

**Anexa nr.71 (71.1/71.2)**  
**la Formularul Specificații tehnice**  
**Servicii de menențanță pentru Mașina de anestezie Carestation 650A1, 620, GE HealthCare**

<b>Specificarea tehnică deplină solicitată, Standarde de referință</b>	<b>Specificarea tehnică ofertată</b>
<p>Lucrări necesare de întreținere a dispozitivului conform manualului de service și recomandării producătorului dispozitivului medical.</p> <p>1. Obligatoriu se va prezenta lista lucrărilor de menențanță și numărul de intervenții planificate de menențanță de la producător, care urmează să fie desfășurată.</p> <p>2. Prezentarea listei detaliate cu costul fiecărei activități întreprinse.</p> <p>3. Prezentarea listei cu prețul piese de schimb, kit de menențanță care urmează să fie înlocuite în procesul de menențanță.</p> <p>Numărul de intervenții tehnice asupra dispozitivului medical conform recomandării producătorului dar nu mai puțin decât numărul de intervenții solicitate.</p> <p>Agentul economic v-a asigura lucrări de întreținere a dispozitivului medical solicitat și lucrări pentru toate dispozitivele aferente care sunt în legătură directă cu dispozitivul medical, sau accesoriu.</p> <p>Înlăturarea tuturor defecțiunilor depistate, tehnice cât și cele de program.</p> <p><b>Intervenții de urgență</b></p> <p>Lucrări de diagnosticare, testare, reparație în cazul defecțiunilor minore neprevăzute (erori tehnice, calibrare, resetare).</p>	<p>Lucrări necesare de întreținere a dispozitivului conform manualului de service și recomandării producătorului dispozitivului medical.</p> <ul style="list-style-type: none"> <li>• Procedura de menențanță preventivă, pag.13-5 din manual Carestation 600 Series</li> </ul> <p>Prețul prezentat în Anexa 23 pentru o vizită include diagnosticarea, repararea în cazul în care nu este nevoie de piese adiționale și efectuarea procedurii de menențanță efectuată anual conform manualului de service:</p> <ol style="list-style-type: none"> <li>1. Inspecție vizuală</li> <li>2. Inspecția sistemului respirator</li> <li>3. Inspecția și menențanța supapelor cu clapetă.</li> <li>4. Testarea bateriei</li> <li>5. Testarea surselor de gaze medicale</li> <li>6. Testarea senzorilor de flux</li> <li>7. Testarea displayului</li> <li>8. Calibrarea ventilatorului</li> <li>9. Testarea valvei de AGGO</li> <li>10. Testarea AGSS</li> <li>11. Calibrarea modulului de gaze</li> </ol> <p>Analizatoare utilizate:</p> <ol style="list-style-type: none"> <li>1. TSI-Flowmeter kit, 500084</li> <li>2. Pressure controller setl, 500058</li> </ol>

Kiturile de mențenanță se vor procura separat, în dependență de starea mașinii de anestezie a beneficiarului.

Pieselete de schimb necesare pentru înlocuire în caz de defecțiune, se vor achiziționa separat conform ofertei prezentate în urma diagnosticului.

- Kit de mențenanță modul de gaze  
(Kitul nu este inclus în oferta de preț!)

Cod	Configuratie	Interval de înlocuire
2093610-001/M1206554	Nafion Tube, 230 mm (mainflow) OM Reference gas filter assembly including O-ring PM sticker	Anual
M1206555	CO2 absorbant	Fiecare 4 ani

- Kit mașină de anestezie  
(Kitul nu este inclus în oferta de preț!)

Cod	Configuratie	Interval de înlocuire
1102-3016-000	vaporizer port O-rings	Anual
0211-1454-100	free breathing flapper valve	Fiecare 2 ani
1503-3208-000	free breathing valve O-ring	Fiecare 2 ani
1009-5800-000	Display Unit battery	Fiecare 4 ani
2071067-001-S, 2 unit	Breathing system check valve kits	Fiecare 4 ani
M1801706-S	Acumulatoare	Fiecare 4 ani

Intervenții de urgență cu reacționarea în maxim 24 ore de la notificarea defecțiunii, problemei, timpul intervenției telefonică maxim 1 oră, soluționarea problemei nu mai mult de 72 ore de la notificare. Chemarea inginerului companiei poate fi în formă scrisă cât și telefonică.

Numărul de intervenții la solicitarea beneficiarului nelimitate pe tot parcursul contractului încheiat.

Intervenția trebuie să se soldeze cu dispozitivul reparat sau problema soluționată. Generarea din partea agentului economic a unui raport cu toate acțiunile de reparație, remediere interprinse și indicarea pieselor utilizate.

#### **Controlul prin verificare a dispozitivelor medicale**

- Verificare stare aparat (să nu aibă lovituri, crăpături, starea șuruburilor și prinderilor roțiilor, etc.);
- Verificare parametrii tensiune de alimentare (tensiune, împământare, verificare întrerupători, etc.);
- Verificarea protecțiilor interne care asigură funcționarea în condiții de siguranță ale aparatului;
- Verificare conectori și cabluri;
- Măsurarea tensiunii din sursa de alimentare și din bateria de back up;
- Măsurarea rezistențelor diferitelor ansamble ale aparatului;
- Verificare și curățare filtre;
- Verificare și curățare ventilatoare de răcire;
- Verificare și calibrare ecran;
- Descărcare fișiere de loguri și erori;
- Verificare parametrii de protecție electrică conform EN 60601;
- Evaluarea parametrilor definitorii de performanță, prin examinare și testare;
- Verificarea îndeplinirii setului de criterii de acceptabilitate pentru dispozitivul medical (valori impuse, limite specificate, accesorii etc.).
- Verificarea și reglarea părților mecanice aflate în mișcare;
- Eliminarea jocurilor la părțile mecanice;
- Curățarea și gresarea părților mecanice aflate în mișcare;
- Curățarea plăcilor electronice (dacă este cazul), precum și a altor componente;

Se va reacționa în maxim 24 ore de la notificarea defecțiunii, problemei, timpul intervenției telefonică maxim 24 ore, soluționarea problemei nu mai mult de 72 ore de la notificare. Chemarea inginerului companiei poate fi în formă scrisă cât și telefonică.

