Chapter 3. Planned Maintenance

Table of Figures

3. PLANNED MAINTENANCE

3.1 Introduction

These instructions include procedures for planned maintenance (PM) of the Datex-Ohmeda Cardiocap/5 monitor. Performance of planned maintenance procedures is recommended once each year after installation of the monitor.

These instructions are for the maximum functional configuration of the monitor. Perform the procedures in order and skip items that do not correspond with the configuration of your monitor. Complete instructions on how to perform complex procedures are included in the *Service Procedures* chapter later in this manual.

3.1.1 Using the Planned Maintenance Form

A *Planned Maintenance Form* is included at the end of this chapter. Complete this "checklist" as you perform the maintenance procedures.

NOTE:  means to sign the form after performing the procedure.

3.1.2 Recommended parts

Part	Order Number
Nafion™ tube	733382
Filter (2 pieces)	886136
OM reference filter	86901
Zero absorber	895933
D-fend O-ring (2 pieces)	65312
D-fend (black)	876446
D-fend+ (green)	881319
Sampling line 3.0 m	73319
Fan filter	896113
Recorder paper (if N-XREC option is installed)	74205
Planned Maintenance Kit, *Anesthesia*	8001760
Planned Maintenance Kit, *Critical Care*	8001761

NOTE: The contents of the Planned Maintenance Kits are listed in the *Spare Parts* chapter.

3.1.3 Recommended tools and accessories

Tool	Order Number
Patient simulator for ECG, Impedance Respiration, and BP	Obtain locally
Pressure manometer	Obtain locally
Temperature test set	884515
5-lead ECG cable	Obtain locally
SpO_2 finger sensor (compatible with the installed pulse oximetry)	Obtain locally
InvBP transducer	Obtain locally
Adult NIBP cuff	572435
Adult NIBP hose	877235
Infant NIBP cuff	877407
Infant NIBP hose	877514
Flowmeter	Obtain locally
Flow cassette 50/1.1	873812
Extra silicon tubing	Obtain locally
Calibration gas (CO_2, N_2O, O_2, Des) North America (must use with regulator 75553-01) Outside North America (must use with regulator 755533)	 755571 755583
Sampling line 3.0 m	73319
Spirometry tester	884202
Spirometry tube	884101
D-lite	733950
Screwdriver, pozidrive type	Obtain locally
Hexagon wrench, M3	Obtain locally
Troubleshooting extension cable	884298

3.2 Planned maintenance checks

1. Visual inspection

1. Switch the monitor to standby and disconnect all cables from the rear of the monitor.
2. Check the external parts of the monitor. For example, check that the power cord receptacle is intact and the D-fend latch moves properly.
3. Check that the markings of the mains fuses correspond to the fuse plate.

2. Parts replacement

1. Dissamble the frame (see section 7.3.1).
2. Replace these items in the gas unit: occlusion filter, zero absorber, Nafion tubing, and OM reference filter. Also replace the D-fend, D-fend O-ring, and sampling line.

   NOTE: Use only Datex-Ohmeda sampling lines to ensure proper function.

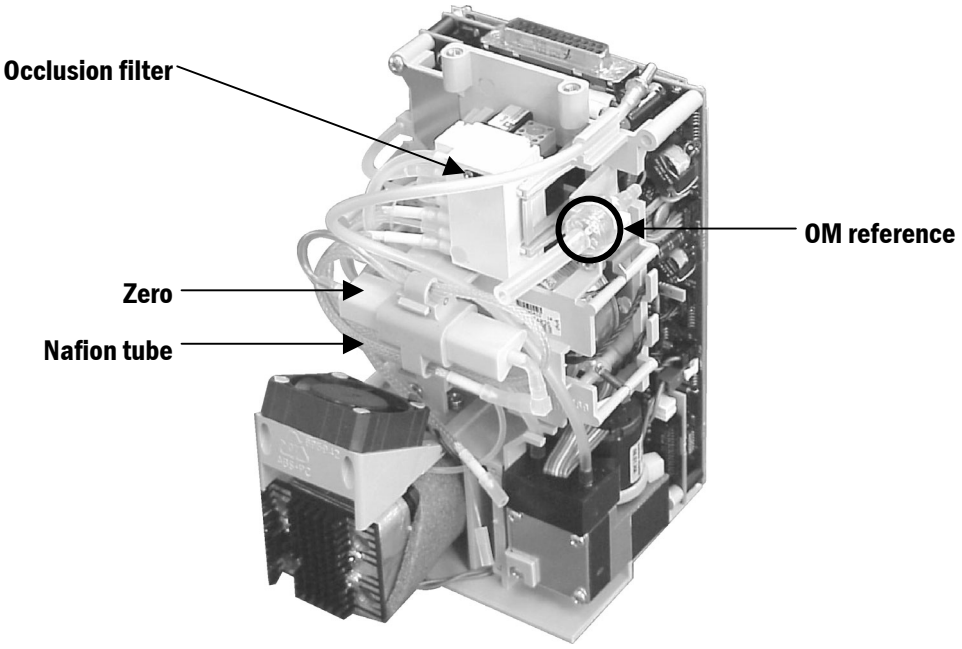
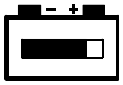


Figure 3-1. Nafion tube and filters to replace in gas unit

3. Clean or replace the fan filter.
4. Clean the recorder unit and replace the recorder paper, if necessary.
5. Reconnect all cables, then perform a gas sampling system leak test (see section 7.4.7).
6. Reassemble the frame.

3. Functional inspection

1. Connect the power cord and check that the Battery charge status LED turns on or flashes.
2. Switch on the monitor and check that it starts up as described below:
   - Both alarm LEDs flash On and Off.
   - The start-up sound is heard from the speaker.
   - The normal monitoring screen appears and no error messages are displayed.
     NOTE: “Check network connectors” is displayed if the N-XNET or N-XDNET option is installed.
   - The time and date are displayed; adjust if they are incorrect.
   - The battery charging symbol is in the upper right corner of the screen:

   - The fan starts running after about 20 seconds.
   - If the monitor contains a recorder, start-up information prints. Verify the time and date.

   Enter the Keyboard service menu (illustrated in the *Service Menus* chapter) by pressing the Comwheel and selecting:
   Monitor Setup
   Install/Service (password 16-4-34)
   Service (password 26-23-8)
   Keyboard

   To test the function of specific direct access keys, select **Dummy Press**.

   Press the **Silence Alarms** key and check that the keypress generates a sound from the speaker and the corresponding text in the service data screen changes color. Repeat for the following keys: **Trends**, **ECG**, **NIBP**, and **Normal Screen**.
3. Go to the Monitor – Voltages service menu (return to the Service View menu and select **Monitor – Voltages**). Check that the supply voltages are within the limit values:

Voltages	Mains power ON	Mains power OFF
VDD/BAT	14.3 to 16.2	10 to 13
VIN 15VB	10 to 14.5	10 to 13.5
VDD	15.0 to 16.5	
+12V	11.4 to 12.6	
+15VD	14.25 to 15.85	
+15V	14.4 to 15.6	
–15V	15.6 to 14.4	
+2.5VREF	2.40 to 2.54	
TEMP	10 to 60	
BATVOLT	10 to 14.5	10 to 13.5
VDD/TEMP OK	0	1
CHG ON	1	0
D Sync test count	0	

4. Check the capacity time of the backup battery:

   Disconnect the power cord (without switching the monitor to standby).
   Note the time and make sure that the monitor continues to run normally with the battery for at least 15 minutes. The battery indicator should appear on the screen:

   NOTE: You can continue the check while the monitor is powered by batteries.

5. Configure the monitor screen according to the monitor configuration so that all parameter information is displayed.

   NOTE: The **Resp** parameter has to be selected in one of the **Waveform Fields** or **Digit Fields** before the respiration measurement can be turned on.

4. ECG measurement test

1. Return to the Service View menu and select **Modules – ESTP : ECG** to enter the ESTP : ECG service menu. Check that:
   - The **Timeouts**, **Bad checksums**, and **Bad c-s by mod** values are not increasing faster than 50 per second.
   - The ECG/RESP board memories passed the internal memory test (that is, **RAM**, **ROM**, and **EEPROM** all state **OK**).
2. Connect a 5-lead ECG cable to the module. Check that the **Cable type** shows **5 lead**. If it shows 3 lead, make sure the 5-lead ECG cable being used contains the necessary wiring for cable recognition (pins 0, 8, and 9 are connected together).
3. Check that each **Electrode** shows **OFF** and the "Leads Off" message is displayed.

   Connect the patient simulator. Check that parameter information is displayed as configured. Check that the waveforms correspond to the simulator settings. Switch off the simulator and check that the "Asystole" and "Apnea" messages are displayed.

5. Temperature measurement test

1. Return to the Modules service menu and select **ESTP : STP** to enter the ESTP : STP service menu. Check that the STP board memories passed the internal memory test (that is, **RAM**, **ROM**, and **EEPROM** all state **OK**).
2. Check the temperature calibrations with the temperature test plugs. Calibrate if necessary.
3. Check that the protection for temperature calibration is on:
   Protect key in the menu should state **OFF**. **Protect mode** should state **ON**.

6. Non-invasive blood pressure (NIBP) measurement test

NOTE: See the *Service Menus* chapter for illustrations of the service menus used for the NIBP test.

1. Return to the Modules service menu and select **NIBP** to enter the NIBP service menu. Check that NIBP board memories passed the internal memory test (**RAM**, **ROM**, and **EEPROM** all state **OK**).
2. From the NIBP service menu, select **Calibrations** to enter the Calibration service menu. Perform the **Active Leak Test** to check the NIBP tubing system for leaks: the pressure must not drop by more than 5 mmHg (0.7 kPa) per minute.
3. Check the NIBP calibration with 200 mmHg (26.7 kPa) pressure and calibrate if necessary.
4. Return to the NIBP service menu and select **Pneumatics** to enter the Pneumatics service menu. Check the Watchdog timer activation pressure: the audible signal must activate at 3 to 8 mmHg (0.4 to 1.1 kPa).

   If necessary, adjust the limit with the trimmer on the NIBP board and recalibrate NIBP.
5. Return to the NIBP service menu and select **Watchdog** to enter the Watchdog service menu. Check the NIBP watchdog timer.

   The time for the infant test should be 60-70 seconds.
6. Return to the NIBP service menu and select **Safety Valve** to enter the Safety Valve service menu. Check the safety valve functions.

   NOTE: Make sure the pressure manometer can measure pressures over 300 mmHg (40.0 kPa). If such a pressure manometer is not available, perform the check with an adult cuff that is connected around a round object, such as a calibration gas bottle.

   The **Max press** and **2 s after stop** pressure values for both transducers should be within 290 to 330 mmHg (38.7 to 44.0 kPa) for **Adult** and 154 to 165 mmHg (20.5 to 22.0 kPa) for **Infant**.
7. Connect an infant cuff to the monitor. Start the measurement and check that the infant cuff is identified correctly. Cancel the measurement.
8. Attach an adult NIBP cuff to your arm and perform one NIBP measurement. Check that the cuff is identified correctly (for example, **Adult** briefly appears in the NIBP digit field).
   Check that the module gives a reasonable measurement result.

7. SpO_2 measurement test

1. Check that “No probe” is displayed when an SpO_2 sensor is not connected to the monitor.

   Connect an SpO_2 finger sensor to the monitor (but not to a finger). Check that “Probe off”or “Check probe” is displayed. The "Pulse search" message may be displayed first.
2. Attach the SpO_2 sensor to a finger and check that the pleth waveform is displayed and the SpO_2 value is in the expected range. Check that the HR value is calculated from SpO_2 when ECG and InvBP (P1/P2) cables are not connected.
3. Remove the SpO_2 sensor from your finger and check that “Probe off” or “Check probe” is displayed.
4. Disconnect the sensor from the monitor and check that “No probe” is displayed.

8. Invasive blood pressure measurement test

1. Check the InvBP channels with a patient simulator. The values and waveforms should correspond to the simulator settings.

   NOTE: If you evaluate the measurement accuracy, remember to add the simulator's accuracy specification to the one of the monitor.

2. Calibrate InvBP channels if necessary.

9. Gas measurement test

NOTE: See the *Service Menus* chapter for illustrations of the service menus used for the gas measurement test.

1. Check that the fan in the gas measurement unit is running.

   NOTE: If you just turned the monitor ON, you have to wait until the "Calibrating gas sensor" message disappears from the screen before entering the Gas Unit service menu.

2. Return to the Modules service menu and select **Gas Unit – General**. Check that the displayed module configuration corresponds with the configuration of the monitor.

3. Return to the Gas Unit service menu and select **Gases**. Check that the displayed **Ambient** value corresponds with the current ambient pressure (± 20 mmHg)

4. Perform a sampling system leak test.

5. Check that the flow rates are within the following ranges:

Sampling flow (ml/min)	180-220
Reference flow (ml/min)	31-45

   Adjust the flow rates if necessary.

6. Perform a gas calibration.
   NOTE: Do not calibrate the gas measurement until the monitor has warmed up for 30 minutes.

10. Anesthetic agent identification test

NOTE: Use only the recommended Datex-Ohmeda calibration gas (see *Recommended tools and accessories* earlier in this chapter).

While displaying the Gases service menu, feed the calibration gas continuously for at least 30 seconds and check that the screen shows:

- The **ID**. is **DES.**
- The **ID unrel**. value is lower than 50.

If the value is higher, recalibrate the agent identification and check the value again.

11. Spirometry test

1. Perform the spirometry leakage test and calibration (see section 7.4.9).
2. With a sample line attached to the D-lite sensor, breathe through the wider side of the D-lite. Check that the flow waveform moves downward when you breathe in, and upward when you breathe out.

12. Gas sampling line and D-fend check

1. Block the tip of the sampling line with your finger and check that the “Sample line blocked” message is displayed on the monitor screen within 30 seconds.
2. Detach the D-fend and check that the”Check D-fend” message is displayed on the monitor screen within 30 seconds.
3. Breathe once into the sampling line and check that the response time of the CO_2 curve is normal.

13. Trend test

Check that the monitor is capable of storing the trend information and temporary settings for over 2 minutes while in standby.

14. Watchdog test

In the Watchdog Tests service menu (**Monitor – Watchdog Tests)**, check that the monitor resets and restarts properly.

NOTE: Restarting should occur within a few seconds.

15. Recorder test

1. Open the paper compartment cover. Check that the “Recorder: Cover open” message appears on the screen, then close the cover.
2. Press the **Record Waveform/Stop** key on the recorder and check that the recorder starts recording the selected waveforms. Press the key again to stop recording.
3. Press the **Record Trend/Stop** key on the recorder and check that the recorder starts recording the selected trends. Press the key again to stop recording.

   Check that the quality of the recording is acceptable.

16. Network test

1. Check that the Mon-Net cable connector and the Identification plug are clean and intact, then connect them to the monitor.

   Check the connection to the network by checking the states of the Network connection LEDs between the connectors:

   Yellow --> should flash intermittently
   Green --> should be lit continuously

2. Check that the monitor connects to the Datex-Ohmeda Network (that is, the network symbol  is displayed on the upper right corner of the screen).

   NOTE: If the battery is being charged, the battery charging symbol is displayed instead of the network symbol.

   A message regarding the connection to the Datex-Ohmeda Information Center should appear in the message field on the screen.

3. In the Communication service menu (**Monitor – Communication**), check that:

   - The **Location ID number** matches with the ID plug connected to X3.
   - The **Packets In** and **Bytes In** are increasing slowly.
   - The **Packets Out** and **Bytes Out** are increasing fast.
   - **Connections** shows the names of the connected networks.
   - The counters for data errors (**CRC**, **Frame**, **Transm**.) are stable

   NOTE: The counters may show values greater than 0 (zero), however, a continuous increase in any value indicates a problem.

4. Check that the counters for hardware errors (**Intern**., **Missed**, **FIFO**, **Overrun**) all show 0.

17. Data card test

1. Insert a memory card labeled "Menu" into the front-most memory card slot. Check that the “Menu card inserted” message appears in the message field.
2. Insert a memory card labeled "Data" into the second slot. Check that the "Data card inserted" message appears in the message field.
3. Check that some trend information is available in trend memory for monitored parameters. Erase the trends. Check that the trends are properly erased.

   Reload the trends from the Data card. To do so, select **Patient Data – Patient from card.** Then, select the last saved file and select **Load.**

   After the monitor has loaded the data, check that the trends are available again.
4. Display the Module Status service screen (**Modules – More Modules – Memory Module**) and check that:
   - **Module present** and **Module active** state **Yes**
   - **RAM**, **ROM**, **PCMCIA,** and **EEPROM** all state **OK**.
   - The **Card type** for **SLOT 1** is **MENU**.
   - The **Card type** for **SLOT 2** is **DATA**.
   - The **File system** is **ATA**.
5. Check that the rest of the information is reliable and no errors have been detected.

18. Service log check

1. Enter the Service Log menu and check for possible problems. If the monitor contains a recorder, record the service log data by selecting **Record Log**.
2. Clear the content of the service log by selecting **Reset Log**.

19. Electrical safety check

1. Perform an electrical safety check and leakage current test.
2. Check that the monitor functions normally after performing the electrical safety check.
3. Switch the monitor to standby, disconnect the power cord, and perform final cleaning.
4. Fill in all necessary documents.

Planned Maintenance Form

Datex-Ohmeda Cardiocap/5

Customer _____

Service _____

Service Engineer _____ **Date** _____

Monitor Configuration

Monitor model:	Hemodynamic model F-MX	☐	Hemodynamic model with gas measurement F-MXG	☐

Measurement options			**Measurement options (SpO_2)**		
N-XP	Two invasive pressure channels and second temperature (T2)	☐	N-XOSAT	Datex-Ohmeda enhanced pulse oximetry	☐
N-XC	CO_2	☐	N-XNSAT	Nellcor compatible pulse oximetry	☐
N-XCO	CO_2, N_2O, Patient Oxygen	☐	**Data collection and data management options**		
N-XCAiO	CO_2, anesthetic agents, agent identification, N_2O, Patient Oxygen	☐	N-XREC	Recorder	☐
N-XV	Patient Spirometry	☐	N-XNET	Network	☐
N-XNMT	NeuroMuscular Transmission (NMT)	☐	N-XDNET	Data card and Network	☐

Planned Maintenance Checks

OK = Test OK N.A. = Test not applicable Fail = Test Failed

		OK	N.A.	Fail
1.	Visual inspection	☐	☐	☐
2.	Parts replacement (note which parts were replaced below)			

☐	Occlusion filter	☐	D-fend O-ring (2 pieces)
☐	Zero absorber	☐	Sampling line, 3.0 m
☐	Nafion™ tubing	☐	Fan filter (optional)
☐	OM reference filter	☐	Recorder paper (optional)
☐	D-fend	☐	Other _____

	OK	N.A.	Fail
3. Functional inspection	☐	☐	☐
4. ECG measurement test	☐	☐	☐
5. Temperature measurement test	☐	☐	☐
6. Non-invasive blood pressure (NIBP) measurement test	☐	☐	☐
7. SpO_2 measurement test	☐	☐	☐
8. Invasive blood pressure measurement test	☐	☐	☐
9. Gas measurement test	☐	☐	☐
10. Anesthetic agent identification test	☐	☐	☐
11. Spirometry test	☐	☐	☐
12. Gas sampling line and D-fend check	☐	☐	☐
13. Trend test	☐	☐	☐
14. Watchdog test	☐	☐	☐
15. Recorder test	☐	☐	☐
16. Network test	☐	☐	☐
17. Data card test	☐	☐	☐
18. Service log check	☐	☐	☐
19. Electrical safety check	☐	☐	☐

Notes: _____

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Signature: _____