MONNAL D2
Maintenance Manual
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GENERAL SAFETY INSTRUCTIONS

Use of oxygen
Keep to the safety rules for the use of oxygen:
   Do not smoke,
   Do not use in the vicinity of a source of sparks or incandescent objects,
   Do not lubricate operating equipment

Use and servicing of the machine
Compliant with NF C 74010 (§ 1.3):
"The manufacturer, assembler, installer or the importer are not considered responsible for
the safety, reliability and the characteristics of a machine unless:
   - Assembly, extensions, settings, modifications or repairs have been carried out by
     persons authorised by them, and
   - The electrical wiring of the relevant premises complies with IEC regulations,
   - The machine is used in accordance with the instructions for use."

If the replacement parts used for the periodic servicing do not comply with the manufacturer’s
specifications, the latter is absolved from all responsibility in the event of an accident.
   - Do not open the machine while it is switched on.
   - Do not use ether type solvents.
   - Do not use pipes or tubes which are anti-static or conductors of electricity.
   - Do not use in a specifically magnetic environment (MRI, etc.).
   - The MONNAL D2 pulmonary ventilator must not be used with inflammable anaesthetic
     materials or explosive products.
GENERAL SAFETY INSTRUCTIONS

Electromagnetic compatibility
The MONNAL D2 ventilator is a medical device compliant with the protection requirements of directive 93/42/CEE.

Its operation may be affected by the use in its vicinity of machines such as diathermy machines, high frequency electrosurgery machines, defibrillators, short-wave therapy machines or mobile telephones, and more generally by electromagnetic interference exceeding the levels specified by standard EN 60 601-1-2 (1993 edition).

The MONNAL D2 ventilator must be associated with the necessary complementary monitoring (O₂, flow measurement, etc.) in compliance with the regulations in force.

It is recommended that a manual ventilation system (Taema type IM5) and an emergency medical oxygen tank equipped with a low pressure pressure reducing valve be kept nearby.

The MONNAL D2 must be used in association with a patient airways monitoring system (Taema Pmax UNIT type).
1.1 Introduction

The MONNAL D2 ventilator is a machine specially designed to meet the needs of anaesthetist-reanimators who wish to use a flexible and multi-purpose ventilator:

- in the recovery room and in post-operative situations
- in anaesthesia (open-circuit)

The MONNAL D2 ventilator can ventilate a patient with a gas or mixture of gases (in the presence of a halogenated agent or not).

To constitute an anaesthesia system, it can be supplied with O_2 and N_2O from a source of O_2 gas under pressure (or from an oxygen concentrator) and from a source of N_2O gas under pressure (and with air from the ventilator).

The MONNAL D2 ventilator is generally associated with:

- a halogenated agent evaporator,
- a safety O_2/N_2O mixer,
- a manual induction circuit,
- an anaesthesia table.
1 - GENERAL

12. Descriptions and settings

FRONT PANEL

1- Bacteriological filter cover
2- Collector nozzle
   Controls expiratory valve operation
3- Flowmeter for ambient air provided by compressor
4- Air flow adjustment
5- Insufflation pressure manometer
6- Safety pressure adjustment (Pmax).
   To adjust, it is necessary to:
   - Block the patient circuit patient at the Y piece
   - Read off P max as it appears on the manometer during insufflation
   - Adjust the setting by turning towards +/-

Note: The user may keep the P max value constant by removing the removable button

7- Green illuminated On/Off button

8- Yellow illuminated compressor start button (on the rear panel on old models).

When the switch is in the on position, the MONNAL D2 ventilator delivers compressed ambient air. Otherwise only the mixture from the anaesthesia rack is used.

9- Pmin alarm setting

Setting by potentiometer.

10- Red LED and disabling button of Pmax. audible alarm

When the audible and visible alarm is triggered, pressing on the button disables the audible alarm for 2 minutes but the red flashing LED continues to operate.

11- I/E ratio setting

   From 1/3 to 1/1.

12- Frequency setting

Minimum controlled cycle frequency setting from 8 to 40 bpm.

13- Trigger sensitivity adjustment (SD/TS)
1 - GENERAL

Trigger sensitivity allows Controlled Assisted Ventilation (CAV). The detection of a call sets off a controlled cycle. If no call is detected a controlled cycle is supplied by the machine to guarantee the minimum set frequency.

The standard SD/TS settings for CAV are from - 1 to - 5 mbar. To move into Controlled Ventilation mode (VC), set trigger sensitivity at -20 mbar.

14- Inspiratory effort trigger

REAR PANEL

15- Hour counter
16- Water trap
17- Abacus: air and oxygen mixtures
18- Aeration
19- Mains socket
20- Fuse
2 supply protection fuses.
21- Compressed ambient air outlet nozzle
Outlet used for autonomous anaesthesia system connection
22- Fresh gas inlet nozzle
23- Manufacturer's label

UPPER COVER CONTROL

21a - Compressed ambient air outlet control
Compressor to outlet air duct control (21) used for autonomous anaesthesia connection.

