

SUBMATIX



REBREATHER

CCR 100 SMS

USER MANUAL_E

Revision 0407

Guarantee

The first owner of the unit must send back to SUBMATIX this complete guarantee within 14 days.

All dives must be planned in the enclosed dive schedule and signed by the user and his/her dive partner. The owner is obliged to give the unit to an annually revision to a service base, authorised by Submatix. In case of irregular carried out revisions or an uncomplete filled in service book, Submatix is not liable for any damages. SUBMATIX accepts also no liability for damages before receiving the guarantee and/or because of a not correct filled in dive schedule.

Serial number:
Purchase date:
Name:
Address:
Postcode, City:
Country:
Telephone:
Email:

I accept the conditions of use.

Signature:

I accept that if no other place is written in this manual, the legal domicile and the place of fulfilment is Erfurt/Germany.

Signature:



CCR Dive Schedule

Name, prename			
Town, dive place			
Date/time (start of the dive)			
Buddy			
Data of the last dive			
Repetitive group/ stopp at the surface	Group: ____/____ stopp: ____/____ h ____/____ min		
CNS O ₂ %-dosage CNS O _{2time} • multiplier = CNS O _{2rest}	____/____ % O _{2old} • ____/____ = ____/____ % O _{2rest}		
Diluent Mix			
Gas mixture diluent → share fO ₂ , with it MOD	____ % O ₂ ____ % N ₂		
Allowed partial pressure of O ₂ → max. length of stay at ppO _{2max}	ppO _{2max} = 1.2 bar max. 1.2 bar		
Maximum operation depth/ depth to switch → MOD (table)	MOD = ____ m		
Constant dosage (f) O ₂ → max. dive time	____ l/min		
Gas supply (Q) O ₂ → Q = V _{unit} • (p _{unit} - p _{reserve}) Diluent bar	Q = ____ l/bar • (____ - ____) bar = ____ l		
Effort	<input type="checkbox"/> low <input type="checkbox"/> normal <input type="checkbox"/> high		
Using time of the scrubber	<input type="checkbox"/> normal 180 min <input type="checkbox"/> high 120 min		
Maximum dive time → t _{max} = Q/f	t _{max} = ____ l/____ l/min = ____ min		
Dive	planned		carried out
Dive depth (D) (Bottom Mix Diluent) → ambient pressure p _a	D = ____ m		D = ____ m
Equivalent air depth → EAD (table)	EAD = ____ m		EAD = ____ m
No decompression time (NZ)/time extra charge (ZZ) → determined with EAD and deco table	NZ = ____ min	ZZ = ____/____ min	NZ = ____ min ZZ = ____/____ min
Rest no decompression time (RNZ) → RNZ = NZ - ZZ	RNZ = ____ min		RNZ = ____ min
Dive time	BASICtime = ____ min		DIVETIME = ____ min
Repetitive group → after the dive			
CNS O _{2new} % → of this dive	____ % O ₂		/
CNS O ₂ % after the dive CNS O ₂ % = CNS O _{2new} % + CNS O _{2rest} %	____ % O ₂		____ % O ₂

Signature diver

Signature buddy

Table of content

1	Security notes.....	6
2	Liability for function and/or damages	7
3	Intended purpose	8
4	Glossary of common rebreather terms.....	9
5	Maximum operation depth.....	11
6	Assembly of the unit.....	13
7	Description	14
8	Technical data	18
9	Component parts and assembling	19
10	Handling and use	28
10.1	General instructions	28
10.2	Preparation of the dive	29
10.2.1	Filling of the scrubber tank.....	29
10.2.2	Filling of tanks	29
10.2.3	Density checks: overpressure and low-pressure	30
10.2.4	Check the tank storage pressure and mixture	33
10.2.5	Checking the bypass valve	33
10.2.6	Flow meter.....	33
10.2.7	ppO ₂ -monitor	35
10.2.8	Checking the direction valves	36
10.3	Diving with the Submatix CCR 100 SMS	36
10.3.1	ppO ₂ -monitoring system.....	38
10.4	Diving to the water surface with the Submatix CCR 100 SMS	39
10.5	Postprocessing of the Submatix CCR 100 SMS.....	40
11	General comments for handling and security	44
12	Service intervals	45
13	Maintenance intervals	46
14	Record card.....	48

For your safety, please pay attention to the following directions for use!

The SUBMATIX CCR 100 SMS is a mix gas rebreather, which was designed and built for recreational diving only. As rebreather the CCR has certain typical characteristics, which can lead to serious injury or death in case of incorrect use. Therefore, it is absolutely necessary to do not attempt to use a CCR 100 SMS without passing successfully a corresponded course by an organization, recognized by Submatix.

This user manual is designed to be a guideline to the proper use of your CCR 100 SMS. It is not a substitute for thorough, appropriate training and certification in the use of this rebreather.

This manual does not contain all information needed for the safe use of the unit but it provides the general information, which are necessary to pass successfully the CCR training.

This manual will also provide you with the necessary manufacturer's guidelines for maintenance and service. These instructions must be followed strictly to avoid serious injuries or death.

Every use of the CCR requires the exact knowledge and observing of this guideline. The unit is only be meant for the prescribed use. You have also to observe the security data sheet and product information of Sofnolime and Spherasorb or of the other used CO₂-absorber.

1 Security notes

These words, and the hazard they describe, are the following:

Danger! This indicates an immediately hazardous situation, which, if not avoided, will result in death or serious injury.

Warning! This indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury.