Intervenția trebuie să se soldeze cu dispozitivul reparat în cazul în care nu este nevoie de piese adiționale sau beneficiarul are piesa în stoc. În cazul în care este nevoie de piese adiționale, în urma diagnosticului se face ofertă de preț. În urma intervenției se generează un raport cu toate acțiunile de reparație, remediere interprinse și indicarea pieselor utilizate.

#### **Controlul prin verificare a dispozitivelor medicale**

- Verificare stare aparat (să nu aibă lovituri, crăpături, starea șuruburilor și prinderilor roțiilor, etc.); **DA**
- Verificare parametrii tensiune de alimentare (tensiune, împământare, verificare întrerupători, etc.); **DA**
- Verificarea protecțiilor interne care asigură funcționarea în condiții de siguranță ale aparatului; **DA**
- Verificare conectori și cabluri; **DA**
- Măsurarea tensiunii din sursa de alimentare și din bateria de back up; **DA**
- Măsurarea rezistențelor diferitelor ansamble ale aparatului; **DA**
- Verificare și curățare filtre; **DA**
- Verificare și curățare ventilatoare de răcire; **DA**
- Verificare și calibrare ecran; **DA**
- Descărcare fișiere de loguri și erori; **DA**
- Verificare parametrii de protecție electrică conform EN 60601; **DA**
- Evaluarea parametrilor definitorii de performanță, prin examinare și testare;
- Verificarea îndeplinirii setului de criterii de acceptabilitate pentru dispozitivul medical (valori impuse, limite specificate, accesorii etc.). **DA**
- Verificarea și reglarea părților mecanice aflate în mișcare; **DA**
- Eliminarea jocurilor la părțile mecanice; **DA**
- Curățarea și gresarea părților mecanice aflate în mișcare; **DA**
- Curățarea plăcilor electronice (dacă este cazul), precum și a altor componente; **DA**
- Verificarea componentelor pneumaticice (acolo unde este cazul). **DA**

***Dacă producător nu prevede alte servicii asupra dispozitivului solicitat***

- Verificarea componentelor pneumatice (acolo unde este cazul).

*Dacă producător nu prevede alte servicii asupra dispozitivului solicitat.*

## 13.2 Planned maintenance checkout procedure

This procedure provides a sequential PM workflow.

**Note** These procedures are not intended for individual tests or calibrations outside of the sequential procedure. To perform an individual test or calibration, refer to the individual procedures in this manual or the User's Reference Manual.

This procedure is for all Carestation 620/650/650c (A1/A2) series factory trained personnel globally.

The following planned maintenance procedures are to be performed every 12 months, except where specifically stated differently.

It is strongly suggested to perform all the checks and tests in the sequences as listed in the Technical Reference Manual.

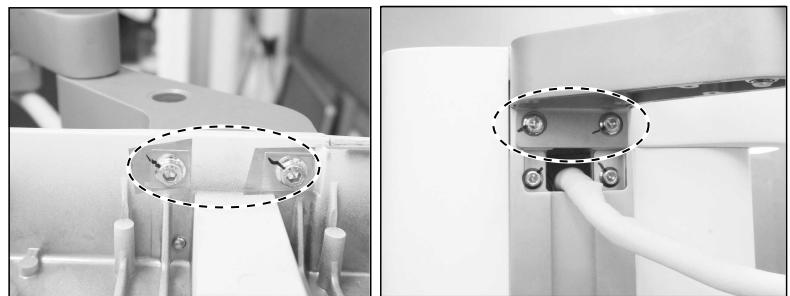
**Note** If any of the tests fail in this procedure, refer to the appropriate sections to perform calibrations or repairs.

There are many types of flow and pressure test devices available that can be used to complete the test procedures. Unless otherwise specified, the flow and pressure test devices should have an accuracy of  $\pm 2.5\%$  of reading or better.

### 13.2.1 Visual inspection procedures

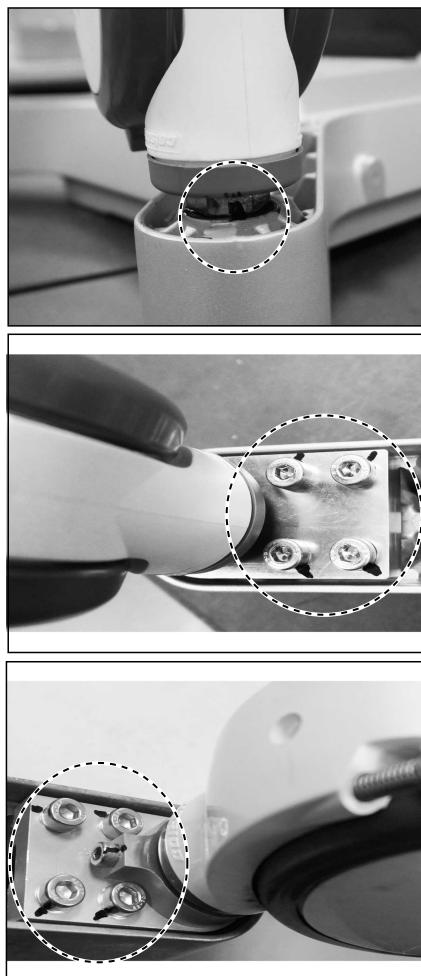
**WARNING** Tightness check of the screws with marks must be strictly implemented and the check result should be recorded.

1. Check the filter inside the lower rear cover. Replace as necessary.
2. Check the condition and tightness of the following: all display(s), frame, drawers, and top shelf PM mount parts.
3. Check the tightness of the four screws that fix the display arm to the frame:
  - remove the top shelf to check the upper two screws.
  - remove the plastic cover under the display arm to check the lower two screws.
  - verify that the marks on the screws and the adjacent surface are still aligned, tighten the screws if loose.