The AIR DIRECT position corresponds to standard operation; the AIR INDIRECT position corresponds to the autonomous system configuration.
1 - GENERAL

1.3 Specifications

PHYSICAL
- Dimensions: L x D x H = 470 x 308 x 150 mm.
- Mass: 14 kg.

ELECTRICAL
- Electrical supply: 220 V~ 50 Hz
  Own electrical consumption: 160 VA
  Class I machine
  Type B machine
- Protection at maximum current:
  General supply protection: 2 F 1A fuses (rear panel),
  Electronic card protection: 1 100 mAT internal fuse.
- Power failure protection:
  Audible alarm (duration of discharge: 10 minutes).

ENVIRONMENT
- Minimum and maximum storage temperatures: From -40°C to +70°C.
- Minimum and maximum operating temperatures: From +10°C to +40°C.
- Atmospheric pressure (use): From 700 to 1060 mbar.
- Relative humidity (storage and use): From 30 to 75%.
- Protection index: IP20 (protected against solid bodies greater than 12 mm and non-protected against penetration by liquids).
1 - GENERAL

PERFORMANCE
- Breathing rate: From 8 to 40 bpm
- I/E ratio: From 1/1 to 1/3.
- Mean flow (insufflated per minute): From 0 to 20 l/min.
- Pmin pressure sensitivity: From 0 to 60 hPa.
- Trigger sensitivity (CAV): From 0 to -20 hPa.
- Instantaneous pressure display: From -20 to 100 hPa.

MATERIALS IN CONTACT WITH THE PATIENT AND GASES BREATHED
Silicone (autoclavable patient circuit),
Latex (accumulation bag),
PVC,
Aluminium.

STANDARDS/DIRECTIVES
NF C 74350: Artificial respiration treatment machines
NF S 90-118: Medical use ventilators
NF EN 601-1: Electromedical machine safety
NF EN 60-601-1-2: Electromagnetic compatibility of electromedical machines.
European directive 93/42/CEE concerning medical devices.
1 - GENERAL

14 Symbols

- Stop (power off)
- Start (power on)
- Pmin audible alarm disable
- Ratio of inspiration phase to expiratory phase
- Breathing rate (frequency)
- Trigger sensitivity
- Protection earth
- Equipotential
- Attention: Refer to accompanying documents
- Type B machine
- Compliance with directive 93/42/CEE (established by notified organisation n° 0459).

(MONNAL D2 units are systematically marked starting from serial number 1770)
2 - OPERATION

2.1 Operating principle

The collector/solenoid block is supplied with air, and/or with a gas mixture (or with pure oxygen), by means of a compressor.

Air ventilation (V) is displayed on a flowmeter and controlled by a tap.

The collector block including diaphragms associated with solenoid valves, controlled by the electronic unit, distributes the continuous flow

- on one hand, towards the reservoir bag during the expiratory phase,
- on the other hand, with the addition of gas stored by the bag, towards the patient through a bacteriological filter during the inspiratory phase.

The insufflation pressure is displayed on a manometer and can be limited by adjusting a safety valve.

By means of the electronic unit the rate, the I/E ratio, the trigger sensitivity SD/TS (in CAV mode) and Pmin sensitivity can be set. It also enables visual indication of the trigger sensitivity SD/TS, audible and visual indication of Pmin, and audible indication of a mains power cut.
DESCRIPTION OF VENTILATION PHASES

Inspiratory phase
The patient receives the continuous flow from the compressor or from the fresh gas inlet nozzle to which are added, by the Venturi effect, the gases which have accumulated in the reservoir bag during the inspiratory phase.

The reservoir bag deflates.

If resistance is felt, the pressure in the patient circuit reaches the Venturi discharge pressure, in which case the bag's non-return valve shuts, and this allows the compressor to increase the insufflation pressure if necessary. This pressure is, however, limited to the value of the patient safety valve setting.

Expiratory phase
The patient circuit is isolated from the machine, and the patient breathes out freely towards the outside, through the expiratory valve.

Meanwhile the circuit towards the reservoir bag opens and the bag inflates.

The pressure in the bag is in any case limited to the opening pressure of the overpressure valve.

AIR AND OXYGEN MIXTURE

If an additional supply of 100% oxygen is insufflated to the patient when the compressor is operating, this oxygen flow is added to the air flow set on the manometer on the front panel.
2.2.1 Inspiratory phase

- Inspiratory phase diagram
- 220 V power supply
- Compressor
- Hour counter
- Fresh gas
- Filter
- 0-20 l/min flow rate
- 550 mbar pressure
- 110 mbar pressure
- 170 mbar pressure
- Pmini setting
- I/E selector
- SD selector
- F selector
- PATIENTCIRCUIT
- PATIENT
- Operating diagrams