Caution! This indicates a potentially hazardous situation, which, if not avoided, can result in minor or moderate injury. It may also be used to warn of unsafe practices.

You must carefully follow all of these hazard indicators to safely enjoy your SUBMATIX SCR 100 ST.

Warning! You must have your SUBMATIX SCR 100 ST inspected and serviced according to the guidelines contained in this owner's manual, and by an authorized service and repair facility. USE ONLY authentic SUBMATIX parts. When you do not do this it may lead to a malfunction of the SUBMATIX SCR 100 ST, resulting in serious injury or death.

The maintenance of your SUBMATIX SCR 100 ST, must be carried out by an authorized SUBMATIX SCR 100 ST repair facility at regular intervals. Both, you and the service facility must keep complete records of all service and repair visits. Pay careful attention to the sections of this owner's manual, which describes the maintenance intervals and procedures. By SUBMATIX trained repair technicians must only carry out service and repair of the SUBMATIX SCR 100 ST. Use only authentic SUBMATIX parts in the maintenance and repair of the SUBMATIX SCR 100 ST.

2 Liability for function and/or damages

The owner or user of the unit is liable for the function of the unit and/or damages if the unit is not maintained or repaired correctly by persons, who belong to Submatix or who were trained by Submatix.

As far as notes to laws, decrees and standards are given, they are based on the legal rules of Germany. Submatix is not liable for damages, which arise from uncorrect use or from the use of components by other dive equipment producers!

Guarantee and liability conditions of the conditions for sales and delivery cannot be extended through the above-mentioned comments!

The Submatix CCR 100 SMS is a mix-gas rebreather for sport divers and it was not designed for working use. It was built for an individual adjustable oxygen consumption. The oxygen consumption must be determined individually and it must be adapted through the adjustable flow nozzle. So the diver will only consume the quantity of gas, which was supplied to the system and the mixture of the diluent gas will be produced in the breathing loop under optimal conditions.

To avoid a hypoxia or a hyperoxia, the unit must be used with at least 2 redundant oxygen monitors. These monitoring systems must have an acoustic or visible low and high ppO_2 -warning. The absolute maximum set points are: low 0.40 bar and high 1.3 bar.

While the use of the corresponding monitoring systems you have to watch that these are certificated by the producer for the use in closed rebreathers.

Submatix recommends the use of at least 2 independent redundant systems.

You are only allowed to dive with the CCR after passing successfully the corresponding training at an organization, recognized by Submatix.

3 Intended purpose

The Submatix CCR 100 SMS is a sport dive unit, which was designed for the use of 2 gas mixtures. It is used for dives started at the water surface. The system was designed for recreational diving only and it is not admitted for working use.

The CCR was developed for sport dives to a maximum depth of 40 metres with nitrox or for technical dives to a maximum depth of 100 metres with trimix.

Attention: Submatix delivers the CCR with adjustments for a depth of 80 meters (low-pressure pressure reducer oxygen 10 bar). For higher depths the unit must be adjusted by an authorized service trader.

The gas mixtures of the CCR are not designed for emergency situations!

The diver must be certificated by an authorized organization. In every case the training's guidelines by the training's federation are valid.

It is important to never breath from the unit when the mix gas tanks are closed or empty!

Before the dive all points of the pre-dive-checklist must be carried out and be ok!

With the Submatix CCR 100 SMS the diver is only allowed to start the dive from the water surface. The unit is worn on the back.

The diver must carry with an additionally bailout system (is not concluded in standard deliveries), which corresponds to the planned dive depth and time.

4 Glossary of common rebreather terms

Bailout: Autonomie Gas supply for emergency

Bar: One atmosphere of pressure, i.e. 14.7 psi.

Gas mix: The used gas for the maximum planned depth.

BCD: Buoyancy Control Device. The inflatable vest is used to trim buoyancy while diving. SUBMATIX sells these separately.

Bypass valve: The demand valve, similar to a scuba second stage, which provides gas to the breathing loop when the diver needs more fresh gas because of an increase in pressure.

Caustic cocktail: The poisonous mix, which occurs, if water is allowed to flood the scrubber.

Counter lung: A plastic bag into which the diver's breath flows. It inflates as your lungs deflate, i.e. counter to your lung. Submit counter lungs are coaxial, i.e. one inside the other.

DSV: Dive Surface Valve. The mouthpiece assembly, which has an 'off/on' switch. The SUBMATIX DSV can be operated with one hand.

Flowmeter: A device to measure the amount of fresh gas flowing into the counter lung during pre-dive checks.

Loop: The hose assembly, scrubber canister and counter lungs, which cycle the breathing, gas in a 'loop'.

Overpressure valve: A valve, which allows excessive pressure in the counter lung to exit.

ppO₂: Partial pressure of oxygen. Maintained between 0.2 and 1.4 bar of the atmosphere. SUBMATIX offers the Oxyscan 100 Pro.

Octopus: An open circuit scuba second stage used for bail out.

Pressure gauge: Shows existing pressure in tanks. One is provided for each cylinder.

Purge: Cleansing of the loop of one gas mixture when changing to another.

Pressure reducer: A valve, which reduces the gas pressure exiting a Nitrox cylinder.

Scrubber: A refillable canister, which holds a carbon dioxide absorbing chemical in a coarse granular form.

Scrubber material: A caustic white granular material, which absorbs carbon dioxide exhaled by the diver.

5 Maximum operation depth

The maximum operation depth results from the used diluent mixture. It corresponds to the maximum partial pressure of oxygen of 1.2 bar.

Attention: The maximum partial pressure of oxygen of 1.2 bar should not be exceeded!!!