AC 24.381

4. Check the casters for proper operation and mounting. DO NOT LUBRICATE THE CASTERS. Check the brakes for proper operation.
5. Check the tightness of the screws that fasten the casters, verify that the marks are still aligned. If any screw is loose, remove the screw, apply Loctite 243 to the threads, then tighten the screw again.



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**Note** Mark locations vary for different caster configurations.

6. For Carestation 650c Pendant or Wall mount machine, check tightness of the screws with marks. If any screw is loose, tighten the screw to

required torque. Refer to related Installation Instructions for locations of the screws with marks and torque requirements (M1807013 - Installation and Service Instructions for Carestation 650c Pendant anesthesia machine, M1807015 - Installation and Service Instructions for Carestation 650c Wallmount anesthesia machine).

7. Check any external tubing, including silicone tubes, hoses and pipeline hoses, and ensure there is no visible deterioration and that they are securely attached.
8. Check all external electrical cabling. Ensure all are correctly connected and are not deteriorated.

### 13.2.2 Breathing system inspection

#### Bellows assembly inspection and test

**WARNING** Objects in the breathing system can stop gas flow to the patient. This can cause injury or death.

- Do not use a test plug that is small enough to fall into the breathing system.
- Make sure that there are no test plugs or other objects caught in the breathing system.

1. Disassemble the bellows assembly from the machine.
2. Inspect all removed components. Check that the bellows housing is not cracked, chipped or damaged. Also check the condition of the housing lettering. Replace any components that appear damaged, distorted or worn.
3. Reassemble the bellows assembly as shown in below picture.
4. Perform the bellows assembly test:
  - Hold the bellows assembly vertical and use the appropriate test plugs to seal the ports shown.



- Invert the bellows assembly. The bellows must not fall within one minute.  
*If it does:*
  - The ports are not tightly sealed.
  - The bellows is incorrectly installed.
  - The seal inside the bellows is not correctly installed (with its groove pointed up).
  - Parts are damaged.
- Remove the plugs from the ports. Permit the bellows to fully extend.
- Use the appropriate test plug to seal the port shown.



- Hold the bellows assembly upright. The bellows must not fall past the guide line within one minute.

*If it does:*

- The port is not tightly sealed.
- The bellows is incorrectly installed.
- The bellows or the pressure-relief valve is not correctly installed.
- Parts are damaged.

5. Reassemble the bellows assembly to the breathing system.

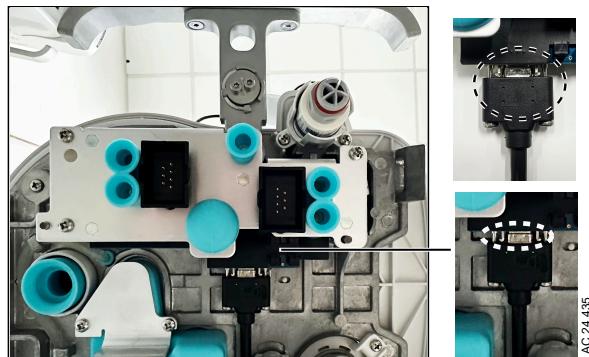
## Absorber canister

1. Release the canister lock ensuring that the release latch operates properly and smoothly.
2. Remove the absorber assembly and inspect. If a reusable canister is present, clean any absorbent dust from the lid and lid ribbed gasket, lightly lubricate the lid ribbed gasket with Krytox. Replace any parts that look damaged, distorted or worn.
3. Inspect the o-rings that make a seal with the top canister ports (located on the Breathing Circuit Module). Ensure the o-rings are properly in place. Replace any parts that look damaged, distorted or worn. Clean any that are contaminated.
4. Lock the canister in place. Ensure the canister locks into position.

## Flow sensors and Sensor Interface Board

1. Release the canister lock and remove the canister.
2. Open the breathing system release button cover.
3. Press the breathing system release button to remove the breathing system lower assembly from the machine.
4. Check the flow sensors and Sensor Interface Board. Inspect the rubber sensing ports, filters and tubing on the Sensor Interface Board module. Ensure the tubing is not kinked, no water in filter, and the electrical and pneumatic connection points are clean with no residue and secure.
5. Replace any components that look damaged or worn.
6. Reassemble the breathing system.

**CAUTION** When reassemble the breathing system, check the cable interconnecting the SIB to ACB (circled), make sure the cable is connected securely.



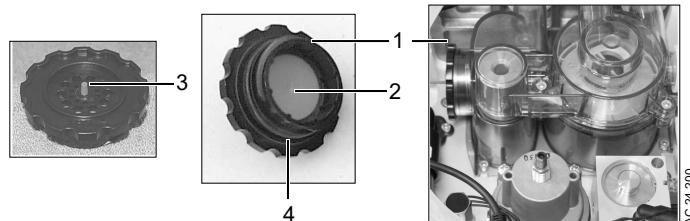
## Breathing system lower assembly inspection

1. Detach the breathing system lower assembly from the machine.
2. Inspect the APL valve diaphragm, poppet and cage. Replace any that look damaged, distorted or worn. Clean the seat and poppet.
3. Cycle the Bag/Vent switch several times. Ensure it snaps firmly from one position to the other. Replace any parts that look damaged, distorted or worn. Lubricate the Bag/Vent switch (2071064-001-S) (See "10.22.4 Bag/Vent switch" for more detailed information).
4. Inspect the Bypass Assembly (M1803995-S), replace any that looked damaged, distorted or worn (See "9.16.2 Replacing the Bag/Vent switch and the CO2 bypass" for more detailed information).
5. Reassemble the breathing system lower assembly to the machine.