2 - OPERATION MONNAL D2

YM002100 - Rev 3 - December 1999
2.2.2 Expiratory phase

- Pmini
- I/E
- SD
- F

Hour counter

220 V

Compressor

Fresh gas

0-20 l/min

550 mbar

-20 + 100 mbar

Filter

0-80 mbar

110 mbar

PATIENT CIRCUIT

PATIENT
2 - OPERATION

2.3 Troubleshooting

2.3.1 Ventilation problems

<table>
<thead>
<tr>
<th>OBSERVATIONS</th>
<th>SYMPTOMS</th>
<th>REMEDIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>No ventilation</td>
<td>The compressor does not operate, the clock is not working and there is no &quot;mains power fault&quot; alarm.</td>
<td>- On/Off button not pressed in.  - Defective electronic unit.</td>
</tr>
<tr>
<td>The compressor does not operate, the clock is not working, but the &quot;mains power fault&quot; alarm trips.</td>
<td>- No electrical supply.  - Defective machine supply fuse(s).</td>
<td>- Check that the machine is properly plugged in.  - Replace the F1A fuse(s).</td>
</tr>
<tr>
<td>The compressor does not operate, but the clock is working.</td>
<td>- Compressor on/off switch not engaged  - Compressor overheating (internal thermal circuit breaker tripped).</td>
<td>- Switch on the compressor (switch on rear panel on old models).  - Check the air vents  - Recondition or replace the compressor.</td>
</tr>
<tr>
<td>The compressor operates, but the reservoir bag does not inflate and the Pmin alarm trips.</td>
<td>- Ventilation button is in off position (flowmeter shows 0) and the fresh gas supply is zero.</td>
<td>- Open the ventilation tap and/or supply the <strong>MONNAL D2</strong> with fresh gas.</td>
</tr>
<tr>
<td>The compressor operates, the reservoir bag inflates and deflates, but the Pmin alarm trips.</td>
<td>- Automatic triggering at wrong time.  - Expiratory valve malfunction.  - Defective patient circuit.</td>
<td>- Press the SD (TS) button (trigger sensitivity).  - Check the expiratory diaphragm and its tube.  - Check the patient circuit very carefully.</td>
</tr>
<tr>
<td>The compressor operates but the clock is not working and the &quot;mains power fault&quot; alarm trips.</td>
<td>- Defective fuse.  - Defective electronic unit.</td>
<td>- Replace the F100 mA fuse  - Replace the unit.</td>
</tr>
</tbody>
</table>
## 2 - OPERATION

<table>
<thead>
<tr>
<th>OBSERVATIONS</th>
<th>SYMPTOMS</th>
<th>REMEDIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insufficient ventilation</td>
<td>- Leak on patient circuit.</td>
<td>- Check patient circuit assembly.</td>
</tr>
<tr>
<td></td>
<td>- Bacteriological filter assembly not airtight.</td>
<td>- Disassemble and re-assemble the assembly.</td>
</tr>
<tr>
<td></td>
<td>- Expiratory valve collector wrongly connected.</td>
<td>- Check the collector and its membrane.</td>
</tr>
<tr>
<td>Failure of Controlled Assisted Ventilation</td>
<td>The “TRIGGER” LED is permanently lit up.</td>
<td>- Set the trigger sensitivity correctly (SD/ TS).</td>
</tr>
<tr>
<td></td>
<td>The “TRIGGER” LED does not light up.</td>
<td>- Set the trigger sensitivity correctly.</td>
</tr>
<tr>
<td></td>
<td>- Automatic triggering.</td>
<td>- Check the power supply to the LED and/or Replace the electronic unit.</td>
</tr>
<tr>
<td></td>
<td>- Trigger sensitivity set around - 20 mbar.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Electronic defect.</td>
<td></td>
</tr>
<tr>
<td>Failure of Controlled Ventilation</td>
<td>- Ventilatory parameters wrongly set.</td>
<td>- Set the ventilatory parameters correctly.</td>
</tr>
<tr>
<td>The “TRIGGER” LED lights up.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure of Pmin disconnection alarm</td>
<td>- Wrong setting.</td>
<td>- Set the Pmin sensitivity correctly.</td>
</tr>
<tr>
<td>The Pmin alarm is permanently triggered.</td>
<td>- Leak on the pressure sensor circuit.</td>
<td>- Check that there are no internal leaks.</td>
</tr>
<tr>
<td></td>
<td>- Electronic defect.</td>
<td>- Replace the Pmin card.</td>
</tr>
<tr>
<td>The Pmin does not trigger.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No humidification (models with humidifier</td>
<td>- Humidifier not connected.</td>
<td>- Plug in the humidifier card.</td>
</tr>
<tr>
<td>socket)</td>
<td>- Humidifier socket fuse blown.</td>
<td>- Replace the fuse.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2 - OPERATION

