

3 SERVICE PROCEDURES

3.1 General service information

Field service of the compact airway modules is limited to replacing faulty circuit boards or mechanical parts. The circuit boards should be returned to Datex-Ohmeda for repair.

Datex-Ohmeda is always available for service advice. Please provide the unit serial number, full type designation and a detailed fault description.

CAUTION Only trained personnel with appropriate equipment should perform the tests and repairs outlined in this section. Unauthorized service may void warranty of the unit.

CAUTION The module electronics can only be repaired and calibrated at the factory.

3.1.1 OM measuring unit

CAUTION Due to the complicated and sensitive mechanical construction of the O₂ measuring unit, no repairs should be attempted inside the unit.

3.1.2 TPX measuring unit

CAUTION The TPX photometer and its components are repaired/calibrated at the factory. Attempts to repair/calibrate the unit elsewhere will adversely affect operation of the unit. The information provided is for reference only.

3.1.3 OM, TPX, and PVX measuring unit

CAUTION The OM, TPX, and PVX measuring units can be repaired only at the factory.

3.1.4 Serviceable or exchangeable parts

- Absorber
- D-fend
- Nafion tubes
- Fan filter
- Fan
- CPU board
- CPU software
- PVX Unit including PVX board
- Pump


NOTE: After any component replacement see chapter [Adjustments and calibrations](#).

3.2 Service check

These instructions include complete procedures for a service check. The service check should be performed after any service repair. However, the service check procedures can also be used for determining possible failures.

The procedures should be performed in ascending order.

The instructions include a check form, [APPENDIX A](#), which should be filled in when performing the procedures.

The mark  in the instructions means that the check form should be signed after performing the procedure.

3.2.1 Recommended tools

Tool	Order No.	Notes
Screwdriver		
Ambient pressure manometer		
Flowmeter		
Flow cassette 50/1.1	873812	
Extra silicon tubing		
Calibration gas and the regulator	755583 (gas) 755534*	for M-CAIOVX/M-CAIOV/M-CAiO
Calibration gas and the regulator	755587 (gas) 755534*	for M-COVX
Calibration gas and the regulator	755581 (gas) 755534*	for M-COV/M-CO/M-C
Gas Interface Cable 2.5 m / 8 ft	884299	

*NOTE: Ensure that the calibration gas and the regulator are functioning properly before calibration. Perform annual maintenance on the regulator as required.
See Calibration gas regulator flow check

3.2.2 Recommended parts

Part	Order No.	Notes
Absorber	895933	
D-fend	876446	
D-fend+	881319	for M-COVX
Sampling line 3 m/10 ft	73319	anesthesia gas sampling line
Sampling line 2 m/7 ft	73318	for M-CAIOVX/M-COVX
D-lite / Pedi-lite	733950/73393	

Part	Order No.	Notes
D-lite+		for condensing active humidification circuits
Spirometry tube 2 m	890031	
Spirometry tube 3 m	884101	
D-fend O-ring (2 pcs)	65312	
Filter (3 pcs)	886136	1 pcs @ latest revisions
Filter assembly	896025	@ latest revisions
Nafion tubes (2 pcs)	733382	
Fan filter	886236	

All modules

Detach the module box by removing the two screws from the back of the module. Be careful with loose latch and spring pin for locking.

1. Check internal parts:
 - all screws are tightened properly
 - all cables are connected properly
 - tubes are not pinched and there are no sharp bends on them
 - all tubes are connected properly
 - the front cover grounding pins are not bent against the CPU board
 - there are no loose objects inside the module

NOTE: The tubes that are connected to the Oxygen board pressure transducers should not be pressed too deep.

NOTE: Make sure that tubes are not in contact with the sampling pump or the O₂ sensor, or its springs.



2. Check external parts:
 - the front cover and the front panel stickers are intact
 - all connectors are intact and are attached properly
 - the D-fend latch is moving properly
 - the module box, the latch and the spring pin are intact



3. Clean or replace the fan filter.



4. Detach the D-fend. Check the condition of the rubber O-rings on the metal D-fend connectors, located in the Compact Airway Module front cover. If necessary, detach the connectors by first disconnecting the tubes, then removing the locking rings from the back of the front cover.

NOTE: The O-rings are recommended to be replaced annually.



5. Check that flow of air through the filters in the reference gas connection block (1 pc) and in the pneumatic unit (1 or 2 pcs) is not obstructed.

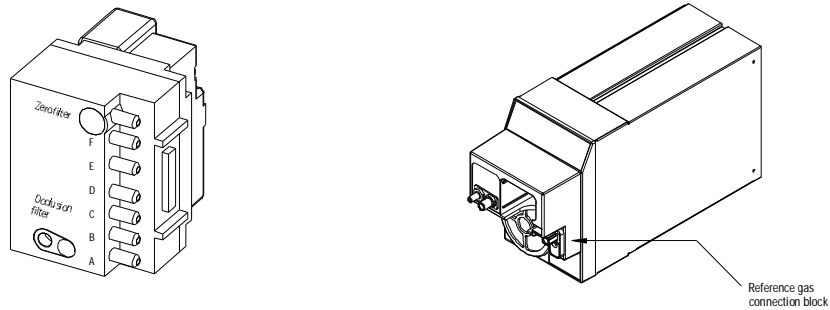


Figure 16 Pneumatic unit and reference gas connection block

NOTE: The filters should be replaced annually.



- Replace the old D-fend and sampling line with new ones.

NOTE: Use only Datex-Ohmeda sampling lines in order to ensure proper function. 2 m/7 ft sampling line should be used with M-COVX and M-CAIOVX.

- Connect the Compact Airway Module to the Central Unit's Module motherboard using the Gas interface cable (the grounding plates of the cable should be removed).
- Turn the monitor on.
- Configure the monitor screen so that all the needed parameters are shown, for example as follows:

Monitor Setup - Screen 1 Setup - Waveform fields - Field 1 - Paw
Field 2 - Flow
Field 3 - Off
Field 4 - O2
Field 5 - AA
Field 6 - CO2

Digit Fields

Lower Field 1 - Gases

- Preset the following gas measurement settings (if available):

Airway Gas - Select Agent - Hal
Spirometry Setup - Scaling Vol
Paw Scale - 20
Flow Scale - 15

6. Check that the fan is running.



7. Wait until the message 'Calibrating gas sensor' disappears from the screen, then enter the Service menu.

Monitor Setup - *Install/Service* (password 16-4-34) - *Service* (password 26-23-8)

Take down the information regarding Compact Airway Module software.



8. Enter the Compact Airway Module service menu.

Parameters - Gas Unit - General

Check that the shown module configuration corresponds with the used Compact Airway Module type.



9. Check that the 'Timeouts', 'Bad checksums' and 'Bad c-s by mod' -values are not increasing faster than by 5 per second.
If one of the values is increasing faster it indicates a failure in module bus communication.



10. Enter the service menu *Gases*:

Gas Unit - Gases

Check that the flow measurement offset, i.e. the shown sample 'Zero' -value is within ± 10 ml/min.



11. Check that the shown 'Ambient' -value corresponds with the current ambient pressure (± 20 mmHg).



12. Check the zero valve.
Feed calibration gas and check that the gas readings in the service menu correspond with the values on the gas bottle sticker. Keep feeding gas, then activate the zero valve from the menu. The CO₂ (N₂O, AA) reading should drop back near 0 %, the O₂ reading near 21 %.



13. Perform the steam test for the Nafion tubes, or replace those by new. Replace the CO₂ absorber, if necessary.

NOTE: The Nafion tubes are recommended to be replaced annually. In case of exchanging the absorber it is recommended to replaced also this nafion tube.

NOTE: The CO₂ absorber is recommended to be replaced once in four years.