### 13.2.3 Ventilator

#### Free breathing valve maintenance

1. Verify the machine is off, gas cylinders are off and the pipelines are disconnected.
2. Remove the tabletop panel.



3. Unscrew the valve seat (1) from the side of the interface manifold.
4. Inspect the flapper (2) and valve seat for nicks, debris and cleanliness.
5. To replace the flapper valve, remove the old flapper valve from the valve seat.
6. If necessary, clean the new flapper valve with isopropyl alcohol.
7. Pull the tail (3) of the new free breathing valve flapper through the center of the valve seat until it locks in place.
8. Trim the tail with 2 to 3 mm protruding outside surface of the valve seat.
9. Replace the o-ring (4). Lubricate with a thin film of Krytox.
10. Hand screw the assembly into the interface manifold.
11. Reconnect the pipeline supplies (if previously removed).

#### Exhalation valve inspection

1. Remove the three screws (circled) and disassemble the exhalation valve.



- Clean disk, relief valve weight and seat, if necessary.

2. Inspect the diaphragm, replace as necessary.
3. Assemble the exhalation valve, and reinstall it.

### 13.2.4 Verify annunciators

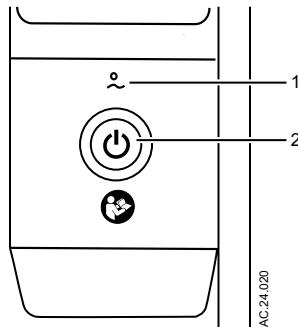
The system includes several annunciators (speakers) that produce audible tones in response to system alarms and other hardware or software fault conditions. Verify the integrity of the annunciators at system startup.

1. Press the On/Standby switch to turn on the system.
2. After several seconds into power-up:  
Verify that an audible “chirp” is heard (Anesthesia Control Board), then a second audible “chirp” is heard from the Display Unit (BIOS).
3. After the self-testing in the power-up process is completed:  
Verify that an audible “beep” is heard from the Display Unit (Display Control Board).

### 13.2.5 Power failure test and battery capacity test

#### Power failure test

1. Connect the AC power cord to a wall outlet. Make sure the mains indicator (1) light is on.



2. Press the On/Standby switch (2) to turn on the system.
3. Start a case.
4. Unplug the AC power cord with the system turned on.
5. Make sure that the power failure alarm comes on.
6. Make sure the following message is displayed:  
***Plug in power cable. On battery.***
7. Connect the power cable again.
8. Make sure the alarm cancels.

#### Battery capacity test

Perform this test as part of the Planned Maintenance (every 12 months) to confirm that the batteries remain in good working condition.

Before testing the batteries, ensure that they are fully charged.

1. Turn the system on and perform the following settings (simulated).

Simulation settings	
Item	Setting
Anesthetic Agent	None (no Tec 6 + installed or plugged in)
Task Light	On - max brightness level (adjust the Light dimmer to max brightness level)
LCD Brightness	5 (or Max)
Keypad brightness	5 (or Max)

2. Unplug the AC power cord.
3. Allow the system to run on battery.
  - If the system is running on battery for greater than 50 minutes, the test has passed and perform the next step.
  - If the system shuts down in less than 50 minutes, the test has failed and both system batteries must be replaced.
4. Plug the AC power cord.

**Note** It is not necessary to perform the battery capacity test during new system installation and after new battery replacement.

**Note** After completing the battery capacity test, plug the power cord into the AC mains supply to charge the system batteries for more than 8 hours until the batteries get fully charged.

**Note** The battery capacity test can be performed along with other necessary maintenance tasks.

### 13.2.6 Pipeline and cylinder tests

#### O2 supply alarm test

1. Turn on the system.
2. Establish O2, Air, and (if equipped) N2O gas supplies.
3. Select Start Case and Start Case Now.
4. Set all flow controls to 3 l/min.
5. Stop the O2 supply.
6. Verify that the "O2 supply pressure low" alarm occurs.
7. Verify that the N2O (if equipped) and O2 flows drop to zero on the flow indicators.
 

If Air is set as the balance gas, verify that Air continues to flow.
8. Reconnect the O2 supply.
9. Select End Case and End Case Now.

**Cross-Connect and high pressure leak test**

**CAUTION** To prevent damage:

- Open the cylinder valve slowly.
- Do not force the flow controls.

**WARNING** Do not leave gas cylinder valves open if the pipeline supply is in use. Cylinder supplies could be depleted, leaving an insufficient reserve supply in case of pipeline failure.

Ensure the Gas Supply window is visible on the screen.

1. Connect the pipeline supplies one at a time and ensure that the corresponding display indicates pipeline pressure.
2. Disconnect all pipeline supplies.
  - Open each cylinder valve one at a time and ensure that the corresponding display indicates appropriate cylinder pressure.
  - Make sure that each cylinder has sufficient pressure and ensure that the corresponding display indicates cylinder pressure. If there is insufficient pressure, close the applicable cylinder valve and install a full cylinder.
3. Test the cylinder supplies for a high pressure leak. Make sure that each cylinder has sufficient pressure:
  - If equipped, turn the auxiliary O2 flow control fully clockwise (no flow).
  - If equipped, turn off venturi derived suction.
  - Start PC Service Application.
  - Access the Gas Delivery Schematic interface from the Gas Delivery Subsystem main menu.
  - Set all the mixer solenoid valves (Mixer Air Solenoid Valve, Mixer N2O Solenoid Valve, O2 Latching Valve and O2 Bypass Solenoid Valve) to off.
  - Open each cylinder.
  - Record the cylinder pressure.
  - Close each cylinder valve.
  - Record the cylinder pressure after one minute. If the pressure decreases more than 690 kPa (100 psi) for all gases, there is a leak.If a cylinder supply fails this test, install a new cylinder gasket and do this step again.
4. Close all cylinder valves.
5. Turn off the system.

### 13.2.7 Flow sensing test

To perform the flow sensing test, you must attach a flow measuring test device to the mixer outlet tubing and access the Gas Diagnostics function of the Service Diagnostics application (PC Service App).

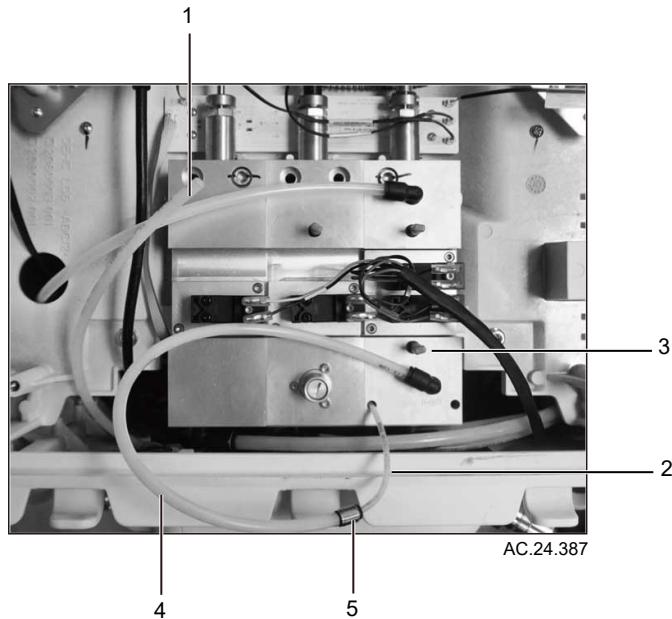
1. Remove the top shelf.
2. Connect a test device capable of reading 15 l/min to the mixer outlet tubing.
3. If the system includes an N2O supply, when flowing N2O connect a tube from the flow device to a scavenger source. (For most digital test devices, the low flow module or low flow port should be used.)

**Note** Some flowmeter test devices are not backpressure compensated. Connecting the output of the flowmeter test device to the input of the vaporizer manifold can cause readings outside limits.

4. On the Main Menu of the Service Application, select Gas Delivery Schematic from the Gas Delivery Subsystem tab. Select the Mixer Air Solenoid Valve, Mixer N2O Solenoid Valve and O2 Bypass Solenoid Valve to Off.
5. Set the O2 Latching Valve to On. Adjust the O2 flow control and verify the readings of the O2 flow sensor.
6. Set the O2 Latching Valve to Off and set the Mixer Air Solenoid Valve to On. Adjust the Air flow control and verify the readings of the Air flowsensor.

**Note** If system does not include N2O, skip steps 7 through 9.

7. Disconnect the 6mm tube (1) from the R-OUT port on the mixer O2 module. Disconnect the 1/8 inch tube (2) from pilot port on the mixer O2 module and occlude the pilot port with a 1/8 inch plug (3) (Part Number: 1006-3611-000). Connect the 1/8 inch tube (2) in line with the R-OUT port on the mixer O2 module with a 6mm tube (4) (Part Number: 1001-3062-000-S) and an adapter connector (5) (Part Number: 1006-3711-000). This setup supplies the pilot pressure to the balance regulator during the N2O flow sensing test.



8. Set the Mixer Air Solenoid Valve to Off, and set the Mixer N2O Solenoid Valve to On. Adjust the N2O flow control and verify the readings of the N2O flow sensor.
9. Remove the N2O flow sensing test setup and recover the original tubing connection. Reassemble the machine.

Verify Flow Sensor Reading		
Set Flow on the flow test device	Lower Limit (l/min)	Upper Limit (l/min)
100% O2 at 1.5 l/min	1.3	1.7
100% O2 at 12 l/min	10.8	13.2
100% Air at 1.5 l/min	1.3	1.7
100% Air at 12 l/min	10.8	13.2
100% N2O at 1.2 l/min	1.1	1.3
100% N2O at 10 l/min	9.0	11.0

### 13.2.8 Flow control test

**WARNING** Nitrous oxide (N2O) flows through the system during this test. Use a safe and approved procedure to collect and remove it.

1. Set up the system:
  - Connect the AGSS to a gas scavenging system.
  - Attach a patient circuit to the breathing system; do not plug the patient port.

- Attach a bag to the bag port (or plug the bag port).
- Set the Bag/Vent switch to Bag.
- Adjust the APL valve to minimum.

2. Connect the pipeline supplies or slowly open the cylinder valves.
3. Set the ACGO selector switch to Circle (if equipped).
4. Ensure the machine is in the normal operation mode.
5. If equipped with O2 sensor, confirm that the O2 sensor measures 21% in room air and 100% in pure O2. If not, calibrate the O2 sensor.
6. Turn all flow controls fully clockwise (minimum flow).
7. Make sure that all flowtubes (digital) minimum flow.
8. Check the Link proportioning system concentration (increasing N2O flow). Observe the following precautions:
  - Start with all valves at the minimum setting.
  - Adjust only the N2O flow control.
  - Increase the N2O flow as specified in the following table and make sure the O2 concentration or the O2 flow is within the allowed range.

**Note** For machines with O2 monitoring, the O2 concentration can be observed on the display. For machines without O2 monitoring, access the Mixer Output/Gas Delivery Subsystem tab (in PC Service Application) and check the O2 flow.

Allow the O2 monitor to stabilize. At the lower flows, the O2 monitor may take up to 90 seconds to stabilize.

- If you overshoot a setting, turn the O2 flow control clockwise till the N2O flow decreases to the previous setting before continuing the test.

Set the N2O flow (l/min)	O2 concentration	O2 flow (l/min)
0.2	21% minimum	> 0.05
1.6	21% to 34%	0.42 to 0.83
5.0	21% to 34%	1.32 to 2.58
9.0	21% to 34%	2.39 to 4.64

9. Check the proportioning system concentration (decreasing O2 flow). Observe the following precautions:
  - Start with N2O valve at the maximum setting.
  - Adjust only the O2 flow control.
  - Decrease the O2 flow as specified in the table and make sure the O2 concentration or the N2O flow is within the allowed range.

**Note** For machines with O2 monitoring, the O2 concentration can be observed on the display. For machines without O2 monitoring, access the Mixer Output/Gas Delivery Subsystem tab (in PC Service Application) and check the N2O flow.

**Note** Allow the O2 monitor to stabilize. At the lower flows, the O2 monitor may take up to 90 seconds to stabilize.

- If you overshoot a setting, turn the N2O flow control counterclockwise till the O2 flow increases to the previous setting before continuing the test.

Set the O2 flow (l/min)	O2 concentration	N2O flow (l/min)
2.5	21% to 34%	4.85 to 9.40
1.0	21% to 34%	1.94 to 3.76
0.4	> 21%	< 1.50

- Turn the N2O and O2 flow control fully clockwise to minimum stop.

10. If the flow control test fails, calibrate the flow control needle valves and the Link system. See "*5.3 Flow control needle valves calibration*" and "*5.4 Link system calibration*" for details.

### 13.2.9 Display diagnostics

Instructions for each test/calibration will appear when the focus is on the individual menu. Follow on-screen instructions to complete each test.

- Test LEDs
- Test speaker
- Test battery
- Test hard keys
- Test LCD
- Calibrate touch

## 13.2.10 Ventilator tests

### Perform the ventilator calibrations

Enter Service Mode, select Calibrations on the Service menu in the right side button bar.

Perform the following calibrations:

- User Calibrations
- Manifold P Span
- Inspiratory Flow Valve
- Bleed Resistor
- Zero ACGO/Zero AGSS/Zero ACGO and AGSS (if ACGO or AGSS is configured)
- Paw Span/Paw and ACGO Span (if ACGO is configured)
- Zero Gas Transducers
- Mixer Flow Sensor Zero

Refer to "4.9 Calibrations" for more details on the calibration instructions.

### Pressure limit circuit test

Perform the following steps to prepare the test setup:

1. Remove the bellows housing from the breathing system.
2. Remove the bellows.
3. Replace the bellows housing to the breathing system.



AC-24-272

4. Connect the inspiratory and expiratory ports with a tube.



AC-24-273

5. Set the Bag/Vent Switch to Vent.

1. Start the PC Service Application.
2. Select Vent Schematic from the Vent Subsystem menu.
3. Set the Gas Inlet Valve to On.
4. Adjust the Insp Flow Valve counts to approximately 25000 counts and observe the Airway Pressure reading on the Vent Schematic.
5. Increase the flow count slowly until the Airway Pressure reading reaches approximately 109 cmH<sub>2</sub>O.
6. Continue to increase the flow slowly and observe the airway pressure until gas flow stops.
7. On the Status page, verify that:  
Gas Inlet Valve Status reads Off.

### **MOPV pressure relief valve test**

This test checks the MOPV in the vent engine assembly.

**WARNING** Objects in the breathing system can stop gas flow to the patient. This can cause injury or death:

- Do not use a test plug that is small enough to fall into the breathing system.
- Make sure that there are no test plugs or other objects caught in the breathing system.

1. Remove the bellows housing from the breathing system.
2. Remove the bellows assembly and pop off valve.
3. Occlude the drive gas port with an 18 mm plug (1407-8503-000).



4. Set the Bag/Vent switch to Vent.

To test the pressure relief valve, you must establish a flow (blocked by setup above) of 30 l/min through the Inspiratory Flow Control valve.

1. Turn on the system.
2. Access the Vent Schematic of the Service Application.
3. Set the Gas Inlet Valve to On.
4. Adjust the Inspiratory Flow Valve counts until the inspiratory flow value on the schematic reads approximately 30 l/min.
5. Carefully listen for the MOPV relief weight to be relieving and “popping off” from its seat (a purring sound). This indicates the valve is functioning correctly.
6. Turn off the system.
7. Remove the tube from the inspiratory and expiratory port.
8. Reinstall the bellows and reassemble the breathing system.
9. Perform the **Ventilator Leak** test. See "3.4.1 Ventilator Leak test" for detail procedures.

### 13.2.11 Auxiliary O2 flowmeter tests

#### Functional test

1. Verify the O2 cylinder valve is ON or machine is connected to an O2 pipeline.
2. Rotate the flow control clockwise (decrease) to shut off the flow. The ball should rest at the bottom of the flow tube and not move.
3. Rotate the flow control counterclockwise (increase). The ball should rise immediately after rotation is begun. It should rise smoothly and steadily

with continued counterclockwise rotation. When a desired flow is set, the ball should maintain in a steady position.

4. Rotate the flow control clockwise to shut off the flow.

### Flow accuracy test

**Note** To check flow accuracy, be sure that the flow test device is capable of measuring 0 to 15 l/min with an accuracy of  $\pm 2\%$  of reading.

1. Connect the Aux O2 port to the flow test device.
2. Adjust the Aux O2 flowmeter so the center of the ball aligns with the selected test point (observe that the ball maintains a steady position for 10 seconds).
3. The test device reading should be between the limits shown for each of the selected settings in the table below.

Flow Tester Reading		
Flowmeter Setting (l/min)	Lower Limit (l/min)	Upper Limit (l/min)
3	2.5	3.5

4. Rotate the flow control clockwise to shut off the flow.
5. Close the O2 cylinder valve or disconnect the O2 pipeline.

## 13.2.12 Integrated suction regulator tests (if equipped)

**Note** There are two types of integrated suction systems for the anesthesia machine:

- Continuous Vacuum Regulator, Three-Mode, Pipeline Vacuum
- Continuous Vacuum Regulator, Three-Mode, Venturi Derived Vacuum

For Pipeline Vacuum systems, a vacuum source of at least 500 mmHg (67 kPa or 20 in Hg) is required for testing. The supply open flow must be a minimum of 50 l/min.

For Venturi Derived Vacuum systems, an Air source of at least 282 kPa (41 psi) is required for testing.

### Gauge accuracy

To check gauge accuracy, be sure that the test gauge is capable of measuring 0 to 550 mmHg with an accuracy of  $\pm 1\%$  of reading.

1. With the suction regulator turned to the Off position, verify the gauge needle is within the zero range bracket.
2. Connect a test device capable of measuring -550 to 0 mmHg to the suction patient port.

3. Turn the mode selector switch to On (the left).
4. Ensure that the vacuum test gauge is in agreement with the suction vacuum gauge  $\pm$  38 mmHg/5 kPa at the following test points.

**Test points**

<b>Suction vacuum gauge</b>	<b>Test gauge tolerance</b>
100 mmHg (13.3 kPa)	62 - 138 mmHg (8.3 - 18.4 kPa)
300 mmHg (40 kPa)	262 - 338 mmHg (35 - 45 kPa)
500 mmHg (66.7 kPa)	462 - 538 mmHg (61.6 - 71.7) kPa)

**Flow test**

**Note** To check flow accuracy, be sure that the flow test device is capable of measuring 0 - 30 l/min with an accuracy of  $\pm$  2% of reading.

1. Connect the patient port of the suction regulator to the flow test device.
2. Rotate the suction control knob fully clockwise (increase).
3. Turn the mode selector switch to On (the left) and verify that the flow rate is:
  - at least 20 l/min.
4. Disconnect the test flowmeter.

**Regulation test**

1. Turn the mode selector switch to On (the left).
2. Occlude the patient port of the suction regulator.
3. Set the vacuum regulator gauge to 100 mmHg/13 kPa.
4. Open and close the patient port several times.
5. With the patient port occluded, the gauge should return to 100 mmHg/13 kPa within a tolerance of  $\pm$  10 mmHg/1.3 kPa.

**Vacuum bleed test**

1. Occlude the patient port of the suction regulator.
2. Set the vacuum regulator gauge to 100 mmHg/13 kPa.
3. Turn the mode selector switch to Off and observe the gauge needle. It must return to the zero range bracket or stop pin within 10 seconds.

**Vacuum leak test**

1. Turn the mode selector switch to Off.
2. Rotate the suction control knob a minimum of two full turns in the clockwise direction (increase suction) to ensure its setting is not at the Off position.
3. Occlude the patient port of the suction regulator.

4. Observe the suction gauge and verify that the needle does not move.
5. Rotate the suction control knob fully counterclockwise to ensure its setting is at the fully off position.
6. Turn the mode selector switch to On (the left).
7. Observe the suction gauge and verify that the needle does not move.

### 13.2.13 ACGO pressure relief valve test

For machines with ACGO, follow below procedures to check the MOPV valve in ACGO module:

1. Set the ACGO selector switch to ACGO.
2. Plug the ACGO port.



AC24274

3. Adjust the O2 flow control knob to create a 15 l/min O2 flow.
4. Carefully listen for the pressure relief weight to be relieving, verify that the pressure relief weight "pops off" from its seat or a purring sound can be heard. This indicates the valve is functioning correctly.
5. Remove the plug from the ACGO port.
6. Turn the O2 flow control fully clockwise to minimum stop.

### 13.2.14 AGSS inspection and testing (only equipped with passive AGSS)

#### Passive AGSS (if equipped)

Refer to "10.25 Active AGSS" and "10.24 Passive AGSS" to check type of the AGSS; if still not sure, check which AGSS is configured from the **Installation - Config.-AGSS Installed** in Display computer .

1. Remove the tabletop panel.
2. Perform the Scavenger Positive Relief Functional Check.

### **Scavenger positive relief functional check (for machine with Passive AGSS)**

1. Connect the inspiratory and expiratory ports with a tube.
2. Occlude the bag port.
3. Occlude the AGSS exhaust port with an adapter (1500-3376-000) and a plug (1407-8504-000).



4. Set the APL Valve to Min and the Bag/Vent switch to Bag position.
5. Adjust the O2 flow to 6 l/min.
6. After one minute, observe the Pmean pressure on the screen.
  - The pressure should rise to approximately 10 cmH2O (some noise chattering should be heard).
  - The pressure should indicate a pressure rise of less than 10 cmH2O.
  - If the pressure rise is greater than 10 cmH2O, replace the pressure relief valve in the AGSS and repeat this test procedure.
7. Remove the occlusions from the AGSS exhaust port and bag port.
8. Remove the short tube from the inspiratory and expiratory ports.
9. Connect the AGSS to the hospital evacuation system.
10. Turn off the O2 gas flow.

#### **13.2.15 Flush flow test**

1. With Bag/Vent switch in Bag, verify case has ended.
2. Set the Bag/Vent switch to Vent. Set the O2 flow to minimum.
3. Attach a patient circuit to the breathing system and plug the patient port.

4. For ACGO equipped machines, set the ACGO selector switch to Circle position.
5. Ensure that the bellows is completely collapsed.
6. Measure the amount of time it takes to fill the bellows when the O2 Flush button is fully and continuously depressed.
7. Repeat above measurement two more times (deflate bellows by removing the plug from the patient port).
8. The bellows should fill in 1.3 to 3 seconds.

Possible causes of failure:

- Large leak in breathing system (if long filling time).
- ACGO selector valve is not correctly connected (if short filling time).

### 13.2.16 Vaporizer back pressure and interlock test

**WARNING** Anesthetic agent comes out of the circuit during this test. Use a safe, approved procedure to collect and remove the agent.

1. Set up the system before the test.
  - Connect the AGSS to a gas scavenging system.
  - Attach a patient circuit and plug the patient port.
  - Attach a bag to the bag port (or plug the bag port).
  - Set the Bag/Vent switch to Bag.
  - Adjust the APL valve to minimum.
2. If ACGO presents, set the ACGO selector switch to Circle position.
3. Set the O2 flow to 6 l/min.
4. Adjust the vaporizer concentration from 0 to 1% one click at a time. The O2 flow must not decrease more than 1 l/min through the full range. If the O2 flow decreases more than 1 l/min:
  - Install a different vaporizer in the same place and try this step again.
  - If the O2 flow decreases less than 1 l/min with a different vaporizer, the malfunction is in the first vaporizer.
  - If the O2 flow also decreases more than 1 l/min with a different vaporizer, the malfunction is in the anesthesia system. Do not use the system until it is serviced (repair vaporizer manifold port valve).
5. Complete steps 4 through 5 for each vaporizer and vaporizer position.
6. Make sure you cannot turn on more than one vaporizer at the same time.