2.2.2 Problems originating in solenoid valve unit

<table>
<thead>
<tr>
<th>SYMPTOMS</th>
<th>CAUSES</th>
<th>REMEDIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>The reservoir balloon stays inflated.</td>
<td>Inspiratory solenoid valve blocked in the open position.</td>
<td>Replace inspiratory solenoid valve.</td>
</tr>
<tr>
<td>The reservoir balloon stays deflated.</td>
<td>Inspiratory solenoid valve blocked in the shut position.</td>
<td>Replace inspiratory solenoid valve.</td>
</tr>
<tr>
<td>The reservoir balloon works, but the test balloon hardly inflates.</td>
<td>Expiratory solenoid valve blocked in the shut position.</td>
<td>Replace expiratory solenoid valve.</td>
</tr>
<tr>
<td>A leak occurs at the expiratory valve during inspiration.</td>
<td>Expiratory solenoid valve blocked in the open position.</td>
<td>Replace expiratory solenoid valve.</td>
</tr>
</tbody>
</table>
3 - DESCRIPTION

N.B. The descriptions in lower case and *italics* are not listed as spare parts
(c.f. § 6 - LIST OF PARTS)

3.1 Overall views

1. MONNAL COVER
2. ELECTRONIC UNIT
3. PNEUMATIC CONTROL BUTTON. (Vmin.)
4. PNEUMATIC CONTROL BUTTON. (Pmax)
5. COMPRESSOR SWITCH
6. ILLUMINATED SWITCH (ON/OFF)
7. CONTROL BUTTON (SD/TS)
8. Trigger sensitivity LED
9. CONTROL BUTTON (f)
10. CONTROL BUTTON (l/E)
11. CONTROL BUTTON (Pmin)
12. PUSH BUTTON (LED included)
13. MANOMETER -20/+100 mbar
14. FLOWMETER
15. COUNTER
16. TROPICALISATION WATER TRAP
17. *Abacus: air and oxygen mixture*
18. *Air vents*
19. *Mains power unit*
20. 2A FUSE
21. *Air compressor outlet*
22. ELBOW SOCKET (gas inlet)
23. *Manufacturer's label*
24. MAINS CABLE
25. RUBBER FOOT
26. BAG CONNECTOR
27. ARTICULATED ARM SUPPORT
28. EXPIRATORY VALVE SUPPORT
29. RESERVOIR BAG
3 - DESCRIPTION

3.2 Compressor assembly

1 NM COMPRESSOR
3 SILENCER/SILENT UNIT
4 GREY NM COMPRESSOR INLET FILTER
6 COMPRESSOR PLATE
7 UNIT FLANGE
3 - DESCRIPTION

3.3 Compressor outlet filter box assembly

0 OUTLET FILTER FOR COMPRESSOR
1 Box
2 Cover
3 FOAM FILTER
4 FELT FILTER
5 FILTER SEAL
6 O-RING 35x2
7 CONNECTOR 280206

3.4 Compressor valve assembly (DC1)

0 VALVE DC1
1 Body
2 Cover
3 Seat
4 RING R10
5 Piston
6 O-RING 6.5x2
7 Washer
8 COMPRESSION SPRING
9 VALVE DIAPHRAGM
10 Counternut
11 Screw HM4 x 30 (4)
12 VYON SILENCER
13 Nut
3 - DESCRIPTION

3.5 Ventilation tap assembly

1  VENTILATION TAP  5  CONNECTOR 280206
2  Connector  6  PNEUMATIC CONTROL BUTTON
3  COMPLETE NON-RETURN VALVE  7  CAP W1-401 FOR END.
4  Elbow socket

3.6 Distributor assembly

0  DISTRIBUTOR
1  Body
2  Cover
3  DISTRIBUTOR DIAPHRAGM
4  Diaphragm piston
5  Spring
6  Compression piston
7  Adjustment screw
8  Counter-nut
3 - DESCRIPTION

3.7 Collectors assembly

1 Inspiration collector
2 Bag collector
3 Injector collector
4 INJECTOR WITHOUT NYLON SEAL
5 NYLON SEAL 14X10X1.5
6 Injector collar
7 Collector seal
8
9 SILICONE VALVE 24X6,1X0,35
10 Ambient air valve port screw
12 Valve port seal
17 O-RING 24x2
18 Non-return valve port screw
19 COLLECTOR COVER
20 WASHER 50 SHORE D33
22 DIAPHRAGM WITH NUT
3 - DESCRIPTION

3.8 Filter frame assembly with valve

3.9 Safety valve assembly

MONNAL D2

3.8 Filter frame assembly with valve

1 MONNAL COVER
2 Base of filter frame with valve
3 CONNECTOR 77109
4 MAIN BACTERIOLOGICAL FILTER
5 P.N. VALVE ASSEMBLY (Negative Pressure)

3.9 Safety valve assembly

0 SAFETY VALVE
1 Body
2 Support/seat
3 O-Ring Ø 30 x 2
4 Cover
5 Control rod
6 RING R1
7 Truarc ring
8 Spring
9 Guide pin
10 Shut-off valve washer
11 Sleeve tube
12 Straight connector
3 - DESCRIPTION