Maximum operation depths with diluent/nitrox/trimix	
O ₂ Mix %	maximum depth pO ₂ 1.2 bar
60%	10 m
50%	14 m
40%	20 m
32%	27 m
21%	47 m
20% O ₂ /45% He	50 m
14% O ₂ /60% He	75 m
10% O ₂ /65% He	100 m

Table 1

Attention: The reading of this manual does not exclude from the participation in a Submatix CCR 100 SMS training. Before a successful passing of this course the diver is not allowed to dive with this unit. The use of the CCR 100 SMS without the previous participation in the corresponding course can lead to serious injuries or death!

Limited by the design of the unit it can be happen that the diver will have a too high or too low partial pressure of oxygen in the breathing gas but this depends on variations in working.

The above-mentioned breathing gas problems are among other things the most often arising problems. A too high share of oxygen causes a poisoning of the central nervous system, which will lead to cramp attacks and drowning. A too low share of oxygen will lead to hypoxia, unconsciousness or drowning. Therefore, you are not allowed to dive the unit without 2 redundant ppO₂-monitors with warning.

Attention: Before every dive the diver must have exact knowledge of the dangers of hypoxia and poisoning through oxygen (hyperoxia). You are not allowed to dive the unit without having the knowledge of these 2 risks and of the avoidance of these risks.

Danger: The Submatix CCR 100 SMS should never be dived with closed tank valves or empty tanks. The disregard of this comment can lead to serious injuries or death!

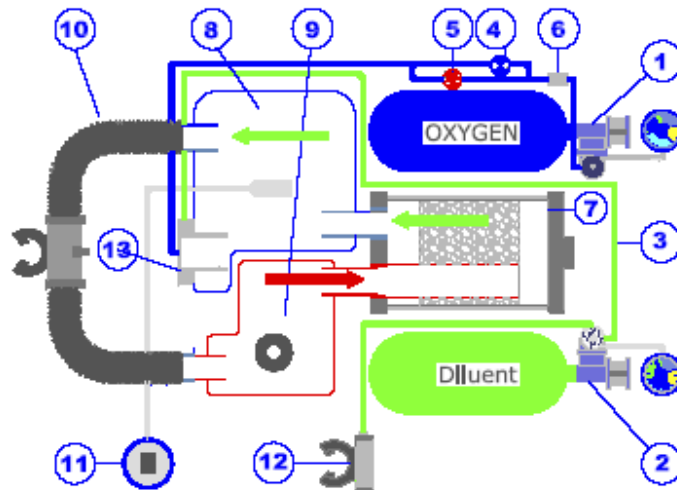
The maximum operation depth is calculated with the diluent mixture. These calculations are always carried out with the mixture of the diluent tank and not with the mixture in the breathing loop.

Attention: As the mixture in the breathing loop depends on the work of the diver, variations are possible. The correct calculation of the decompression is only possible with a dive computer with connected oxygen sensors!

Attention: At the use of dive computer you have to have to pay attention to use only units, which are determined for high frequencies and which can calculate with mixtures lower than 21% oxygen! The optional available Submatix Oxyscan A can be used as pO₂-monitor (only for checking, variations are possible through humidity and warmth).

Attention: The CCR should only be used with at least 2 redundant oxygen ppO₂-monitors with acoustical and visible warnings. Systems with several sensors on a connected ppO₂-monitor and/or a connected dive computer are considered to be not redundant.

6 Assembly of the unit



- 1 pressure reducer oxygen with pressure gauge
- 2 pressure reducer diluent with pressure gauge
- 3 diluent supply to bypass
- 4 adjustable needle valve
- 5 booster
- 6 filter
- 7 scrubber tank
- 8 inhale bag
- 9 exhale bag with overpressure valve
- 10 breathing hose set with slide valve mouthpiece
- 11 ppO₂-monitor (double redundant necessary)
- 12 lung automate
- 13 bypass valve

7 Description

The CCR is a mix gas rebreather with closed breathing loop. The diver breathes from the valve mouthpiece (10). The exhale gas flows through the breathing hose into the exhale bag (9). From the exhale bag the gas flows to the scrubber tank (7). Surplus gas is expelled to the surroundings over the adjustable overpressure valve.

While passing the scrubber tank (7) Spherasorb will remove the CO₂ from the gas. From the scrubber tank the gas flows to the inhale bag (8). The design of the breathing bags is called coaxial, that means that the exhale bag (9) is in the inhale bag (8). Through this design the breathing resistance was improved enormously.

The flow direction of the breathing is adjusted in the slide valve mouthpiece (10) through the direction valves. Through the slide valve the mouthpiece can be closed waterproof.

In the cover of the unit a short checklist is fixed. The points on this list must be carried out and be ok before every dive!

The fresh gas is stocked in 2 x 2 litres 200 bar tanks. Through Velcro tapes the tanks are fixed in the case of the unit. The pressure of the tanks is relaxed to low-pressure through the pressure reducers (1, 2). The left tank contains the diluent mixture and the right tank contains the oxygen. The pressure reducer of the diluent tank is depth compensated and the pressure reducer of the oxygen tank is not depth compensated. So it delivers a constant low-pressure, which is independent on depth with the corresponding diluent gas.

The oxygen is dosaged through the adjustable needle valve (4) to the individual need for oxygen of the diver. In case of a too low ppO₂ additionally oxygen can be fed to the system by the gas booster (5). The information about the existing partial pressure of oxygen the diver receives from the optional available ppO₂-monitor.

