Edit configuration

Available only in Standby mode.

Default Alarm limits can be changed in this window:

Adult alarm limits and Infant alarm limits

- Pressure – Upper alarm limit
- Minute Volume – Lower and Upper alarm limit
- Respiratory Rate – Lower and Upper alarm limit
- End Exp. Pressure – Lower alarm limit
- End Tidal CO_2 – Lower and Upper alarm limit
- Apnea time – Upper alarm limit.

Default configuration regarding 'General' and 'Units' cannot be changed in this window. Access to the Field Service System (FSS) is required.

Displayed values

The Measured value boxes on the User Interface shows different parameters. Some of these parameters are fixed and some are selectable in this window.

NIV adult alarms and NIV infant alarms

- Pressure – Upper alarm limit
- Minute Volume – Lower and Upper alarm limit
- Respiratory Rate – Lower and Upper alarm limit
- End Exp. Pressure – Lower alarm limit
- End Tidal CO_2 – Lower and Upper alarm limit

The alarms listed above, except Pressure alarm, can be permanently silenced in this window.

Default configuration regarding 'General' and 'Units' cannot be changed in this window. Access to the Field Service System (FSS) is required.

Copy configuration

Available only in Standby mode.

Default user configuration can be copied to / from a PC Card.

Default configuration regarding 'General', 'Units' and 'Alarm limits' will be copied.

Useful when applying the same user configuration on a number of units.

Set date and clock

Available only in Standby mode.

Date and time setting can be changed in this window.

O_2 cell adaptation

Available only during ventilation.

Adjustment of the O_2 concentration reading.

Refer to the 'Servo-i Ventilator System – User's Manual', chapter Operating your Servo-i / Operating - Adjustments for further information.

Software installation

General

- Before starting any software upgrade or update, check the version of the:
  - Installed System SW ("see 'System SW version' in the General / Status window)
  - System SW stored on the PC Card.

  It is not recommended to install System SW with lower version number than already installed in the Servo Ventilator System.
- After any installation, maintenance or service intervention in the Servo-i, perform a 'Pre-use check' according to instructions in the 'Servo-i Ventilator System – User's manual'.

Software information

There are two different intentions for software installation:

System SW Update

A 'System SW Update' will install a new System SW version in the Servo-i Ventilator System. System SW Updates are not dependent on the serial number of the ventilator and will not alter the installed options.

Option Upgrade

An 'Option Upgrade' will change the function of the Servo-i Ventilator System. An Option Upgrade is individually created for each ventilator and can only be installed on this ventilator. Serial number of the ventilator must be stated when ordering an Option Upgrade.

Software installation procedure

Further information regarding the different softwares and the software installation procedure can be found in the Installation Instructions enclosed with the PC Cards. The Installation Instructions is also available on the 'MAQUET Critical Care SW download' web site.

Field Service System

General

- The Field Service System (FSS) is a software provided to facilitate troubleshooting, service and maintenance of the Servo-i Ventilator System.
- To access the Field Service System, a Service card (PC Card) and an access code must be used. The access code is unique for each Service card.
- The Service card is personal and must not be handed-over to anyone else.
- It is only possible to access the Field Service System with the Servo-i in Standby mode.
- The Field Service System must not be activated with a patient connected the Servo-i.

Field Service System functions

In the Field Service System, it is possible to:

- Display information regarding the ventilator including options and parts installed.
- Calibrate the internal barometer.
- Display service and event logs.
- Run complete or selected test sequences.
- Create and save service reports.
- Export selected logs to a PC Card.
- Create user default configurations.

Only personnel trained and authorized by Maquet shall be permitted to perform installation, service or maintenance of the Servo-i.

Make sure to prepare the Servo-i properly before disassembling and assembling. Refer to section 'Hazard notices' in chapter 'Important'.

Any service or maintenance must be noted in a log book.

Discard disposable, replaced and left-over parts in accordance with appropriate industrial and environmental standards.

After any installation, maintenance or service intervention in the Servo-i, perform a 'Pre-use check'. Refer to the 'Servo-i Ventilator System – User's Manual' for details.

6. Troubleshooting

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Pre-use check ..... 6 - 3
Technical error codes ..... 6 - 11

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Possible causes to malfunction not mentioned in the following troubleshooting guides are:

- The system has not been correctly assembled after cleaning, maintenance or service.
- Disconnection or bad connection in cable connectors, PC board connectors, and interconnection boards.
- Disconnected or defective gas tubes.

These possible causes to malfunction must always be concidered during troubleshooting.

General

Before starting troubleshooting, try to eliminate all possibilities of operational errors. If the malfunction remains, use the troubleshooting guides below as well as the information in chapter 'Description of functions' to locate the faulty part. Perform actions step by step and check that the malfunction is eliminated.

When the fault is corrected, carry out a complete 'Pre-use check' as described in the 'Servo-i Ventilator System – User's manual'.

The troubleshooting guides below are focused only on technical problems. Information about clinical related problems can be found in the 'Servo-i Ventilator System – User's manual'.

For functionality enhancement, the latest released version of the System SW is always recommended.

Pre-use check

The Servo-i demands the user to start the automatic Pre-use check at every start-up of the unit. It is also possible to select the Pre-use check via the Standby menu.

The 'Servo-i Ventilator System – User's Manual' describes how to perform this Pre-use check. The Pre-use check-description on the following pages gives more detailed information about the Pre-use check. This information can be used e.g. during troubleshooting of the unit.

Some of the recommended actions described below refer to the Field Service System (FSS). The Service card is required to access the FSS. Troubleshooting can of course be performed without access to the FSS, but for some of the recommended actions, the FSS will make troubleshooting faster and easier.

Check if the fault remains after each performed service action. Re-run the complete Pre-use check or run the concerned test using the FSS.

* Text within brackets refers to the tested subsystem; BRE = Breathing, MON = Monitor, PAN = Panel.

Test	Test description *	Recommended action if the test fails
During system start-up.	Internal technical tests: • SW check • Reading EEPROM • Checksum EEPROM • Panel button stuck test • Audio test. (BRE + MON + PAN)	1. Restart the unit. Do not touch the User Interface during system start-up. Interfering with the knobs, keys, touch screen, loudspeaker grid, etc, may affect the internal technical tests. 2. Reinstall the System SW.

Start Pre-use check

Internal tests	Audio test. (MON + PAN) Alarm output connector test. Performed only if this option is installed. (MON) Power failure test. (MON)	If possible, check the 'Test results'-log in the 'More detailed' mode (FSS). If the audio test failed: 1. Make sure that the Patient Unit main cover and the User Interface rear cover are correctly mounted. Otherwise the audio tests may fail. 2. Check in the Test results-log (FSS) if it was the Panel test or the Monitoring test that failed: • If the Monitoring test failed: Replace PC 1772 Monitoring. • If the Panel test failed: Replace the loudspeaker or PC 1777 Panel.

Test	Test description *	Recommended action if the test fails
Internal tests (continued)		If the Alarm output connector test failed: 1. Replace PC 1789 Remote alarm connector. 2. Replace PC 1772 Monitoring If the power test failed: 1. Replace PC 1772 Monitoring.
Barometer test	Checks that the barometric pressure measured by the internal barometer is within 630–1080 hPa. Checks that the measured barometric pressure values differs less than 8 hPa between BRE and MON. (BRE + MON)	Check the Barometric pressure value in the Status window: If that value is within 630–1080 hPa: 1. Replace PC 1771 Control 2. Replace PC 1772 Monitoring 3. Replace PC 1784 Expiratory channel 4. Replace the gas modules. Replace one gas module at a time. If that value is outside 630–1080 hPa: 1. Replace PC 1772 Monitoring.
Gas supply pressure test	Checks that the gas supply pressures (Air and O_2) measured by the internal gas supply pressure transducers are within 200–650 kPa (2.0–6.5 bar). Checks that the measured supply gas pressure values differs less than 20 mbar between MON and BRE. (BRE + MON)	1. Check that the connected gas supply pressure (Air and O_2) is within the specified range. 2. Start the unit in a ventilation mode and check the alarms: • If an Air supply pressure-alarm is activated, replace the Gas module Air. • If an O_2 supply pressure-alarm is activated, replace the Gas module O_2. 3. Replace PC 1771 Control. 4. Replace PC 1772 Monitoring.

Test	Test description *	Recommended action if the test fails
Internal leakage test	Checks the internal leakage, with test tube connected, using the inspiratory and expiratory pressure transducers. Checks that the leakage at 80 cm H_2O is max. 10 ml/min. Checks that the measured pressure values differs less than 5 cm H_2O between Insp. and Exp. (BRE)	If message 'Leakage' or 'Excessive leakage' appears: 1. Check that the test tube is correctly connected. 2. Check the expiratory cassette: • Check that the cassette is correctly seated in the cassette compartment. • If possible, replace the expiratory cassette and check if the new cassette is accepted by the Pre-use check. • If the new cassette was accepted by the Pre-use check, the fault was located to the cassette. To repair the old cassette, check that the expiratory valve membrane is clean and correctly seated in the cassette. Replace the membrane if required. 3. Check that the pressure transducer tubes/filters are correctly mounted. 4. Check the inspiratory section: • Check that the inspiratory pipe is correctly mounted in the inspiratory section. • Check that the safety valve membrane is clean and correctly seated in the inspiratory pipe. • Check that the safety valve closes properly when the Pre-use check is started (distinct clicking sound from the valve). If the safety valve opens during this test, the opening pressure may not be correctly calibrated (see 'Safety valve test' below). Run the 'Safety valve test' and repeat the complete Pre-use check.

Test	Test description *	Recommended action if the test fails
Internal leakage test (continued)		If message 'Pressure Transducer difference > 5 cm H_2O' appears: 1. Check that the pressure transducer tubes and the inspiratory filter are correctly mounted. 2. Check that both PC 1781 Pressure transducer (Insp. and Exp.) are correctly mounted. 3. If the 'Pressure transducer test' also fails (see below), refer to the recommended actions if 'Pressure transducer test' failed. If message 'System volume too small' appears: 1. Replace the gas modules. Replace one gas module at a time. If message 'System volume too large' appears: 1. Check that the correct test tube is used during the Pre-use check. 2. If the 'Flow transducer test' also fails (see below), replace the gas modules. Replace one gas module at a time. 3. Refer to troubleshooting as described for 'Leakage' or 'Excessive leakage' above.

Test	Test description *	Recommended action if the test fails
Pressure transducer test	Calibrates and checks the inspiratory and expiratory pressure transducers. The new zero value for the pressure transducers may not differ more than ±6 cm H_2O from factory calibration. With the inspiratory pressure transducers used as a reference, a new gain factor is set for the expiratory pressure transducer. The new gain factor may not differ more than ±5% from factory calibration. During this test, the different subsystems concerned are compared. The difference between the sub-systems must not be more than ±1 cm H_2O at 60 cm H_2O. Expiratory valve coil test. Measures offset and gain in the valve coil. (BRE + MON)	Check that System SW V1.03.01 (or later) is installed. Update System SW if required. Check the 'Test results'-log in the 'More detailed' mode. (FSS) If 'Pressure transducer test' failed: 1. Check the expiratory cassette: • If possible, replace the expiratory cassette and check if the new cassette is accepted by the Pre-use check. • If the new cassette was accepted by the Pre-use check, the fault was located to the cassette. The fail with the old cassette may in this case be due to water collected at the pressure transducer filter inside the cassette. Dry the old cassette properly. 2. Check/replace PC 1781 Pressure transducer (Insp. and Exp.). To locate the faulty pressure transducer, replace one transducer at a time. 3. Replace PC 1771 Control. 4. Replace PC 1772 Monitoring. If 'Expiration valve test' failed: 1. Check the expiratory cassette: • If possible, replace the expiratory cassette and check if the new cassette is accepted by the Pre-use check. • If the new cassette was accepted by the Pre-use check, the fault was located to the cassette. To repair the old cassette, check that the expiratory valve membrane is clean and correctly seated in the cassette. Replace the membrane if required. 2. Replace the Expiratory valve coil.

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Test	Test description *	Recommended action if the test fails
Safety valve test	Checks and if necessary adjusts the opening pressure for the safety valve to 117 ±3 cm H_2O. Checks the hardware signals related to the safety valve functions. (BRE + MON)	1. Check the inspiratory section: • Check that the inspiratory pipe is correctly mounted in inspiratory section. • Check that the safety valve membrane is clean and correctly seated in the inspiratory pipe. 2. Replace the safety valve pull magnet. 3. Replace PC 1784 Expiratory channel. 4. Replace PC 1772 Monitoring.
O_2 cell test	Calibrates and checks the O_2 cell at 21% O_2 and 100% O_2. Checks if the O_2 cell is worn out. As different gas mixtures are used during this test, calibration and check of O_2 cell will not be performed if one gas is missing. (BRE + MON)	1. Check that the connected gas supply pressure (Air and O_2) is within the specified range. 2. Replace the O_2 cell. 3. Replace the gas modules. Replace one gas module at a time. 4. Replace PC 1771 Control. 5. Replace PC 1772 Monitoring.

Test	Test description *	Recommended action if the test fails
Flow transducer test	Checks the inspiratory flow transducer. Calibrates and checks the expiratory flow transducer. Calibrates at 60% O_2 and checks at 100% and 21% O_2. As different gas mixtures are used during this test, calibration of the expiratory flow transducer will only be performed if both gases are connected. The check using the connected gas, (100% alt. 21% O_2) will however be performed. The 'Flow transducer test' will pass if the result of this check corresponds to the old calibration factor from a previous Pre-use check. The same expiratory cassette must be used. The new calibration factor for the expiratory flow transducer may not differ more than -10% to +15% from factory calibration. During this test, the different subsystems concerned are compared. The difference between the subsystems must not be more than ±0.3 l/min. (BRE + MON)	1. Check that the connected gas supply pressure (Air and O_2) is within the specified range. 2. Check the expiratory cassette: • Check that the cassette is correctly seated in the cassette compartment. • If possible, replace the expiratory cassette and check if the new cassette is accepted by the Pre-use check. • If the new cassette was accepted by the Pre-use check, the fault was located to the cassette. The fail with the old cassette may in this case be due to water collected at the pressure transducer filter inside the cassette. Dry the old cassette properly. 3. Replace the gas modules. Replace one gas module at a time. 4. Replace PC 1785 Expiratory channel connector. 5. Replace PC 1771 Control. 6. Replace PC 1772 Monitoring. 7. Replace PC 1784 Expiratory channel.
Battery switch test	Checks that the power supply switches to battery when mains power is disconnected. Checks that the power supply switches back to mains power when re-connected. This test will not be performed if: • Less than 10 min. backup time remains in the connected Battery module(s). • No Battery module is connected. (MON)	1. Check that the total remaining time for the Battery module(s) is >10 min. If not, allow the battery to charge and repeat the test. 2. Replace PC1775 Plug-and-play back-plane. 3. Replace the Battery module(s).

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Test	Test description *	Recommended action if the test fails
Patient circuit leakage test	Checks the patient circuit leakage, with patient tubing connected, using the inspiratory and expiratory pressure transducers. Checks that the leakage at 50 cm H_2O is max. 80 ml/min. Will allow the system to calculate a compensation for circuit compliance (if the leakage requirements are met). (BRE)	If the internal leakage test (see above) has passed, the leakage is to be located to the patient circuit. Check for leakage or replace the patient circuit.
Alarm state test	Checks that no Technical error alarms are active during the Pre-use check. (MON)	Refer to section regarding Technical error alarms for further information.
External alarm system test	If the option Alarm Output Connector is enabled, the user can test the external alarm system. The external alarm output signal is activated and the user must verify the external alarm.	1. Check the external alarm system. 2. Replace PC 1789 Remote alarm connector. The result of the test does not affect the outcome of the Pre-use Check

Technical error codes

The table below shows recommended actions in case of Technical error alarms.

Some of the Error codes are intended only for R&D, not for field service. If so, the text 'N/A' is stated in the 'Recommended action'-column.

Error code	Error message / Possible cause	Recommended action
	Monitoring	
1	POWER_FAILURE_MINUS_12_VOLTS_ TOO_LOW (i.e. < -13.2 V)	1. Replace PC 1778 DC/DC & Standard Connectors.
2	POWER_FAILURE_MINUS_12_VOLTS_ TOO_HIGH (i.e. > -10.8 V)	1. Check status of external battery (if connected). 2. Replace PC 1778 DC/DC & Standard Connectors. 3. Replace PC 1775 Plug-and-play back-plane.
3	POWER_FAILURE_12_VOLTS_TOO_LOW	1. Check status of external battery (if connected). 2. Replace PC 1778 DC/DC & Standard Connectors. 3. Replace PC 1775 Plug-and-play back-plane.
4	POWER_FAILURE_12_VOLTS_TOO_HIGH	1. Replace PC 1778 DC/DC & Standard Connectors.
5	POWER_FAILURE_24_VOLTS_TOO_LOW	1. Replace PC 1778 DC/DC & Standard Connectors. 2. Replace the gas modules. Replace one gas module at a time and check that this technical error code will not appear.
6	POWER_FAILURE_24_VOLTS_TOO_HIGH	1. Replace PC 1778 DC/DC & Standard Connectors.
7	INSP_VALVE_RANGE_ERR	1. Replace PC 1771 Control. 2. Replace PC 1772 Monitoring. 3. Replace the gas modules. Replace one gas module at a time and check that this technical error code will not appear.
8	TECH_ERR_INSP_PAUSE_HOLD_TIME_ EXCEEDED	1. Replace PC 1771 Control.
9	TECH_ERR_EXP_PAUSE_HOLD_TIME_ EXCEEDED	1. Replace PC 1771 Control.

Error code	Error message / Possible cause	Recommended action
10	VALVES_DISABLED	1. Replace PC 1784 Expiratory channel. 2. Replace PC 1771 Control. 3. Replace PC 1778 DC/DC & Standard Connectors. 4. Replace PC 1772 Monitoring.
11	SAFETY_VALVE_OPEN	1. Check inspiratory channel. 2. Replace safety valve pull magnet. 3. Replace PC 1784 Expiratory channel.
12	BRE_NODE_DISCON	1. Replace PC 1771 Control.
13	BRE_NODEID_CONFLICT	N/A
14	PANEL_NODE_DISCON	1. Check the control cable 2. Replace PC 1777 Panel. 3. Replace PC 1778 DC/DC & Standard Connectors. Note: This error indicates communication failure between PC 1777 and PC 1772 and the error code will thus not be shown on the display (but will be logged).
15	PANEL_NODEID_CONFLICT	N/A
16	EXP_FLOW_MTR_NODE_DISCON	1. Replace PC 1784 Expiratory channel.
17	EXP_FLOW_MTR_NODEID_CONFLICT	N/A
18	N/A	N/A
19	N/A	N/A
20	N/A	N/A
21	N/A	N/A
22	BUZZER_SILENCER	1. Replace PC 1772 Monitoring.
23	N/A	N/A
24	BACKUP_CAP_ERR_MON	1. Replace PC 1772 Monitoring

Error code	Error message / Possible cause	Recommended action
25	TECH_MON_DEVICE_COMM_ERR	Depending on ID #. If repeated, replace parts as follows: 0: Report to MCC HSC for further information. 1: PC 1772 Monitoring. 2: PC 1775 Plug-and-play back-plane. 3: PC 1778 DC/DC & Standard Connectors. 4: PC 1781 Inspiratory pressure transducer. 5: PC 1781 Expiratory pressure transducer. 6: O2 cell or O2 cell cable or PC 1772 Monitoring. 32: PC 1784 Expiratory channel or PC 1772 Monitoring. 33: Gas module Air or PC 1772 Monitoring. 34: Gas module O2 or PC 1772 Monitoring. 35: PC 1772 Monitoring. 256: PC 1771 Control. 512: PC 1777 Panel. 784: N/A
27	TECH_ERR_BUZZER_FAILURE	1. Replace PC 1772 Monitoring. Note: If the Patient Unit front cover is removed, this error may be activated.
28	PANEL_AUDIO_FAIL	1. Replace the loudspeaker. 2. Replace PC 1777 Panel. Note: If the User Interface rear cover is removed, this error may be activated.
29	LITHIUM_BATTERY_LOW	1. Replace battery on PC 1772 Monitoring.
32	ALARM_ID_MISMATCH	N/A
33	BRE_NODE_CONNECT_TIMEOUT	1. Replace PC 1771 Control.
34	PANEL_NODE_CONNECT_TIMEOUT	1. Check the control cable. 2. Replace PC 1777 Panel. 3. Replace PC 1778 DC/DC & Standard Connectors. Note: This error indicates communication failure between PC 1777 and PC 1772 and the error code will thus not be shown on the display (but will be logged).

Error code	Error message / Possible cause	Recommended action
35	EXP_FLOW_MTR_NODE_CONNECT_TIME-OUT	1. Replace PC 1784 Expiratory channel.
36	N/A	N/A
37	EXP_FLOW_MTR_RANGE_ERR	N/A
38	BARO_UPPER_LIMIT_EXCEEDED	1. Check/calibrate barometer. 2. Replace PC 1772 Monitoring.
39	BARO_LOWER_LIMIT_EXCEEDED	1. Check/calibrate barometer. 2. Replace PC 1772 Monitoring. Note: This alarm will be activated if the ambient pressure is below 650 hPa, e.g. on a high altitude.
40	INVALID_METRIC	N/A
41	REAL_TIME_CLOCK_ERR	1. Check that System SW V1.02.05 (or later) is installed. Update System SW if required. 2. Replace PC 1772 Monitoring.
42	PERSISTENT_CHECKSUM_ERR	1. Restart the unit. 2. Replace PC 1772 Monitoring (if not Error code 29).
43	POWER_COMM_ERR	1. Replace the Battery module(s). 2. Replace PC 1775 Plug-and-play back-plane. 3. Replace PC 1772 Monitoring.
44	ALARM_LIM_XOR_ERR	1. Restart the unit. 2. Replace PC 1772 Monitoring (if not Error code 29).
45	ABNORMAL_SHUTDOWN	1. Restart the unit and run a Pre-use check. 2. Replace PC 1772 Monitoring.
46	REMOTE_ALARM_ERR	1. Replace PC 1789 Remote alarm connector. 2. Replace PC 1772 Monitoring.
47	N/A	N/A
48	PRE_OXYGEN_PHASE_TOO_LONG	1. Replace PC1771 Control.
49	DISCONNECT_PHASE_TOO_LONG	1. Replace PC1771 Control.
50	BACKPLANE_EEPROM_INVALID	1. Replace PC1772 Monitoring. 2. Replace PC1770 Main back-plane.

Error code	Error message / Possible cause	Recommended action
Breathing		
10001	BATTERY_MIN_VOLTAGE	1. Replace battery on PC 1771 Control.
10002	BRE_I2C_ERROR	1. Replace PC 1771 Control.
10003	BRE_FATAL_MEMORY_ERROR	1. Restart the unit. 2. Replace PC 1771 Control.
Panel		
20001	PANEL_DEVICE_ERROR	1. Replace PC 1777 Panel.
20002	PANEL_BACKLIGHT_BROKEN This error message may also be logged immediately before the 'No battery capacity' alarm when the unit is running in battery mode.	If the display is lit (and the error code is shown on the display): 1. Replace PC 1777 Panel. If the display is not lit (the display is dark): 1. Replace backlight lamps. 2. Replace PC board Backlight Inverter. Note: If one of the lamps is broken, the other lamp will automatically be switched off. Thus, with a failure on a backlight lamp, or likely also on PC board Backlight Inverter, the User Interface display will become dark. This error code will in such case not be possible to see (but will be logged).
20003	PANEL_BUTTON_STUCK	1. Restart the unit. Do not touch the User Interface during system start-up. Interfering the knobs, keys, touch screen, loudspeaker grid, etc, may affect the internal technical tests. 2. Check that System SW V1.03.00 (or later) is installed. Update System SW if required. 3. Check the user interface membrane buttons (FSS). 4. Replace the touch screen. 5. Replace PC 1777 Panel.

Error code	Error message / Possible cause	Recommended action
20004	PANEL_AUDIO_FAILED	1. Restart the unit. Do not touch the User Interface during system start-up. Interfering the knobs, keys, touch screen, loudspeaker grid, etc, may affect the internal technical tests. 2. Check that System SW V1.03.00 (or later) is installed. Update System SW if required. 3. Replace the loudspeaker. 4. Replace PC 1777 Panel.
20005	PANEL_PERSISTENT_CHECKSUM_ERR	1. Replace PC 1772 Monitoring.
Restart ventilator	Communication error between PC 1777 Panel and PC 1772 Monitoring.	1. Restart the ventilator and perform a Pre-use check. 2. Check the Control cable that connects the Patient Unit with the User Interface. 3. Replace PC 1778 DC/DC & Standard connectors. 4. Replace PC 1772 Monitoring.

Error code	Error message / Possible cause	Recommended action
Expiratory Flow Meter		
40001	Technical error in Exp flow meter. If the technical alarm 'Expiration flow meter PC 1784 60 V underrange' is logged together with error code 40001, see recommended action for this specific fault.	1. Replace the expiratory cassette. 2. Replace PC 1784 Expiratory channel. 3. Replace PC 1785 Expiratory channel connector. If technical alarm 'Expiration flow meter PC 1784 60 V underrange' is present: 1. Replace PC 1778 DC/DC & Standard Connectors.
Expiratory cassette		
Technical error in Expiratory cassette	Technical error in Expiratory cassette or in the communication with the cassette. If the technical alarm 'Expiration flow meter Exp. cassette power failure' is logged together with error code 'Technical error in Expiratory cassette', see recommended action for this specific fault.	1. Replace the expiratory cassette. 2. Replace PC 1785 Expiratory channel connector. 3. Replace PC 1784 Expiratory channel. If technical alarm 'Expiration flow meter Exp. cassette power failure' is present: 1. Replace PC 1778 DC/DC & Standard Connectors.

Notes

Only personnel trained and authorized by Maquet shall be permitted to perform installation, service or maintenance of the Servo-i.

Make sure to prepare the Servo-i properly before disassembling and assembling. Refer to section 'Hazard notices' in chapter 'Important'.

Any service or maintenance must be noted in a log book.

Discard disposable, replaced and left-over parts in accordance with appropriate industrial and environmental standards.

After any installation, maintenance or service intervention in the Servo-i, perform a 'Pre-use check'. Refer to the 'Servo-i Ventilator System – User's Manual' for details.

7. Preventive maintenance

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Preparations ..... 7 - 2
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Performing the Preventive maintenance ..... 7 - 3

General

- A 'Preventive maintenance' must be performed at least once every year as long as the unit is not used more than normal. Normal operation is estimated to correspond to approx. 5,000 hours of operation.
- The Battery modules shall be replaced every three years.
- The internal Lithium batteries on PC 1771 and PC 1772 shall be replaced every five years.
- After or in combination with performing the 'Preventive maintenance' described in this chapter, a 'Routine cleaning' and an 'Extended cleaning of Inspiratory channel' must be performed.
  For cleaning procedures, refer to the 'Servo-i Ventilator System – User's manual'.
- In some parts of the Preventive maintenance, as described in this chapter, access to the Field Service System (FSS) is required.
- Some optional equipment used with the Servo-i, but not covered by this Service Manual, may also demand maintenance actions. Refer to the optional equipments documentation. Example on such optional equipment are:
  - Humidifier
  - Compressor Mini.

Preparations

- Make sure that the Servo-i works properly before performing any maintenance.
- Set the On/Off switch on the User Interface to Off.
- Disconnect the mains power cable.
- Disconnect the gas supplies (wall and/or cylinder).
- Remove patient tubing.
- If fitted, remove bacteria filter from the expiratory inlet.

Equipment

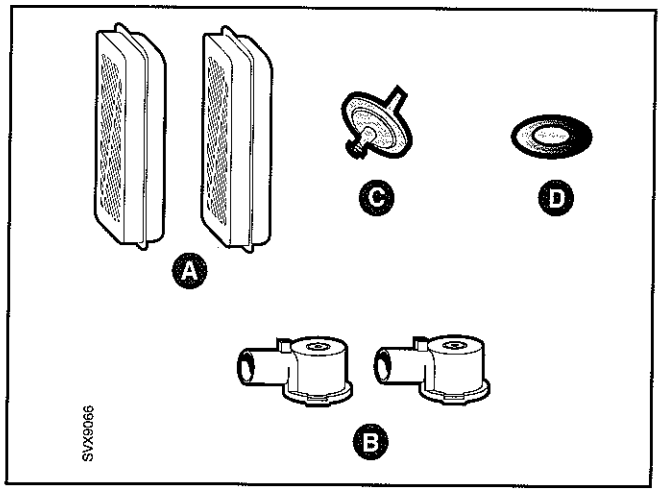
- Standard service tools.
- Barometer (or information about the actual barometric pressure).
- Access to the Field Service System (FSS). Recommended but not required.
- Preventive maintenance-kit containing all parts needed during the maintenance.

Preventive maintenance

Maintenance kit, 5,000 hours

Only original parts from the manufacturer must be used. Spare parts and maintenance kits can be ordered from your local Maquet representative.

When performing this maintenance, a 'Maintenance kit, 5,000 hours' should be used.



The following parts shall be replaced and they are included in the 'Maintenance kit, 5,000 hours':

A. Filters for the gas modules

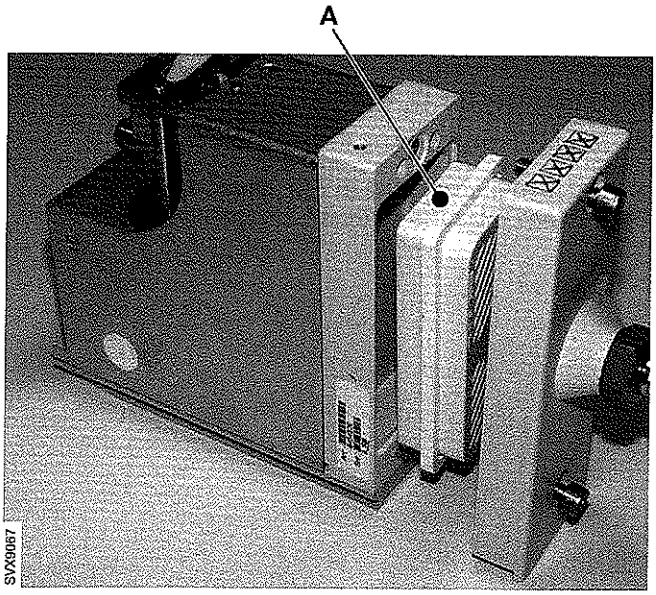
B. Nozzle units for the gas modules

C. Bacteria filter for the inspiratory pressure transducer

D. Bacteria filter for the O_2 cell

Performing the Preventive maintenance

- Disassembling and assembling of the unit is required when replacing parts included in the 'Maintenance kit, 5,000 hours'. If not stated otherwise, refer to chapter 'Disassembling and assembling' for instructions.
- The letters A – D in the text below refers to the description of the Maintenance kit above.
- Prepare the unit as described in section 'Preparations' above in this chapter.



Gas modules

A. Replace filters in the gas modules. When replacing filter, move the rubber seal from the old to the new filter.

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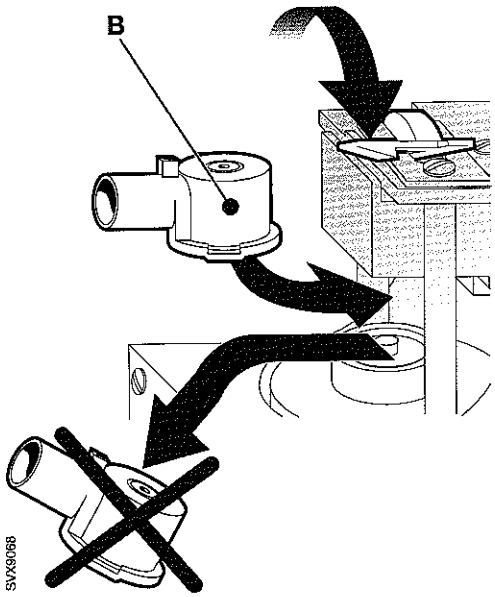
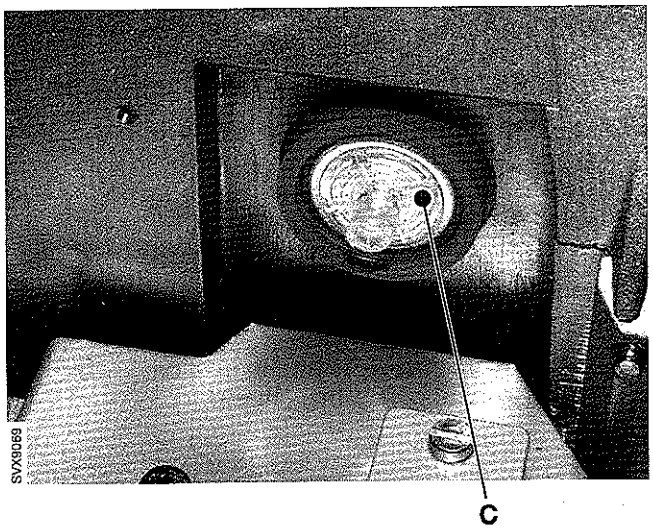


B. Replace plastic nozzle units in the gas modules.

After replacement of plastic nozzle units, wait 10 minutes before connecting pressure to the gas modules.

Inspiratory pressure transducer filter



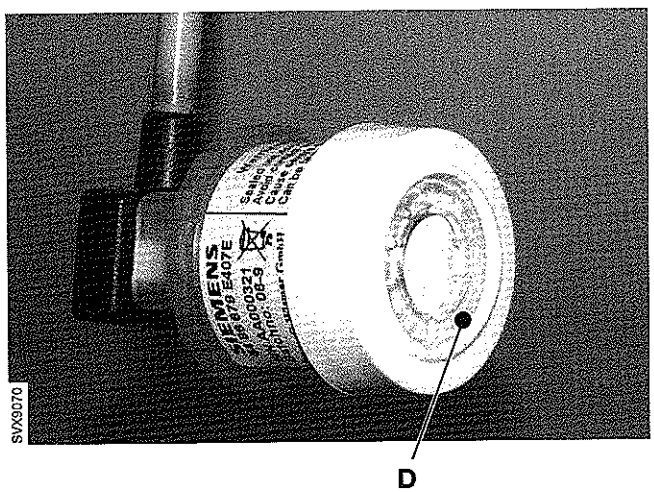
C. Replace the filter for the inspiratory pressure transducer. Make sure that the filter is correctly seated into the rubber ring.

Refer to instructions in the 'Servo-i Ventilator System – User's manual', chapter 'Maintenance'.

Note: This filter may already be replaced as a part of the 'Extended cleaning of Inspiratory channel' performed in combination with the Preventive maintenance.

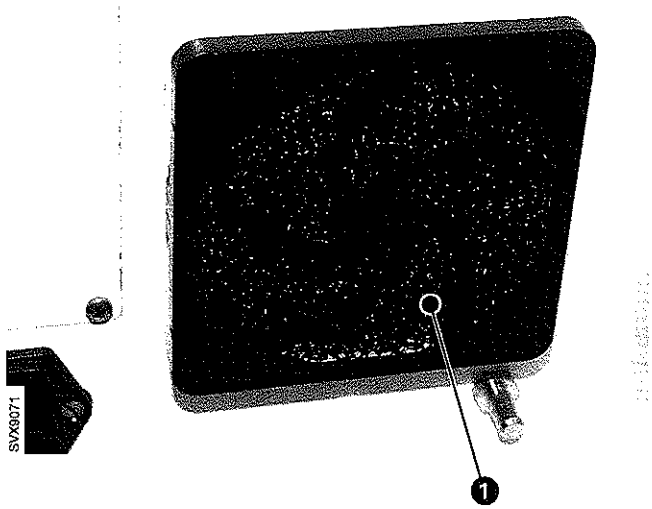
7

Bacteria filter for O_2 cell



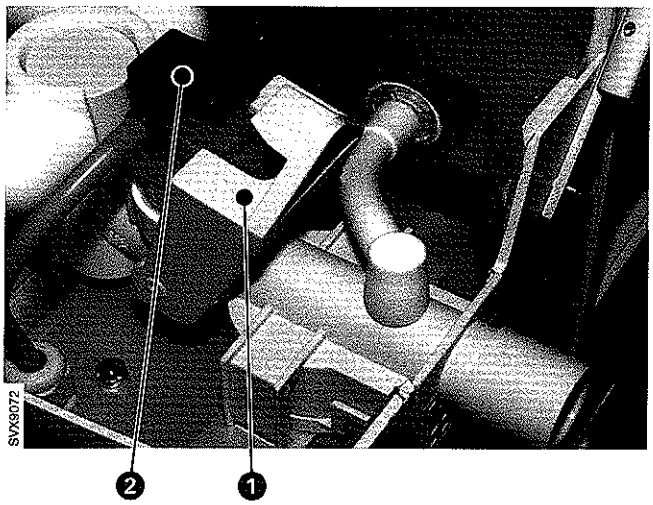
D. Replace the bacteria filter for the O_2 cell.

Refer to instructions in the 'Servo-i Ventilator System – User's manual', chapter 'Maintenance'.



Internal fan filter

- Remove the internal fan filter (1).
- Check if the filter is damaged. Replace damaged filter.
- If not damaged, clean the filter. The filter can be rinsed in water. Shake out and make sure that the filter is free from excess water.
- Mount the new/cleaned filter.



Internal fan

- Connect the mains power cable.
- Set the On/Off switch to Standby.
- Lower the locking catch (1) and disconnect the connector (2). This is done to protect the O_2 cell during the Internal fan-test.
- The temperatur sensor controlling the Internal fan is mounted in the cable connector (2). Carefully warm-up the cable connector (2) and check that the Internal fan starts. Use e. g. a light bulb or a heat fan to warm the connector.
- The Internal fan will start with half effect at approx. 33 °C (91 °F) and with full effect at approx. 43 °C (109 °F). **Note:** The temperature must not exceed 70 °C (158 °F).
- Re-connect the connector (2) and mount the inspiratory section cover.

It is also possible to check the Internal fan by running the unit in a ventilation mode and wait until the Internal fan starts. If this test method is used, all covers must be mounted in order to raise the temperature inside the compartment.

7

Expiratory cassette

- Remaining operating capacity (in %) for the membrane can be shown in the 'Status' window. Select Status / Exp. cassette to check 'Remaining membrane capacity'.
- When this capacity limit is passed or if the membrane for some reason has become defective, it must be replaced. Refer to instructions in chapter 'Disassembling and assembling'.
- The operating capacity meter must be reset after replacement of the membrane. To access the reset button, select Menu / Biomed / Service.

User Interface

- Check the touch screen readability:
  - Transparency
  - Surface
  - Brightness (backlight). Estimated lifetime (with acceptable brightness level) for the lamps is 30,000 hours. Using the Field Service System (FSS), a time meter for the lamps can be shown. The time meter must be reset after replacement of the lamps.
- Check if pixels on the touch screen are defective. Open the Status window. A few defective pixels can be accepted. Check that defective pixels are not concentrated to a small area thus reducing the readability in this area.
  FSS is recommended but not required.
- Perform the checks listed below and make sure that the software responds to these actions. FSS is recommended but not required.
  - Check the touch screen functions. Press buttons on different parts of the touch screen.
  - Check the Main Rotary Dial. Turn and press the Main Rotary Dial.
  - Check the Direct Access Knobs. Turn and press all Direct Access Knobs.
  - Check the membrane buttons. Press all membrane buttons.

Barometric pressure

- Select Status / General on the User Interface. Check that the Barometric pressure value shown on the User Interface corresponds to the actual Barometric pressure value at the local site. The value shown on the User Interface may not differ more than ±5% from the actual barometric pressure.
- If the value shown on the User Interface differs more than ±5% from the actual barometric pressure, the barometer in Servo-i must be calibrated. FSS is required.

Gas supply pressure transducers

- Connect the gas supplies (Air and O_2).
- Select Status / General on the User Interface.
- Disconnect the gas supply, one gas at the time.
- Check that the corresponding supply pressure value in the 'Status'-window drops.

Battery modules

- Check the status of the Battery modules used:
  - Check the manufacturing date of the Battery modules. Manufacturing date (year-week) is printed on the battery label. The batteries must be replaced after 3 years.
  - Check that the battery housing is not damaged.
  - Press the battery power symbol button and check that the green LEDs are lit. All 4 LEDs must be lit if the battery is fully charged.

If required, an extended check of the Battery modules can be performed. This extended check is described in chapter 'Service procedures'.

Lithium batteries

- Check manufacturing date for the lithium batteries mounted onto PC 1771 and PC 1772. The batteries must be replaced after 5 years. Replacement is described in chapter 'Service procedures'.

Safety inspection

- Make a visual inspection of the Servo-i for external defects or damages. Replace defective or damaged parts.
- Check the mains power cable and control cable and their connections for damage.
- Perform a leakage current test. The leakage current test is a standard procedure regulated by IEC 60 601-1 or corresponding national standards. Allowable values and test methods are defined in the standard. The use of a leakage tester, e. g. Bender Safety Tester 601/751 or equivalent is recommended.
- Check that a 'Servo-i Ventilator System – User's manual' and a 'Servo-i Ventilator System – Brief instructions' corresponding to the installed System SW version is present. Also check that operating manuals for all optional equipment connected to the Servo-i are present.

Completing the Preventive maintenance

- Perform a 'Pre-use check'. Refer to the 'Servo-i Ventilator System – User's manual'.
- Perform 'Function checks' on the optional equipments connected to the Servo-i. Refer to the operating manuals for these optional equipments.
- Note in the Servo-i System SW (select Menu / Biomed / Service / Report PM) and also in a Servo-i log book that a Preventive maintenance has been performed.

Only personnel trained and authorized by Maquet shall be permitted to perform installation, service or maintenance of the Servo-i.

Make sure to prepare the Servo-i properly before disassembling and assembling. Refer to section 'Hazard notices' in chapter 'Important'.

Any service or maintenance must be noted in a log book.

Discard disposable, replaced and left-over parts in accordance with appropriate industrial and environmental standards.

After any installation, maintenance or service intervention in the Servo-i, perform a 'Pre-use check'. Refer to the 'Servo-i Ventilator System – User's Manual' for details.

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Discard disposable, replaced and left-over parts in accordance with appropriate industrial and environmental standards.

After any installation, maintenance or service intervention in the Servo-i, perform a 'Pre-use check'. Refer to the 'Servo-i Ventilator System – User's Manual' for details.

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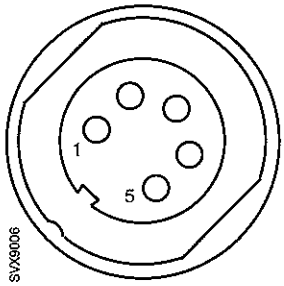
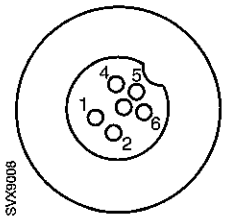
Standard and optional connectors



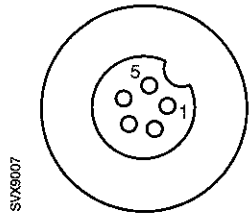
N26 – External +12 V DC supply input

1. +12V_UNREG_EXT_DC
2. +12V_UNREG_EXT_DC
3. –
4. GND
5. GND



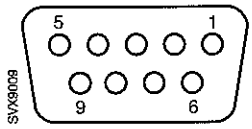
N28 / N70 – Control cable

1. +12V_UNREG_PANEL
2. GND
3. LED_CONTROL
4. ON_OFF_CONTROL
5. CAN_PANEL.H
6. CAN_PANEL.L



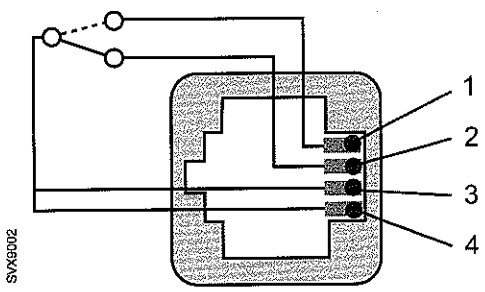
N27 – Optional equipment

1. GND
2. DISABLE_VALVES_EXT.L
3. CAN_EXPANSION.H
4. CAN_EXPANSION.L
5. +12V_UNREG_EXPANSION



N29 – RS232

1. –
2. CI_RDX_ISO
3. CI_TDX_ISO
4. CI_DTR_ISO
5. GND_ISO
6. –
7. –
8. –
9. –



P67 – Alarm output connector (option)

1. NO – Normally Open
2. NC – Normally Closed
3. Common
4. Common

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