3.10 Non-return valve assembly

- 0 COMPLETE NON-RETURN VALVE
- 1 Grooved female connector
- 2 Grooved male connector
- 3 NEW MODEL NON-RETURN VALVE
- 4 Valve support

3.11 Reservoir bag connector assembly

- 0 CONNECTOR FOR MONNAL BAG
- 1 O-RING 16X2
- 2 O-RING 24X2
- 3 Bakelite ball
- 4 Seal
- 5 Spring
3 - DESCRIPTION

3.12 Pneumatic connector for pressure sensor assembly

1. Connector fitting
2. O-RING 6.5X2
3. Straight connector
4 - MAINTENANCE

4.1 Maintenance recommendations

4.1.1 Routine maintenance

Cleaning / Disinfection
Wash the patient circuit assembly by immersing it in a cleaning solution such as Surfanios®. Rinse it in hot water and dry. It can be disinfected/decontaminated with a solution of the Hexanios® G+R type.
Clean or replace the patient circuit for each new patient and whenever necessary (damaged or soiled circuit, etc.).
The respirator can be washed in soapy water with using a cloth (well wrung) impregnated with soapy water and dried with a dry cloth, or alternatively with wipes impregnated with an alcohol based aqueous solution.

Routine sterilisation
The bacteriological filter (27) at the machine outlet means that the patient circuit has to be sterilised.
Change the bacteriological filter every 600 hours.
Sterilisation by autoclave: The Taema autoclavable patient circuit is compatible with the following AFNOR cycles:

- 134°C, 18 minutes (cf prions)
- 121°C, 30 minutes.

Recommended frequency of autoclave sterilisation: Between each patient or after each cleaning/disinfection cycle.
The patient circuit is also sterilisable by all normal procedures (gaseous formaldehyde, etc.).
Warning: Do not use abrasive powders, pure alcohol, acetone or other powerful solvents.
4 - MAINTENANCE

4.1.2 Maintenance by a technician

Every 600 hours (if not done by the user):
- Replace bacteriological filter,
- Check the patient circuit,
- Test machine's functions,
- Fill in a MONNAL D2 RETURN TO SERVICE SHEET: 1st LEVEL (§ 7 - APPENDICES).

Every 1500 hours or at least once a year:
- Replace bacteriological filter,
- Replace compressor inlet filter,
- Replace the diaphragms of the collector unit and expiratory valve,
- Test the ventilator according to § 4.2 Test procedures.
- Fill in a MONNAL D2 RETURN TO SERVICE SHEET: 2nd LEVEL (§ 7 - APPENDICES).

Every 5000 hours:
- Replace bacteriological filter,
- Replace compressor inlet and outlet filters,
- Replace the diaphragms of the collector unit and expiratory valve,
- Replace valve silencer DC1,
- Replace the reservoir bag,
- Replace the solenoid valve filter,
- Test the ventilator according to § 4.2 Test procedures.
- Fill in a MONNAL D2 RETURN TO SERVICE SHEET: 2nd LEVEL (§ 7 - APPENDICES).
4 - MAINTENANCE

4.2 Testing and adjustment procedures

4.2.1 Compressor flow

Connect a manometer and a distributor to the cooling coil outlet, apply a counter-pressure \( P \), and check the flows:

- at \( P = 0 \) Flow \( \sim 30 \) l/min (for information),
- at \( P = 550 \) mbar Flow \( > 20 \) l/min

If necessary:
1. Check that there are no leaks at the compressor outlet,
2. Proceed to reconditioning or standard exchange of the compressor.

4.2.2 Compressor valve (DC1)

Set the flow on the MONNAL D2 flow meter and measure the pressure upstream from the valve:

- for 0 l/min check \( P < 600 \) mbar
- for 15 l/min check \( P = 550 \) mbar +/- 50 mbar
- for 20 l/min check \( P > 500 \) mbar

If necessary:
- check the compressor inlet and outlet filters,
- adjust the valve so as to obtain a pressure of 550 mbar at 15 l/min:
  1. untighten the counter-nut (10),
  2. tighten or untighten the seat by 10 ths of turns (3)
  3. re-tighten the counter-nut (10).

N.B. to locate parts, see. § 3.4 Valve compressor assembly
4 - MAINTENANCE

4.2.3 Reservoir bag valve
Plug the patient outlet. Set ventilation at 20 l/min, breathing rate at 8 bpm, the I/E ratio at 1/3. Let the MONNAL D2 ventilate a few cycles, then check that the bag pressure at the end of the expiratory phase is somewhere between 105 and 115 mbar. During expiration, the manometer pointer will fall back slightly.

If necessary: set the bag valve 110 +/- 5 mbar
(c.f. § 3.11 Connector reservoir bag assembly).

4.2.4 Safety valve
Shut the nebulizer tap and set the flow at 10 l/min and the breathing rate at 8 bpm.
Plug the patient outlet.
Set the safety valve at stop (clockwise).
Check that:
1- Pmax > 80 mbar;
2- During expiration, the pointer will fall back without ever reaching 0 mbar;
Then check the possible setting of the valve across the whole range of 20 - 80 mbar.