In accordance to the planned dive the diver has to carry with a sufficiently stock of bailout gas. The bailout gas must be enough for the buoyancy system and the supply in emergency situations. A separate bailout tank is not concluded in standard deliveries.

The tank pressure can be checked with the help of the connected pressure gauges.

The unit is supplied with fresh gas through the lung demand bypass (13). The bypass is supplied with fresh gas by the pressure reducer in case of drops in pressure (diluent). Over a second supply the constant flow is delivered, which is supplied through the oxygen tank.

The constant flow must always be determined for the individual oxygen consumption of the diver. The settings have to be checked before every dive. As the oxygen consumption verifies through the work, it must be checked permanently (ppO₂-monitoring system). The ppO₂ should not be lower than 0.2 bar and higher than 1.4 bar. The setpoints should be adjusted to 0.3 bar and to 1.3 bar. These set points give the diver the possibility to react to possible variations.

As scrubber we recommend the use of Sofnolime. While the use of other scrubber types (Divesorb, Sofnolime, Spherasorb, Soda Lime) the data given by the producer must be observed. Spherasorb and Sofnolime have a colour indicator, which has to be checked immediately after the dive. Used up scrubber must be removed and should not be used again. It must be wasted.

The Submatix scrubber tank has a maximum volume of about 1.7 kg scrubber. Under the following conditions the using times result:

Example with Spherasorb:

- water temperature: 4 (-2)°C
- breathing: 40 l/min
- consumption of oxygen: 1.78 l/min
- criterion of break-off: 0.5 Vol % carbon dioxide in inhaled gas
- absorption of carbon dioxide: 1.6 l/min

determined life time: 125 min

- water temperature: 4 (-2)°C
- breathing: 30 l/min
- consumption of oxygen: 1.33 l/min
- criterion of break-off: 0.5 Vol % carbon dioxide in inhaled gas
- absorption of carbon dioxide: 1.2 l/min

determined life time: 170 min

Absorption of carbon dioxide SPHERASORB/SOFNOLIME			
CO ₂ absorption 1 kg	CO ₂ production	Using time of scrubber at 1.7 kg filling	Water temperature
Sofnolime CD 100 l/min	1.2 l/min	140 min	4°C
	1.6 l/min	105 min	4°C
Spherasorb 120 l/min	1.2 l/min	170 min	4°C
	1.6 l/min	125 min	4°C
Sofnolime 797 140 l/min	1.2 l/min	198 min	4°C
	1.6 l/min	148 min	4°C

Table 2

According to the US Navy Manual (revision 4: 20th January 1999) the oxygen consumption of 1.7 l/min comes up to hard work and an oxygen consumption of 2.5 l/min comes up to an extremely hard work under water. A middle physical work corresponds to oxygen consumptions between 0.8 l/min and 1.4 l/min.

If you reduces the test conditions to an oxygen consumption of 1.33 l/min, you will simulate a middle physical work, which a diver can make permanently under water. At the use of Sofnolime CD, Submatix recommends a maximum using time of the scrubber of 105 min!!!

Attention: At the moment Spherasorb has no producer admittance for the use in diving units. The values, given in this manual, are the result of US Navy tests.

8 Technical data

Weight (ready for use):	nearly 15 kg
Dimensions case (without hoses):	620 x 390 x 170 mm
Volume:	9 liters (breathing loop with filled scrubber tank)
Moved volume:	7 litres
Gas supply:	1 x 2 litres diluent 1 x 2 litres oxygen breathing gases must correspond to the guidelines for medical oxygen (DIN 3188, EN 132)
Operating temperature:	+4°C to +34°C
Operating pressures:	200 to 20 bar
Volume scrubber tank:	about 1.7 kg
Positive buoyancy:	2.5 kg (with filled breathing bags)

9 Component parts and assembling



Pressure reducer Oxygen with overpressure valve and label factory settings 10 bar/80 m



Gas supply: right: oxygen tank with fixed first stage, left: diluent tank with depth compensated first stage, below: gas booster with adjustable needle valve and quick-release coupling, console mounted with 2 x Oxyscan 100 Pro A



Gas supply: below: Oxygen, above: Diluent



Bypass and breathing hoses with security devices, connectors for breathing hoses different in colour (no mix-up possible)



Gas booster with adjustable flow nozzle



Breathing loop



Breathing bags (old material, not available anymore)



Scrubber tank



Breathing hose



Slide valve mouthpiece



Breathing hoses with direction valves (assembly only through authorised persons!!!)



Submatix ULLI TEC Jacket



Submatix Weight Harness



Submatix buoyancy lifejacket



ppO₂-monitoring system (Oxyscan), console mounted with gas booster



Multi cell holder

All component parts must be assembled in accordance to the instructions. At plug-in connectors you have to pay attention to use the corresponding O-rings (they must be ok). While putting them together the locking must snap in. The connection can be checked by pulling. All connections of the breathing loop are different in colour (green - fresh gas, red - used up gas). You have to note that all connections must be assembled correctly in accordance to the colours.

While assembling you have to pay attention to the right direction of the breathing hose. Also the mouthpiece must be in a position for the diver. The connections of the breathing hoses are secured with security locks against removing by mistake.

While the installation of the breathing bag you have to note that the overpressure valve snaps in correctly in the existing holding device. In case of a canted overpressure valve it is possible that water gets into the breathing loop. The inhale and exhale tubes must be fixed from the outside with 1 ½" screws. The bypass and the scrubber tank must be connected correctly and the connector rings must snap in audibly.

While the installation of the scrubber tank you have to see that the inlet and the outlet be on the right position and that the scrubber tank is secured with the help of the existing Velcro tape.

While the assembling of the mix gas tanks you have to pay attention to the right position of the tanks (diluent and oxygen stickers must be readable). The tanks must be connected with the corresponding first stages and secured with the Velcro tape.

While closing the unit you have to pay attention to do not buckle the hoses, to do not clamp the breathing bag and to close correctly the cover with the existing locking.

The pro-con couplings (patented by Submatix) are easy to handle: They must be put together and connected with the connector rings.



Attention: The connector rings must snap in audible! Afterwards, the security rings must be pushed over the connector rings.

The rings are different in colour. While the assembling you have to pay attention to the right colours.

10 Handling and use

10.1 General instructions

You should

- check the unit and equipment before every dive.
- check and maintain the unit and equipment after every dive.
- protect the unit against direct sun.
- assemble the unit in accordance to the instructions.
- check if the tanks are filled.
- check the gas compounds. The oxygen concentration must be controlled personally before every dive!
- check the dosage through the flow meter. The flow is measured with the attached flow meter at the outlet of the bypass valve.
- calibrate the ppO₂-monitor to the ambient air and Oxygen before every dive.

You should never

- have a bad buoyancy (wrong buoyancy system, too much or too less trim weights).
- travel with filled tanks.
- keep in touch the high pressure leading components of the unit with oils or greases.
- dry up the scrubber.
- use uncontrolled gas mixtures.
- breath at the water surface from the unit for a longer period of time.
- dive without having adjust the needle valve to the personal setting and check this setting.
- dive without a bailout system, which is calculated for the planned dive.
- use components by other producers, which are not certificated for the used unit.

10.2 Preparation of the dive

10.2.1 Filling of the scrubber tank

The scrubber tank will be open and filled with fresh scrubber. Therefore, the scrubber tank is filled half. Afterwards, the scrubber will be compressed through lateral knocks with the fist. Then the scrubber tank is filled to the red filling mark and compressed. Following, the scrubber tank will be closed and checked for density.

To check the density the breathing hoses are connected to the connections and with the mouth it is put under pressure. Next, the mouthpiece is closed. After nearly 10 seconds the mouthpiece is open again. Now the flowing out of the overpressure is audible.

Attention: While working with scrubber you have to use safety goggles and protective gloves because scrubber can lead to cauterisations!



1. Filling half



2. Compress



3. Filling to the filling mark and compress

10.2.2 Filling of tanks

The Oxygen tank must be filled with medical Oxygen to 200 bar. The Diluent tank must be filled with Diluent in correspondence with planned depth (best mix) to 200 bar. Before assembly of tanks into case, in both tanks the gas must be analysed.

10.2.3 Density checks: overpressure and low-pressure

10.2.3.1 Overpressure test exhale bag (only for old coaxial system!)

For this test the overpressure valve must be closed and the outlet of scrubber tank must be closed tightly (rubber plug or breathing hose). Afterwards, the exhale bag is inflated with the help of the mouthpiece. Following, the 1 kg weight is put on the exhale bag. The breathing bag must lecture this test for 1 minute. If the result of the test will be negative, you should not dive with the unit (danger of hypercapnia)!



Sealing of the scrubber tank with the breathing hose (coaxiale breathing bags)

At the version with the separate breathing bags the overpressure test exhale bag must not be carried out.

10.2.3.2 Overpressure test breathing loop

The breathing loop must be inflated through the mouthpiece till the overpressure valve will response. Afterwards, the mouthpiece must be closed and a 1 kg weight must be put on the breathing bag. The weight should not sink for 1 minute.

If the test result is negative, all screws, O-rings and plug connections must be checked. If the check of these component parts does not lead to a positive result of the test, the unit must be repaired by a service station, authorised by Submatix.



Overpressure test breathing loop (coaxiale breathing bags)



Overpressure test breathing loop (separate breathing bags)

10.2.3.3 Low-pressure test breathing loop

The low-pressure test is carried out after the overpressure test. Therefore, in the unit is produced a vacuum through the mouthpiece. After closing the mouthpiece the breathing bags should not relax again. After the low-pressure test the breathing loop keep closed.



Low-pressure test breathing loop (coaxiale breathing bags)



Low-pressure test breathing loop (separate breathing bags)

10.2.4 Check the tank storage pressure and mixture

Both tank valves must be open and checked with the manometer. With a suitable analysis unit both mixtures can be analysed. The gas analysis of diluent can be carried out with the measuring adapter of the Oxyscan A.

Attention: You should never dive the Submatix SCR 100 ST with closed or empty tanks otherwise this can lead to serious injuries or death!

10.2.5 Checking the bypass valve

While an open diluent tank valve gas you have to inhale through the mouthpiece and exhale through the nose. When the breathing bag is completely empty the bypass valve must response and while further inhaling it must supply permanently gas. The bypass valve must deliver so much gas as you inhale. If this test is negative, all connections from the pressure reducer to the bypass valve must be controlled. If this is not the mistake, the unit must be repaired by an authorised service trader.

Attention: If one of the prescribed test do not lead to a positive result you should never dive with the unit! The unit must be repaired imperatively by an authorised service trader!

10.2.6 Flow meter

The following flow meters are available:

- MMA-21 0-2.5 l/min
- MMA-23 0-10 l/min
- MMA-24 2.5-25 l/min

You have to use the flow meter MMA-21.

Before the first use the flow meter must be assembled in accordance to the instructions.
On the lower connection the enclosed rubber plug must be put.



The flow meter must be fixed to bypass ventil (photo) with the help of a rubber plug to measure the constant flow. If the ball in flow meter swings, it can be settled through adjustments at handwheel of flow meter.

Attention: The constant flow must be checked before every use. Therefore, you have to use always the same flow meter.

The constant flow must be setted always to the individual oxygen consumption of diver!



Gas booster with adjustable needle valve

10.2.7 ppO₂-monitor

While the use of the CCR 100 SMS it can happen that the ppO₂ will be higher or lower than the prescribed values. This can be checked with a suitable ppO₂-monitor. We prescribe the use of at least 2 independent redundant systems with CE-certification. These must have each an acoustic or visible warning. Systems with 2 or 3 sensor displays are not redundant!

The calibration of Oxyscan 100 Pro A is carried out like the following: Before starting the assembly of unit, the Oxyscans have to be calibrated with air. After correct calibration (please have a look to manual Oxyscan) the components of breathing loop are assembled. Afterwards, the overpressure test and low-pressure test are carried out. Following the low-pressure test, the system is rinsed with Oxygen. After the rinsing the turn slide valve short-termed. In the following on the display of Oxyscans the user can read the share of oxygen. It must be at least 99%. If the shown value is smaller than 99%, you are not allowed to dive with this unit (sensors have to be replaced by new ones).

The prescribed maximum ppO₂-set points of the warning are:

- low: 0.4 bar
- high: 1.3 bar

With the help of these conservative warning set points the diver will have enough time to react to the ppO₂-warnings. In case of a too low ppO₂ the system can be supplied quickly with fresh gas through rinsing.

While the dive, the maximum ppO₂ of 1.2 must not be exceeded!

10.2.8 Checking the direction valves

Keep close the exhale end of the breathing hose with your hand and blow into the mouthpiece. As a result no air should escape from the breathing hose. Now keep close the inhale end of the breathing hose. While inhaling your hand must be sucked in and no air should come in through the exhale side. If negative results arise, the breathing hose must be repaired by an authorised service station.

10.3 Diving with the Submatix CCR 100 SMS

The unit is worn on the back.

The overpressure valve must adjusted to the individual setting. The setting is different from diver to diver and should be determined in a swimming pool before the first dive with the unit. As first setting we recommend to close the overpressure valve clockwise and then open it with 10 clicks anti-clockwise. After the dive it can be opened or closed again.

Attention: Before enter the water, both tank valves must be open!

Danger: The tanks must be open shortly before the dive otherwise the gas mixture will loose quickly a lot of oxygen, which can lead to unconsciousness and drowning. If the buoyancy system is connected with the diluent supply, it is also dangerous. The diver can drown because no positive buoyancy can be produced.

When both tanks are open you have to check again the tank pressure with the pressure gauges!

Take the mouthpiece in your mouth and open it. Important: The mouthpiece must always be open or closed completely because otherwise water can get into the unit.

Before starting the dive the breathing loop must be rinsed completely. To rinse the breathing loop you have to exhale 3 times through your nose and inhale from the unit. After the rinsing you should no longer breathe from the surroundings. The rinsing is necessary to remove the ambient air with its 21% oxygen from the unit and to replace it with the oxygen enriched breathing gas from the mix gas tanks. If you ignore this comment it can lead to a lack of oxygen and to death!

While the dive you have to permanently check the function of the direction valves. The typical sound of working direction valves must be audible in case of every breathing!

Do not take out the mouthpiece out of your mouth while the dive when the slide valve is open because so water can get into the scrubber tank.

If water got into the scrubber tank, you can recognize it by the following symptoms:

- higher breathing resistance
- sounds while the breathing (bubbles)
- the overpressure valve response while every breathing
- higher negative buoyancy

If water is in the system, you have to change permanently to the emergency system and dive to the surface. Use the bailout system. If you use the nitrox mixture for the filling of the jacket or of the buoyancy system, you must keep in mind that with an empty nitrox mixture no buoyancy for the jacket is possible! The lung automate of the nitrox mixture is no sufficiently bailout system. Therefore, carry with you always a corresponding bailout system.

10.3.1 ppO₂-monitoring system

The ppO₂ must be checked every 3 minutes through reading the ppO₂-monitoring system. If the shown values verifies by maximum 0.05 bar, the dive must be ended while starting the corresponded emergency measures. Therefore, you have to change to the bailout system and dive to the water surface. For security reasons the dive should not be continued with only one working oxygen monitoring system. The damaged ppO₂-monitor has to be checked and repaired by authorised persons.

While the dive to the water surface the system should be rinsed every 2 minutes.

The dive to the water surface is carried out to a depth of 6 meters, where the system is rinsed with pure oxygen. In this depth you have also the carry out a security stop with pure oxygen for 3 to 6 minutes.

The prescribed ppO₂-set points are:

- high: 1.2 bar maximum

The recommended set points are the following:

- low: 0.4 bar
- high: 1.3 bar

Through these conservative set points of the warnings the diver will have enough time to react to the ppO₂-warning of the ppO₂-monitoring systems. In case of a too low ppO₂, oxygen must be supplied to the system with the help of the gas booster and in case of a too high ppO₂, the system must be rinsed with diluent (exhale through the nose for several times).

10.4 Diving to the water surface with the Submatix CCR 100 SMS

Before starting the dive to the water surface the system must be rinsed (3 times exhaling through the nose). While the dive to the water surface you have to check permanently your ppO_2 -monitor. In a depth of 6 meters the system must be rinsed again and for 3 to 6 minutes a security stop with oxygen must be carried out.

The Submatix CCR 100 SMS cannot be used for fast dives to the water surface. While a fast dive to the surface the breathing bags, the BCD and maybe the dry dive suit can expand at the same time, which can lead to hard to control way up speeds (danger of decompression and overpressure accident).

The BCD should only be filled with small air pushes from the power inflator. At the same time you should pay attention to the exhaust valve to control the dive to the surface. While the dive to the surface you should have one hand always at the exhaust valve to guarantee a slow and normal dive to the surface. The same principle is valid for use of the dry dive suit.

Attention: At the use of the dry dive suit you have to pay attention to use a filling gas, which does not have a too high share of oxygen (maximum: 40% oxygen). You imperative have to note the recommends by the producer for the allowed filling gases!

In case of hypoxia symptoms you have to change immediately to the bailout system!!!

10.5 Postprocessing of the Submatix CCR 100 SMS

When you have arrived the water surface, you have to close the mouthpiece. On the water surface you should not breath from the unit. After leaving the water, the gas tanks must be closed. Afterwards, you have to check the breathing loop if water got into it. Directly after the dive you have also to check the saturation of the scrubber. The scrubber (Spherasorb) has a colour indicator. The change in colour is only visible for a certain period of time. Used up or humid scrubber must be removed from the scrubber tank and replaced by new on. Used up scrubber should not be used again and it must be wasted.

Attention: You have to pay attention carefully to keep not in touch your skin or clothing with humid scrubber (you have to wear security gloves and safety goggles)!

If you have not planned a repetitive dive, you must dismantle the unit and disinfect all component parts of the breathing loop.

If the unit will be used by a second person, you have to disinfect also all component parts of the breathing loop (renew the scrubber).

While the storage or the transport of the unit, you must absolutely see that the breathing hoses and breathing bags will not be crestfallen or keep in touch with sharp-edged things. The complete unit must be cleaned with clear water. Pay attention to keep close the mouthpiece valve while the cleaning process. Water must never gets into the pressure tanks or the pressure reducers. After the carefully cleaning of the complete unit the breathing hoses and breathing bags must be dried at a cool and shady place. Avoid direct sun!

For the cleaning the component parts of the breathing loop must be dismantled. The scrubber tank must be empty. The breathing hoses, the scrubber tank and the breathing bags must be disinfected and afterwards they have to be rinsed with clear water and dried. Avoid direct sun to the component parts! The bypass valve must be inspected for scrubber dust and, if necessary, it must be rinsed with clear water. We recommend the disinfectant EW 80 DES.

The transport takes place under observance of the local transport regulations. In airplanes the tanks must be empty and without pressure. The scrubber is not seen as hazardous substance. In the following you will find a transport certification by the German Federal Aviation Agency.



Luftfahrt-Bundesamt

Bundesoberbehörde im Geschäftsbereich des Bundesministeriums für Verkehr,
Bau- und Wohnungswesen (BMVWB)

LBA-Außenstelle Frankfurt – Kelsterbacher Str. 23 – 65479 Raunheim

SUBMATIX GmbH & Co. KG
Herrn Matthias Leßmann
Hinter der Rennbahn 10
99089 Erfurt

Ihr Zeichen:

Ihre Nachricht vom: 18. August 2005

Unser Zeichen: B633F/438.2/2005

Unsere Nachricht vom:

Auskunft erteilt: Herr Closhen

Telefon: 06142 9461-35

Fax: 06142 9461-59

e-Mail: Georg.Closhen@lba.de

Datum: 24. August 2005

Ihre Anfrage

Sehr geehrter Herr Leßmann,

der in Ihren Kreislauchauchgeräten Submatix SCR 100 ST verwendete Atemkalk (Handelsname: Spherasorb™ der Firma Intersurgical) ist in der folgenden Zusammensetzung kein Gefahrgut im Sinne der Bestimmungen nach ICAO T. I. (*International Civil Aviation Organisation Technical Instructions for the Safe Transport of Dangerous Goods by Air*) resp. IATA-DGR (*International Air Transport Association*):

Calciumhydroxid	75 – 80 %
Natriumhydroxid	< 2 %
Zeolith	4 – 5 %
Ethylviolett	< 0,1 %
Wasser	13,5 – 17,5 %

Die Kreislauchauchgeräte dürfen nur mit leeren Frischgas Nitroxflaschen im Passagiergepäck befördert werden.

Sind diese befüllt, so unterliegen sie eindeutig den Gefahrgutvorschriften für den Verkehrsträger Luft nach ICAO T. I. resp. IATA-DGR und sind nicht als „klein“ für das Passagiergepäck freigestellt.

Mit freundlichen Grüßen

Im Auftrag

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TO WHOM IT MAY CONCERN

We hereby certify that the Soda Lime (Sofnolime) manufactured by
Molecular Products Ltd contains less than 4% (Four Per Cent) Caustic Soda (NaOH)
is classified as non-hazardous and that it is not restricted for transport.
The label showing the corrosive symbol is a label for use of the product – not for
transport.

Signed

A Harding, Despatch Co-ordinator
For Molecular Products Ltd

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A member of Molecular Products Group plc

11 General comments for handling and security

- check the dive unit and equipment before and between every dive
- clean and maintain the unit at the end of every dive
- check the connections between the rebreather and the nitrox tanks
- familiarize with the unit through exercises in the swimming pool
- protect the unit against direct sun
- inflate the BCD while the cleaning and test it before every use

For the cleaning of the unit you should

- rinse all component parts with fresh water after every dive
- dry all component parts at a shady place before the assembling
- check if humidity got into the low-pressure sector of the gas supply

The unit should not be stored with a filled scrubber tank. The storage should take place at a dry, shady and good ventilated place. You have to avoid unnecessary UV-radiation. If the unit should be stored for a longer period of time all component parts of the breathing loop should be disinfected carefully. The breathing hoses and breathing bags must not be snaped. The breathing loop must be closed with the attached locking cap. The breathing hoses must be dismantled.

You have to pay attention to do not get any foreign substances and organisms!

12 Service intervals

Attention: The component parts of the breathing loop should only be greased with MOLYKOTE 111 and the low-pressure parts should only be greased with HALOCARBON 25-5S. All high pressure leading parts should not be greased and they not get in touch with oils and greases. Danger of explosion!!!

Service intervals				
Component part	Necessary work	Before every dive	After every dive	Annually
Complete unit	Check of function and density	x		
	Cleaning		x	
Breathing loop	Disinfection		x	
	Grease of mouthpiece slide valve			x ^{1, 2}
	O-rings bypass valve, O-rings scrubber tank			x ^{1, 2}
	O-rings breathing hoses			x ^{1, 2}
	Pro-con connections, carefully cleaning of scrubber tank			x ^{1, 2, x2}
Nitrox tanks	Filling	x		
	Pressure check	x		
Manometer	Check of notice	x		
Dosage	Check of dosage	x		
ppO ₂ -monitors	Calibrating	x		

1 in case of a more often use in shorter periods

2 only by authorised persons

13 Maintenance intervals

After maintaining works or the change of component parts, the function of the corresponding component must be checked. You are only allowed to use original Submatix parts!

Component part	Description of necessary works	After every dive	Every year	Every 2 years	Every 4 years
CCR 100 SMS	Cleaning (manual)	o			
	Complete overhaul		o ^{x)}		
	Check of low-pressure hoses		o ^{x)}		
	Change of O-rings at low-pressure connections			o ^{x)}	
	Change of low-pressure hoses				o ^{x)}
2 l nitrox tanks	Repetitive test			o ^{x)} xx)	
Oxygen valve	Check of function and density			o ^{x)}	
	Change of O-rings			o ^{x)}	
Pressure reducers	Check of low-pressure setting		o ^{x)}		
	General maintenance		o ^{x)}		
Oxygen pressure reducer	Manometer comparison test		o		
Breathing loop	Change of O-rings of all pro-con connections		o		
Breathing hose	Change of diaphragm in direction valves		o ^{x)}		
	Change of valve seat in direction valves			o ^{x)}	
	Maintenance of mouthpiece slide valve		o ^{x)}		
	Change of mouthpiece slide valve			o ^{x)}	
	Change of breathing hoses				o
Scrubber tank	Change of O-ring cover screw			o	
	Change of O-ring cover			o	
ADV/bypass valve	Change of diaphragm			o	
	Change of valve seat			o ^{x)}	
	Check of responding pressure and characteristic		o ^{x)}		
Flow nozzle	Change of air flow filter		o ^{x)}		
Breathing bag				o ^{x)}	

x)

in case of more often use in shorter periods

xx)

carried out by authorised persons or in accordance to the stamp of the tank

Corresponding to the frequency of the use, all component parts of the unit should be serviced periodically. The diver should check the functions of the unit before and after every dive. At least one times in the year the unit should be checked by authorized technicians. We recommend to keep a record of all repairs, services and replacement parts. You are only allowed to use original parts!

Troubleshooting		
Problem	Reason	Help
No notice on manometer after opening of nitrox tank.	Empty tank	Fill in tank
	Damaged manometer, jammed connection	Change of manometer through authorised persons
Leaking tank valve, high pressure connections, pressure reducers or bypass valve	Damaged or uncorrect installed O-ring	Close tank, no pressure in system, check of connections, if necessary check and repair by authorised persons
Pressure reducer supplies no gas despite of notice on manometer	Damaged pressure reducer	Service of pressure reducer by authorised persons
Bypass supplies no gas despite of notice on manometer	Plugged connections, damaged bypass valve	Change of connections and/or bypass valve through authorised persons
Bypass responses constantly or very hard	Wrong adjusted or damaged bypass valve	New setting or maintenance of bypass valve by authorised persons
Measured gas dosage is higher or lower than prescribed values	Misadjusted low-pressure, damaged flow nozzle	Check and if necessary setting or change of low-pressure and flow nozzle by authorised persons
Direction valves do not open against breathing direction	Damaged valves	Change of valve disc by authorised persons
Direction valves no not open in direction of breathing	Valve stick together	Rinsing and cleaning of valve
Mouthpiece slide valve works hard	Dirty slide valve	Disassembly, greasing and installation of slide valve through authorised persons
Leaking breathing loop	Damaged or dirty sealing parts	Change or cleaning of authorised persons
Swimmer swings in flow meter	Flow meter is not closed enough	Close flow meter more
To low test value	Leaking connection from flow meter to bypass case	Apply flow meter again

14 Record card

[illegible]

This manual applies only to the Submatix SCR 100 ST with the serial number:	
Pressure reducer 1 with serial number:	
Pressure reducer 2 with serial number:	
Scrubber tank with serial number:	
Bailout lung demand valve with serial number:	
Nitrox tank 1	
Nitrox tank 2	
If the serial number has not been filled in by Submatix, these instructions for use are provided for general information and are not intended for use with any specific unit or device. After repair or change of registered components, it is necessary to replace the corresponding numbers.	

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