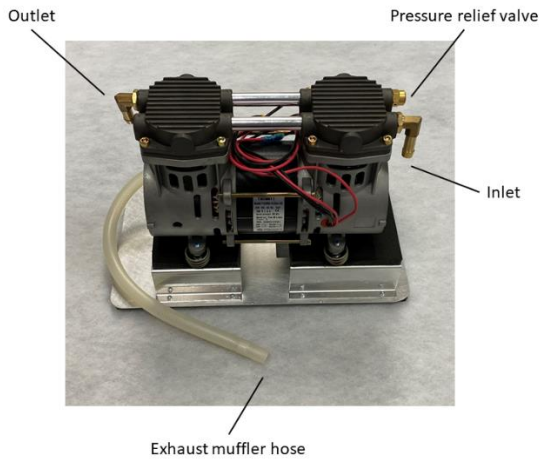


10. Route the compressor connection line to the control board. Securely connect the marked connection strands (5, 6) in the respective connection terminals (5, 6) of the control board.



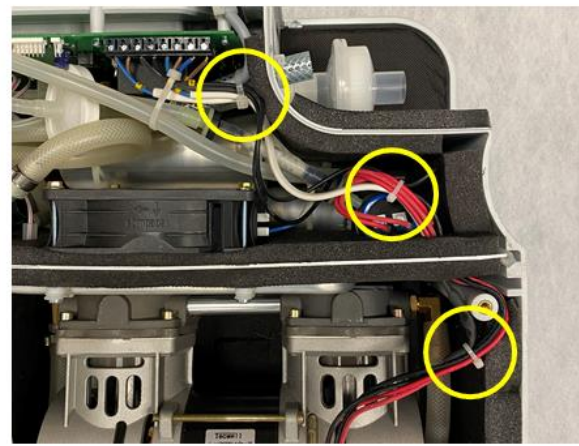
11. Secure the entire wiring harness to the hose again with a cable tie.

3.6.2 The compressor model Tecwell (or GDT 2380)

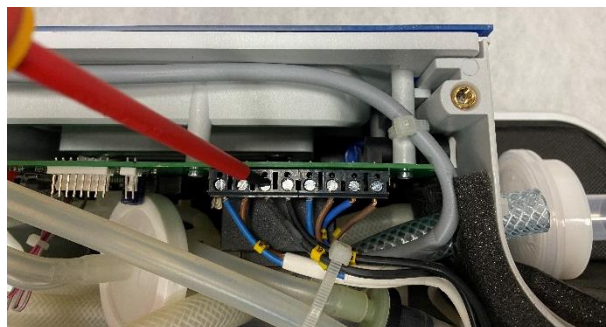


3.6.2.1 Compressor removal

1. Loosen the cable ties on the electric compressor line.



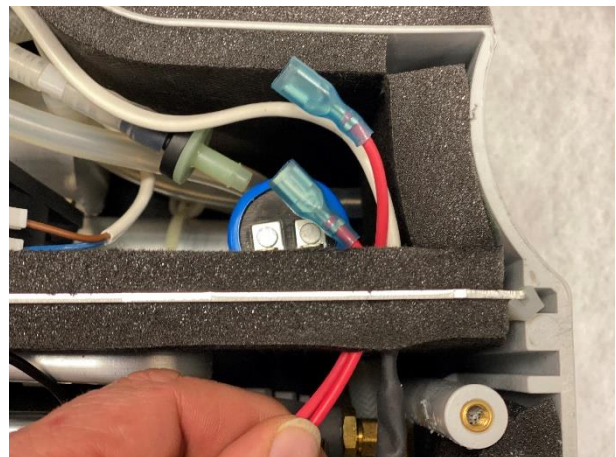
2. Disconnect strands no. 5 and 6 of the compressor at the terminal strip of the control board.



3. Disconnect the two terminals on the capacitor.



4. Pull back the two condenser and compressor connection lines.



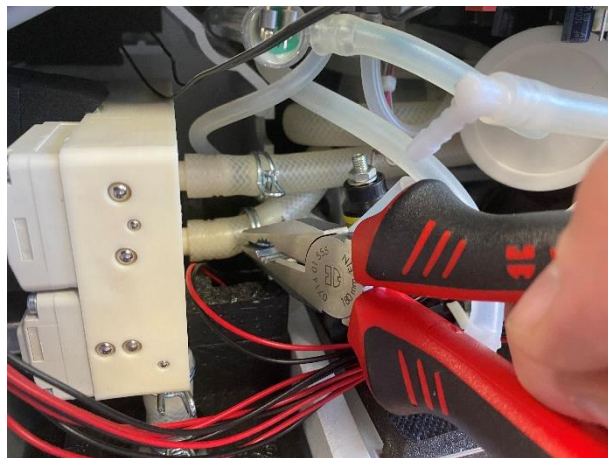
5. Loosen the hose clamp on the cooling coil using pinch pliers.



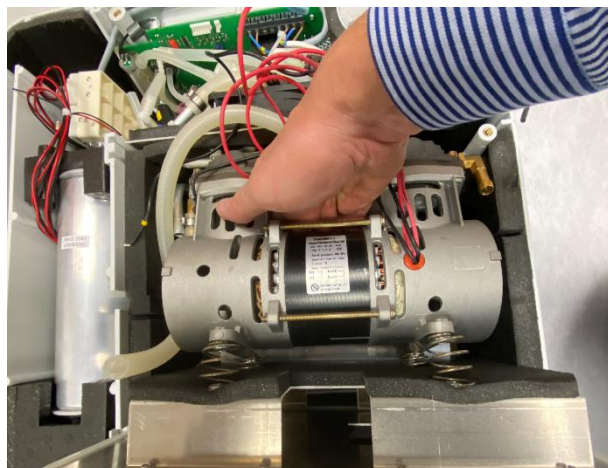
6. Pulling off the suction hose from the compressor.



7. Loosen the lower clamp on the 4-way valve block.
Pulling off the hose.
Pulling off the clamp.



8. Lifting the entire compressor plate



9. Pulling back the exhaust damper hose through the fan plate.



10. Pull the compressor plate completely out of the guide

3.6.2.2 Compressor installation

1. The compressor is installed in the reverse order to removal

Hint!

Threading the compressor plate is facilitated if both guides are wetted with flushing agent.

3.7 The power cord



3.7.1 Removing the mains power cord

1. Disconnect wire #1 & #2 from the control board terminal block.

The strands are numbered in ascending order to avoid confusion.



2. Loosen the two cable ties of the power cord.



3. Completely unthread the power cord from the housing.

3.7.2 Installation of the mains power cable

1. Thread the bend protection of the mains cable into the corresponding recess on the underside of the housing.



2. Feed the power cable through the vertical air duct and then above the left housing dome and the printed circuit board to the terminal strip.



3. Strand 1 to terminal 1
Strand 2 to terminal 2
connect and screw tight.



4. Maintenance

4.1 Safety check, semi-annually

When the Kröber O2 is used in the home, the manufacturer prescribes an annual safety check. Additional documents are made available to the service personnel for the safety check if they are required for repair, maintenance, etc. The procedure is in accordance with the STK protocol:

- ➔ Measure and document oxygen concentration.
- ➔ Measure and document flow performance.
- ➔ Check oxygen status.



Kröber Medizintechnik GmbH
Salzheck 4
D 56332 Dieblich
Germany

Maintenance and safety check report valid for: Kröber O2

This protocol lists in bullet points the measures for the safety-related inspection and the recommended scope of maintenance.
The measures must be carried out and documented at least every 12 months.

Customer	S/N KröberO2	SW version	Date
		Operating hours	Technician

The specification for the minimum O2 concentration depends on the year of manufacture of the equipment as follows:

minimum O2 concentration: ± 3%			
until 2016-12	from 2017-01 until 2018-06	from 2018-07 until 2019-11	as of 2019-11
0.1 - 4.0 l/min. 95%	0.1 - 4.0 l/min. 95%	0.1 - 4.0 l/min. 95%	0.1 - 5.0 l/min. 93%
4.0 - 5.0 l/min. 85%	4.0 - 5.0 l/min. 90%	4.0 - 5.0 l/min. 93%	
5.0 - 6.0 l/min. 75%	5.0 - 6.0 l/min. 85%	5.0 - 6.0 l/min. 90%	5.0 - 6.0 l/min. 90%

1. Visual inspection KröberO2	
1.1. The safety-related inscriptions must be legible.	<input type="checkbox"/>
1.2. The mechanical condition must permit continued safe use.	<input type="checkbox"/>
1.3. The KröberO2 must not have any safety-reducing contamination.	<input type="checkbox"/>
1.4. Physical integrity/insulation of the mains cable ok?	<input type="checkbox"/>
2. Maintenance parts replacement	
2.1. Coarse filter	<input type="checkbox"/>
2.2. Device input filter	<input type="checkbox"/>
3. Self-test	
3.1. Switch on KröberO2, observe self-test, self-test passed without error message	<input type="checkbox"/>
4. Function test	
4.1. Function LCD / LED	<input type="checkbox"/>
4.2. Function backlight	<input type="checkbox"/>
4.3. Function alarm speaker	<input type="checkbox"/>
4.4. Function and state of the buttons	<input type="checkbox"/>

5. Measurements	
5.1. Minimum O2 concentration according to above specifications: +/-3% @1 lpm: > ___ % +/- 3% ___ % @6 lpm: > ___ % +/- 3% ___ %	<input type="checkbox"/>
5.2. Flow	
@ 1.0 lpm (> 0.8, < 1.2 lpm)	<input type="checkbox"/>
@ 6.0 lpm (> 5.4, < 6.6 lpm)	<input type="checkbox"/>
6. Overall result	
safe & functional to use	<input type="checkbox"/>

Place, date, signature technician

4.2 Filter change

4.2.1 Coarse dust filter

Time interval: if required by the user, monthly at the latest.

1. Opening the coarse dust filter cover on the back of the Kröber



2. Pull out the old filter.
3. Dispose of the old filter.
4. Threading the new filter fleece.



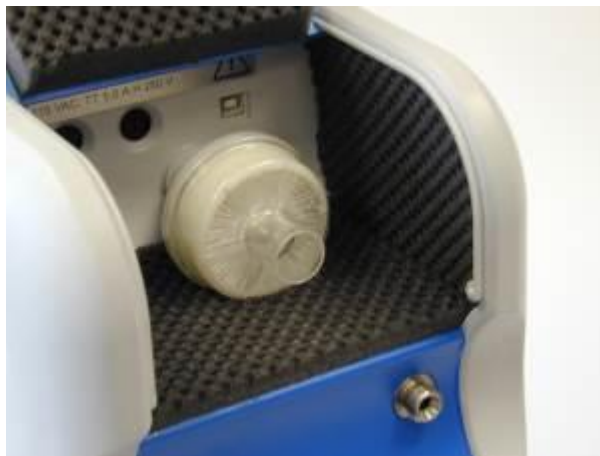
5. Reinsert the filter cover into the back of the Kröber O2.

4.2.2 Device input filter

Time interval: semi-annually by the technician, after 5000 h at the latest.

The unit inlet filter is located behind the service flap and is intended to protect the compressor from contamination.

1. Opening the service hatch



2. Pull out the old filter while rotating it slightly.
3. Dispose of the old filter.
4. Reinsert the new filter while rotating it slightly.
5. Closing the service flap.

4.2.3 Device output filter (bacteria filter)

The instrument outlet filter is located inside the instrument before the gas outlet of the instrument and filters particles $>8\mu$.

1. Opening the Kröber O2.
2. Pull off both silicone hoses on the device outlet filter and remove the old device outlet filter.

(see chapter 3.1)



3. Dispose of the old filter.

4. Reinsert the new filter. Observe the direction of flow. The arrow on the filter must point away from the valve in the direction of the multifunction sensor.
5. Close the Kröber O2 again.

5. Processing recommendations

Applies to accessories and consumables at six-monthly maintenance.

5.1 without change of patient

Breathing gas humidifier (reusable):	clean and disinfect
Respiratory humidifier (n. reusable):	dispose
Breathing gas humidifier holder:	clean and disinfect
Hoses, nasal cannulae, masks, or the like:	dispose of

5.2 With patient change

Respiratory humidifier (reusable):	dispose
Respiratory humidifier (n. reusable):	dispose
Breathing gas humidifier holder:	clean and disinfect
Hoses, nasal cannulae, masks, or the like:	dispose of

6. Functional description

6.1 General

The ambient air is drawn into the unit via the coarse dust filter located in the rear of the unit. There, the air is used on the one hand to cool the compressor and to generate the oxygen product gas.

The air compressed by the compressor is protected by a unit inlet filter before being alternately supplied to the two molecular sieves of the functional unit. Molecular sieve A is supplied via inlet valve E1 and molecular sieve B is supplied via inlet valve E 2. The two outlet valves A 1 and A 2 vent the molecular sieves A and B. The previously bound nitrogen is blown off to the environment via an exhaust silencer. The respective inactive molecular sieve is purged with product gas from the active molecular sieve and precharged with oxygen-enriched air at the end of a cycle.

All valves are controlled directly, microprocessor-controlled by the control board.

The temperature sensor is led into the compressor room on stranded wires and responds at a temperature of $>60^{\circ}\text{C}$.

The pressure in the oxygen tank is detected by a pressure sensor and evaluated by the microprocessor.

The product gas is passed through the multifunction sensor, which simultaneously determines the volume flow and oxygen content of the product gas by means of ultrasonic transit time measurement.

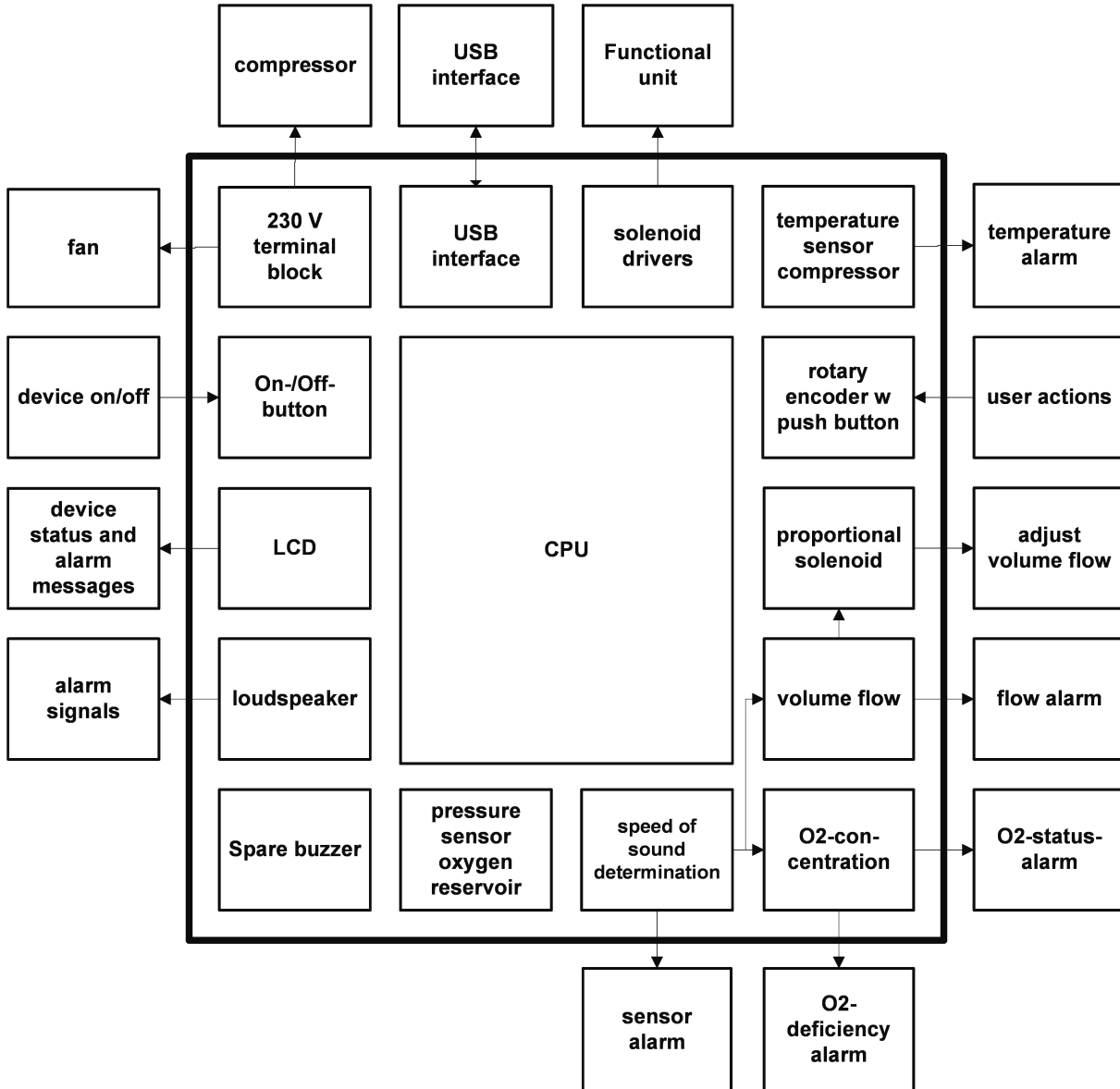
If the O₂ concentration in the product gas drops below 82%, the oxygen status alarm is triggered.

If the O₂ concentration in the oxygen tank drops below 60%, the oxygen deficiency alarm is triggered.

An adjustable pressure regulator reduces the outlet pressure to approx. 475 mbar.

6.2 Control board

Block diagram

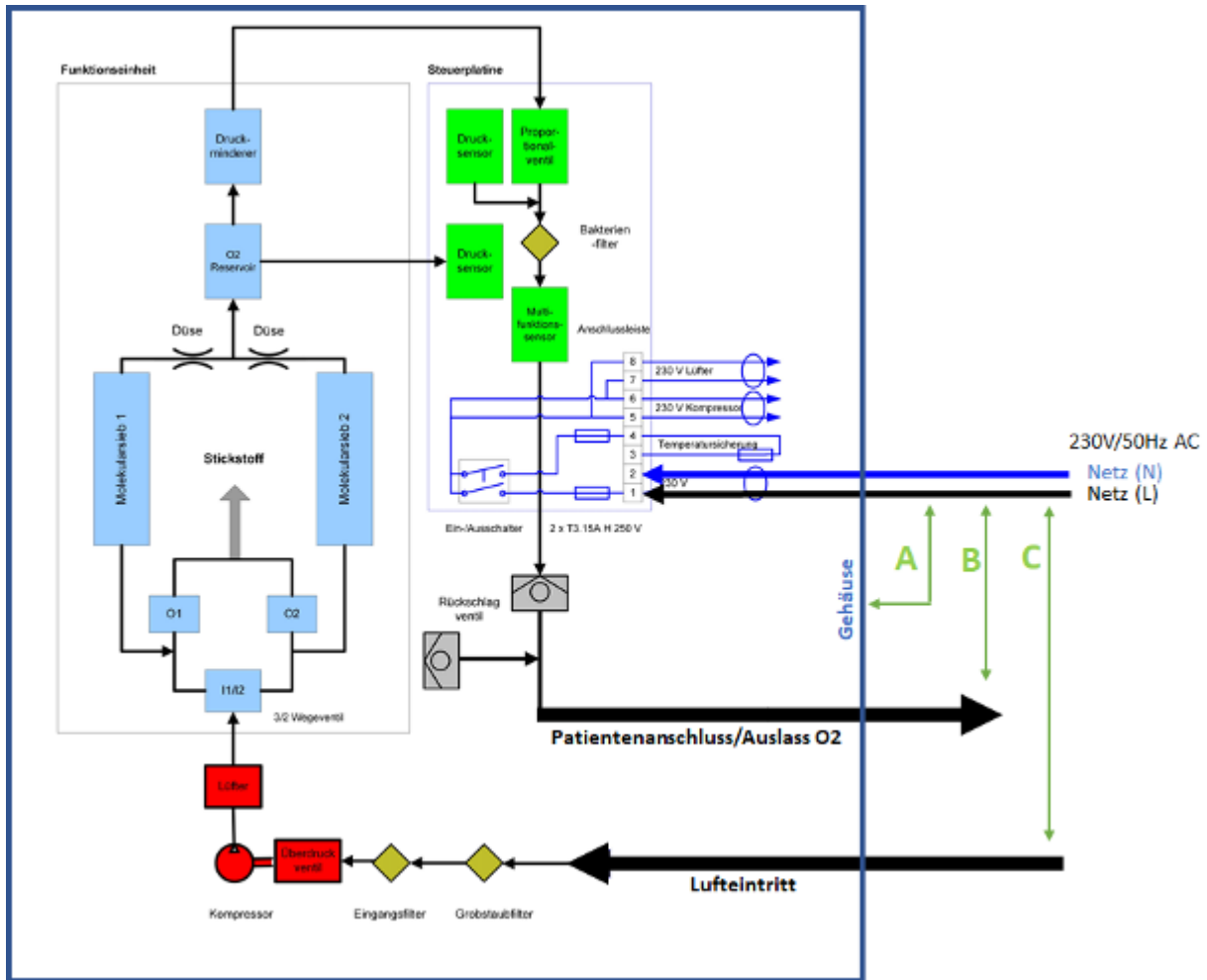


6.3 Integrated protective measures (safety concept according to MOPP)

The following protective measures have been integrated into the device:

- The device has two input fuses, which are designed as fuses. In the event of overcurrent, such as in the event of a short circuit, these melt and interrupt the power supply to the device.
- The double-pole single-throw switch (DPST) simultaneously interrupts the live outer conductor (L) and the neutral conductor (N). This means that the dangerous voltage is always switched off for plugs that can be plugged into a socket on both sides.
- From an internal housing temperature of 65°C, the temperature sensor triggers and gives a temperature alarm. As a measure, the pressure valves open, which in turn results in a pressure reduction. This means that the compressor no longer has to work against a high back pressure and less heat is generated.
- From temperatures higher than 84°C (+0°C/-5°C), the thermal fuse interrupts the motor circuit if the temperature in the compressor compartment is too high. The unit goes into the safe state and can no longer be switched on by the user. The service technician will inspect the unit and replace the thermal fuse.
- At temperatures higher than 145°C, the motor fuse (bimetal) intervenes to prevent the motor winding from being destroyed. These temperatures are rather unlikely, since the thermal fuse is already triggered before this.
- In case of overpressure (pressure ≥ 2.75 bar), the compressor relief valve responds and limits the system pressure.

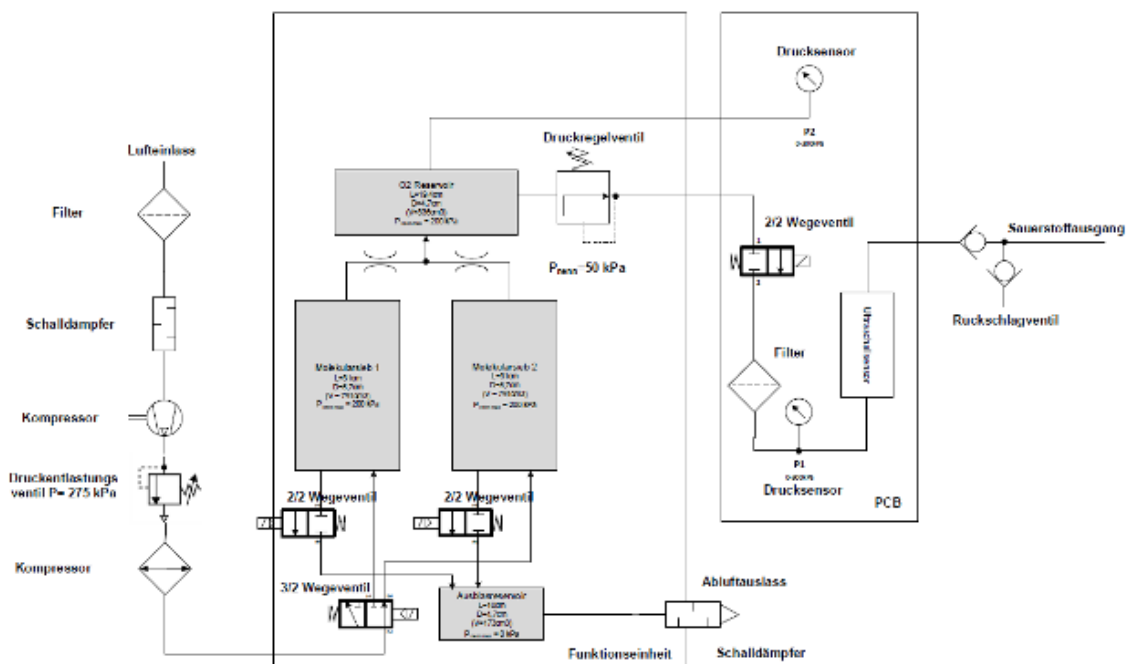
The device corresponds to equipment of protection class II. Between the active parts inside the device and the parts that can be touched by the patient, there is a non-conductive housing that ensures reinforced or double insulation at the level of the rated insulation voltage. This ensures double patient protection (2 MOPP) on all touchable parts, as shown in the figure below:



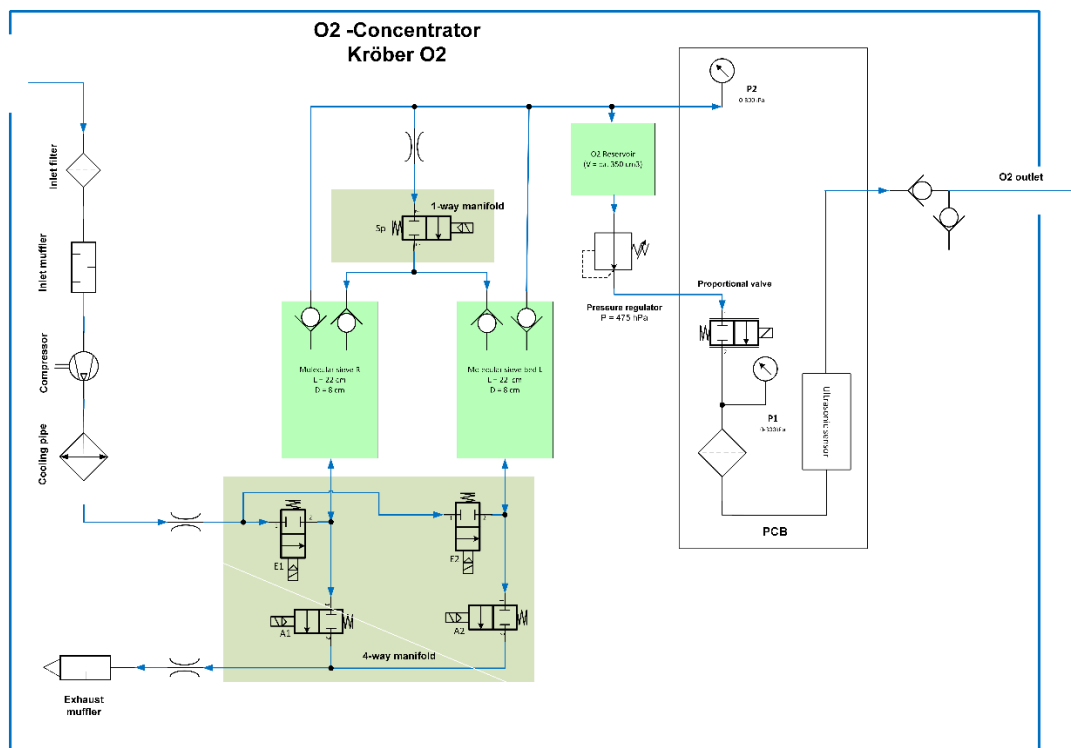
Peak operating voltage V _{peak} (U)	Touch point	Protective measure to the patient
212<U<354	A: Outer conductor/mains (L) to housing	Two MOPP
	B: Outer conductor/mains (L) to patient connection	Two MOPP
	C: Outer conductor/mains (L) to air inlet	Two MOPP

6.4 Pneumatic diagram

6.4.1 with Camozzi functional unit









6.4.2 with SMC functional unit






7. Abnormal conditions and their correction


7.1 Alarm conditions

Alarm category /LC display	Description
<p>Temperature alarm</p> 	<p>The operating temperature in the concentrator interior has risen above 60°C.</p> <p>Countermeasures:</p> <ul style="list-style-type: none"> • The device must be switched off immediately. <p>Check that air can enter the unit unhindered. Furthermore, it must be ensured that there is sufficient distance to objects (wall, cabinet etc.) and to heaters etc.</p> <ul style="list-style-type: none"> • If the coarse dust filter is clogged: replace it. <p> NOTE!</p> <p><i>To protect the patient, oxygen delivery is stopped immediately. However, the compressor continues to run.</i></p> <ul style="list-style-type: none"> • In case of defective fan: replacement • In case of defective compressor: replacement or maintenance

Alarm category /LC display	Description
<p>Power failure alarm</p> 	<p>The power supply to the device is interrupted. This leads to an immediate functional failure of the Kröber O2!</p> <p>Countermeasures</p> <p>The following should be checked:</p> <ul style="list-style-type: none"> • Is the power cord securely plugged into the outlet? • Has a fuse blown? Check fuse and replace if necessary. • Mains switch defective? - Exchange control board • Error in the wiring? - Check wiring with device open <p>Note</p> <p>If a functional test of the power failure alarm is to be performed, this can be done as follows:</p> <ul style="list-style-type: none"> -Unplug the power cord from the wall outlet. -Switch on the device. <p>The alarm works when activated now during the power-on self-test.</p> <p> NOTE! <i>If the alarm is triggered again after switching on, the service department must be notified.</i></p> <p> NOTE! <i>The power failure alarm is powered by an internal, maintenance-free capacitor.</i></p>
<p>Oxygen deficiency alarm</p> 	<p>The Kröber O₂ oxygen concentrator is equipped with an innovative multifunction sensor that monitors the oxygen concentration of the delivered oxygen.</p> <p>If this is less than 60%, then an oxygen deficiency alarm is triggered.</p> <p>Countermeasures</p> <ul style="list-style-type: none"> • check humidifier and hoses (internal and external) for leaks. • defect of the valves: replacement of the functional unit

Abnormal conditions and their correction

Alarm category /LC display	Description
<p>Oxygen status alarm</p> 	<p>The Kröber O2 oxygen concentrator is equipped with an innovative multifunction sensor that monitors the oxygen concentration of the delivered oxygen.</p> <p>If this is less than 82%, then an oxygen status alarm is triggered.</p> <p>Countermeasures</p> <ul style="list-style-type: none"> • Check humidifier and hoses (internal and external) for leaks. • Defect of the valves: replacement of the functional unit
<p>Sensor alarm</p> 	<p>There is a malfunction of the multifunction sensor, oxygen quantity and oxygen concentration cannot be determined with sufficient accuracy.</p> <p>Countermeasures</p> <ul style="list-style-type: none"> • Internal tubing check for kinks, etc. • Check if the accessories are connected correctly.
<p>System alarm</p> 	<p>There is a microprocessor error.</p> <p>Countermeasures</p> <ul style="list-style-type: none"> • Replacement of the control board.

Alarm category /LC display	Description
<p>Volume flow alarm</p>  <p>The image shows a digital display with '5.0 lpm' in the center and 'ERROR' in the bottom left corner. The display has a grid-like background.</p>	<p>The delivered volume flow does not match the set one.</p> <p>Countermeasures</p> <ul style="list-style-type: none"> -Check if the oxygen hose is kinked or pinched. -Check if the accessories are connected correctly. -Replacement of the control board.

8. PC Service Program

8.1 Installation

Hardware requirements:

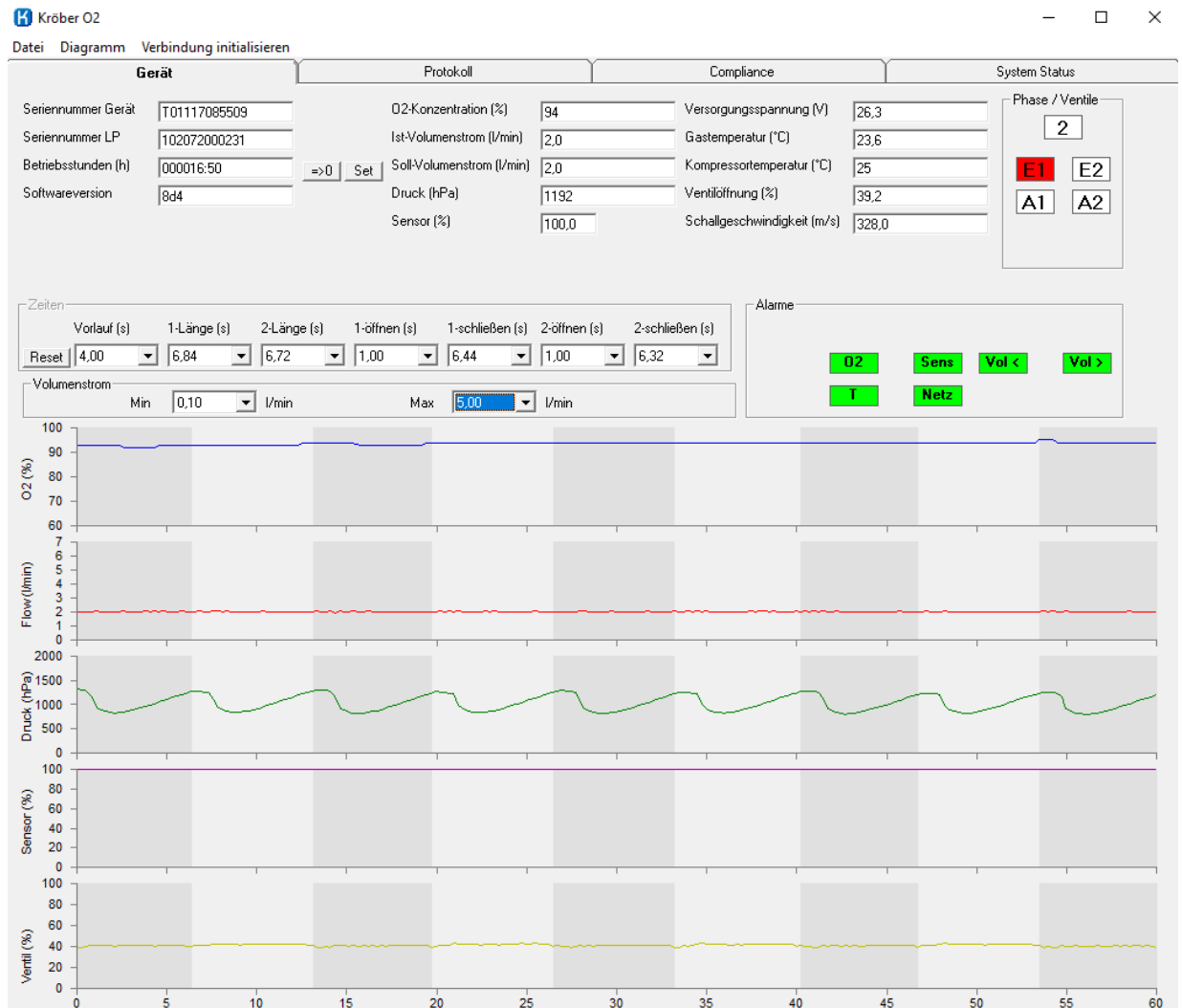
- PC with Windows 2000 / XP / W7 / W10
- USB interface
- Printer

Step-by-Step instructions

1. Download and decompress setup file Kroeber_x_x_x_x.zip.
(x_x_x_x represents the actual version)
2. Install the driver for the USB interface by starting setup.exe in the destination folder.
3. Connect the Kröber O2 to the USB interface of your PC and on the concentrator.
4. Windows detects the new hardware and automatically installs the necessary drivers.
5. Install the Kröber O2 service software by starting setup.exe in the destination folder.
6. Start Kröber O2 after successful installation in the start menu.
7. Enter the registration code: 1360103134
8. The installation processed is finished. The service software establishes a connection to the Kröber O2.

8.2 Usage

After start of the program, following screen will appear



The following administrative information is displayed:

- Serial number of the Kröber O2
- Serial number of the PCB
- Operating hours
- Software version

In the middle and right column, the actual control parameters are displayed:

- O2 concentration
- Actual volume flow
- Set volume flow

- Reservoir pressure
- Sensor quality
- Operating voltage
- Gas temperature
- Compressor compartment temperature
- Solenoid PMW signal
- Speed of sound

In the right block, the activated solenoids are colour coded.

In the second row, you can find the cycle times:

- Start-up duration (initial preload)
- Cycle durations for sieve beds 1 and 2
- Open and close durations for sieve beds 1 and 2

In the lower right block, the current alarms are displayed (green: not active; red: active):

O2 status, sensor, low volume flow, high volume flow, temperature, mains

Below this information, five one-minute-traces are shown (from top to the bottom):

- O2 concentration
- Volume flow
- Reservoir pressure
- Sensor quality
- Solenoid PMW signal

For further error investigation, it might be necessary to create a screen-dump of the the current shown screen.

To produce such a screen-dump:

- press the key "print" on the keyboard. This will copy the picture into the Windows clipboard.
- Open Word or Excel.
- Insert the picture with CTRL-V and send the document by email.

8.3 Printable Report

The second folder allows you to create a maintenance and status report.

The screenshot shows the 'Protokoll' (Protocol) window in the Kröber O2 PC Service Program. The window is divided into several sections for data entry:

- Gerät (Device):** Includes fields for Krankenkasse, Patient, Straße, Ort, and Telefon.
- Gerätedaten (Device Data):**
 - Daten (Data):**

Seriennummer Gerät	T01117085509
Seriennummer LP	102072000231
Softwareversion	8d4
Soll-Volumenstrom	2.0 l/min
Ist-Volumenstrom	2.0 l/min
Volumenstrom Min	0.1 l/min
Volumenstrom Max	5.0 l/min
O2-Konzentration	95 %
Gastemperatur	23.8 °C
Kompressor Temperatur	28.0 °C
Betriebsstunden	000016:50 h
 - Zeiten (Times):**

Vorlauf	4.00 s
1-Länge	6.04 s
2-Länge	6.16 s
1-öffnen	1.00 s
1-schließen	5.64 s
2-öffnen	1.00 s
2-schließen	5.76 s
- Prüfer (Tester):** Field for the tester's name.
- Datum (Date):** 10.01.2021
- Uhrzeit (Time):** 15:13:31
- Funktionstest (Function Test):** A list of checkboxes for various tests:
 - Selbsttest, alle Funktionen vorhanden
 - Ansaugtest Kompressor
 - maximaler Flow
 - minimaler Flow
 - visuelle Kontrolle
 - STK
 - STK durchgeführt
 - nur Hersteller
 - Typenschild anbringen
- Bemerkungen (Remarks):** A text area for notes, with a sub-section for 'ausgeliefertes Zubehör' (delivered accessories).
- Buttons:** Drucken (Print), Speichern (Save), and Öffnen (Open).

It is possible to fill in patient and tester data.

Check boxes are for the required maintenance procedures.

One can print, save and open existing reports.

8.4 Flight recorder

All Kröber O2 contain a flight recorder that might help to analyse the technical status of the unit.

For this reason, the Kröber O2 will continuously store cumulated data in predefined interval.

To retrieve this information press the read button in the lower left corner.

For further analysis, it can be advised to make also a printscreen of this information.



The screenshot shows the 'System Status' window of the Kröber O2 PC Service Program. The window title is 'Kröber O2' and it contains several tabs: 'Gerät', 'Protokoll', 'Compliance', and 'System Status'. The 'System Status' tab is active, displaying a table of flight recorder data. The table has columns for Block, Zeit, Al., SE, O2, Uo1, Pr., SE-Q, U.low, mw, max, mw, min, T.min, T.max, T1.mw, T2.mw, U.mw, O2min, O2max, and O2.mw. The data is organized into sections: 'ALARME', 'Status', 'PropVent', 'Druck', 'SENSOR', 'ZEITEN', and 'SYSTEM'. The 'Status' section shows a list of blocks with their corresponding time, altitude, and various sensor readings. The 'Druck' section shows pressure readings in hPa. The 'SENSOR' section shows temperature readings in °C. The 'ZEITEN' section shows time intervals in seconds. The 'SYSTEM' section shows oxygen levels in %.




Block	Zeit [s]	Al. [s]	SE [s]	O2 [s]	Uo1 [s]	Pr. [s]	SE-Q [s]	U.low [s]	mw [%]	max [%]	mw [hPa]	min [hPa]	T.min [C]	T.max [C]	T1.mw [s]	T2.mw [s]	U.mw [lpm]	O2min [%]	O2max [%]	O2.mw [%]
29	1200	\$00	-	-	-	\$00	-	-	51,8	54,1	710	590	0,8	5,0	5,48	5,52	5,0	92,4	94,9	94,3
28	1200	\$00	-	-	-	\$00	-	-	49,8	52,2	760	620	1,0	6,3	6,12	6,16	4,5	93,0	95,5	94,9
27	1200	\$00	-	-	-	\$00	-	-	48,6	51,0	800	660	1,0	6,3	6,56	6,60	4,0	93,8	95,7	95,2
26	1200	\$00	-	-	-	\$00	-	-	47,8	50,2	820	670	1,0	5,0	6,80	6,84	3,8	93,8	95,6	95,1
25	1200	\$00	-	-	-	\$00	-	-	47,5	49,4	840	680	1,0	7,5	6,96	7,00	3,6	93,9	95,7	95,1
24	1200	\$00	-	-	-	\$00	-	-	46,7	49,0	850	690	0,8	5,0	7,12	7,16	3,4	94,0	95,7	95,2
23	1200	\$00	-	-	-	\$00	-	-	45,9	48,6	870	700	1,0	6,3	7,28	7,32	3,2	93,5	95,7	95,1
22	1200	\$00	-	-	-	\$00	-	-	45,5	47,8	890	720	1,0	5,0	7,44	7,48	3,0	94,3	95,6	95,1
21	1200	\$00	-	-	-	\$00	-	-	44,7	47,1	900	720	1,0	6,3	7,52	7,56	2,8	93,8	95,7	95,2
20	1200	\$00	-	-	-	\$00	-	-	44,3	46,3	920	730	1,3	7,5	7,68	7,72	2,6	94,6	95,7	95,2
19	1200	\$00	-	-	-	\$00	-	-	43,9	45,9	930	740	1,0	7,5	7,80	7,80	2,4	94,4	95,7	95,2
18	1200	\$00	-	-	-	\$00	-	-	43,1	45,1	950	750	1,3	6,3	7,92	7,96	2,2	93,9	95,7	95,2
17	1200	\$00	-	-	-	\$00	-	-	42,7	44,7	970	760	1,3	7,5	8,08	8,12	2,0	94,6	95,6	95,2
16	1200	\$00	-	-	-	\$00	-	-	42,4	44,3	980	770	1,3	6,3	8,16	8,20	1,9	94,1	95,6	95,1
15	1200	\$00	-	-	-	\$00	-	-	42,0	43,9	990	780	1,3	6,3	8,24	8,28	1,8	94,4	95,6	95,1
14	1200	\$00	-	-	-	\$00	-	-	42,0	43,9	1000	780	1,3	8,8	8,32	8,36	1,7	94,4	95,6	95,1
13	1200	\$00	-	-	-	\$00	-	-	41,6	43,5	1000	790	1,3	7,5	8,32	8,36	1,6	94,4	95,6	95,2
12	1200	\$00	-	-	-	\$00	-	-	41,2	43,1	1010	790	1,5	7,5	8,40	8,44	1,5	94,7	95,6	95,2
11	1200	\$00	-	-	-	\$00	-	-	41,2	43,1	1010	800	1,3	7,5	8,40	8,44	1,4	94,9	95,8	95,4
10	1200	\$00	-	-	-	\$00	-	-	40,8	42,7	1020	800	1,5	7,5	8,40	8,44	1,3	95,1	95,9	95,5
9	1200	\$00	-	-	-	\$00	-	-	40,4	42,4	1030	800	1,5	8,8	8,40	8,44	1,2	95,2	95,9	95,6
8	1200	\$00	-	-	-	\$00	-	-	40,0	42,0	1030	810	1,5	8,8	8,40	8,40	1,1	95,2	96,0	95,6
7	1200	\$00	-	-	-	\$00	-	-	40,0	42,0	1040	810	1,5	7,5	8,40	8,40	1,0	95,3	96,0	95,7
6	1800	\$00	-	-	-	\$00	-	-	43,9	46,7	800	680	21,5	22,0	5,40	5,44	3,0	93,8	94,5	94,1
5	1800	\$00	-	-	-	\$00	-	-	43,5	46,3	800	670	20,8	21,8	5,40	5,44	3,0	93,6	94,3	94,0
4	1800	\$00	-	-	-	\$00	-	-	43,5	45,9	800	680	21,0	21,8	5,40	5,44	3,0	93,8	94,4	94,1
3	1800	\$00	-	-	-	\$00	-	-	43,1	45,5	800	670	21,3	21,8	5,40	5,40	3,0	93,8	94,4	94,1
2	1800	\$00	-	-	-	\$00	-	-	43,1	45,5	790	660	21,0	21,3	5,40	5,40	3,0	93,7	94,4	94,1
1	1780	\$00	-	-	-	\$00	-	-	43,1	49,4	800	630	19,0	21,3	5,40	5,44	3,2	78,5	94,4	93,6
0	1780	\$00	-	-	-	\$00	-	-	49,4	52,2	760	620	31,8	32,8	6,12	6,12	4,5	93,8	96,4	95,8




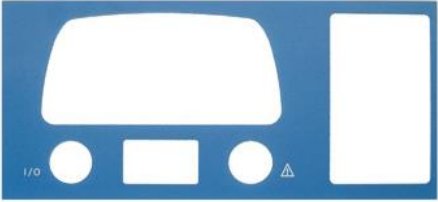
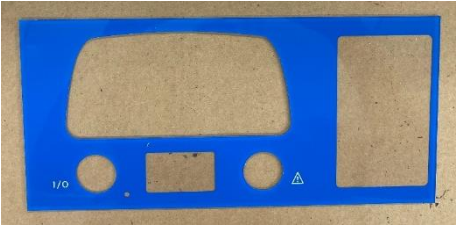
At the bottom of the window, there are two buttons: 'Systemstatus-Speicher auslesen' and 'Speichern'.




9. Appendix

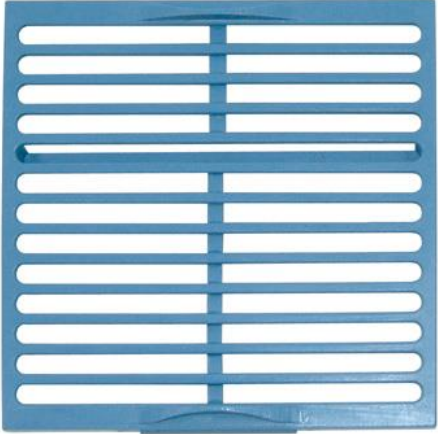


9.1 Spare parts list


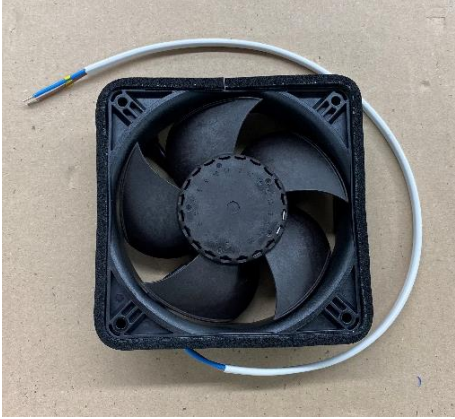

p/n	Description	Picture
E- KRO2.20	Base housing Kröber O20, with <ul style="list-style-type: none"> • foam • O2 connector + internal hose • cable retainers blue cover foil for GDT compressor version	
E- KRO2.20-R2	Base housing Kröber O20, with <ul style="list-style-type: none"> • foam • O2 connector + internal hose • cable retainers blue cover foil for Tecwell compressor version	

p/n	Description	Picture
E-KRO2.21	Lid for Kröber O2 housing, with foam for GDT compressor version	
E-KRO2.21-R2	Lid for Kröber O2 housing, with foam for Tecwell compressor version	
E-KRO2.22	Service Lid, with foam	




p/n	Description	Picture
E-KRO2.23	Slide-in module control elements <ul style="list-style-type: none"> old version without LED hole with mounted handle	
E-KRO2.23-R2	Slide-in module control elements <ul style="list-style-type: none"> new version with LED hole with mounted handle 	
KRO2.24	Grip	
KRO2.25	Perspex panel <ul style="list-style-type: none"> old version without LED hole 	
KRO2.25-R2	Perspex panel <ul style="list-style-type: none"> new version with LED hole 	




p/n	Description	Picture
KRO2.26	Printed card for Kröber	
E-KRO2.27	Turning knob for flow adjustment	
KRO2.28	Push button for main switch	
E-KRO2.29	Retainer for power supply cord <ul style="list-style-type: none"> with 4 mounting screws 	

p/n	Description	Picture
E-KRO2.30	Grid for coarse dust filter <ul style="list-style-type: none"> • with coarse dust filter 	
E-KRO2.32	O2-connector UNF 9/16" mith screw M10	
KRO2.33	Castor	


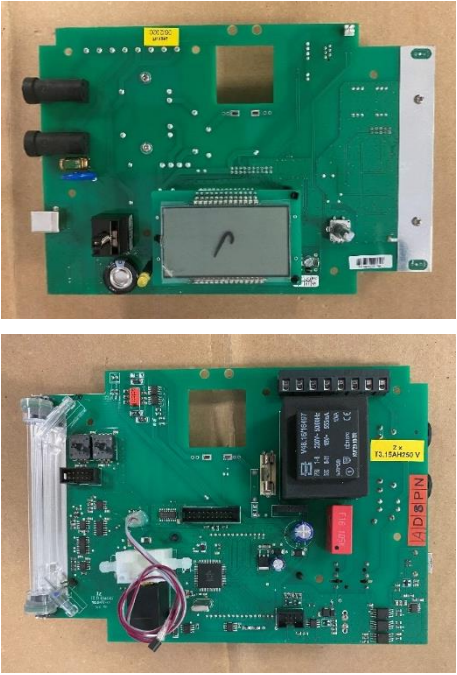
p/n	Description	Picture
KRO2.33-B	Castor with brake	
E-KRO2.34	Fan 230 Volt 50 Hz <ul style="list-style-type: none"> • without mounting foam • with connecting cable with 4 mounting screws	
KRO2.37-2	Check valve	

p/n	Description	Picture
E-KRO2.41	Aluminium sheet metal for lower airduct	
KR4.28	Support for airduct	
E-KRO2.50	Full Compressor module <ul style="list-style-type: none"> • version Gardner Denver Thomas (GDT) mounted with springs on base metal sheet	

p/n	Description	Picture
E-KRO2.50-TC	<p>Full Compressor module</p> <ul style="list-style-type: none"> • version Tecwell • mounted with springs on base metal sheet with outlet muffler 	 <p>A photograph of a full compressor module. It consists of a rectangular metal base with a white metal sheet mounted on top. The base has two yellow electrical terminals on the right side and a central black component. The white sheet has a spring mechanism visible on its top surface.</p>
KRO2.55	Capacitor 10 μ F für GDT compressor	 <p>A photograph of a cylindrical capacitor with a silver metal body and a white label. The label includes the text 'CSC', '10µF ±5%', and '450V AC'. There are two metal terminals on top. A black plastic cap is shown next to it.</p>
KRO2.55-R2	Capacitor 6 μ F für Tecwell compressor	 <p>A photograph of a blue cylindrical capacitor with two metal terminals on top. The label on the capacitor reads 'CBB60 SH', '6µF ±5%', '450V AC', '50/60Hz', 'DB B 50', '40/70/21', and '18 9 H'.</p>

p/n	Description	Picture
KRO2.55-R2	Capacitor 8 μ F für Tecwell compressor	
E-KRO2.60-1	Thermal fuse 72°	
E-AEE.17	Thermal fuse 84°	


p/n	Description	Picture
KRO2.63	Power cord EU	
KRO2.63-2	Power supply CH plug	
KRO2.63-3	Power supply Taiwan plug	
KRO2.63-4	Power supply UK	

p/n	Description	Picture
KRO2.60	<p>Main board Kröber</p> <ul style="list-style-type: none"> • tested • with loudspeaker • no LED 	
KRO2.60-R2	<p>Main board Kröber</p> <ul style="list-style-type: none"> • tested • no loudspeaker • with EMC shield • with LED 	

p/n	Description	Picture
KRO2.60-A	KRO2.60 fully assembled with slide-in module <ul style="list-style-type: none"> • without LED 	 A photograph of the KRO2.60-A module, showing a white plastic housing with a green PCB slide-in module. The module has a small LCD screen and two rotary buttons.
KRO2.60-A-R2	KRO2.60-R2 fully assembled with slide-in module <ul style="list-style-type: none"> • with LED 	 A photograph of the KRO2.60-A-R2 module, which is identical in appearance to the KRO2.60-A but includes an LED indicator.
E-201.04-R3	Buzzer	 A photograph of a black circular buzzer component with a white square PCB and a black cable with a connector.

p/n	Description	Picture
E-KRO2.70	Functional unit for O2-production <ul style="list-style-type: none"> • model Camozzi 	
E-KRO2.70-SMC	Functional unit for O2-production <ul style="list-style-type: none"> • model SMC 	

p/n	Description	Picture
201.43-R1	4-way-manifold SMC	
201.42-R1	1-way-manifold SMC purge valve	
201.07-L-R3	Sieve bed left, marked "L"	
201.07-R-R3	Sieve bed right, marked "R"	

p/n	Description	Picture
AEE.45	Clamp	 A photograph showing two metal clamps. Each clamp consists of a circular ring with a small hook-like protrusion on one side. The clamps are made of a shiny, reflective metal, likely stainless steel, and are positioned on a light-colored surface.

9.2 EMC Guidelines

9.2.1 Electromagnetic compatibility, interference emission

Guidelines and manufacturer's declaration - Electromagnetic compatibility, emission of interference		
The Kröber O2 is intended for operation in an environment as specified below. The operator of the Kröber O2 must ensure that it is operated in such an environment.		
Interference emission measurements	Match	Electromagnetic environment - Guidelines
RF emissions according to CISPR 11	Group 1	The Kröber O2 uses RF energy exclusively for its internal function. therefore, its RF emission is very low and it is unlikely that - neighboring electronic devices will be disturbed.
RF emissions according to CISPR 11	Class B	The Kröber O2 is intended for use in all facilities, including residential areas and those directly connected to a public supply network that also supplies buildings used for residential purposes.
Emission of harmonics according to IEC 61000-3-2	Class A	
Emission of voltage fluctuations/flicker according to IEC 61000-3-3	Agrees	

Table 1: Electromagnetic compatibility, interference emission

9.2.2 Electromagnetic compatibility, immunity

Guidelines and manufacturer's declaration - Electromagnetic compatibility, immunity to interference			
The Kröber O2 is intended for operation in an environment as specified below. The operator of the Kröber O2 must ensure that it is operated in such an environment.			
Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment - Guidelines
Discharge of static electricity according to IEC 61000-4-2	±6 kV Contact discharge ±8 kV air discharge	±6 kV Contact discharge ±8 kV air discharge	Floors should be made of wood or concrete, or have ceramic tiles. If the floor is covered with synthetic - material, the relative humidity must be at least 30%.
fast transient electrical disturbances/bursts according to IEC 61000-4-4	±2 kV for power lines ±1 kV for input/output lines	±2 kV for power lines ±1 kV for input/output lines	The quality of the supply voltage should be that of a typical business or hospital environment.
Surges according to IEC 61000-4-5	±1 kV push-pull	±1 kV push-pull	The quality of the supply voltage should be that of a typical business or hospital environment.
Voltage dips, short-term interruptions - and fluctuations in the supply voltage IEC 61000-4-11	< 5 % UT (>95 % dip of UT) for ½ period	limited functionality	The quality of the supply voltage should be that of a typical business or hospital environment. NOTE: U_T is the AC line voltage - before applying the test levels.
	40 % U_T (60 % dip of U_T) for 5 periods	Power failure alarm Device restart	
	70 % U_T (30 % dip of U_T) for 25 periods	limited functionality	
	<5 % UT (95 % dip of U_T) for 5 s	Power failure alarm Device restart	
Magnetic field at a supply frequency - (50 Hz) according to IEC 61000-4-8	3 A/m		Magnetic fields at the mains frequency should - correspond to typical values found in business and hospital environments.
			Portable and mobile radios should not be used at a - distance from the Kröber O2 , including lines, less - than the recommended separation distance -

Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment - Guidelines
			calculated from the - equation applicable to the - transmit frequency. Recommended protective distance:
radiated RF disturbances - according to IEC 61000-4-3	3 V/m 80 MHz to 2.5 GHz	3 V/m	$d = 1.2 \sqrt{P}$ for 80 MHz to 800 MHz $d = 2.3 \sqrt{P}$ for 800 MHz to 2.5 GHz


Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment - Guidelines
<p>Conducted RF disturbances according to IEC 61000-4-6</p>	<p>3 V_{rms} 150 kHz to 80 MHz</p>	<p>3 V_{rms}</p>	<p>$d = 1.2 \sqrt{P}$</p> <p>where P is the transmitter's rated power in watts (W) as specified by the transmitter manufacturer and d is the recommended separation distance in meters (m).</p> <p>The field strength of stationary radio transmitters is lower than the compliance level ^b at all frequencies according to an on-site investigation ^a.</p> <p>There is a possibility of interference in the surroundings which have the following pictogram:</p> <div style="text-align: center;">  </div>
<p>NOTE 1: At 80 MHz, the higher value applies.</p>			
<p>NOTE 2: These guidelines may not apply in all situations. Electromagnetic wave propagation is affected by absorption and reflection from buildings, objects and people.</p>			
<p>^a The field strength of stationary transmitters, such as base stations of radiotelephones and land mobile services, amateur stations, AM and FM radio and television transmitters, cannot be predicted theoretically with accuracy. To determine the electromagnetic environment and consequence of stationary RF transmitters, a site survey is recommended. If the determined field strength at the location of the Kröber O2 exceeds the compliance level specified above, the Kröber O2 must be observed with respect to its normal operation at any application site. If unusual performance characteristics are observed, it may be necessary to take additional measures, such as reorienting or relocating the Kröber O2.</p>			
<p>^b Over the frequency range from 150 kHz to 80 MHz, the field strength is less than 3 V/m.</p>			








Table 2: Electromagnetic compatibility, immunity to interference

9.2.3 Recommended protective distances

Recommended protective distances between portable and mobile RF communication devices and the <i>Kröber O2 Version 4.0</i>			
The Kröber O2 is intended for operation in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the Kröber O2 can help prevent electromagnetic interference by maintaining minimum distances between portable and mobile RF communications equipment (transmitters) and the Kröber O2 as recommended below according to the maximum output power of the communications equipment.			
Nominal power of the transmitter W	Protective distance according to transmission frequency m		
	150 kHz to 80 MHz $d=1.2\sqrt{P}$	80 MHz to 800 MHz $d=1.2\sqrt{P}$	800 MHz to 2.5 GHz $d=2.3\sqrt{P}$
0,01	0,12	0,12	0,23
0,1	0,38	0,38	0,73
1	1,2	1,2	2,3
10	3,8	3,8	7,3
100	12	12	23
For transmitters whose rated power is not specified in the above table, the distance can be determined using the equation associated with the respective column, where <i>P</i> is the rated power of the transmitter in watts (W) as specified by the transmitter manufacturer.			
NOTE 1 AN additional factor of 10/3 was used to calculate the recommended separation distance of transmitters in the frequency range of 80 MHz to 2.5 GHz to reduce the likelihood that a mobile/portable communication device inadvertently introduced into the patient area would cause interference.			
NOTE 2 These guidelines may not apply in all situations. Electromagnetic wave propagation is affected by absorption and reflection from buildings, objects and people.			

Table 3: Recommended protective distances

9.3 Explanation of symbols

Symbol	Meaning
	WARNING! General warning sign (according to ISO 7010-W001)
	WARNING! Electricity (according to ISO 7010-W001)
	Attention, follow the instructions in the operating manual.
	Applied part type BF
	Protection class II
	Notified body: TÜV Rheinland LGA Product Service
	On/Off switch