If necessary: Check that there are no internal leaks,
check for the satisfactory mechanical operation of the safety valve.
4 - MAINTENANCE

4.2.5 Tightness of the O₂ non-return valve

With a flowmeter, check on the gas inlet nozzle that the leak is less than or equal to 0.1 l/min (make the measurement for a flow set on the MONNAL D2 of 0 to 5 l/min).

If necessary: Change the non-return valve.

4.2.6 Distributor

Stop the MONNAL D2 and supply the machine with gas at 10 l/min
Clamp the pipe linking the non-return valve and the inspiratory unit.

The pressure upstream from the MONNAL D2 must be equal to 170 mbar +/- 5 mbar

If necessary: Adjust the distributor, having previously untightened its counter-nut (see § 3.6 Distributor assembly).
4 - MAINTENANCE

4.2.7 Patient flow

Remove the fuse from the electronic unit.

Connect the flow meter directly to the machine outlet (with the bacteriological filter in place).

<table>
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<tr>
<th>Flow displayed (l/min)</th>
<th>Flow measured (l/min)</th>
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<tbody>
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<td>10</td>
<td>9 to 11</td>
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<td>15</td>
<td>14 to 16</td>
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<tr>
<td>20</td>
<td>19 to 21</td>
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If necessary: 1- change the setting of valve DC1

2- replace the MONNAL D2 flowmeter
4 - MAINTENANCE

4.2.8 Breathing rate
Check the 8, 20 and 40 bpm rates, with the aid of a RT200 Timeter (or equivalent) or an FC10 flow meter connected directly to the machine outlet.

If necessary: Adjust the recommended rate on the front panel to 40.
   Adjust the rate read off by turning Pa 1.
   Adjust the recommended rate on the front panel to 8.
   Adjust the rate read off by turning Pa 3.
Check the rates again.

Note: In the absence of measuring equipment, it is possible to use a mechanical chronometer but measurement is less easy and less accurate.

4.2.9 I/E ratio
Check the I/E ratios: 1/3, 1/2 and 1/1 (Inspiratory time / Expiratory time) with the aid of an RT200 Timeter (or equivalent) connected directly to the machine outlet.

If necessary: Adjust the recommendation on the front panel to I/E = 1/1.
   Adjust the ratio read by turning Pa 2.
   Adjust the recommendation on the front panel to I/E = 1/3.
   Adjust the ratio read by turning Pa 4.
Check the I/E ratios again.

Note: In the absence of measuring equipment, it is possible to use a mechanical chronometer but measurement is less easy and less accurate.

4.2.10 Trigger sensitivity (SD/TS)
Connect a patient circuit equipped with a test bag.
Set the SD/TS on the front panel at 0 mbar.
Check that there is no self-triggering (the trigger LED does not light up).
Using the bag, create a slight pressure drop during the expiratory phase.
Check that the SD/TS LED lights up and an inspiratory phase is triggered.
Set SD/TS at -10 mbar.
Using the bag, create a pressure drop during the expiratory phase and check this trigger sensitivity on the manometer on the front panel.
4 - MAINTENANCE

If necessary: Reset the trigger:
Set the potentiometer on the front panel at 0 mbar.
Adjust P1 so that it is at the limit of self-triggering.
Set the potentiometer on the front panel at -20 mbar.
Disconnect the pressure sampling line at the T connector.
Connect a syringe and effect a pressure drop.
With P4 set trigger sensitivity at -20 mbar.

N.B. : To locate the potentiometers see the Pmin card layout diagram (§ 5 DIAGRAMS)

4.2.11 Pmin disconnection alarm

Effect a ventilation on the test bag to obtain a peak pressure slightly less than 20 mbar.
Set the Pmin alarm threshold on the front panel at 20 mbar.
Check the tripping of the audible and visual alarm.
Disable the audible alarm and check the disabling time limit: 1 min 45 ± 15 s.
Set the Pmin alarm threshold at a value less than peak pressure.
Check that the audible and visual alarm stop.
Set the Pmin alarm threshold at 60 mbar and simultaneously start a chronometer.
Check the disabling time limit of the audible and visual alarm: 10 s ± 1 s.
(Warning: For effective triggering of the audible alarm, the last disabling of this alarm must have occurred more than 2 min earlier)

If need be: Reset the threshold and the time limit:

Disconnect the patient pressure sampling line at the T connector, then connect a syringe on this line.

1- Setting of min. pressure
Connect a voltmeter (DC) between test points TP2 (+) and TP1 (-); the voltage is nil (0V). Set the Pmin button on the front panel at 40 mbar.
Bring the pressure to 40 mbar and adjust to P2 to obtain a voltage of (4,7 V).

2- Setting the alarm trigger time limit (and disabling time limit)
Adjust the potentiometer by P5 so as to obtain a triggering time limit of the Pmin alarm equal to 10 s ± 1 s.