14. Perform sampling system leak test.

Prevent the module from performing the normal occlusion functions, i.e. controlling the valves, by turning the pump first off, then on again from the menu.

Block the reference gas connector at the front panel.

Connect a flow cassette with high flow resistance value (50/1.1) to the end of the sampling line and start following the 'Amb-Work' -value in the service menu. When the value exceeds 170 mmHg connect the other port of the flow cassette to the sample gas out connector and switch the pump off.

Wait until pressure inside the sampling system is stabilized then notice the shown 'Amb-Work' -value. The value, i.e. the pressure inside the sampling system should not drop more than 6 mmHg in one minute.

If the pressure drops more, first ensure the made connections and repeat the test.



15. Check the flow rates.

Wait until the 'Sample Flow' -value is back near 200 ml /min.

Connect a flowmeter to the 3 meter sampling line (use a 2 meter sampling line for M-CAiOVX and M-COVX) and check that the flow (the flowmeter reading) is within the following range:

Sampling flow (ml/min) 180...220

If necessary, readjust the sampling flow:

Select 'Sample gain adj' from the menu. To increase the sampling flow, turn the ComWheel counterclockwise, to decrease the flow, turn the ComWheel clockwise.

A change of 0.050 in the 'Gain' -value changes the flow approximately 10 ml/min.

After you have changed the gain, wait until the 'Sample Flow' -value on the screen gets back near the original then check the flowmeter reading again.

Connect the flowmeter to the reference gas connector, check that the flow is within the following range:

Reference flow (ml/min)	M-CAiOVX/ M-COVX	M-C	Others
	27...40	25...45	31...45
	(with 2m sampling line)	(with 3m sampling line)	(with 3m sampling line)

Activate the zero valve on from the service menu. The 'Sample Flow' -value should not change more than 20 ml/min. If the absorber is connected the value is 30 ml/min.



16. Check that the 'Amb-Work' -value in the service menu is within the following range:

Amb-Work (mmHg)	M-CAiOVX/M-COVX	Others
	70...115	40...75



17. Perform the gas calibration.

Airway Gas - Gas Calibration

NOTE: Calibration is not recommended until 30 minutes warm-up time has elapsed.
 Use calibration gas 755587 (5 % CO₂, 95 % O₂) for calibrating Airway Module, M-COVX,
 and calibration gas 755583 (2 % Desflurane, 5 % CO₂, 33 % N₂O, 55 % O₂, balance N₂) for
 M-CAiOVX/M-CAiOV/M-CAiO,
 and calibration gas 755581 (5 % CO₂, 40 % N₂O, 55 % O₂) for calibrating
 M-COV/M-CO/M-C.

NOTE: You can calibrate the modules M-CO and M-COV with the same calibration gas as the
 M-COVX module, but M-C must always be calibrated with the gas 755581.

NOTE: For correct measurement values, modules need different amounts of oxygen in the
 calibration mixture. If you do not use the recommended calibration gases, the calibration will
 not succeed.



18. Perform the fall time measurement in the GASES service menu.

Monitor Setup - Install/Service (password 16-4-34) - Service (password 26-23-8) - Parameters - Gas Unit - Gases

Activate the measurement by selecting Fall Time Meas from the service menu. Feed
 calibration gas until the message 'Feed' near the fall time values changes to 'READY'. If
 necessary, repeat the same procedure to get all the values on the screen.

Check that the measured values are within the following ranges:

CO₂ fall time < 400 ms

O₂ fall time < 400 ms

CO₂-O₂ delay < 800 ms



Anesthesia Agent measurement

19. Agent ID reliability.
Feed calibration gas (order code 755583) continuously for at least 30 seconds and check that the 'ID' in the service menu shows 'DES' and that the value for 'ID unrel.' is lower than 50.

If the value is higher, repeat the gas calibration and check the value again.



Patient Spirometry measurement

20. Enter the service menu *Spirometry*:

Gas Unit - Spirometry

Connect a clean Spirometry tube to the module and a clean D-lite to the other end of the tube. Block the D-lite's sampling line port, for example with a Luer stopper.

NOTE: Make sure that the date marking on the D-lite is 10/94 or newer.

Take the D-lite into your hand and occlude both ends tightly with your fingers (or with both hands). Pressing creates a pressure inside the D-lite. Check that pressure near 5 cmH₂O is generated (the 'Aw Pressure' -value in the service menu).

If the system leaks heavily, no pressure will be generated.

If there is a small leak in the connections, the monitor will measure a pressure difference which is then interpreted as flow and seen on the monitor screen. The pressure waveform (and the 'Aw Pressure' -value) decreases slowly and the flow waveform (the 'Flow' -value) either goes above, or below the zero line, depending on which of the connectors is leaking.

In case of leakage, first check all the connections and try again.



21. Remove the blockage from the sampling line port and connect the sampling line. Breath through the wider side of the D-lite. Check that the flow waveform moves downwards when you breath in, and upwards when you breath out.



22. If possible, check the Side Stream Spirometry measurement also with the Spirometry Tester (order code 884202). Follow the instructions that are supplied with the tester.



All modules

Turn the monitor off, disconnect the Gas interface cable and reassemble the module. Remember to attach the plastic cover against the CPU board before installing the module box.

NOTE: When reassembling the module make sure that the tubes are not pinched between the module box and internal parts.

23. Perform electrical safety check and leakage current test.



Install the Compact Airway Module into the Central Unit, turn the monitor on and wait until the message 'Calibrating gas sensor' disappears from the screen.

24. Block the tip of the sampling line by your finger and check that the message 'Sample line blocked' appears onto the monitor screen within 60 seconds.



25. Detach the D-fend and check that the messages 'Check D-fend' appears onto the monitor screen within 30 seconds.



Reattach the D-fend. Simulate at least 5 breaths by feeding calibration gas into the sampling line. Check that the shown gas information is correct.

26. Check that the monitor shows the message 'Apnea' within 30 seconds after you have stopped feeding the gas.



27. Turn the monitor off, disconnect and clean the module.



- Fill in all necessary documents.
- It is recommended that you fill in the PM sticker, since the service check includes all the Planned Maintenance actions. Attach it to a suitable place on the module box.

3.3 Disassembly and reassembly

Disassemble the compact airway module in the following way. See also the exploded view of the module.

1. Remove two screws from the back of the module.
2. Pull the module box slowly backwards and detach it from the main body.

Reassembling is essentially reversing what was described above.

CAUTION When reassembling the module, make sure that the tubes and cables are not pinched between the boards and the cover.

CAUTION While reassembling the module, make sure that the grounding pins of the front unit EMC shield are in contact with the module box. Bend the pins carefully, if necessary.

3.3.1 PVX unit

1. Remove the module box.
2. Detach the CPU board and OM board from the module chassis (4 screws).
3. Disconnect the pump cable, pneumatics unit cable, fan cable, and the other cable of the TPX unit from CPU board.
4. Disconnect OM unit's cables, spirometry keyboard cable and PVX unit's cables from the OM board.
5. Detach the front panel from the module chassis (1 screw).
6. Detach the PVX unit from the front panel (1 screw).
7. Reassembling is essentially reversing what was described above.

3.3.2 Pump unit

1. Remove the module box.
2. Cut off the pump's clamp (panduit).
3. Unplug the hoses of the pump.
4. Disconnect the pump's cable from CPU board. Pass the cable under the pneumatic unit by lifting it.
5. Reassembling is essentially reversing what was described above.

3.3.3 CPU board

1. Remove the module box.
2. Detach the CPU board and OM board from the module chassis (4 screws).
3. Disconnect the pump cable, pneumatics unit cable, fan cable, and both cables of the TPX

unit from CPU board.

4. Detach the CPU board from the OM board.
5. Reassembling is essentially reversing what was described above.

3.3.4 Software of CPU board

1. Remove the module box.
2. Detach the CPU board and OM board from the module chassis (4 screws).
3. Disconnect the pump cable, pneumatics unit cable, fan cable, and the other cable of the TPX unit from CPU board.
4. Detach the CPU board from the OM board.
5. Detach the software from the CPU board.
6. Reassembling is essentially reversing what was described above.

3.3.5 Instructions after replacing software or CPU board

After replacing the software or CPU board:

- perform the sampling system leak test.
- perform the occlusion test
- perform the gas calibration.
- perform Fall time Measurement

3.4 Adjustments and calibrations

See *User's Reference Manual* for normal gas calibration instructions.

3.4.1 Gas sampling system adjustment

NOTE: Let the monitor run for 15 minutes before measuring flow rates.

For the flow rate measurements a flowmeter with a low flow resistance and capability to measure low flow rates is required. A normal length of sampling line has to be connected to the monitor as it has a considerable effect on the flow.

3.4.2 Flow rate measurement

If any flow rates are not correct, first replace the D-fend water trap. Then recheck the incorrect flows.

Sampling flow rate is measured by rotameter at the sampling line. The rate should be between 180 and 220 ml/min. The flow rate is adjusted in the Gas Service Menu with 'Sample Gain Adj.'.

Reference flow of the oxygen measuring unit are checked as follows:

Connect rotameter to the Gas Ref. inlet on the front panel. The flow rate should be between 31 and 45 ml/min (M-CAIOVX/M-COVX: 27-40 ml/min, M-C: 24-45 ml/min). The flow rate is not adjustable.

3.4.3 Flow rate adjustment

NOTE: Before adjusting the sampling flow make sure there is no leakage in the sampling system.
Refer to chapter 3.2 *Service check*, step 15; Check the flow rates.

3.4.4 Gas calibration

NOTE: Ensure that the calibration gas and the regulator are functioning properly before calibration.
Perform annual maintenance on the regulator as required.

The gas calibration is performed in the *Airway Gas* menu. Please refer *User's Reference Manual*.

Calibration gas regulator flow check

Interval: every 12 months

Regulator flow specification:

REF 755533 & 755534: 260 – 410 ml/min at 1-10 bar cylinder pressure

REF 755530: 260 – 410ml/min at 5-7psi cylinder pressure

Tools needed: calibration gas ca, regulator, piece of silicon hose and a flow meter. Datex-Ohmeda recommends use of TSI 4140 Flow Meter.

Insert the calibration gas regulator on the gas cylinder. Connect a silicon hose between the regulator and the flow meter. Block the regulator overflow port and open the regulator. Check the flow rate from the flow meter and verify that the flow is within the specification.

3.4.5 Flow calibration

The PVX measuring unit is calibrated at the factory and due to the unit's design calibration is not regularly needed. The calibration data is saved into the board's EEPROM. In case calibration is needed, it is recommended to perform the calibration both with adult values using the D-lite, and with pediatric values using Pedi-lite.

1. Connect a spirometry tube with a D-lite sensor to the compact airway module. To improve the accuracy, the endotracheal tube and all accessories, which normally are in use, should be attached also during the calibration.
2. Enter the Gas Unit service menu: *Monitor Setup - Install Service - Service - Parameters*. Enter the Spirometry menu.
3. After the flow is zeroed ('Zero OK' message displayed) attach a preferably spirometry tester to the flow sensor (D-lite or Pedi-lite). Select the sensor type.
4. Perform the calibration according to the tester instructions. Observe the values of inspired and expired tidal volumes.
5. Adjust the reading to match the calibration volume (about 1000 ml for the D-lite and 300 ml for the Pedi-lite). Adjust Exp Flow Gain and Insp Flow Gain values in proportion to the difference between measured values and the spirometry tester reading.