### 13.2.17 Calibrating the airway module

Calibrate airway modules once every six months or whenever there are indications of errors in the gas readings. Use a manufacturer approved calibration gas and regulator to calibrate the modules. See "10.1.7 Test tools" for stock numbers of the calibration gas and regulator.

**WARNING** Only use manufacturer approved calibration gas. Do not use any other calibration gases or the calibration will not succeed. Dispose of calibration gas containers in accordance with local environmental procedures.

**Note** The Calibration menu is not available during Checkout or during a case.

During gas calibration, % units are used for CO2 regardless of selected measuring units.

1. Turn on the system. Let the module warm up for 30 minutes before starting calibration.
2. Attach the regulator to the calibration gas cylinder.
3. Attach a new sampling line to the water trap. Connect the loose end of the sampling line to the regulator on the calibration gas cylinder.
4. Select the System Setup button.
5. Select Calibration.
6. Select Airway Gas.
7. Wait until 'Feed Gas' appears.
8. For regulators with a numbered gauge, open the regulator until the gauge reads between 5 to 7 psi. For regulators with a non-numbered gauge, open the valve.
9. Feed the calibration gas until 'Adjust' appears.
  - If an error occurs during calibration or if no gas is fed, 'Calibration error' appears. Push the ComWheel to perform a new calibration.
  - Do not close the regulator until all the adjustments have been made.
10. If a gas needs adjustment, select the gas to be adjusted. Use the ComWheel to change the value until it matches the calibration gas cylinder value. Push the ComWheel to confirm the change.
11. If a gas does not need adjustment, select the gas. Push the ComWheel to confirm the value.
12. Close the regulator.

### 13.2.18 Alarm tests

1. Connect a test lung to the patient connection.
2. Start a case.
3. Set the Bag/Vent switch to Vent.

4. Set O<sub>2</sub> flow to approximately 500 ml/min and Air flow to approximately 5 l/min.
5. Test the O<sub>2</sub> alarms:

**WARNING**

If an Airway Module is installed, FiO<sub>2</sub> readings are taken from the module instead of the O<sub>2</sub> sensor in the breathing circuit. When using an Airway Module, a sample line must be connected to the patient circuit for testing the O<sub>2</sub> alarms.

- Set the FiO<sub>2</sub> low alarm limit to 50%. Make sure an FiO<sub>2</sub> low alarm occurs.
- Set the FiO<sub>2</sub> low alarm limit to 21% and make sure that the FiO<sub>2</sub> low alarm cancels.
- Set the FiO<sub>2</sub> high alarm limit to 50%.
- Push the O<sub>2</sub> flush button.
- Make sure the FiO<sub>2</sub> high alarm occurs.
- Set the FiO<sub>2</sub> high alarm limit to 100%. Make sure that the FiO<sub>2</sub> high alarm cancels.

6. Test the MVexp low alarm:
  - Go to the Alarm Setup menu.
  - Set the MV low alarm limit to greater than the measured minute volume.
  - Make sure that a MVexp low alarm occurs.
  - Set the MV low alarm limit to off.
7. Test the Ppeak high alarm:
  - Set the Pmax to less than the peak airway pressure.
  - Make sure that the Ppeak high alarm occurs.
  - Set the Pmax to the desired level.
8. Test the PEEP high. Blockage? alarm:
  - Close the APL valve.
  - Set the Bag/Vent switch to Bag.
  - Block the patient connection and push the O<sub>2</sub> flush button.
  - Make sure that the PEEP high. Blockage? alarm occurs after approximately 15 seconds.
9. Test the Ppeak low. Leak? alarms:
  - Unblock the patient connection.
  - Set the Bag/Vent switch to Vent.
  - Set the tidal volume and total flow to minimum.
  - Other alarms such as MVexp low can occur.
  - Make sure that the Ppeak low. Leak? alarms occur.

10. Set all alarm limits to approved clinical values (normally, user's last settings).

### 13.2.19 System checkout

Perform the **Full Test**. See "3.3.1 Full Test" for detailed checkout procedure.

**WARNING** Do not use a system with a low-pressure leak. Anesthetic gas will go into the atmosphere, not into the breathing circuit.

### 13.2.20 Electrical safety checks

**Note** Perform electrical Safety Tests every time the cover to a machine is removed.

**Note** If tests are conducted with power from an isolated electrical power system, conduct the tests as detailed below. Do not use an electrical jumper plug to defeat the isolation of the power system.

#### Preparation

1. Set the system to STANDBY status.
2. Disconnect all pipeline hoses from the medical gas outlets.
3. Disconnect all electrical monitors and accessories from the unit under test.
4. Plug the unit under test into the safety analyzer. Plug the analyzer into an AC wall outlet.
5. Set the safety analyzer to measure line voltage. Verify normal polarity is indicated.
6. Connect the grounding clip assembly to the safety analyzer.

#### Ground resistance check

1. Use the electrical safety analyzer to measure the resistance between an exposed metal surface and the ground pin on the power cord.
2. The ground resistance must be less than  $0.20 \Omega$ .

#### Chassis leakage current

Connect an approved test device (for example; UL, CSA, or AAMI) and verify that the leakage current is less than:

<b>Voltage</b>	<b>Max. Leakage Current</b>
120/100 Vac	300 $\mu$ Amps
220/240 Vac	500 $\mu$ Amps

### 13.2.21 Final machine checks

1. Disconnect all test devices and reconnect pipeline hoses, monitors and accessories.
2. Verify correct operation of the work lights.
3. Ensure the following:
  - The APL valve is open (minimum setting, fully counterclockwise).
  - All panels and tray tops are attached.
  - The pipeline hoses are connected.
  - If equipped, all cylinder supply readings are at zero.
  - All units are plugged into an appropriate power source.
  - All Vaporizers are locked and in the "OFF" position.
  - Aux O2, if present, is turned to minimum.
4. Place the appropriate labels on the machine advising that routine service has taken place and that the controls have been adjusted.



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