Note: To locate the potentiometers see the Pmin card layout diagram (§ 5 DIAGRAMS).
4 - MAINTENANCE

4.3 Tools and special equipment

4.3.1 Tools
- Flat spanners: Size 7, 8, 10, 12, 14, 21, and 26
- Test bag and circuit with nebulizer
- Syringe
- Special key for disassembling taps (See diagram below): YA003800

4.3.2 Measurement
- Timeter RT200 (or equivalent)
  or electronic flow meter FC 10
  or failing that, a mechanical chronometer
- Mechanical chronometer
- Manometer 1.6 bar (class 1)
- Manometer -20 to 100 mbar (class 1.6)
- Rotameter 3 to 30 l/min (air) (accuracy 1% full scale)
5.1 Pneumatic circuit diagrams

Non-return valve

3-way tap

Compressor

Solenoid valve

Discharge filter

Filter

Safety valve

Manometer

Ventilation tap

Trigger Connector

Valve DC1

Collector unit

Distributor

Water trap

VE nozzle

Flowmeter

5.1.1 Pneumatic circuit diagram n°1300

5-10 mm

2-130 mm

4-160 mm

21-150 mm

23-60 mm

3-290 mm

6-200 mm

9-115 mm

13-190 mm

17-200 mm

10-95 mm

11-105 mm

18-190 mm

19-50 mm

24-45 mm

27-155 mm

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5.1.2 Pneumatic circuit for 551n° ≤ 1300

- Non-return valve
- Compressor
- Solenoid valve unit
- Non-return valve
- To safety valve
- Patient Pressure
- Atmospheric Pressure
- Valve DC1
- Flowmeter outlet
- Ventilation Tap
- Manometer
- To Trigger
5.1.3 Pneumatic circuit for n° 551

To Trigger

To Safety valve

Non-return Valve

Compressor

Solenoid valve

Unit

Non-return Valve

Manometer

Ventilation Tap

Flowmeter Outlet

DC1 Collector unit

Distributor

Pressure

Negative Pressure

O2

3.5 bar

Patient Pressure

Atmospheric Pressure

To Safety valve

To Trigger

Pressure reducing valve

5.4.3 Pneumatic circuit for n° 551

5 - DIAGRAMS
5 - DIAGRAMS

5.2 Pneumatic circuit for autonomous anaesthesia system

![Diagram of a pneumatic circuit for autonomous anaesthesia system]

- O₂
- \(\text{O}_2/\text{N}_2\)O Mixer \(\text{OP25}\)
- Air
- Evaporator
- ZEFIR 5 Concentrator

\(\text{MONNAL D2}\)
\(n^o \geq 1300\)
5.3 Electrical circuit diagrams

- Equipment
- Mother Board
- Compressor
- Ventilator
- Mains Filter

5.3.1 Electrical circuit n° ≥ 1300

- T 100 mA
- Isolated
- Green/yellow

- Brown
- Blue
- Black
- Grey
- Orange

- COMPRESSOR ON/OFF
- MOTHER BOARD

- MAINS FILTER
- EQUIPOTENTIAL TERMINAL

- BRACKET
- COMPRESSOR ON/OFF

- EQUIPOTENTIAL TERMINAL

- 53 - DIAGRAMS
5.3.2 Electrical circuit $650 \leq n^\circ < 1300$
5.3.3 Electrical circuit n° < 650
5.4 Skeleton diagrams of motherboards

Diagram of Motherboard n° ≥ 1300
5.4.2 Motherboard 650 s.n. < 1300

Supply 220V 50Hz
ON/OFF
Ventilator
Compressor
Counter
220V socket
Battery

Diagrams
5.5 Skeleton diagram of Pmin card for n° ≥ 1300
5.6 Layout diagram of components on motherboard for n° ≥ 1300
5.7 Layout diagram of components of Pmin card for n° ≥ 1300
## 6 - PARTS LIST

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# PARTS LIST

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<td>SKIRT W7 321</td>
<td>KY134000</td>
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<td>MIDGET LAMP 6V 40 mA 528 E TRIGGER AM</td>
<td>KY002600</td>
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<td>POTENTIOMETER</td>
<td>KY097700</td>
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<td>UNION CONNECTOR DIAMETER 0.3</td>
<td>KY069200</td>
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### 6 - PARTS LIST

<table>
<thead>
<tr>
<th>PARA.</th>
<th>ITEM</th>
<th>DESCRIPTION</th>
<th>CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>VALVE WASHER, NEOPRENE</td>
<td>KY004200</td>
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<td>VALVE WASHER, FLAT 7780</td>
<td>KY003900</td>
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<td>HEAD OF FUSE HOLDER</td>
<td>YR016800</td>
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<td></td>
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<td>MOVABLE BUTTON ROD</td>
<td>KY007800</td>
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<td>TRANSFORMER FOR MONNAL D</td>
<td>KY006100</td>
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<td>SILICONE TUBE 5X8 FOR PRESSURE PORT</td>
<td>YB002400</td>
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<td>FLEXIBLE CLEAR TUBE 3X5</td>
<td>YB002500</td>
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<td>BLUE RILSAN TUBE, BY METRE</td>
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<td>SILICONE TUBE 3X5</td>
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<td>SILICONE TUBE 3X6 EXPIRATORY VALVE CONTROL</td>
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<td>VENTILATOR FOR MONNAL D ET D2</td>
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</tbody>
</table>

_N.B.: For unlisted parts contact:_

Taema - Direction des Services Clients  
Parc de Haute Technologie  
6, rue Georges Besse - CE80  
F-92182 ANTONY CEDEX  
FRANCE  

Tel.: +33 (0)1 40 96 66 88  
Fax.: +33 (0)1 40 96 66 21
# 7 - APPENDICES

## RETURN TO SERVICE SHEET

**MONNAL D2 1st level**

### Maintenance: commissioning
- 600 hours

### Serial N° No. H WORK DOCUMENT N°

### Stages and Details

<table>
<thead>
<tr>
<th>STAGE</th>
<th>DETAIL</th>
<th>VALUE OR ⬤</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(according to maintenance manual)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Compressor start-up</td>
<td>⬤</td>
</tr>
<tr>
<td></td>
<td>Compressor stop</td>
<td>⬤</td>
</tr>
<tr>
<td>2</td>
<td>Coherence of parameters:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Breathing rate</td>
<td>⬤</td>
</tr>
<tr>
<td></td>
<td>I/E ratio</td>
<td>⬤</td>
</tr>
<tr>
<td></td>
<td>Ventilatory flow (if spirometer available)</td>
<td>⬤</td>
</tr>
<tr>
<td>3</td>
<td>Valve setting value</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Valve operation</td>
<td>⬤</td>
</tr>
<tr>
<td>4</td>
<td>SD = 0 mbar, Test bag disconnected: No self-triggering</td>
<td>⬤</td>
</tr>
<tr>
<td></td>
<td>SD = -10 mbar, Pressure drop on connected test bag &gt; -10 mbar: Triggering of an inspiratory phase</td>
<td>⬤</td>
</tr>
<tr>
<td>5</td>
<td>Disconnection alarm (Pmin)</td>
<td>⬤</td>
</tr>
<tr>
<td></td>
<td>Triggering time limit</td>
<td>⬤</td>
</tr>
<tr>
<td></td>
<td>Alarm disabling</td>
<td>⬤</td>
</tr>
<tr>
<td></td>
<td>Mains power cut alarm</td>
<td>⬤</td>
</tr>
</tbody>
</table>

### Returned to service on:
by:
Technician's stamp/signature:

---

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## 7 - APPENDICES

### RETURN TO SERVICE SHEET

**MONNAL D2  2nd level**

Maintenance: 1500 hours (or annual)
- 
5000 hours
- 

Serial N°  No H  WORK DOCUMENT N°

<table>
<thead>
<tr>
<th>ETAPÉ</th>
<th>DETAIL</th>
<th>VALUE OR Φ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(according to maintenance manual)</td>
<td></td>
</tr>
</tbody>
</table>

### COMPRESSOR TEST (l/min)

1. **Accuracy**: +/- 1 l/min
   - Counter-pressure = 0 mbar
   - Counter-pressure = 550 mbar

### VALVE DC1 TEST (mbar)

2. **Accuracy**: +/- 50 mbar
   - 0 l/min  P < 600 mbar
   - 15 l/min  P = 550 mbar
   - 20 l/min  P > 500 mbar

### VALVES TEST

3. **Accuracy**: +/- 2 mbar
   - Bag valve  105 < P < 115
   - Safety valve  P > 80 then adjustable
     - internal seal

### NON-RETURN VALVE TIGHTNESS TEST

4. Leak towards gas inlet< 0.1 l/min

### DISTRIBUTOR TEST

5. **Accuracy**: +/- 5 mbar
   - Pressure for 10 l/min: 170 mbar

### FLOW TESTS (l/min) q

6. | 0 l/min | q = 0 |
   | 5 l/min | 3.5 < q < 6 |
   | 10 l/min | 9 < q < 11 |
   | 15 l/min | 14 < q < 16 |
   | 20 l/min | 18 < q < 20 |

### ELECTRONICS TESTS

7. | Breathing rate | 8 c/min |
   | 20 c/min |
   | 40 c/min |
   | I/E ratio | 1/1 |
   | 1/2 |
   | 1/3 |
   | Trigger sensitivity (SD/TS) | -10 mbar |

### ALARMS TEST

8. | Disconnection alarm (Pmin) | 20 mbar |
   | Trigger time limit | 10 s +/- 1 s |
   | Alarm disable | 1 min 45 s +/- 15 s |
   | Mains power cut alarm |

Returned to service on:
by:
Technician's stamp or signature: