

# Aisys CS<sup>2</sup>

## User's Reference Manual

*Software Revision 10.X*



## User responsibility

Datex-Ohmeda, Inc. a General Electric Company, doing business as GE Healthcare.

This product will perform in conformity with the description thereof contained in this User's Reference manual and accompanying labels and/or inserts, when assembled, operated, maintained, and repaired in accordance with the instruction provided. This Product must be checked periodically. A defective Product should not be used. Parts that are broken, missing, plainly worn, distorted, or contaminated should be replaced immediately. Should repair or replacement become necessary, Datex-Ohmeda recommends that a telephonic or written request for service advice be made to the nearest Datex-Ohmeda Customer Service Center. This Product or any of its parts should not be repaired other than in accordance with written instructions provided by Datex-Ohmeda and by Datex-Ohmeda trained personnel. The Product must not be altered without the prior written approval of Datex-Ohmeda. The user of this Product shall have the sole responsibility for any malfunction which results from improper use, faulty maintenance, improper repair, damage, or alteration by anyone other than Datex-Ohmeda.

### **CAUTION**

U.S. Federal law restricts this device to sale by or on the order of a licensed medical practitioner. Outside the U.S.A., check the local laws for any restriction that may apply.

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## Intended use

The Aisys CS<sup>2</sup> is scalable, flexible, and functionally integrated, featuring the most advanced design, ventilation, respiratory monitoring, and breathing system. Module bays allow for the physical integration of legacy Datex-Ohmeda patient monitors and supports mounting of other GE Healthcare monitors. Optionally, the open architecture design supports mounting of non-Datex-Ohmeda patient monitors, record keeping, and connections to the hospital information system. The INview movable display arm helps keep the anesthetist's focus on the patient by offering control of all hemodynamic, gas delivery, anesthetic agent, and ventilation parameters.

This anesthesia system is designed for mixing and delivering inhalation anesthetics, Air, O<sub>2</sub>, and N<sub>2</sub>O.

The anesthesia system's small breathing system volume allows an anesthetic agent delivery response time of less than 7 seconds. (Agent response time defined as achieving 90% of the setting change measured while in non-circle circuit with a 2 l/min fresh gas flow.)

This anesthesia system uses SmartVent ventilation technology offering Volume Control Ventilation with tidal volume compensation and electronic PEEP. The proven SmartVent technology also features optional Pressure Control Ventilation, Pressure Support Ventilation with an Apnea Backup (PSVPro) that is used for spontaneously breathing patients, Synchronized Intermittent Mandatory Ventilation (SIMV) modes, Pressure Control Ventilation-Volume Guarantee (PCV-VG), Continuous Positive Airway Pressure + Pressure Support Ventilation (CPAP + PSV), and VCV Cardiac Bypass. In Volume Control Ventilation, a patient can be ventilated using a minimal tidal volume of 20 ml. In Pressure Control Ventilation, volumes as low as 5 ml can be measured. These advanced features allow for the ventilation of a broad patient range.

### **WARNING**

This system is not suitable for use in an MRI environment.

## Indications for use

The system is intended to provide general inhalation anesthesia and ventilatory support to a wide range of patients (neonate, pediatric, and adult). The device is intended for volume or pressure control ventilation.

## General information

This anesthesia system uses the Advanced Breathing System (ABS). This integrated breathing system is easy to remove and disassemble and is autoclavable. Its fully integrated design

enhances the system's elegance while minimizing tube connections, minimizing circuit volume, and increasing the work surface area.

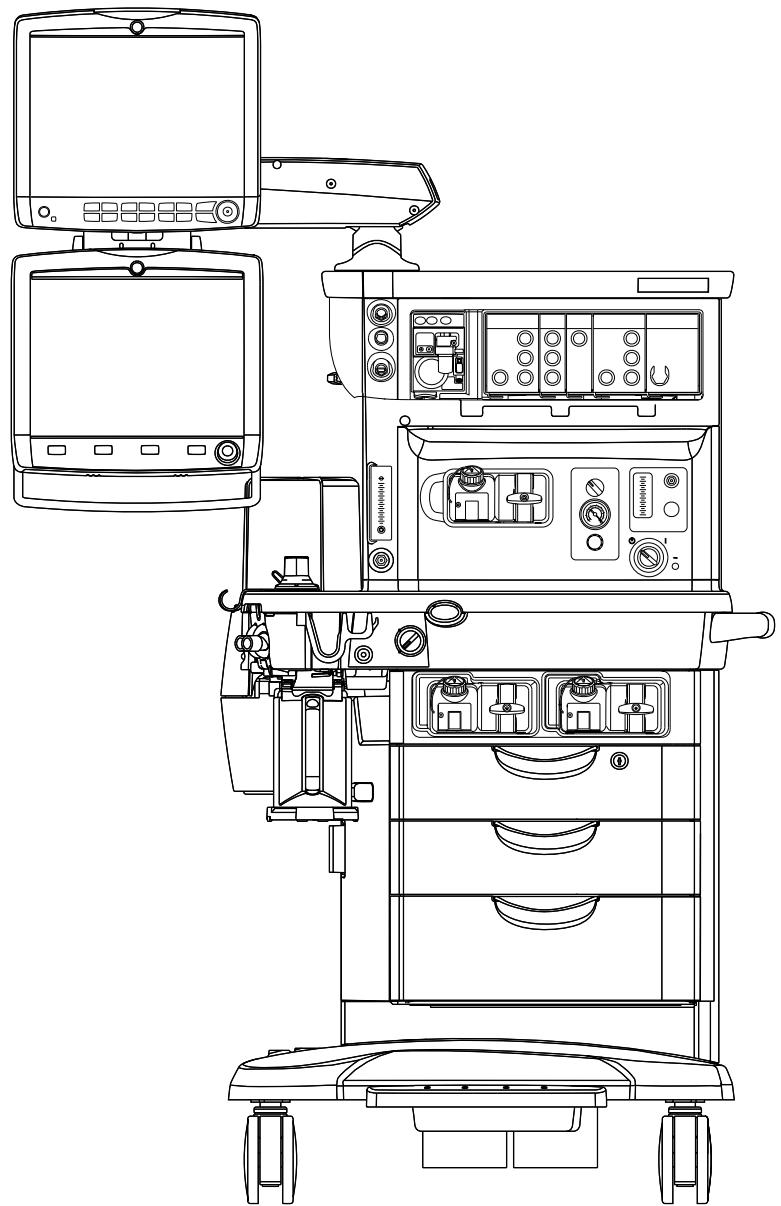
This anesthesia system is designed for expansion and upgrades, so it is easy to add new technologies and ventilation capabilities without investing in a new system.

The anesthesia system is suitable for use in a patient environment. The system must only be operated by personnel trained and qualified in the administration of general anesthesia. The User's Reference manual is intended to provide training on the operation of the system. Operate the system from the front with a clear view of the display. It must be operated according to the instructions in this User's Reference manual. Make sure that all user documents are obtained from the manufacturer.

Refer to the Technical Reference manual for service information including: special installation instructions, installation checklist, means of isolating the supply mains, and replacement of fuses, supply cord, and other parts.

**WARNING** Explosion Hazard. Do not use this system with flammable anesthetic agents.

**Note** Configurations available for this product depend on local market and standards requirements. Illustrations in this manual may not represent all configurations of the product. This manual does not cover the operation of every accessory. Refer to the accessory documentation for further information.



AB.75.253

Figure 1-1 • Front view

## Serial numbers

Datex-Ohmeda products have unit serial numbers with coded logic which indicates a product group code, the year of manufacture, and a sequential unit number for identification. The serial number can be in one of two formats.

AAAX11111	AAAXX11111AA
The X represents an alpha character indicating the year the product was manufactured; H = 2004, J = 2005, etc. I and O are not used.	The XX represents a number indicating the year the product was manufactured; 04 = 2004, 05 = 2005, etc.

## Trademarks

**Aisys, Carestation, Advanced Breathing System, ComWheel, D-fend, EZchange, Disposable Multi Absorber, Reusable Multi Absorber, PSVPro, SmartVent, Easy-Fil, Aladin, and Aladin2** are registered trademarks of Datex-Ohmeda, Inc.

Other brand names or product names used in this manual are trademarks or registered trademarks of their respective holders.

## Symbols used in the manual or on the equipment

Symbols replace words on the equipment, on the display, or in product manuals.

Warnings and Cautions tell you about dangerous conditions that can occur if you do not follow all instructions in this manual.

Warnings tell about a condition that can cause injury to the operator or the patient.

Cautions tell about a condition that can cause damage to the equipment. Read and follow all warnings and cautions.

## Symbols used on the equipment

<b>O2+</b>	O2 Flush button	<b>O2%</b>	O2 cell connection
<b>Air</b>	Air	<b>AIR</b>	Air
<b>≈ cmH<sub>2</sub>O</b>	APL settings are approximate	<b>AGSS</b>	Anesthetic Gas Scavenging System
<b>MAX</b>	Maximum	<b>VACUUM</b>	Vacuum
<b>SN</b>	Serial number	<b>REF</b>	Stock number
<b>EXHAUST</b>	Exhaust	<b>≈ V<sub>T</sub> (mL)</b>	Bellows volumes are approximate
<b>+</b>	Plus, positive polarity	<b>-</b>	Minus, negative polarity
<b>XXX Kg</b>	Maximum mass of configured mobile equipment	<b>Rx ONLY</b>	Caution: federal law prohibits dispensing without prescription.
<b>134 °C</b>	Autoclavable		
	On (power)		Off (power)
	Standby		Interference
	Type BF equipment		Type B equipment
	Dangerous voltage		Frame or chassis ground
	Protective earth ground		Earth ground
	Direct current		Alternating current
	Caution		Refer to instruction manual or booklet (blue background)

	Operating instructions		General warning (yellow background)
	Electrical input/output		Sample gas inlet to scavenging
	Pneumatic inlet		Pneumatic outlet
	Equipotential		Lamp, lighting, illumination
	Variability		Variability in steps
	Suction bottle outlet		Vacuum inlet
	Bag position/manual ventilation		Mechanical ventilation
	Inspiratory flow		Expiratory flow
	Movement in one direction		Movement in two directions
	Lock		Unlock
	Open drain (remove liquid)		Low pressure leak test
	This way up		Not autoclavable
	Read to center of float		EZchange canister (CO2 bypass)
	Systems with this mark agree with the European Council Directive (93/42/EEC) for Medical Devices when they are used as specified in their User's Reference manuals. The xxxx is the certification number of the Notified Body used by Datex-Ohmeda's Quality Systems.		Authorized representative in the European Community
	Date of manufacture		Manufacturer

## Aisys CS<sup>2</sup>

	Indicates that the waste of electrical and electronic equipment must not be disposed as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer for information concerning the decommissioning of equipment.		GOST R Russian certification
	Stepping prohibited		When moving or transporting anesthesia machine, place the display arm and shelf in the transport position as shown.
	Device contains phthalates XXXX indicates phthalate Possible phthalates include: DBP: Di-n-butyl phthalate DNPP: 1,2-Benzenedicarboxylic acid, dipentylester, branched and linear; N-pentyl-isopentylphthalate; Di-n-pentyl phthalate; Diisopentylphthalate BBP: Benzyl butyl phthalate DEHP: Bis(2-ethylhexyl) phthalate; Di-(2-ethylhexyl) phthalate DMEP: Bis(2-methoxyethyl) phthalate DIBP: Dissobutyl phthalate		Single use device
	Union made		Stacking limit by mass
	Keep dry		Do not stack
	Temperature limitation		Fragile, handle with care
	Protect from heat and radioactive sources		Recyclable material
	Humidity limitation		Electrical test certification
	USB port		Network
	Not a USB port		VGA connection
	Serial connection		Pinch hazard



Atmospheric limitation

## Symbols used on the user interface



Lock

Indicates the touchscreen is locked.



Lock/unlock button

Button label to lock or unlock the touchscreen.



O2% indicator on left and balance gas indicator on right. Colors associated with gas settings.



Gas indicator. Color associated with gas settings.



Audio Pause



Submenu



No battery/battery failure



Battery in use. Bar indicates amount of battery power remaining.



Airway module indicator



ACGO active



Drop-down menu



Start/end case



Pediatric



Adult



Lung procedure



Home screen



Timer



Alarm off



Pipeline



Cylinder



Test indicator: red for failure, yellow for conditional outcome, and green for pass.



Alarm low and alarm high limit indicator



Manual ventilation



Enhanced temperature sensing



Agent level sensing supported. Bar indicates amount of agent remaining.



Agent level unknown

## Typeface conventions used

Soft keys and menu items are written in bold italic typeface; for example, ***System Setup***.

Messages that are displayed on the screen are enclosed in single quotes; for example, 'Check sample gas out'.

When referring to different sections and other documents, the names are written in italic typeface and enclosed in double quotes; for example, "*System controls and menus*".

## Abbreviations

Abbreviation	Definition
<b>A</b>	
AA	Anesthetic agent
ABS	Advanced breathing system
ACGO	Auxiliary common gas outlet
AGSS	Anesthesia gas scavenging system
Alt O <sub>2</sub>	Alternate O <sub>2</sub>
APL	Adjustable pressure-limiting
APN	Apnea
ATPD	Ambient temperature and pressure, dry humidity conditions
<b>B</b>	
BTSPS	Body temperature, ambient pressure, saturated humidity conditions
<b>C</b>	
CGO	Common gas outlet
CO	Carbon monoxide
CO <sub>2</sub>	Carbon dioxide
Compl	Compliance
CPAP + PSV	Continuous positive airway pressure + pressure support ventilation
<b>E</b>	
EMC	Electromagnetic Compatibility
ET	End-tidal concentration
EtCO <sub>2</sub>	End-tidal carbon dioxide
EtO <sub>2</sub>	End-tidal oxygen
Exp	Expiratory
<b>F</b>	
FI	Fraction of inspired gas
FiCO <sub>2</sub>	Fraction of inspired carbon dioxide
FiO <sub>2</sub>	Fraction of inspired oxygen
Flow-Vol	Flow-volume loop
<b>I</b>	
I:E	Inspiratory-expiratory ratio
Insp	Inspiratory
Insp Pause	Inspiratory pause time
<b>K</b>	
kg	Kilogram
<b>M</b>	

<b>Abbreviation</b>	<b>Definition</b>
MAC	Minimum alveolar concentration
MV	Minute volume
MVexp	Expired minute volume
MVinsp	Inspired minute volume
<b>N</b>	
N2O	Nitrous oxide
<b>O</b>	
O2	Oxygen
<b>P</b>	
Paw	Airway pressure
PCV	Pressure control ventilation
PCV-VG	Pressure control ventilation - volume guaranteed
PEEP	Positive end expiratory pressure
Paw-Flow	Pressure-flow loop
Pinsp	Inspiratory pressure
Pmax	Maximum pressure
Pmean	Mean pressure
Ppeak	Peak pressure
Pplat	Plateau pressure
Psupport	Support pressure
PSV	Pressure support ventilation
PSVPro	Pressure support ventilation with apnea backup
Paw-Vol	Pressure-volume loop
<b>R</b>	
Raw	Airway resistance
RF	Radio frequency
RR	Respiratory rate
<b>S</b>	
SIMV PCV	Synchronized intermittent mandatory ventilation - pressure control ventilation
SIMV PCV-VG	Synchronized intermittent mandatory ventilation - pressure control ventilation - volume guaranteed
SIMV VCV	Synchronized intermittent mandatory ventilation - volume control ventilation
<b>T</b>	
Texp	Expiratory time
Tinsp	Inspiratory time
Tpause	Time where breath is paused with no flow
TV	Tidal volume
TVexp	Expired tidal volume
TVinsp	Inspired tidal volume
<b>V</b>	

<b>Abbreviation</b>	<b>Definition</b>
VCV	Volume control ventilation
Vol	Volume

## System information

### System classification

This system is classified as follows:

- Class I Equipment.
- Type B Equipment.
- Type BF Equipment (airway modules).
- Ordinary Equipment.
- Not for use with flammable anesthetics.
- Continuous operation.

### Device standards IEC 60601-1:2005

Devices used with this anesthesia system shall comply with the following standards where applicable:

- Breathing system and breathing system components ISO 80601-2-13.
- Anesthetic gas scavenging systems ISO 80601-2-13
- Anesthetic vapor delivery devices ISO 80601-2-13.
- Anesthetic agent monitors ISO 80601-2-55.
- Oxygen monitors ISO 80601-2-55.
- Carbon dioxide monitors ISO 80601-2-55.
- Exhaled volume monitors ISO 80601-2-13.

### Device standards IEC 60601-1:1988

Devices used with this anesthesia system shall comply with the following standards where applicable:

- Breathing system and breathing system components ISO 8835-2.
- Anesthetic gas scavenging systems ISO 8835-3
- Anesthetic vapor delivery devices ISO 8835-4.
- Anesthetic agent monitors ISO21647.
- Oxygen monitors ISO 21647.
- Carbon dioxide monitors ISO 21647.
- Exhaled volume monitors IEC 60601-2-13.

## Integral system components

This anesthesia system contains the following integral components, monitoring devices, alarm systems, and protection devices that comply with European, international, and national standards:

- Breathing system pressure-measuring device.
- Airway pressure-limitation device.
- Exhaled-volume monitor.
- Breathing system integrity alarm.
- Breathing system continuing-pressure alarm.
- O<sub>2</sub> monitor (optional O<sub>2</sub> cell).
- Anesthesia ventilator.
- Breathing system.
- Anesthetic vapor delivery device.

## Not integral system components

These devices are not integral to this anesthesia system:

- CO<sub>2</sub> monitor.
- Anesthetic agent monitor.
- O<sub>2</sub> monitor (when O<sub>2</sub> cell is not installed).
- Suction regulator.
- EZchange canister system.
- Condenser.

When adding devices to the anesthesia system, follow the installation instructions provided by the device manufacturer. Whoever adds individual devices to the anesthesia system shall provide instructions on how to enable the individual devices. For example, a preoperative checklist.

## System accessories

These devices can be used as accessories on this anesthesia system:

- Suction regulator.
- EZchange canister system.
- Condenser.
- Aladin and Aladin2 vaporizer cassettes.

## System safety

### Preparing for use

**WARNING** Read each component's User's Reference manual and understand the following before using this system:

- All system connections.
- All warnings and cautions.
- How to use each system component.
- How to test each system component.
- Before using the system:
  - Complete all of the tests in the "*Preoperative tests*" section.
  - Test all other system components.
  - If a test fails, do not use the equipment. Have an authorized service representative repair the equipment.
- European, international, and national standards require the following monitoring be used with this system:
  - Exhaled volume monitoring.
  - O<sub>2</sub> monitoring.
  - CO<sub>2</sub> monitoring.
  - Anesthetic agent monitoring be used when anesthetic vaporizers are in use.
- Single-use products are not designed or validated to be reused. Reuse may cause a risk of cross-contamination, affect the measurement accuracy, system performance, or cause a malfunction as a result of the product being physically damaged due to cleaning, disinfection, re-sterilization, or reuse.
- Be aware of the risks and precautionary measures related to phthalates. The following types of procedures may increase the risk of exposure to phthalates when a

device containing phthalates is used for treatment of children or treatment of pregnant or nursing women:

- Exchange transfusion in neonates, total parenteral nutrition in neonates, multiple procedures in sick neonates, haemodialysis in peripuberal males, male fetus and male infant of pregnant women, and lactating women; and massive blood infusion into trauma patients. Although these procedures have the potential for increased risk of exposure, conclusive evidence of human health risks has not been established. As a precautionary measure, to reduce the potential for unnecessary exposures to phthalates, the product must be used in accordance with the instructions for use, and practitioners should refrain from using this product beyond the period of time the product is medically necessary or needed.
- Follow hospital procedures for the prevention and treatment of malignant hyperthermia for patients sensitive to inhalation anesthetic agents.
- Risk of fire. Limit the use of supplemental oxygen concentrations to less than 30 percent when using a heat source or device that may lead to combustion. Consult facility risk management procedures to minimize the risk of fire if an oxygen concentration of more than 30 percent is required for any reason.
- This system is not intended for use where the surrounding oxygen concentration is in excess of 25 percent. Increased oxygen concentrations can result in an increased risk of fire.

See "Device standards IEC 60601-1 2005" and "*Integral system components*" for information regarding monitoring built into this device.

## Inspecting the system

Before using the system, make sure that:

- The equipment is not damaged.
- Components are correctly attached.
- The breathing circuit is correctly connected and not damaged.
- The breathing system is correctly assembled and contains sufficient absorbent. Refer to the "Cleaning and Sterilization" manual for breathing system assembly instructions.
- The Aladin cassette is locked in position and contains sufficient agent.

- Pipeline gas supplies are connected and the pressures are correct.
- Cylinder valves are closed.
- Models with cylinder supplies have a cylinder wrench attached to the system.
- Models with cylinder supplies have a reserve supply of O<sub>2</sub> connected to the machine during system checkout.
- The necessary emergency equipment is available and in good condition.
- Equipment for airway maintenance, manual ventilation, tracheal intubation, and IV administration is available and in good condition. In the case of system failure, the lack of immediate access to alternative means of ventilation can result in patient injury.
- Applicable anesthetic and emergency drugs are available.
- Check that the brake is set to prevent movement.
- The power cord is connected to an electrical outlet. The mains indicator comes on when AC power is connected. If the indicator is not on, the system does not have mains (electrical) power. Use a different outlet, close the circuit breaker, or replace or connect the power cable.
- If an optional suction regulator is present, ensure there is adequate suction.
- If an optional O<sub>2</sub> flowmeter is present, ensure there is adequate flow.

## Electrical safety

Do not connect non-medical electrical equipment directly to the AC outlet at the wall instead of an AC power source which uses a separating transformer. Doing so may increase enclosure leakage current above levels allowed by IEC 60601-1 in normal conditions and under single-fault conditions. This may cause an unsafe electrical shock to the patient or operator.

After connecting anything to these outlets, conduct a complete system leakage current test (according to IEC 60601-1).

### **WARNING**

The system provides connections for items such as printers, visual displays and hospital information networks (only connect items that are intended to be part of the system). When these items (non-medical equipment) are combined with the system, these precautions must be followed:

- Do not place items not approved to IEC 60601-1 closer than 1.5 m to the patient.
- All items (medical electrical equipment or non-medical electrical equipment) connected to the system by a signal input/signal output cable must be

supplied from an AC power source which uses a separating transformer (in accordance with IEC 60989) or be provided with an additional protective earth conductor.

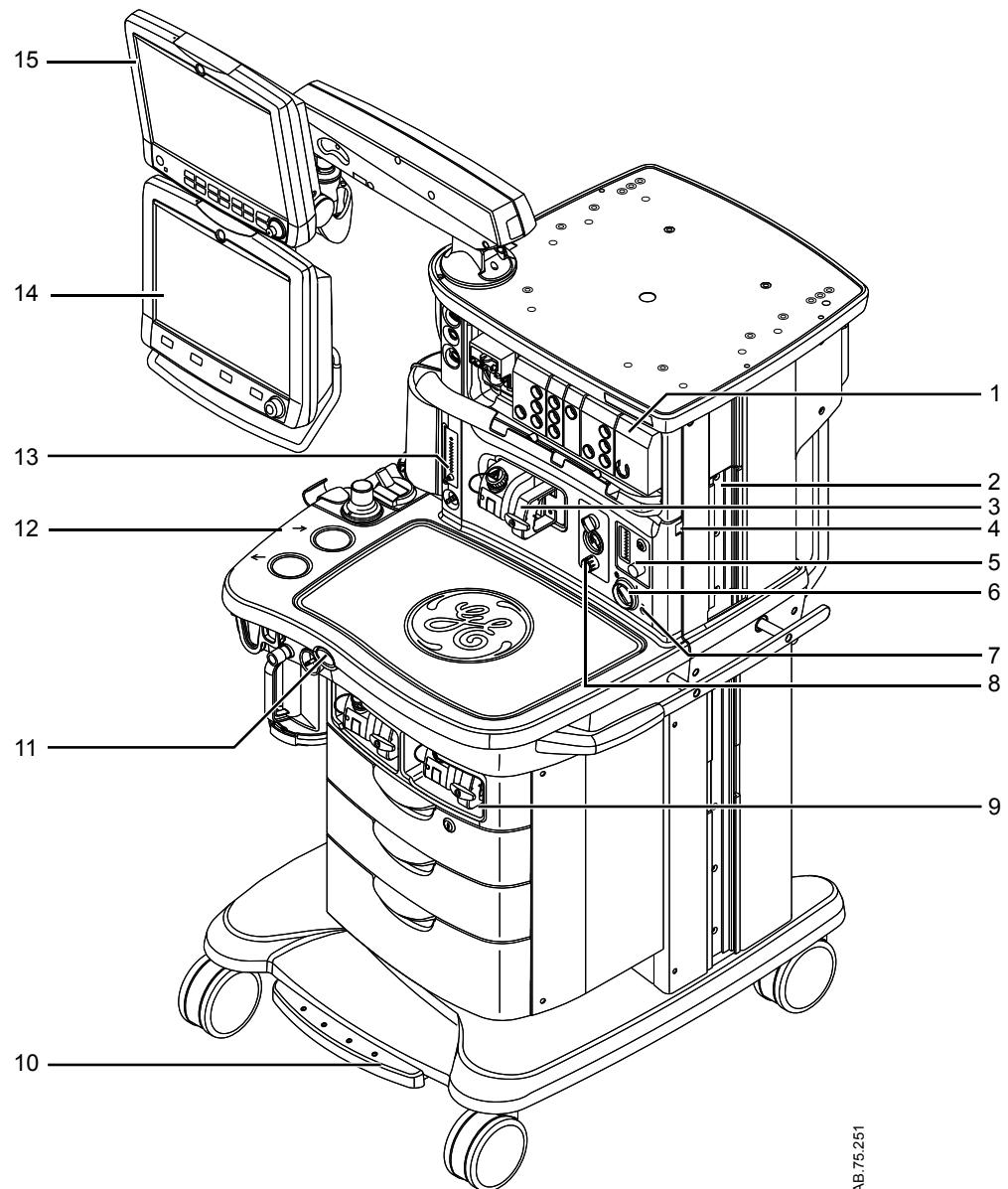
- If a portable multiple socket outlet assembly is used as an AC power source, it must comply with IEC 60601-1-1. The assembly must not be placed on the floor. Using more than one portable multiple socket outlet assembly is not recommended. Using an extension cord is not recommended.
- An operator of the medical electrical system must not touch non-medical electrical equipment and the patient simultaneously. This may cause an unsafe electrical shock to the patient.
- Use of portable phones or other radio frequency (RF) emitting equipment (that exceed electromagnetic interference levels specified in IEC 60601-1-2) near the system may cause unexpected or adverse operation. Monitor operation when RF emitters are in the vicinity.
- Use of other electrical equipment on or near this system may cause interference. Verify normal operation of equipment in the system before use on patients.



## **2 System controls and menus**

<b>In this section</b>	
System overview.	2-2
Advanced breathing system components.	2-6
Aladin cassette controls.	2-8
Display controls.	2-9
Anesthesia system display.	2-12
Display navigation.	2-15

## System overview



- 1. Patient monitoring modules
- 2. Dovetail
- 3. Aladin cassette and active bay
- 4. Light switch
- 5. Alternate O2 control
- 6. System switch
- 7. Mains indicator
- 8. Integrated suction
- 9. Aladin cassette storage bay
- 10. Brake
- 11. O2 flush button
- 12. Advanced breathing system
- 13. Auxiliary O2 flow control
- 14. Anesthesia display
- 15. Patient monitoring display

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Figure 2-1 • Front view

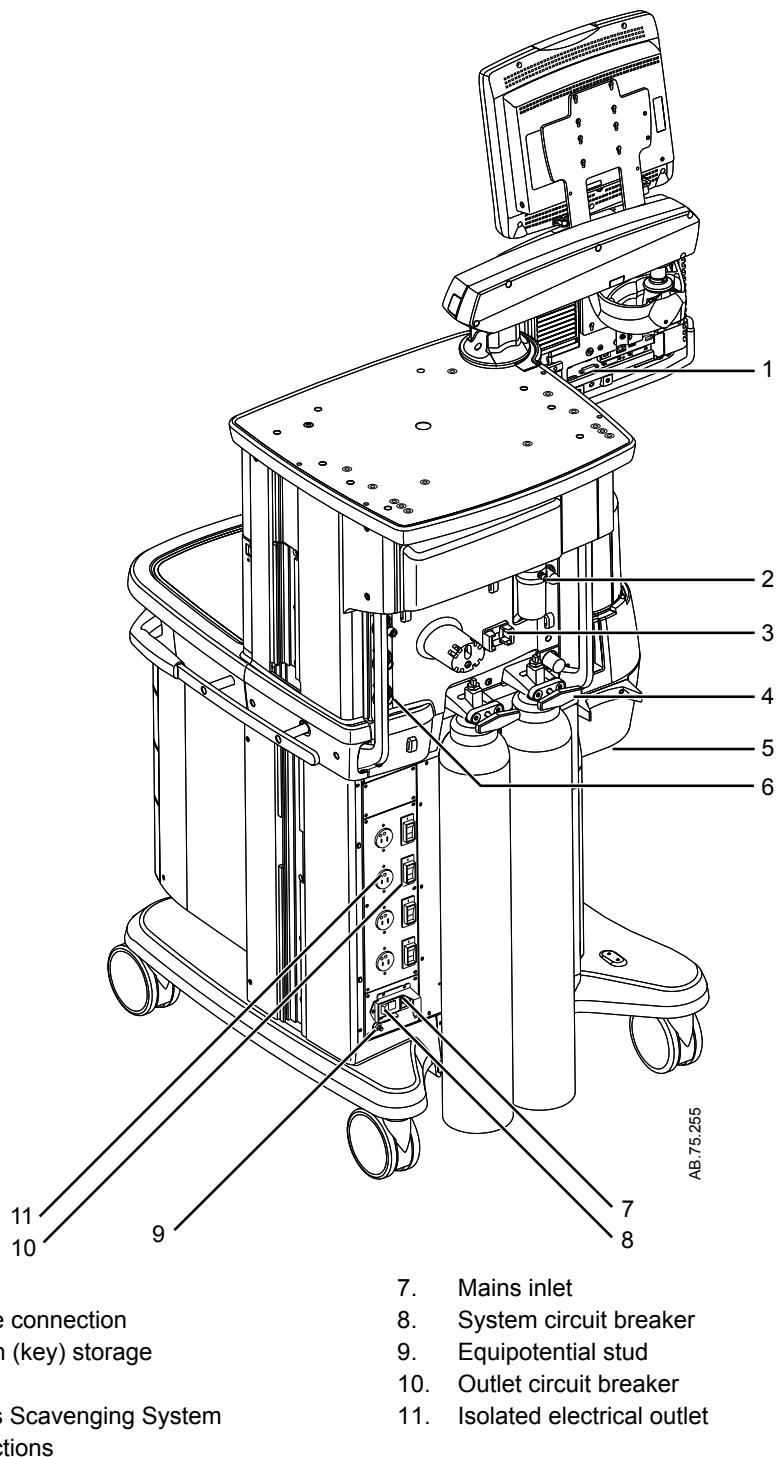


Figure 2-2 • Rear view

## Using the brake

The central brake holds the system in place.

**WARNING** Do not use the brake while moving the anesthesia system. This could cause the machine to tip over. Only use the brake to keep the system in place.



1. Push down on the brake pedal to lock the system in place.
2. Lift up on the brake pedal to release the brake.

## Using the O2 flush button

The O2 flush button supplies a high flow of O2 to the breathing system.

1. Push the O2 flush button to deliver a high flow of O2.
2. Release the O2 flush button to stop the delivery of a high flow of O2.

## Positioning the display

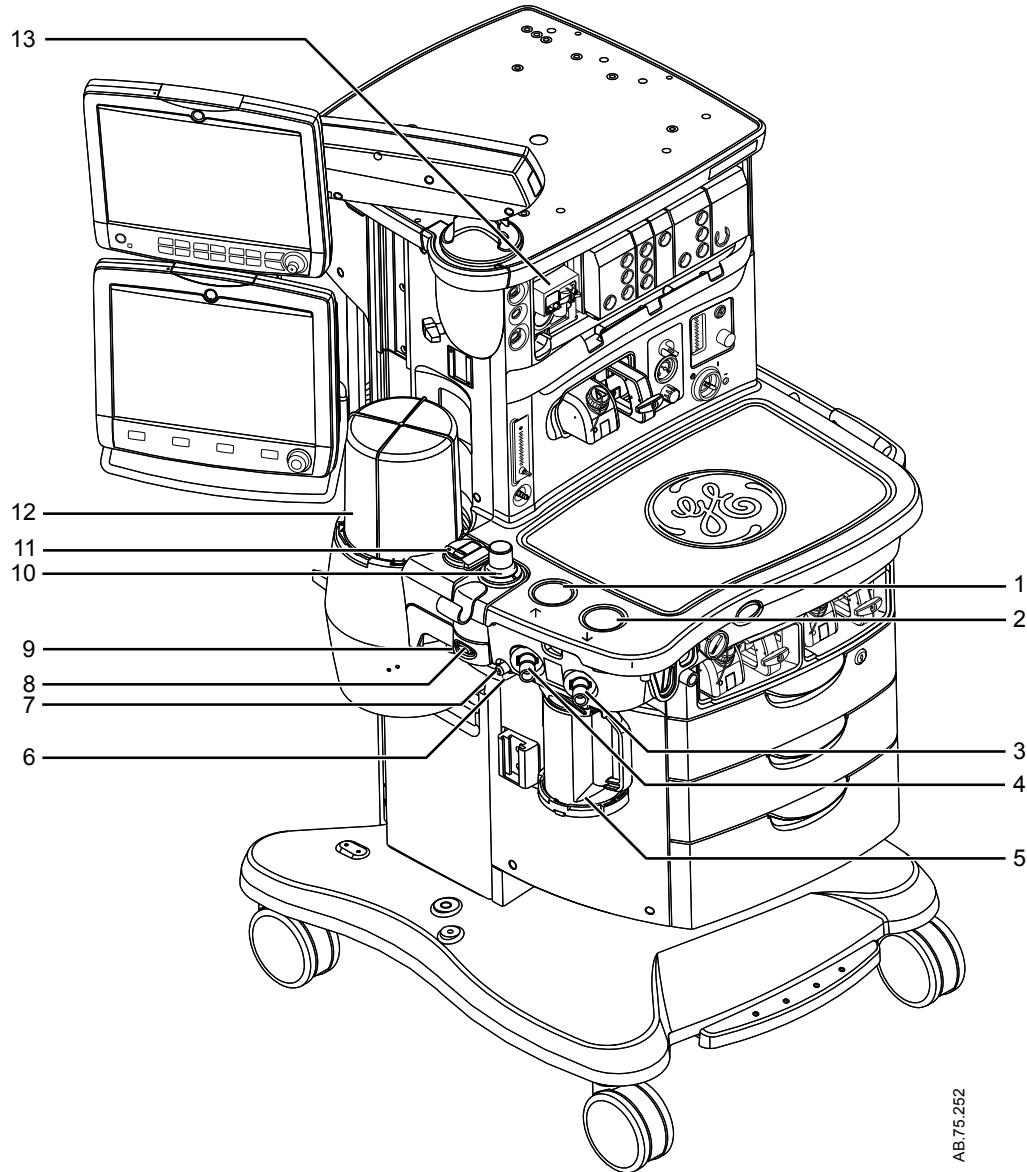
The display can be moved for optimal viewing.

1. Unlock the display arm.
2. Raise or lower the display arm to adjust the height of the display.
3. Lock the display arm.
4. Rotate the display arm toward or away from the system to adjust the horizontal position of the display.
5. Tilt the display up or down to adjust the vertical angle of the display.

## 2 System controls and menus

6. Tilt the display left or right to adjust the horizontal angle of the display.

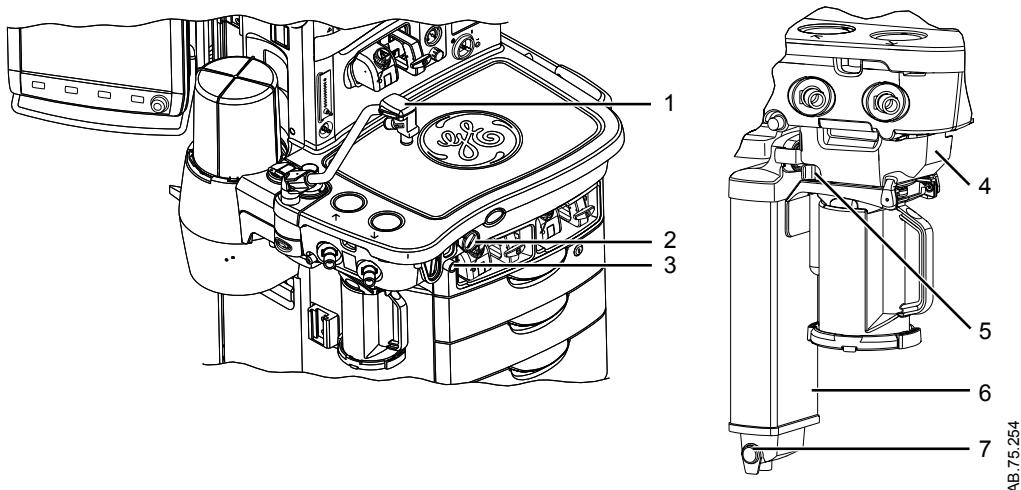
## Advanced breathing system components



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1. Expiratory check valve
2. Inspiratory check valve
3. Inspiratory flow sensor
4. Expiratory flow sensor
5. Absorber canister
6. Absorber canister release
7. Leak test plug
8. Breathing system release
9. Manual bag port
10. Adjustable pressure-limiting (APL) valve
11. Bag/Vent switch
12. Bellows assembly
13. Airway module

Figure 2-3 • Advanced breathing system

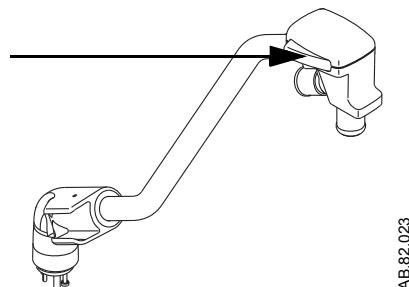


1. Bag support arm
2. Auxiliary Common Gas Outlet (ACGO) switch
3. ACGO port
4. EZchange canister module (CO2 bypass)
5. Ezchange canister release
6. Condenser
7. Condenser drain button

*Figure 2-4 • Breathing system options*

## Using the bag support arm

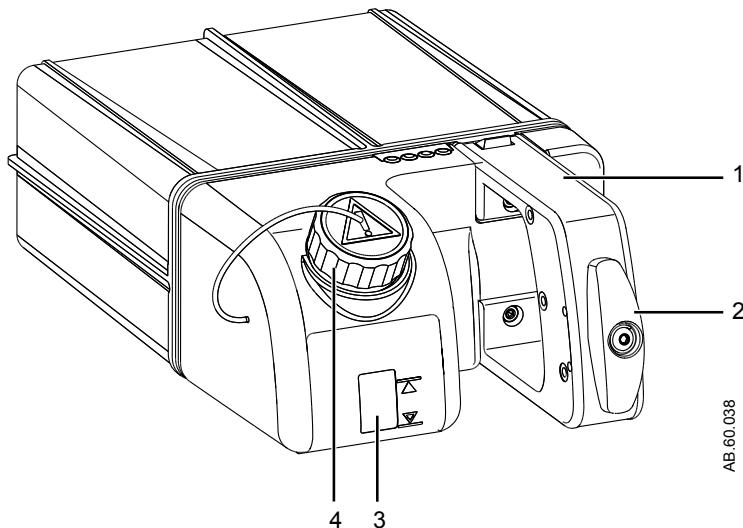
Use the optional bag support arm to hold the breathing circuit bag.



1. To raise the bag support arm, squeeze the button and rotate the arm up the top position.
2. To lower the bag support arm, squeeze the button and rotate the arm down to the lower position.

## Aladin cassette controls

The electronically controlled vaporizer consists of the internal electronic control unit and the Aladin agent cassette. See the "Vaporizer" section for more information.



1. Handle with release trigger
2. Lock
3. Liquid level indicator
4. Agent filling port

*Figure 2-5 • Aladin2 cassette*

## Display controls

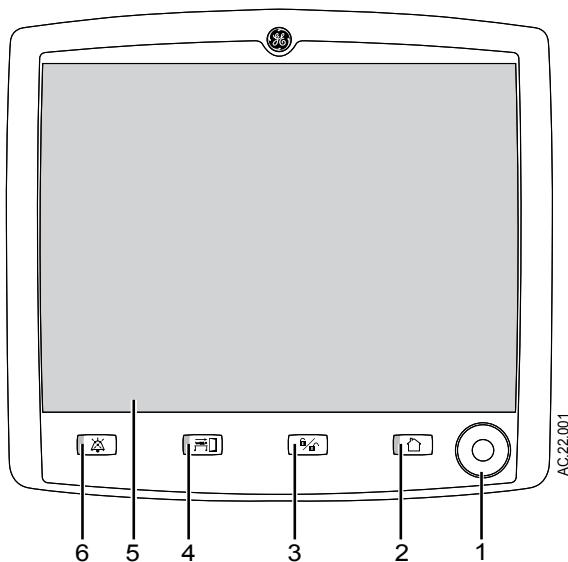
The system uses touchscreen technology, hard keys, and a ComWheel to access system functions, menus, and settings.

The touchscreen has numerous touch point areas that make accessing menus and settings quick and easy. The buttons on the right side of the screen provide direct access to commonly used functions. The ventilation quick keys enable setup of ventilation modes. The gas control quick keys provide a method to set up the gas used for a case.

Touch only one touch point at a time to ensure the correct selection is made.

**WARNING** Liquids on the display may degrade the performance of the touchscreen. If liquids come in contact with the display, lock the touchscreen and clean the display. Unlock the touchscreen once the display has been cleaned to resume use of the touchscreen.

**CAUTION** Do not apply excessive force to the touchscreen as damage may occur.



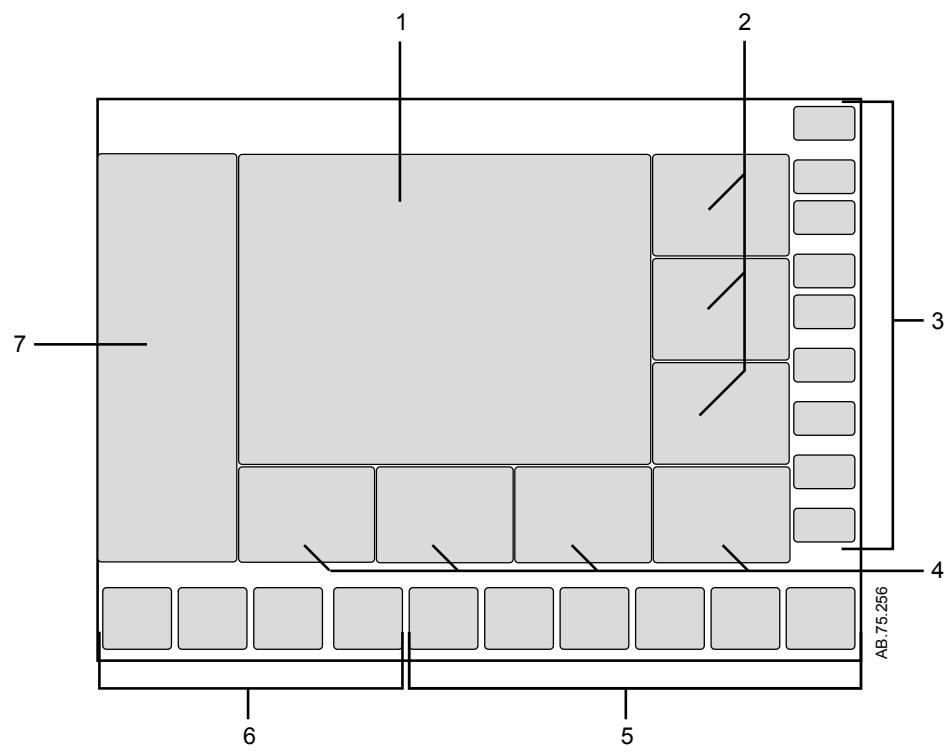
1. ComWheel Selects a menu item or confirms a setting. Turn clockwise or counterclockwise to scroll through menu items or change settings.
2. Home key Removes all menus from the screen.
3. Screen Lock/Unlock Locks the touchscreen. Toggles between lock and unlock functions.
4. Start/End Case key Initiates Start or End Case function.
5. Touchscreen Activates functions when touch areas on the screen are selected.

## Aisys CS<sup>2</sup>

6. Audio Pause key Stops audio for 120 seconds for any active, eligible high and medium priority alarms. Prevents audio (audio off) for 90 seconds when no medium or high priority alarms are active. Allows the operator to acknowledge any non-active medium or high priority latched alarms.

Figure 2-6 • Display controls

## Touch points



- |                    |                          |
|--------------------|--------------------------|
| 1. Wave fields     | 5. Ventilator quick keys |
| 2. Measured values | 6. Gas quick keys        |
| 3. Function keys   | 7. Split screen values   |
| 4. Digit fields    |                          |

Figure 2-7 • Normal/Full screen view with shaded touch point areas

## Measured value touch points

Touching measured values provides access to the **Alarm Setup** menu and alarm limits.

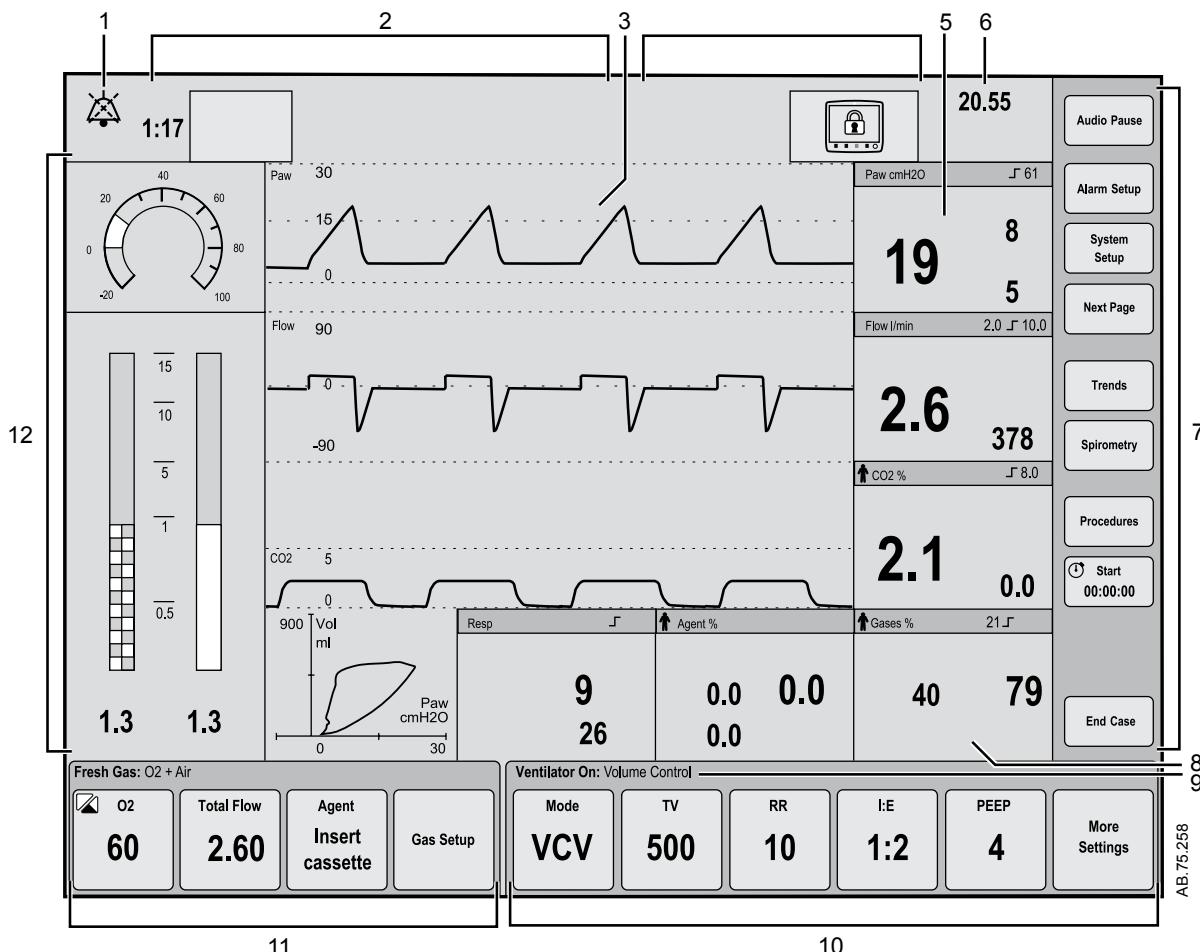
1. Touch the measured value to access the **Alarm Setup** menu.
2. The **Alarm Setup** menu displays.
3. Select the alarm limit and set it to the correct value. Touch the value on the touchscreen or push the ComWheel to confirm the desired setting.
4. Push the Home key, touch the waveform area of the display, or select **Close** to close the menu.

## Active alarm touch points

When an alarm sounds the alarm message is displayed at the top of the screen and, if applicable, the alarming numeric field and digit field flashes. The Alarm messages at the top of the screen are message alerts only and not active touch points.

1. Touch the flashing numeric field to access the **Alarm Setup** menu and alarm limits for the active alarm.
2. The **Alarm Setup** menu displays with the active alarm limit highlighted. For example: If the 'Ppeak high' alarm activates, the high alarm limit setting for Ppeak displays with the highlight.
3. Select the active alarm limit and change it to the desired setting.

## Anesthesia system display



1. Audio pause symbol and countdown clock
  2. Alarm message fields
  3. Waveform fields
  4. General message fields or lock touchscreen indicator
  5. Measured values fields
  6. Clock
  7. Function keys
  8. Digit fields
  9. Ventilation mode
  10. Ventilator quick keys
- Indicates when alarm audio is paused and the countdown clock until audio is on.
- Displays the active alarms.
- Displays the waveforms of measured values. For example: Paw, Flow, and CO<sub>2</sub>.
- Displays general messages and the touchscreen lock indicator.
- Displays the measured values. For example: Paw, Flow, and CO<sub>2</sub>.
- Displays the current time.
- Functions available are: Audio Pause, Alarm Setup, Alarms On/Off, Auto Limits, System Setup, Next Page, Trends, Spirometry, Procedures, Timer, Start, and End Case.
- Contains information for Spirometry, Resp, Agent, and Gases.
- Displays the selected ventilation mode. For example: Ventilator On, and Volume Control.
- Displays Mode, associated ventilation parameters, and More Settings. For example: Mode, TV, RR, I:E, PEEP, and More Settings.

- 11. Gas quick keys      Displays O2, Total Flow, and Gas Setup.
- 12. Split screen      Contains airway pressure, gas flow values, compliance, trends, and optional ecoFLOW information.

Figure 2-8 • Typical Normal/Full view

## Digit fields

The digit field can be set to show specific information such as gas types, gas supply, flow, agent, respiration, and spirometry loops. If the digit field is set to show agent and no airway module is inserted, the area is blank.

Paw, O2, and either TVexp or CO2 must show on the display during a case. If any of these parameters are not selected to show on the display, the right most digit field information is replaced with the missing parameter.

See "Screen setup menu" in the "Operation" section for more information.

## Waveform fields

Up to three waveforms can be shown on the normal screen view. Each waveform can be set to show specific Paw, agent, flow, or CO2 data. The corresponding numeric information shows in the measured values field to the right of the waveform. If the waveform is set to show the agent and no airway module is inserted, that waveform and numeric area is blank.

When one waveform is turned off, that waveform and the corresponding numerics information are removed from the normal screen view. The remaining waveforms and numerics increase in size to fill the waveform area. When two waveforms are turned off, those waveforms and the corresponding numerics information are removed from the normal screen view. The remaining waveform is centered in the waveform area.

When in a case, touch the waveform field area to close the menu.

See "Screen setup menu" in the "Operation" section for more information.

## Split screen field

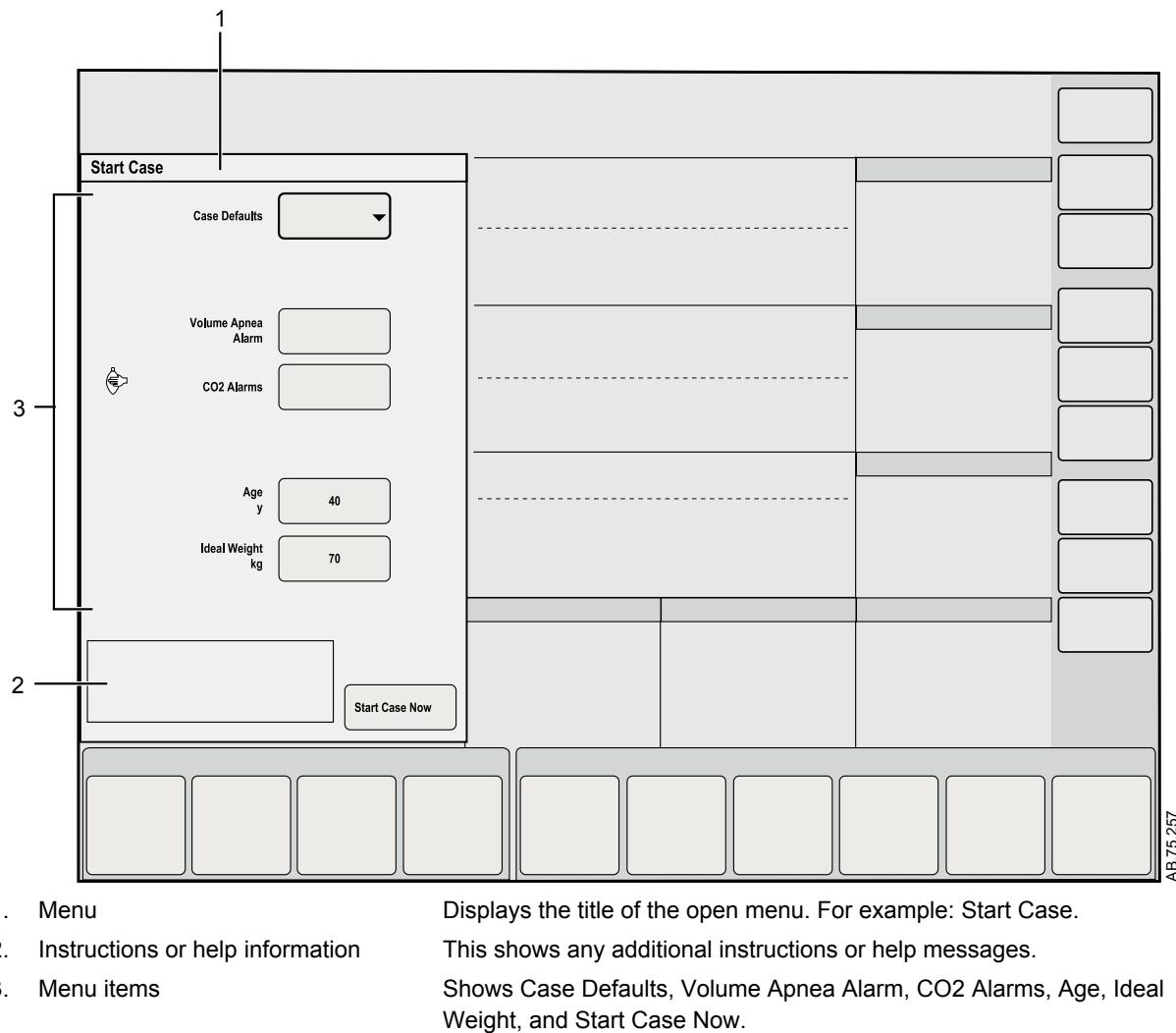
The split screen field can be set to show gas metabolics, trends, spirometry loops, Paw gauge, airway compliance, and optional ecoFLOW information. If **None** is selected, the waveforms expand to fill the split screen area.

Touch the split screen field to directly open the **Screen Setup** menu.

See "*Screen setup menu*" in the "*Operation*" section for more information.

## Display navigation

Use the touchscreen and ComWheel to navigate the display.



*Figure 2-9 • Menu view and menu example*

## Using menus

Use the function keys to access the corresponding menus. When a menu is selected, the menu field overlays the normal view and the waveform fields start at the right edge of the menu.

1. Select the menu key to access the corresponding menu.

2. Select a menu item to choose the item, or turn the ComWheel left or right to highlight a menu item and then push to confirm.
3. If the menu item selected is an adjustment, turn the ComWheel left or right to make the setting and then push to confirm.  
If the menu item has a drop-down list, select the desired value from the list by touching the item.
4. Select **Close**, touch the waveform area, or push the Home key to exit the menu.

## Using the ComWheel

Use the ComWheel to scroll through the quick key settings and function keys, make selections, change settings, and confirm settings.

- Push the ComWheel to make a selection.
- Turn the ComWheel to the right.  
For menu items, the highlight moves down.  
For quick keys, the highlight moves to the next key on the right.  
For settings, the value changes to the next available setting.  
For pull-down selections, the highlight moves to the next available selection.
- Turn the ComWheel to the left.  
For menu items, the highlight moves up.  
For quick keys, the highlight moves to the next key on the left.  
For settings, the value changes to the previous available setting.  
For pull-down selections, the highlight moves to the previous available selection.
- Push the ComWheel to confirm a setting.

## Using quick keys

The gas settings and the main ventilator settings for each ventilation mode can be changed using the quick keys.

1. Select a quick key to open the menu or select a parameter.
2. If **Gas Setup**, **Mode**, or **More Settings** is selected, a menu displays. Select the desired value on the menu by touching the value.  
If any other quick key is selected, the value displays with a highlight. Turn the ComWheel left or right to set the desired value.
3. Push the ComWheel or select the quick key to confirm the change.

# 3 Operation

<b>In this section</b>	
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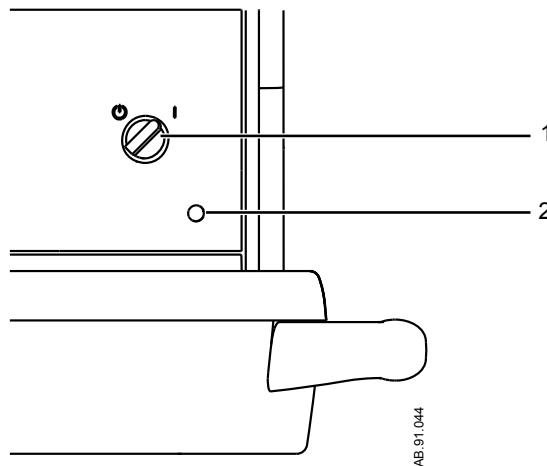
## System operation safety

**WARNING** Do not use antistatic or electrically-conductive breathing tubes or masks. They can cause burns if used near high-frequency surgical equipment.

- Explosion Hazard. Do not use this system with flammable anesthetic agents.
- Ventilator alarms indicate potential hazard conditions. Investigate all alarms that occur to help ensure adequate patient safety.
- If an alarm occurs, safeguard the patient first before performing troubleshooting or doing repair procedures. Failure to safeguard the patient could result in patient injury.
- Make sure that the patient breathing circuit is correctly assembled and that the ventilator settings are clinically appropriate before starting ventilation. Incorrect breathing circuit assembly and incorrect ventilator settings can injure the patient.
- Make sure that the breathing circuit is correctly connected and not damaged. Replace the breathing circuit if it is damaged.
- Maintain sufficient fresh gas flow when using sevoflurane.
- Desiccated (dehydrated) absorbent material may produce dangerous chemical reactions when exposed to inhalation anesthetics. Adequate precautions should be taken to ensure that absorbent does not dry out. Turn off all gases when finished using the system.
- Do not leave gas cylinder valves open if the pipeline supply is in use. Cylinder supplies could be depleted, leaving insufficient reserve supply in case of pipeline failure.
- Unplug the system power cord to run the system on the battery power if the integrity of the protective earth conductor is in doubt.
- The top shelf weight limit is 45 kg (100 lb).
- Do not subject the system to excessive shock and vibration. Equipment damage could occur.
- Do not place excessive weight on flat surfaces or drawers. Equipment damage could occur.

## Turning on the system

1. Plug the power cord into an electrical outlet. Make sure the system circuit breaker is on.
  - The mains indicator is lit when AC power is connected.
  - Battery is charging if it is not already fully charged.



1. System switch
2. Mains indicator

*Figure 3-1 • Mains indicator and system switch*

2. Check that the breathing system is properly connected.

**CAUTION** Do not turn on the system with the right-hand (inspiratory) port plugged.

3. Turn the System switch to On.  
The display shows the power-up screen.  
The system does a series of automated self tests.
4. Perform a **Full Test** before the first case of the day.
5. Perform a preoperative checkout before each case. See the "Preoperative checkout" section.

**Note** The system must perform a power-up self test after 12 hours of remaining on. If the system has been on longer than 12 hours without a power-up self test, the 'Turn power Off and On for self tests' alarm occurs. Turn the power off and then back on between cases to resolve the alarm.

## Start a case

Use the **Start Case** menu to set the case data and to start the gas flow.

A case can be started using default settings or using custom settings. The default settings are configured by the Super User. See the "Super user mode" section for information on the **Start Case** menu defaults.

Default Settings selection shows the first of five default case types when the **Start Case** menu is accessed. Four of the default case types are configured by the Super User. The fifth default case is Last Case.

The **Ideal Weight**, **Age**, and **Volume Apnea Alarm** values are set to the pre-selected settings defined by the Super User corresponding to the case type.

**WARNING** Make sure that the patient breathing circuit is correctly assembled and that the ventilator settings are clinically appropriate before starting ventilation. Incorrect breathing circuit assembly and incorrect ventilator settings can injure the patient.

- Make sure that the preset alarm limits are appropriate for the patient before starting ventilation. Incorrect alarm settings can injure the patient.

**Note** **Volume Apnea Alarm** is not shown on the **Start Case** menu when the **Volume Apnea Selection** is set to **Disable** in the Super User settings.

**Note** The **TV for Ideal Body Weight** menu item from the **Patient Demographics** menu can only be accessed when the ventilation mode is set to **VCV**, **PCV-VG**, **SIMV VCV**, and **SIMV PCV-VG**. Use this setting for breath rate and tidal volume calculations based on the set patient weight.

## Minimum Alveolar Concentration

The adjusted Minimum Alveolar Concentration (MAC) is calculated based on the patient age entered in the **Start Case** menu or the **Patient Demographics** menu. The default patient age of the selected case type is used if no patient age value is entered.

The MAC value is calculated from the exhaled gas concentration and the related affects based on the age of the patient. Typically, younger patients have better liver function and can clear a drug faster, resulting in a higher MAC value. The MAC calculation used is based on the Eger formula. When two agents are detected, the MAC values of each agent are added together. The MAC value range is 0.0 to 9.9.

The adjusted MAC value shows on several areas of the screen including in the mini-trend, agent waveform numeric information, agent digit field, and graphical trends page.

## Starting a case using default settings

Start a case using the default settings by case type defined by the Super User.

Case Defaults contain five case type selections. Each case type has preset values for **Ideal Weight**, **Age**, and **Volume Apnea Alarm**. The first four default case types are configured and named by the Super User. The fifth default case is Last Case.

1. Set the Bag/Vent switch to Bag.
2. Select **Start Case**.

The **Case Defaults** selection shows the first preset case type. **Ideal Weight**, **Age**, **CO2 Alarms**, and **Volume Apnea Alarm** show the default settings that correspond to the case type shown.

3. Verify or change the **Case Defaults** selected.
4. Verify the settings are clinically appropriate.
5. Select **Start Case Now**. Gas flow starts.

## Starting a case using custom settings

**Ideal Weight**, **Age**, **CO2 Alarms**, and **Volume Apnea Alarm** can be custom set on the **Start Case** menu before starting a case. Additional ventilator settings, ventilation mode, alarm settings, and gas settings can be custom set through the **Vent Mode** menu and other ventilation quick keys, **Alarm Setup** menu, **Gas Setup** menu.

1. Set the Bag/Vent switch to Bag.
2. Select **Start Case**.

The **Case Defaults** selection shows the first preset case type. **Ideal Weight**, **Age**, **CO2 Alarms**, and **Volume Apnea Alarm** show the default settings that correspond to the case type shown.

3. Change **Ideal Weight**, **Age**, or **Volume Apnea Alarm** settings on the menu.

The **Case Defaults** changes from the case name to Preset. If the **CO2 Alarms** setting on the menu is changed, the **Case Defaults** remains as previously selected.

4. To change ventilation mode, select **Mode**. Make the change. To change the ventilation settings, select a ventilator quick key or **More Settings**. Make the change.
5. To change alarm settings, select **Alarm Setup**. Make the change.
6. To change the gas settings or the circuit type, select **Gas Setup**. Make the change.
7. From the **Start Case** menu, select **Start Case Now**. Gas flow starts.

See the "Ventilator setup" section for information on the **Vent Mode** menu.

See the "Gas setup" section for information on the **Gas Setup** menu.

See the "Alarm setup" section for information on the **Alarm Setup** menu.

## End a case

Use the **End Case** menu to stop gas flow and end the patient alarms.

1. Set the Bag/Vent switch to Bag.
2. Select **End Case**.
3. Select **End Case Now** on the menu to put the system in standby (stops the gas flow and patient alarms). The **End Case** menu shows the gas and agent usage for the case.

## Turning off the system

1. Perform the "*End a case*" procedure, if appropriate.
2. Turn the System switch to Standby.
3. Turn the suction switch (optional) to the off position.
4. Rotate the Auxiliary O<sub>2</sub> knob fully clockwise to turn off the flow.
5. Disconnect or turn off any scavenging.

## Ventilator setup

Use the **Vent Mode** menu to set the ventilation mode. Use ventilator quick keys and **More Settings** to change ventilator settings.

- WARNING** Most anesthetic agents will cause patients to have reduced ventilatory responses to carbon dioxide and to hypoxemia. Therefore, triggered modes of ventilation may not produce adequate ventilation.
- The use of neuromuscular blocking agents will reduce the patient's breathing response, which will interfere with triggering.
- Important** See the "*Specifications and theory of operation*" section for more information on ventilation modes.

### Changing ventilator mode

1. Select the **Mode** quick key. The **Vent Mode** menu shows.
  2. Select the desired ventilation mode.
  3. Set and confirm the primary ventilation setting to activate the ventilation mode.
- Controls that are frequently used in the ventilation mode can be adjusted with the ventilator quick keys and the **More Settings** quick key.

### Changing ventilator settings

Change the ventilator settings for the ventilation mode when a case is running.

1. Select the ventilation setting to be adjusted. Set the desired value.
2. Push the ComWheel to activate the change.

### Optional ventilator procedures

See "*Procedures*" for more information on **Vital Capacity** and **Cycling** procedures.

## Auto limits

Use the ***Auto Limits*** menu to quickly set alarm ranges for 'MV', 'TV', and 'EtCO<sub>2</sub>' during mechanical ventilation.

### Setting auto limits

1. Select ***Auto Limits***.

The menu shows the current measured values and the proposed low and high alarm limits.

2. Check the proposed parameters.

- Select ***Confirm*** to use the proposed low and high alarm limits.
- Select ***Cancel*** to leave the alarm limits unchanged.
- Select ***Case Default Limits*** to set the alarm limits to the case default limits.

**Note** The proposed low and high alarm limits are shown in highlighted text. The alarm limits that are not highlighted do not change.

## Gas setup

Use the **Gas Setup** menu to adjust the Agent, O2% and total flow, to change the balance gas, and to change the circuit type.

### Changing gas settings

1. Select the **Gas Setup** quick key.
2. Select the setting to change from the **Gas Setup** menu.
3. Change the setting.
4. For **Circuit**, select the menu item and change using the drop-down menu. Select **Confirm**.
5. For **Other Gas**, select the menu item and change using the drop-down menu.
6. For **Agent**, **O2%**, and **Total Flow**, select the setting and make the change using the ComWheel and push to confirm the setting.

### Changing balance gas

1. Select the **Gas Setup** quick key.
2. Select the **Other Gas** menu item.
3. Select the balance gas to use with O2.

### Changing circuit type

1. Select the **Gas Setup** quick key.
2. Select **Circle** or **Non-Circle**
3. Select **Confirm**.

## Using the circle circuit

Use the circle circuit mode to combine fresh gas with recirculated gas from the CO<sub>2</sub> absorber. The combined gas flows out through the inspiratory port. Patient gas is returned to the system through the expiratory port.

Mechanical ventilation and tidal volume monitoring are available when using the circle circuit.

O<sub>2</sub> monitoring of fresh gas is available automatically when using the circle circuit if the system has the airway module option or the O<sub>2</sub> cell monitoring option. Systems with both an airway module and an O<sub>2</sub> cell will display the O<sub>2</sub> values obtained from the airway module.

1. Select the **Gas Setup** quick key.
2. Select **Circle**.  
Fresh gas oxygen concentration is displayed on the screen.  
Fresh gas flow combines with the exhaled gas and exits out through the inspiratory port.
3. Set the alarm limits to clinically appropriate settings.

## Using the non-circle circuit

Use the non-circle circuit mode to divert fresh gas around the inspiratory check valve and out through the inspiratory port. This fresh gas source may be used with circuits that do not have CO<sub>2</sub> absorbent capability (for example, Mapleson variants). Mechanical ventilation is not available when using the non-circle circuit. Tidal volume monitoring is not available when using the non-circle circuit.

O<sub>2</sub> monitoring of fresh gas is available automatically when using the non-circle circuit if the system has the airway module option or the O<sub>2</sub> cell monitoring option. Systems with both an airway module and an O<sub>2</sub> cell will display the O<sub>2</sub> values obtained from the airway module.

### **WARNING**

Do not use an external ventilator when using the non-circle circuit. Do not use the non-circle circuit to drive external ventilators or for jet ventilation.

- The maximum pressure at the non-circle circuit can be up to 27 kPa (4 psi). Use a breathing circuit with a pressure limiting device to limit the pressure at the patient connection port, during normal and single-fault conditions, to less than 12.5 kPa (125 cmH<sub>2</sub>O) or to the maximum pressure required by local standards.

1. Select the **Gas Setup** quick key.

2. Select **Non-Circle**.

Fresh gas oxygen concentration is displayed on the screen.

Fresh gas flow is diverted around the inspiratory check valve and out through the inspiratory port.

3. Set the alarm limits to clinically appropriate settings.

## System setup

Use **System Setup** to access menus and settings for **Patient Demographics**, **Screen Setup**, **Fresh Gas Usage**, **System Status**, **Calibration**, and **Checkout**.

**Note** **System Status** shows the status of gas supplies, electrical supplies, and the software version.

See the "User maintenance" section for information on the **Calibration** menu item.

See the "Preoperative tests" section for information on the **Checkout** menu item.

## Patient demographics

Use the **Patient Demographics** menu to access menus and settings for **Age**, **Ideal Weight**, **TV for Ideal Body Weight**, and **Set Vent by Weight**.

## Screen setup menu

Use the **Screen Setup** menus to customize the screen view. Areas of the screen can be customized to show specific information.

**Screen Setup** contains the **Layout**, **Scales**, **Time and Date**, and **More Settings** submenus.

### Setting waveform fields

The waveforms can be set to show agent, CO<sub>2</sub>, flow, Paw, or set to Off. If a waveform is set to the same value as another waveform, the previously set waveform changes to off and is removed from the screen.

1. Select **System Setup - Screen Setup**.
2. Select the **Layout** tab.
3. Select the desired waveform button and select the value from the drop-down menu.
4. Select **Close**.

### Setting digit fields

The digit field can be set to show gas supply, flow, spirometry loops, gases, respiration, or agent. If the digit field is set to show agent and no airway module is inserted, the digit field will be blank.

1. Select **System Setup - Screen Setup**.
2. Select the **Layout** tab.
3. Select the desired digit field button and select the value from the drop-down menu.
4. Select **Close**.

### **Setting the split screen**

Use the **Split Screen** setting to show metabolics, trends, spirometry loops, Paw gauge, airway compliance, and optional ecoFLOW information.

See the "ecoFLOW" for information on the **ecoFLOW** option.

**Note** Resistance (Raw) shows in the airway compliance split screen when the system detects an airway module with spirometry and the module has completed a warm-up phase.

1. Select **System Setup - Screen Setup**.
2. Select the **Layout** tab.
3. Select **Split Screen** and select the desired view from the drop-down menu.
4. Select **Close**.

### **Setting time and date**

Use the **Time and Date** menu to set the time and date.

**Note** The **Time and Date** menu cannot be changed when a case is running.

1. Select **System Setup - Screen Setup**.
2. Select the **Time and Date** tab.
3. Select the time or date item to change. Make the change.  
The clock format factory default is 24 hours.
  - When the clock format is set to **12 h**, the hour selections are in '1a' format for a.m. and '1p' format for p.m.
  - When the clock format is set to **24 h**, the hour selections are 0 to 23 in one hour increments.
4. Select **Close**.

### **Setting the data source**

Use **Data Source** to specify the source of spirometry data.

1. Select **System Setup - Screen Setup - More Settings** or **Spirometry - Setup Loops**.
2. Select **Data Source**.

3. Select **Patient** to have spirometry data sourced from the airway module or **Vent** to have spirometry data sourced from the ventilator.
4. Select **Back** to view changes made and access other functions of the **Spirometry** menu.

### Setting sweep speed

Use the **Sweep Speed** setting to set the waveform draw rate to fast (6.25 mm/s) or slow (0.625 mm/s). When the sweep speed changes, waveforms redraw at the new rate.

1. Select **System Setup - Screen Setup**.
2. Select **More Settings**.
3. Select **Sweep Speed** and then select **Fast** or **Slow**.
4. Select **Close**.

### Setting display brightness

Use the brightness setting to adjust the contrast level of the display.

1. Select **System Setup - Screen Setup**.
2. Select **More Settings**.
3. Select **Display Brightness**.
4. Select the desired brightness level with 1 being the dimmest and 5 being the brightest.
5. Select **Close**.

### Setting keypad brightness

Use the brightness setting to adjust the contrast level of the hard keys on the bezel.

1. Select **System Setup - Screen Setup**.
2. Select **More Settings**.
3. Select **Keypad Brightness**.
4. Select the desired brightness level with 1 being the dimmest and 5 being the brightest.  
Set to 0 to turn off the keypad brightness.
5. Select **Close**.

## Setting fresh gas controls

Use the **Fresh Gas Controls** selection to set the gas control style to O2% with Total Flow or to individual gas flow.

Selecting **O2%** shows O2% as the first quick key and Total Flow l/min as the second quick key.

Selecting **Flow** shows balance gas l/min as one of the quick keys and O2 l/min as the other quick key.

**Note** Both **O2%** and **Flow** are available if **User** is selected by the Super User. If **User** is not selected by the Super User, either **O2%** or **Flow** will be unavailable.

**Note** **Fresh Gas Controls** cannot be accessed during a case.

1. Select **System Setup - Screen Setup**.
2. Select **More Settings**.
3. Select **Fresh Gas Controls**.
4. Select **O2%** or **Flow** from the drop-down menu.

When set to **O2%**, balance gas adjusts automatically when either the O2% or the Total Flow is changed using the gas quick keys.

When set to **Flow**, balance gas and the O2% are controlled individually using the gas quick keys.

5. Select **Close**.

## Fresh gas usage

Use **Fresh Gas Usage** to view the volume of O2, Air, N2O, and agents used for the three most recent cases.

- Data only shows for gases available on the system.
- Agent data shows the three most recently used agents.

1. Select **System Setup - Fresh Gas Usage**.
2. Select **Case Start Time** to select the patient case to view.
3. Select **Close**.

## Alarm setup

Use the **Alarm Setup** menu to set and adjust alarm limits, alarm volume, and other alarm settings and to view alarm history. The **Alarm Setup** menu contains the **Primary Limits**, **More Limits**, **Alarm History**, and **Configure** submenus.

Setting **Leak Audio** to **Off** silences audio alarms for small leaks. **Leak Audio** is automatically set to **On** and cannot be changed when either the Low MV alarm limits are off or the **MV/TV Alarms** is set to **Off**.

- Note** Selecting **Change to Default Limits** loads the default settings as set by the Super User or the factory defaults if no Super User settings have been entered.

## Setting CO2 alarms

Use the CO2 Alarms setting to turn off the CO2 ‘Apnea’ alarm, ‘EtCO2 low’, ‘EtCO2 high’, and ‘FiCO2 high. Absorbent OK?’ alarms during manual ventilation.

CO2 information is obtained from the airway module installed in the anesthesia system module bay. The CO2 alarms setting has no effect if there is no airway module in the anesthesia system.

1. Select **Alarm Setup**.
2. To turn off the CO2 alarms, set **CO2 Alarms** to **Off**.  
The ‘CO2 Alarms Off’ message shows in the general message field.  
The CO2 alarm limit waveform numerics shows dashes during a case.  
The alarms remain disabled until the Bag/Vent switch is set to Vent, the case is ended, or the **CO2 Alarms** is set to **On**.
3. To turn on the CO2 alarms, set **CO2 Alarms** to **On**.
4. Select **Close**.

## Setting volume apnea alarm

Use the **Vol Apnea Alarm** setting to turn off the volume apnea alarm during manual ventilation. The volume apnea alarm remains off until the Bag/Vent switch is set to Vent or **Vol Apnea Alarm** is set to **On**.

- Note** **Vol Apnea Alarm** does not show on the **Alarm Setup** menu when the **Volume Apnea Selection** has been disabled by the Super User. See the “Super user mode” section for more information.

1. Select **Alarm Setup**.

2. To turn the volume apnea alarms off, select **Vol Apnea Alarm** to **Off**.  
‘Volume Apnea Off’ shows in the general message field.
  - If mechanical ventilation is started, the volume apnea alarms are active.
  - If manual ventilation is restarted, a pop-up confirmation window appears to resume the **Off** setting.
3. To turn the volume apnea alarms on, set **Vol Apnea Alarm** to **On**.
4. Select **Close**.

## Setting MV TV alarms

Use the **MV/TV Alarms** setting to turn off the MV and TV alarms.

Settings made during manual ventilation are not retained when mechanical ventilation starts. Settings made during mechanical ventilation are retained when manual ventilation starts.

For example, if **MV/TV Alarms** is set to **Off** during manual ventilation, the alarms remain off until the Bag/Vent switch is set to Vent or the **MV/TV Alarms** is set to **On**.

For example, if the **MV/TV Alarms** is set to **Off** during mechanical ventilation, the alarms remain off when manual ventilation starts.

1. Select **Alarm Setup**.
2. To turn the volume alarms off, set **MV/TV Alarms** to **Off**.  
‘MV/TV Alarms Off’ appears in the general message field.  
The volume alarm limits waveform numerics shows dashes during a case.
3. To turn the volume alarms on, set **MV/TV Alarms** to **On**.
4. Select **Close**.

## Setting alarm limits

**WARNING** Do not set alarm limits to extreme values. Setting limits to extreme values can render the alarm useless.

1. Select **Alarm Setup**.
2. From the **Primary Limits** and **More Limits** tabs, select the alarm limit and make the change.
3. Push the Home key, touch the waveform area of the display, or select **Close** to close the menu.

## Viewing alarm history

Use the **Alarm History** tab to view the list of the 12 most recent high and medium priority alarms that occurred since the start of the case. The alarm history clears at the start of a new case.

1. Select **Alarm Setup**.
2. Select the **Alarm History** tab.  
The list of alarms shows in the window.
3. Select **Close**.

## Setting alarm volume

1. Select **Alarm Setup**.
2. Select the **Configure** tab.
3. Set **Alarm Volume** to the desired value.  
The alarm volume range is 1 to 5.
4. Select **Close**.

## Setting apnea delay

Use the **Apnea Delay** setting to set the desired apnea time delay. The apnea time delay is the amount of time that can pass without the system detecting a measured breath before the apnea alarm occurs.

1. Select **Alarm Setup**.
2. Select the **Configure** tab.
3. Set **Apnea Delay** to the desired time.
  - The apnea time delay range is 10 to 30 seconds.
  - The apnea time settings are in 1 second increments.
4. Select **Close**.

## Silencing leak audio alarms

Use the **Leak Audio** setting to silence audio alarms of small leaks.

1. Select **Alarm Setup**.
2. Select the **Configure** tab.

3. Set **Leak Audio** to **Off**.

The audio alarms for small leaks are silenced.

4. To turn audio alarms back on, set **Leak Audio** to **On**.

5. Select **Close**.

**Note** If the Low MV alarm limits are off or **MV/TV Alarms** is set to **Off**, **Leak Audio** is automatically set to **On** and cannot be changed.

## Setting auto MV limits

MV alarm limits can be calculated automatically for mechanical ventilation when in VCV or PCV-VG modes and volume compensation is enabled. Use the **Auto MV Limits** setting to turn on automatic calculations of the MV alarm limits.

If the automatic calculation of the low or high minute volume alarm limit exceeds the allowable limit, the minimum or maximum alarm limit is used.

1. Select **Alarm Setup**.
2. Select the **Configure** tab.
3. Set **Auto MV Limits** to **On**.

The MV alarm limits are automatically calculated until **Auto MV Limits** is set to **Off** or until an MV limit is manually adjusted during mechanical ventilation. The MV alarm limits are automatically calculated based on TV and RR settings.

4. Select **Close**.

## Setting to default limits

Use **Change to Default Limits** to set alarm limits to the values set by the Super User.

1. Select **Alarm Setup**.
2. Select the **Configure** tab.
3. Select **Change to Default Limits**.
4. Select **Close**.

## Alarms On Off

Use the **Alarms On/Off** menu to turn On or turn Off the **CO2 Alarms Limits** and **MV/TV Alarm Limits** during manual ventilation. Alarm limits are enabled at the start of mechanical ventilation.

**Note** The CO2 ‘Apnea’ alarm cannot be turned off through the **Alarms On/Off** menu. Only the ‘EtCO<sub>2</sub>’ and ‘FiCO<sub>2</sub>’ alarms are turned off using this menu.

### Disable alarm limits

1. Select **Alarms On/Off**.
2. View the alarm limit status.
3. Select **Confirm** to change the alarm limit settings. Select **Cancel** to leave the alarm limits unchanged.
  - If the **CO2 Alarms Limits** and **MV/TV Alarm Limits** are **On**, the alarm limits change to **Off**.
  - If the **CO2 Alarms Limits** or **MV/TV Alarm Limits** are **On**, the alarm limits change to **Off**.
  - If the **CO2 Alarms Limits** and **MV/TV Alarm Limits** are **Off**, the alarm limits change to **On**.

## Next page

Select **Next Page** to change the screen view. A default view and four configurable screen views are available. A general message displays identifying the page number of the screen view.

See the "*Super user mode*" section for information on setting the preset screen views.

## Trends

Use the ***Trends*** menu to view patient trends and set the time scale. There are three views for patient trends: measured (numerical), settings, and graphical. Trend information is saved every 15 seconds for the most recent 24 hours.

### Setting trends

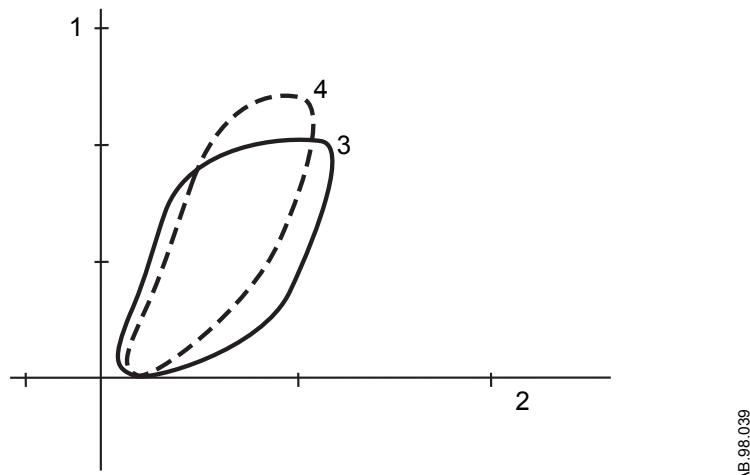
1. Select ***Trends***.
2. Select the desired view.
3. Select ***Scroll*** to move through the current trend view.
4. Select ***Time Scale*** to select the desired scale from the drop-down menu.
5. Select ***Next Page*** to view additional parameters.
6. Select ***Close***.

## Spirometry

Use the **Spirometry** menu to:

- Set the loop type.
- Adjust the loop scaling.
- Save a loop to memory.
- Access the **Setup Loops** menu.
- View a saved loop.
- Delete a saved loop.

There are three types of spirometry loops: Pressure-Volume (**Paw-Vol**), Flow-Volume (**Flow-Vol**), and Pressure-Flow (**Paw-Flow**). The spirometry loops show in the spirometry window and can be set to show alongside the waveforms as the split screen.



1. Volume axis
2. Pressure axis
3. Real-time loop
4. Reference loop (appears on display in gray)

Figure 3-2 • Example of a Paw-Vol loop

## Setting loop type

1. Select **Spirometry**.
2. Select **Loop Type** and select the loop from the drop-down list.
3. Select **Close**.

## Setting loop graph scaling

Use **Spirometry Scaling** to set the scales of the spirometry loop graph. The available settings for the volume, Paw, and flow graph axes are dependent on the set patient type of adult or pediatric.

- **Auto** automatically adjusts the volume, Paw, and flow axes of the loop based on the minimum and maximum breath reading shown in the waveform.
- **Linked** links the adjustment of the volume, Paw, and flow axes of the loop graph together. Change one of the scales and the remaining two scales automatically change based on the one set scale.
- **Indep.** allows the axes of the loop graph to be changed separately for the volume, Paw, and flow axes.

1. Select **Spirometry - Setup Loops**.
2. Select **Spirometry Scaling** and set the scale type from the drop-down list.
3. Select **Back** to view changes made and access other functions of the **Spirometry** menu.

## Setting patient and sensor type

Patient and sensor type refer to the style of airway adapter used with the airway module. If spirometry data is obtained from the airway module, make sure that the sensor type matches the type of airway adapter used. Adult or pediatric patient types are available.

**WARNING** Make sure that the set sensor type corresponds to the type of airway adapter in use. If the sensor type is not set correctly, the information displayed may not be accurate.

1. Select **Spirometry - Setup Loops**.
2. Select **Patient and Sensor** and then select **Adult** or **Pedi** depending on the sensor used.
3. Select **Back** to view changes made and access other functions of the **Spirometry** menu.

## Setting the data source

Use **Data Source** to specify the source of spirometry data.

1. Select **System Setup - Screen Setup - More Settings** or **Spirometry - Setup Loops**.
2. Select **Data Source**.
3. Select **Patient** to have spirometry data sourced from the airway module or **Vent** to have spirometry data sourced from the ventilator.
4. Select **Back** to view changes made and access other functions of the **Spirometry** menu.

## Setting spirometry volume type

The volume shown on the spirometry split screen can be set to minute volume or tidal volume.

1. Select **Spirometry - Setup Loops**.
2. Select **Show MV or TV** and select MV or TV from the drop-down list.  
Set to **TV** to show TVinsp and TVexp on the spirometry split screen.  
Set to **MV** to show MVexp and TVexp on the spirometry split screen.
3. Select **Back** to view changes made and access other functions of the **Spirometry** menu.

## Saving, viewing, and deleting spirometry loops

Spirometry loops can be saved, viewed, and deleted through the **Spirometry** menu.

1. Select **Spirometry**.
2. To store a loop to memory, select **Save Loop**. Up to six loops can be saved.
3. To view a saved loop, set **Show Ref. Loop** to the time at which it was saved.
4. To delete a saved loop, set **Delete Ref. Loop** to the time at which it was saved.
5. Select **Close**.

## Procedures

Use the **Procedures** menu to pause the gas flow, start cardiac bypass, perform or change settings for a vital capacity procedure, or perform or change the settings for a cycling procedure.

**Note** **Vital Capacity** shows in the menu if it is set to **Yes** by the Super User. **Vital Capacity** is only selectable during mechanical ventilation.

**Note** **Cycling** shows in the menu if it is set to **Yes** by the Super User. **Cycling** is only selectable during mechanical ventilation.

### Pause gas flow

Use **Pause Gas Flow** to temporarily suspend the flow of gas during a case. Using **Pause Gas Flow** while the breathing circuit is disconnected prevents the flow of gas into the room. **Pause Gas Flow** is available during both mechanical ventilation and manual ventilation.

1. Select **Procedures**.
2. Select **Pause Gas Flow**.

The amount of time remaining in the gas flow pause shows in the window.

Gas flow stops for 1 minute and automatically resumes after 1 minute.

If mechanical ventilation is on, mechanical ventilation stops for 1 minute and then automatically resumes after 1 minute.

3. Resume the flow of gas at any time during the pause by selecting **Restart Gas Flow**.

### Cardiac bypass

There are two types of cardiac bypass. Manual ventilation cardiac bypass is standard. VCV cardiac bypass is optional.

Manual ventilation cardiac bypass suspends alarms for patients on cardiac bypass when the ventilator is not mechanically ventilating. The volume, apnea, low agent, CO2, and respiratory rate alarms are suspended. The alarms are enabled when cardiac bypass is turned off or mechanical ventilation is started.

Systems with the VCV cardiac bypass option enabled can mechanically ventilate while in VCV mode. The VCV mode is the only ventilation mode available while using VCV cardiac bypass. The volume, apnea, low agent, CO2, low Paw, and respiratory rate alarms are suspended. The alarms are enabled when VCV cardiac bypass is turned off or mechanical ventilation is stopped.

**WARNING** Manual ventilation cardiac bypass and VCV cardiac bypass modes should only be used when the patient is receiving extra-corporeal oxygenation by means of a heart-lung machine. These modes of ventilation are not intended to provide metabolic levels of ventilation to the patient.

### Using manual ventilation cardiac bypass

1. Set the Bag/Vent switch to Bag.
2. Select **Procedures**.
3. Select **Start Cardiac Bypass**.  
The 'Cardiac Bypass' message shows in the waveforms and in the general message field when manual ventilation cardiac bypass is active.
4. Select **Close**.

### Using VCV cardiac bypass

1. Start mechanical ventilation in VCV mode.
2. Select **Procedures**.
3. Select **Start Cardiac Bypass**.  
PEEP is set to 5 cmH<sub>2</sub>O.  
TV settings of less than 170 ml prior to starting cardiac bypass remain at the set TV.  
TV settings of more than 170 ml prior to starting cardiac bypass change to 170 ml.  
The 'VCV Cardiac Bypass' message shows in the waveforms and in the general message field when VCV cardiac bypass is active.

**Note** PEEP and TV settings can be changed after entering cardiac bypass mode.

4. Select **Close**.

## Vital capacity

Use the Vital Capacity procedure to deliver a pressure breath for a set time. The Vital Capacity procedure provides a simple way to deliver one pressure breath during mechanical ventilation without making multiple ventilator setting changes. The **PEEP on Exit** setting provides a way to change the ventilation PEEP setting automatically at the end of the Vital Capacity procedure.

The **Pressure Hold**, **Hold Time**, and **PEEP on Exit** settings can be preset by the Super User. These settings can be changed by the user before starting the procedure.

**Note** **PEEP on Exit** shows if it is set to **Yes** by the Super User.

### Using vital capacity

1. Select **Procedures**.
2. Select **Start Vital Capacity**.
 

One pressure breath is given at the set pressure.  
The pressure is held for the set time.  
PEEP is set to the **PEEP on Exit** setting.
3. Select **Stop Vital Capacity** at any time to stop the procedure.
4. Select **Close**.

**Note** If the procedure is stopped before completion, the **PEEP on Exit** setting is not used.

### Changing vital capacity settings

1. Select **Procedures**.
2. Select the setting to change and make the change.
  - Set **Pressure Hold** to between 20 and 60 cmH<sub>2</sub>O.
  - Set **Hold Time** to between 10 and 40 seconds.
  - Set **PEEP on Exit** to Off or between 4 and 30 cmH<sub>2</sub>O.
3. Select **Start Vital Capacity**.
4. Select **Close**.

## Cycling

Use the Cycling procedure to deliver pressure breaths through a series of ventilation steps. The Cycling procedure provides a flexible way to deliver pressure breaths during ventilation without making multiple ventilator setting changes. Up to seven preset steps with multiple breaths are available.

Each procedure defaults steps and ventilation settings which can be preset by the Super User. The ventilation settings of each step can be changed by the user before starting a procedure.

**Note** There is a limited amount of gas in the bellows. No additional gas enters the bellows during the cycling procedure. Increase fresh gas flow to avoid bellows collapse.

### Using cycling

1. Select **Procedures**.

2. Select **Cycling**.
3. Select a **Procedure** to perform.
4. Select **Start Cycling**.  
The procedure begins.  
Procedure progress shows in the procedure window.
5. Stop the procedure anytime by selecting **Stop Cycling**.
6. Select **Close**.

### Changing cycling settings

1. Select **Procedures**.
2. Select **Cycling**.
3. Select a **Procedure** to perform.
4. Select **Adjust Settings**.  
The first setting of Step 1 in the procedure window is selected.
5. Push the ComWheel to enter the adjustment window.
6. Use the ComWheel to navigate the adjustment window and change a value.
7. Select **Start Cycling**.
8. Select **Close**.

## Timer function

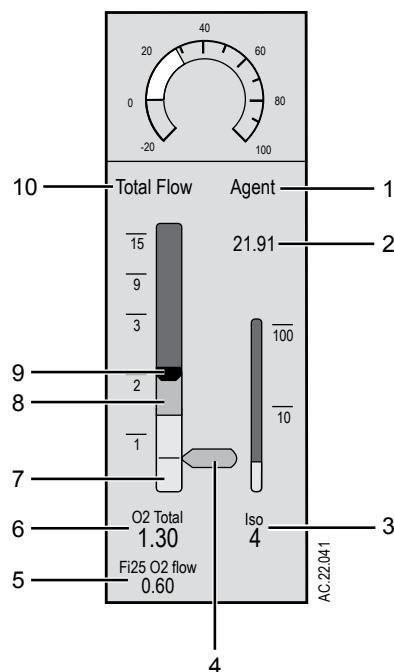
Use **Start** as a timer function. When selected a clock will display counting up from zero.

### Using the timer

1. Select **Start** to start the clock.
2. Select **Stop** to pause or stop the clock.  
If **Start** is selected, the clock will resume operation.  
If **Start** is selected and held for longer than 1 second, the clock will reset to zero.

## ecoFLOW

This feature provides a split screen view that shows the approximate minimum O<sub>2</sub> flow to maintain a preset inspired O<sub>2</sub> concentration. Also shown is the approximate agent used per hour and the cost.



1. Agent Shows Agent cost and flow information.
2. Agent cost The cost of the current agent flow. This value is determined by the agent flow multiplied by the agent cost set in Super user mode.
3. Agent flow The measured value of the liquid agent flow from the vaporizer. The agent flow may have a delayed response. For example: Iso.
4. FiO<sub>2</sub> flow marker The graphical representation on the flow tube of the FiO<sub>2</sub> flow value. This marker can be removed by disabling it in Super user mode.
5. FiO<sub>2</sub> flow The minimum O<sub>2</sub> flow needed to maintain the set inspired O<sub>2</sub> flow. This item can be disabled in Super user mode. For example: Fi25 O<sub>2</sub> flow.
6. O<sub>2</sub> total (numeric) The numeric representation of the total O<sub>2</sub> flow. If N<sub>2</sub>O is the balance gas, this equals the set O<sub>2</sub> flow. If Air is the balance gas, this is the set O<sub>2</sub> flow plus 21% of the Air flow. For example: O<sub>2</sub> Total.
7. O<sub>2</sub> total (graphical) The graphical representation of the total O<sub>2</sub> flow. If N<sub>2</sub>O is the balance gas, this equals the set O<sub>2</sub> flow. If Air is the balance gas, this is the set O<sub>2</sub> flow plus 21% of the Air flow.
8. Remaining gas flow If N<sub>2</sub>O is the balance gas, this equals the set N<sub>2</sub>O flow. If Air is the balance gas, this N<sub>2</sub> is 79% of the Air flow.
9. Flow bobbin The height of this represents the total fresh gas flow delivered to the patient.
10. Total flow Shows Total Flow information.

*Figure 3-3 • ecoFLOW feature*

## Using ecoFLOW

1. Select **System Setup - Screen Setup**.
2. Select the **Layout** tab.
3. Select **Split Screen** and select **ecoFLOW** from the drop-down menu.
4. Select **Close**.

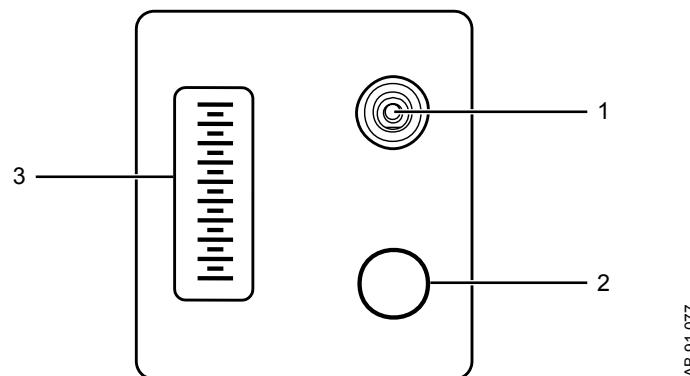
## Alternate O2 control

**WARNING** The Alternate O2 control is not an auxiliary source of O2.

- When Alternate O2 control is enabled, flow from the electronic mixer is stopped and the agent concentration is set to off. O2 is flowing through the Alternate O2 control to the breathing system. To activate anesthetic agent flow to the breathing system, set the agent to the desired concentration.
- Agent delivery cannot be activated in the case of certain electronic mixer or agent delivery failures. The Agent quick key will be blank if agent delivery is unavailable.

Use the Alternate O2 control to deliver O2 through an independent pneumatic path to the vaporizer and patient circuit. Alternate O2 is connected to the system O2 supply. Alternate O2 control activates automatically in the case of certain failures or errors. It can also be activated manually.

The Alternate O2 control is available approximately 20 seconds after the system is turned on. The Alternate O2 flow is adjustable to approximately 0.5 l/min to 10 l/min as indicated on the flow tube.



1. ON/OFF button
2. Flow control
3. Flow tube

Figure 3-4 • Alternate O2 control

## Using Alternate O2 control

1. Push the Alternate O2 ON/OFF button.  
The O2 flow is indicated on the flow tube.

### 3 Operation

2. Use the flow control to adjust the O2 flow.
3. Set the agent to the desired concentration.
4. To end Alternate O2 control, push the Alternate O2 ON/OFF button.

## EZchange canister mode

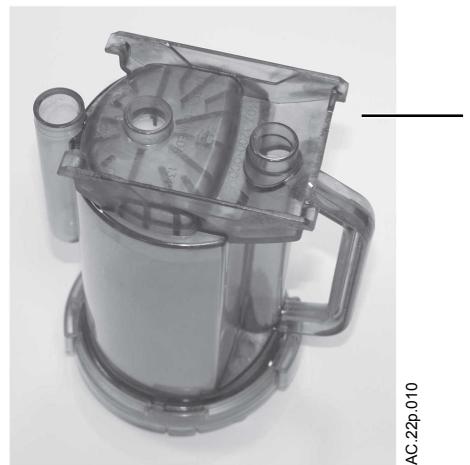
Use the optional EZchange canister mode for continued ventilation of the patient while changing the absorber canister. The EZchange canister mode seals the breathing circuit when the canister holder is down. While the absorber canister is out of the breathing circuit, the patient re-breathes exhaled gases without any gas passing through the absorbent.

Systems with EZchange canister mode have a label on the canister holder. An EZchange canister has side rails that fit in the EZchange canister holder.



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Figure 3-5 • EZchange canister holder label



1. Side rails

Figure 3-6 • EZchange canister

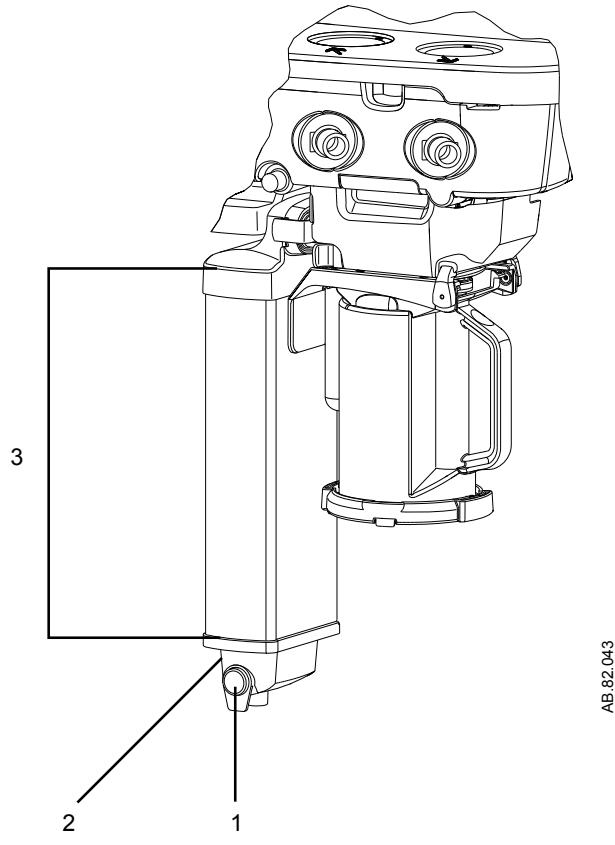
## Using EZchange canister mode

**Note** Make sure that the absorber canister has side rails. If the canister does not have side rails, it will not work in the EZchange canister holder.

1. Push the absorber canister release to activate the EZchange canister mode.  
The canister swings down to the EZchange position.  
'CO2 Absorber Out of Circuit' shows in the waveform area on the anesthesia display.
2. Remove the canister from the holder.
3. Install a canister with fresh absorbent into the holder.
4. Push the canister back up and snap it into absorber position.  
The exhaled gas flows through the absorber, removing CO2.

## Condenser

Use the optional condenser to remove water in the system that is produced from the reaction of CO<sub>2</sub> gas with the absorbent. The condenser is connected between the outlet of the absorber canister and the inlet of the circuit module. Moisture in the gas is condensed into water droplets, which run into the condenser's reservoir.



1. Drain button
2. Reservoir
3. Condenser

*Figure 3-7 • Condenser*

## Draining the condenser

1. Visually check the condenser reservoir daily. Drain the reservoir daily.
2. Place a container under the reservoir.

### 3 Operation

3. Push the drain button to empty any water in the condenser.

## Auxiliary Common Gas Outlet

Use the optional Auxiliary Common Gas Outlet (ACGO) switch to direct the fresh gas flow through the ACGO port on the front of the system. The ACGO may be used to provide fresh gas to an auxiliary manual breathing circuit.

Mechanical ventilation is not available when using an auxiliary manual breathing circuit with fresh gas from the ACGO. The Bag/Vent switch, APL valve, and CO<sub>2</sub> absorber are not part of the external circuit. Volume and pressure monitoring are not available.

O<sub>2</sub> monitoring of fresh gas is available when the ACGO is selected if the system has the airway module option or the O<sub>2</sub> cell monitoring option. Systems with both an airway module and an O<sub>2</sub> cell will display the circuit O<sub>2</sub> value obtained from the airway module.

<b>WARNING</b>	<p>The Bag/Vent switch and the APL valve do not control the ACGO or any breathing circuit connected to the ACGO. Do not use these controls when using a breathing circuit with fresh gas from the ACGO. Patient injury may occur.</p> <ul style="list-style-type: none"><li>Volume and pressure monitoring are not available through the system when using the ACGO port. Monitor the patient using other methods.</li><li>Do not use an external ventilator on the ACGO. Do not use the ACGO to drive external ventilators or for jet ventilation.</li><li>The maximum pressure at the ACGO can be up to 55 kPa (8 psi). Use a breathing circuit with a pressure limiting device to limit the pressure at the patient connection port, during normal and single-fault conditions, to less than 12.5 kPa (125 cmH<sub>2</sub>O) or to the maximum pressure required by local standards.</li></ul>
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## Using the ACGO

- Set the ACGO switch to the ACGO position.  
Fresh gas flows through the ACGO port.  
Fresh gas oxygen concentration is displayed on the screen.
- Set the alarm limits to clinically appropriate settings.
- To stop fresh gas flow through the ACGO port, set the ACGO switch to the circle circuit position.

**Note** Displayed fresh gas oxygen concentration may not reflect FiO<sub>2</sub> during spontaneous breathing or in rebreathing circuits. Use an external O<sub>2</sub> monitor if using a rebreathing circuit on ACGO.

### 3 Operation

**Note** A sample of the fresh gas is diverted to the O<sub>2</sub> cell in the breathing system. The sample flow to the O<sub>2</sub> cell is dependent on the pressure in the external circuit. The sample flow reduces the fresh gas flow rate to the auxiliary breathing circuit equal to the amount diverted to the O<sub>2</sub> cell.



# 4 Preoperative checkout

<b>In this section</b>	Every day before your first patient. . . . .	4-2
	Before every patient. . . . .	4-3

## Every day before your first patient

- Check that necessary emergency equipment is available and in good condition.
- Check that the equipment is not damaged and that components are correctly attached.
- Check that the pipeline gas supplies are connected. If equipped with cylinders, check that there is sufficient reserve capacity and that the cylinder valve is closed.
- Connect scavenging and verify operation.
- Check that the amount of liquid agent in the cassette is adequate. Install the agent cassette into the active bay. The cassette is properly inserted when the agent is identified on the display.
- Check that the breathing circuit is correctly connected, not damaged, and the breathing system contains sufficient absorbent in the canister.
- Turn the System switch On.
- Perform a **Full Test** from the **Checkout** menu.
- Do an Agent Delivery check in the Checkout menu for each agent cassette that will be used during the day.
- Check that an adequate reserve O<sub>2</sub> supply is available.
- Check that the ventilator functions correctly:
  - Connect a test lung to the patient breathing circuit connection.
  - Set the ventilator to VCV mode and the settings to TV to 400 ml, RR to 12, I:E to 1:2, Tpause to Off, and Pmax to 40 cmH<sub>2</sub>O.
  - Set the gas flow to the minimum settings.
  - Start a case.
  - Set the Bag/Vent switch to Vent.
  - Fill the bellows using O<sub>2</sub> flush.
  - Check that mechanical ventilation starts. Check that the bellows inflate and deflate. Check that the display shows the correct ventilator data. Check that there are no inappropriate alarms.
- Turn the system circuit breaker off and check that mechanical ventilation continues while the system is running on battery power. After completing the check, turn the system circuit breaker on. The mains indicator is lit when AC power is connected.
- Set the appropriate controls and alarm limits for the case.

## Before every patient

**Note** This check does not need to be done before the first case of the day if the "Every day before your first patient" checklist was done.

- Check that the necessary emergency equipment is available and in good condition.
- Select **Checkout** and perform a **Low P Leak** test.
- If the cassette was changed since the last case:
  - Check that the amount of liquid agent in the cassette is adequate.
  - Check that the cassette is properly inserted. The cassette is properly inserted when the agent is identified on the display.
- Check that an adequate reserve O<sub>2</sub> supply is available.
- Check that the breathing circuit is correctly connected, not damaged, and the breathing system contains sufficient absorbent in the canister.
- Select **Checkout** and perform a **Circuit Leak** test.
- Check that the ventilator functions correctly:
  - Connect a test lung to the patient breathing circuit connection.
  - Set the ventilator to VCV mode and the settings for TV to 400 ml, RR to 12, I:E to 1:2, Tpause to Off, and Pmax to 40 cmH<sub>2</sub>O.
  - Set the gas flow to the minimum settings.
  - Start a case.
  - Set the Bag/Vent switch to Vent.
  - Fill the bellows using O<sub>2</sub> flush.
  - Check that mechanical ventilation starts. Check that the bellows inflate and deflate. Check that the display shows the correct ventilator data. Check that there are no inappropriate alarms.
  - Set the appropriate controls and alarm limits for the case. Make sure that the alarms function. See the "*Alarm tests*".
- Set the appropriate controls and alarm limits for the case.



# 5 Preoperative tests

<b>In this section</b>	
Aladin cassette installation.	5-2
Flow and pressure calibration.	5-3
Circuit compliance compensation.	5-4
Checkout menu.	5-5
Full test.	5-6
Individual tests.	5-8
Positive low pressure leak test (ACGO systems only).	5-10

## Aladin cassette installation

1. Using the liquid level indicator, check that the cassette is filled to the appropriate level.
2. If using Aladin2, unlock the cassette handle before installing it into the active bay.
3. Insert the cassette into the active bay until a click is heard. An audible click indicates that the cassette is in position.
4. Turn the lock on the handle to the horizontal position (Aladin2 cassettes only).
5. The cassette is properly inserted when the agent is identified on the display. Make sure that the displayed agent matches the cassette.

**Note** Store the cassettes in the cassette storage bay when they are not in use. See the "Vaporizer cassettes" section for additional cassette information.

## Flow and pressure calibration

**Important** Room temperature fluctuations of more than 5°C may affect sensor measurements. Recalibrate the flow sensors if the room temperature changes by more than 5°C.

Calibrate the flow sensors by removing the flow sensor module from the system. On-screen instructions are available through **System Setup - Calibration - Flow and Pressure**.

1. Set the Bag/Vent switch to Bag.
2. Remove the flow sensor module.
3. Wait for 'No insp flow sensor' and 'No exp flow sensor' alarms to occur.
4. Reinsert the flow sensor module. Make sure the flow sensors are securely latched when they are reinserted. Wait for alarms to clear.
5. Start mechanical ventilation when ready.

## Circuit compliance compensation

The ventilator adjusts gas delivery and monitoring to compensate for the compliance of the patient circuit if:

- The system has an airway module installed.
- The **Circuit Compliance** is set to **On** from **Super User - System Config. - Ventilator Settings**.
- The **Checkout** is completed after the system is turned on.

Circuit compliance is determined during the **Checkout - Full Test** or when the **Vent and Gas** check is done as an individual test. Circuit compliance must be set by the Super User for the Circuit Compliance compensation function to be active. See the “Super user mode” section for information on the circuit compliance setting.

In volume modes, circuit compliance compensation increases the volume delivered at the inspiratory port by taking into consideration the circuit compliance value. In all modes, circuit compliance compensation adjusts the volume measurements. Circuit compliance compensation provides consistent ventilator accuracy at the patient circuit.

- WARNING** Perform a **Vent and Gas** test after changing the patient tube type. Changing the patient breathing circuit after completing a **Vent and Gas** test affects the volume measurements in all modes.
- Breathing circuits and breathing circuit components are available in many different configurations from multiple suppliers. Attributes of the breathing circuits such as materials, tube length, tube diameter, and configuration of components within the breathing circuit, may result in hazards to the patient from increased leakage, added resistance, or changed circuit compliance.

## Checkout menu

The **Checkout** menu shows on the display after turning on the system. To access the **Checkout** menu between cases, select **Checkout**. Step-by-step instructions show in the **Checkout** menu during the tests. Use the **Checkout** menu to:

- Perform a **Full Test**.
- Perform any of the individual tests.
- View the **Test Log**.
- Start a case.

## Full test

The **Full Test** or the individual tests must be performed at least once within every 24-hour period.

Perform the **Full Test** at the start of each day. The full test runs automatically and beeps to indicate when it is finished or if interaction is required.

The **Full Test** does the following tests: **Vent and Gas**, **Circuit Leak**, and **Circuit O2 Cell** (if circuit O2 cell is present). When one of the tests is completed, the next test begins.

1. From the **Checkout** menu, select **Full Test** and follow the instructions.
2. If a test fails, follow the instructions to perform a retest or accept the results.
3. When the **Full Test** is completed, start a case.

**Note** In case of a patient emergency, the **Full Test** may be bypassed by selecting **Start Case**. The general message ‘Please Do Checkout’ is displayed if a **Full Test** or all of the individual tests are not completed with passing results within 24 hours.

## Vent and gas

The **Vent and Gas** test checks the agent delivery, airway module, Bag/Vent switch, proper gas supply pressures, ventilator operation and leak, battery and electrical power, circuit compliance, and flow control operation. This is a two-step test.

To run this test, follow the on-screen instructions. When the test passes, the next test starts.

**Note** Any cassette may be used during the test. Use a non-desflurane cassette during the test to check the full functionality of the internal electronic control unit.

## Circuit leak

The **Circuit Leak** test checks the Bag/Vent switch, proper gas supply pressures, airway pressure measurement transducer, APL valve, and manual circuit leak.

To run this test, follow the on-screen instructions. When the test passes, the next test starts.

## Circuit O2 cell

The ***Circuit O2 Cell*** test measures the O2 percent.

To run this test, follow the on-screen instructions. Do not select ***Done*** when 21 is first displayed. Allow the reading to stabilize, then select ***Done***. Calibrate the O2 cell if necessary.

## External gas monitor

When ***External Gas Monitor*** is set to ***Yes*** by the Super User, the ***External Gas Monitor*** reminder occurs. This is not a test. This is a reminder to connect a respiratory gas monitor.

## Individual tests

The **Full Test** or all of the individual tests must be completed with passing results at least once within every 24-hour period.

Individual tests allow the user to perform any combination of single tests. These tests are helpful if there is a specific problem/alarm and the user wishes to test only that portion of the system.

The tests do not automatically move on to the next test. After completing a test, do another or start a case. If a test fails, follow the instructions to perform a recheck or accept the results.

### Vent and gas

The **Vent and Gas** test checks the agent delivery, airway module, Bag/Vent switch, proper gas supply pressures, ventilator operation and leak, battery and electrical power, circuit compliance, and flow control operation. This is a two-step test.

To run this test, follow the on-screen instructions.

**Note** Any cassette may be used during the test. Use a non-desflurane cassette during the test to check the full functionality of the internal electronic control unit.

### Circuit leak

The **Circuit Leak** test checks the Bag/Vent switch, proper gas supply pressures, airway pressure measurement transducer, APL valve, and manual circuit leak.

To run this test, follow the on-screen instructions.

### Circuit O2 cell

The **Circuit O2 Cell** test measures the O2 percent.

To run this test, follow the on-screen instructions.

### Low P leak

The positive pressure **Low P Leak** test measures machine leaks before the breathing system, between the common gas outlet and the high-pressure pneumatics and includes the gas mixer and vaporizer. It measures low-pressure pneumatic leaks with a pass or fail limit of 50 ml.

To run this test, follow the on-screen instructions.

## Low P leak (machines with ACGO)

The negative **Low P Leak** measures machine leaks before the breathing system, between the common gas outlet and the high-pressure pneumatics and includes the gas mixer and vaporizer. It measures low pressure pneumatic leaks with a pass or fail limit of 50 ml.

- Note** Any cassette may be used during the check. Using a desflurane cassette only checks for leaks between the vaporizer and common gas outlet.

To run this test, follow the on-screen instructions.

## Agent delivery

The agent delivery test checks the agent delivery systems and the cassette. This check releases agent to the circuit.

- Note** Any cassette may be used during the test. Use a non-desflurane cassette during the test to check the full functionality of the internal electronic control unit.

To run this test, follow the on-screen instructions.

## Positive low pressure leak test (ACGO systems only)

- Note** For ACGO machines, perform either a negative **Low P Leak** test or a positive low-pressure leak test depending on local requirements.
- CAUTION** Do a positive-pressure leak test at the ACGO port only.
1. Connect the leak test device to the ACGO port with the positive-pressure leak test adapter. Push the adapter into the ACGO port throughout the test to get a good seal.
  2. Fully open the needle valve on the test device. Keep the test device flow tube vertical for accurate results.
- CAUTION** If the needle valve is not fully open, this test can damage the pressure gauge on the test device.
3. Turn the ACGO switch to the ACGO position.
  4. Set the O<sub>2</sub> flow to 500 ml.
  5. Make sure that the total flow through the flowmeter on the test device is 0.5 l/min.
  6. Make sure that the pressure gauge on the test device reads zero.
  7. Close the needle valve on the test device until the test gauge reads 20 kPa (3 psi) (BSI) or 3 kPa (0.4 psi) (ISO).
  8. If the flow through the test device is less than 0.45 l/min (ISO) or 0.4 l/min (BSI), there is a low pressure leak in the anesthesia machine. See the "Alarms and troubleshooting" section for more information.
  9. Remove the adapter and leak test device.
  10. Set the O<sub>2</sub> flow to 1 l/min and continue flow for one minute to flush out any residual agent.
- WARNING** Agent mixtures from the low-pressure leak test stay in the system. Always flush the system with O<sub>2</sub> after the low-pressure leak test (1 l/min for at least one minute).

# 6 Airway modules

<b>In this section</b>	
Airway modules.	6-2
Connecting the airway module.	6-5
Parameters setup.	6-6
Automatic agent identification.	6-7
Calibrating the airway module.	6-8

## Airway modules

The optional compact airway modules measure and monitor gases delivered to the patient and exhaled through the breathing circuit. The modules consist of:

- An infrared sensor for measuring CO<sub>2</sub>, N<sub>2</sub>O, and anesthetic agents.
- A paramagnetic O<sub>2</sub> sensor.
- A gas sampling system with D-fend water separation system.

Systems with both an airway module and an O<sub>2</sub> cell will display the patient inspired O<sub>2</sub> value obtained from the airway module.

Respiratory rate is the frequency of peak (end tidal) CO<sub>2</sub> measurements per minute. A breath is defined as a change in the CO<sub>2</sub> signal that exceeds 1% (8 mmHg). All concentrations are measured and displayed breath by breath.

### **WARNING**

Remove the airway sampling line for the patient's airway and seal the sample port while nebulized medications are being delivered. Nebulized medications interfere with accurate gas reading.

- In the **Spirometry** menu, if the **Data Source** is set to **Patient**, no Paw, Agent, or CO<sub>2</sub> waveforms or numeric information is displayed during the airway gas module warm-up period (approximately 2 minutes). Set the **Data Source** to **Vent** to display the waveforms and numeric information from the ventilator during the airway gas module warm-up period.
- Leaks in the gas sampling circuit (water trap and sampling line) may cause inaccurate readings.

### **CAUTION**

Use only cables and accessories approved by GE Healthcare Finland Oy. Other cables and accessories may damage the system or interfere with measurement. Single-use accessories are not designed to be reused.

- Strong scavenging suction on the monitor exhaust port may change the operation pressure of the monitor and cause inaccurate readings or internal damage.

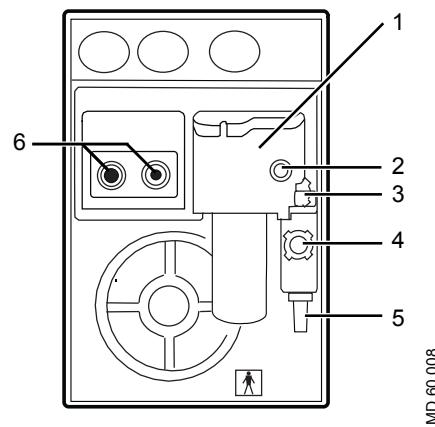
Use only airway modules that have anesthetic agent monitoring and O<sub>2</sub> monitoring on this system. Refer to the manual supplied with the airway modules for detailed information on the modules. The following modules can be used on this system:

- E-series: E-CAiO, E-CAiOV, E-CAiOVX (software version 4.5 and above).
- M-series: M-CAiO, M-CAiOV, M-CAiOVX (software version 3.2 and above).
- CARESCAPE series: E-sCAiO and E-sCAiOV.

Letters in the airway module name indicate:

- E - E series plug-in gas module.
- M - M series plug-in gas module.
- E-s - CARESCAPE series plug-in gas module.
- C - CO<sub>2</sub> and N<sub>2</sub>O.
- A - anesthetic agents.
- i - agent identification.
- O - patient O<sub>2</sub>.
- V - patient spirometry.
- X - gas exchange.

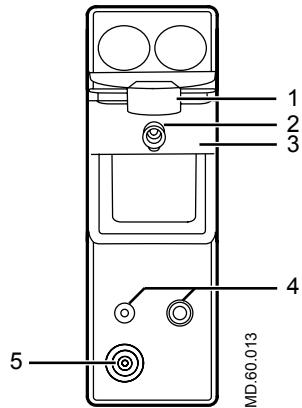
## E and M series airway modules



1. D-fend water trap
2. Sampling line connector
3. Water trap latch
4. Reference gas inlet
5. Sample gas outlet
6. Connectors for patient spirometry

Figure 6-1 • E- and M-series compact airway module

## CARESCAPE airway modules



1. Water trap latch
2. Gas sample connector
3. D-fend Pro water trap
4. Connectors for patient spirometry
5. Sample gas outlet

*Figure 6-2 • CARESCAPE airway module (figure may not represent all models)*

## Connecting the airway module

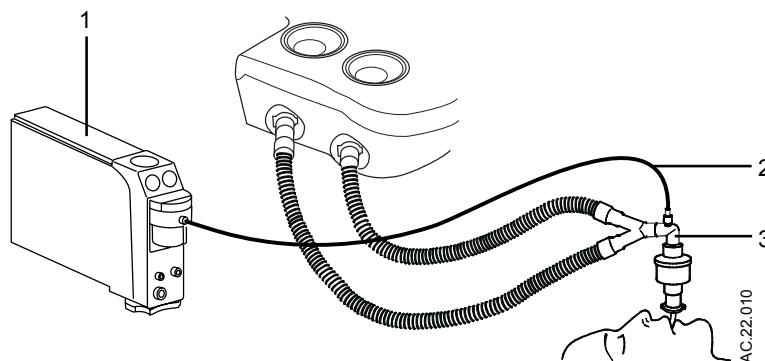
1. Check that the airway gas module is installed.
2. Check that the airway adapter connections are tight and that the adapter is correctly installed.
3. Check that the water trap container is empty and properly attached.

Empty the water trap container whenever the container is more than half full. Under normal conditions, the D-fend container fills in 24 hours.

### **WARNING**

Before connecting the exhaust line to the sample gas outlet on the compact airway module, ensure the other end is connected to the sample gas return port on the anesthesia machine. Incorrect connections may cause patient injury.

4. Connect a line from the airway module sample gas outlet to the sample gas return port on the anesthesia machine.
5. Attach the gas sampling line to the sampling line connector on the water trap.
6. Turn the system on. The system does a series of automated self tests. The automatic agent identification is activated.
7. Connect the sampling line to the airway adapter. Take the gas sample as close to the patient's airway as possible. Position the adapter's sampling port upwards to prevent condensed water from entering the sampling line.



1. Airway module
2. Gas sampling line
3. Airway adapter with sampling line connector

*Figure 6-3 • Airway gases setup with compact airway module*

## Parameters setup

Use the **Spirometry** menu to change the monitoring settings of the data source, CO<sub>2</sub>, O<sub>2</sub>, agent, and spirometry. To access the **Spirometry** menu, push the **Spirometry** button and then select **Setup Loops**.

### Data source

Several monitoring parameters can be obtained from the ventilator or the airway module. Information retrieved from the airway module is identified with the module data indicator.



*Figure 6-4 • Airway module data indicator*

Set the **Data Source** to **Patient** or **Vent** to select the primary source for information. If **Patient** is selected, the airway module will be the first source for information. If **Vent** is selected, the internal sensors of the ventilator will be the first source for information.

When setting the airway module as the data source, make sure that a D-lite or Pedi-lite sensor is properly connected on the airway module. If the sensor is not properly connected, but the airway module is installed, the waveform shows no flow. The gas monitor samples and displays room air.

If information is not available through the airway module, information comes from the internal ventilator sensors.

## Automatic agent identification

Airway modules with agent identification automatically identify Halothane, Enflurane, Isoflurane, Sevoflurane, and Desflurane. The inspiratory and expiratory concentrations of the agent appear in the digit field or the agent waveform field if selected.

Minimum concentration for the identification is 0.15% volume. The agent selection remains active even if the concentration decreases below 0.15% volume during the case.

Automatic agent identification operates after the normal warm up of the gas module (approximately five minutes).

## 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 the "Parts" section for the 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 CO<sub>2</sub> regardless of selected measuring units.

1. Turn on the power. 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 (34 to 48 kPa). 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.  
If a gas does not need adjustment, select the gas. Push the ComWheel to confirm the value.
11. Close the regulator.

# **7 Alarms and troubleshooting**

<b>In this section</b>	
Alarms.....	7-2
List of alarms.....	7-5
Alarm ranges.....	7-13
Alarm tests.....	7-15
Breathing system problems.....	7-17
Electrical problems.....	7-18
Pneumatic problems.....	7-19

## Alarms

Alarms may be high priority, medium priority, or low. When an alarm occurs during a case, an alarm tone sounds and the alarm message is displayed in the alarm message field. The system checks for alarm conditions at 1 second intervals. The alarm tone is from 47 to 78 db(A) depending on the alarm volume setting.

**CAUTION** No repair should ever be attempted by anyone not having experience in the repair of devices of this nature. See the "Repair policy" in the "*User maintenance*" section.

**WARNING** If an alarm occurs, safeguard the patient first before performing troubleshooting or doing repair procedures.

### Alarm priorities

Alarm priority is indicated by the color of the alarm message and the audio sequence.

- High-priority alarm messages appear in white text on a red background.
- Medium-priority alarm messages appear in black text on a yellow background.
- Low-priority alarms appear in black text on a blue background.

### Pausing alarms

Selecting **Audio Pause** for an active alarm stops the audible tone for 120 seconds. The alarm message shows in the alarm message field. Selecting **Audio Pause** when no medium or high priority alarms are active prevents the audible alarm tones (audio off) for 90 seconds.

Alarms in the apnea alarm family have special silence behavior to reduce apnea nuisance alarms. Apnea family alarms include 'Apnea', 'EtCO<sub>2</sub> low', 'MVexp low', 'RR low', and 'TVexp low'.

When pausing an apnea family alarm, the audio tone for the active alarm is paused for 120 seconds. The audible tone for any additional apnea family alarm that occurs during the audio paused period is silenced for the remaining time shown on the audio pause countdown. Only the audible alarm tone is silenced. The alarm messages still show in the alarm message fields. 'APN' shows above the audio pause countdown when the audible tone silence is in effect for the apnea family alarms.

## Cancelling audio pause

Selecting and holding **Audio Pause** for 2 seconds will cancel the audio pause function.

## Display changes during alarms

Messages may appear in the waveform field during some alarms. If more than one alarm has a message, the message for the highest priority alarm is displayed. The message is removed when the alarm is resolved.

The color of the alarm text shown in the alarm message fields is dependent on the alarm priority. Messages for high-priority alarms use white text. Messages for medium-priority alarms use black text. Low-priority alarm messages use black text.

When the O<sub>2</sub> pipeline supply pressure drops to less than 252 kPa (36 psi), O<sub>2</sub> supply information is displayed.

Some patient parameter alarms such as 'Ppeak high' and 'FiO<sub>2</sub> low' will latch when the alarm condition is corrected. When an alarm is latched, it is displayed in gray text on a black background. The parameter box will stop flashing. All the associated waveform, numeric, and digit field messages are removed from the display. The alarm will remain in this condition until it is acknowledged by selecting **Audio Pause** or until the alarm reoccurs. When the alarm is acknowledged, it is removed from the screen. If an alarm has latched and the alarm reoccurs before it is acknowledged, the alarm will revert to an active state.

## De-escalating alarms

Some device related alarms, such as 'No insp flow sensor' will de-escalate priority when the alarm is acknowledged by selecting Audio Pause. The alarm message shows at the low-priority alarm level until the alarm condition is resolved and the alarm is cleared. If that alarm reoccurs after it has been resolved, the alarm occurs at its standard priority level.

## Battery indicator

The color and fill amount of the battery in use symbol indicates the amount of battery power remaining.

- Green indicates greater than 10 minutes.
- Yellow indicates between 10 and 5 minutes.

- Red indicates less than 5 minutes.

## Internal failure

'Internal problem prevents normal operation.' shows on the display during a software or hardware failure that requires service. If this message occurs, contact an authorized service representative.

## Informational tones

The system provides informational tones that are 47 to 78 dB(A) depending on the alarm volume setting.

- Notification tone is a medium pitched tone that sounds for approximately 480 milliseconds. This tone signifies that an action must be taken.
- Reject tone is a low pitched tone that sounds for approximately 200 milliseconds. This tone signifies that the previous action was rejected.

## List of alarms

If corrective action does not resolve the alarm message, contact an authorized service representative.

Circuit pressures and volumetric flows are measured by the ventilator and airway gas module. If the **Data Source** is set to **Patient** the displayed waveforms and numeric information are measured by the airway gas module. Although not displayed, the ventilator measurements continue and if a measured value violates an alarm setting, the appropriate alarm occurs. The value highlighted in the parameter numeric box may not appear to have violated the alarm setting. Changing the **Data Source** to **Vent** will display the circuit pressures and volumetric flows measured by the ventilator.

Message	Priority	Cause	Action
AA, CO2 monitoring not connected	Medium	No gas monitor is detected when the External Gas Monitor setting in Super User is set to No.  The monitor condition changes to disconnected when the External Gas Monitor setting in Super User is set to Yes.	Connect or install a gas module in the machine or set External Gas Monitor setting to Yes if the system uses a stand-alone monitor for O2, AA, and CO2.
Agent mixture	Medium	Two different agents are detected by the airway module and the MAC calculation is greater than or equal to 3.	Make sure only one agent is on. Wait approximately two minutes for the first agent to wash out of the system.
Agent mixture	Low	Two different agents are detected by the airway module and the MAC calculation is less than 3.	Make sure only one agent is on. Wait approximately two minutes for the first agent to wash out of the system.
Agent output inaccurate. Contact service.	Medium	Vaporizer detected a flow meter temperature sensor failure and is using a default temperature value.	Contact an authorized service representative.
Air pressure low. Increase O2 %.	High	O2% is set to Air at 21%. Air pipeline pressure is less than 252 kPa (36 psi) and the air cylinder pressure dropped below 2633 kPa (381 psi) for one second.	Ensure the Air pipeline and cylinder are properly connected. Increase the O2% flow.
Air supply pressure low	Medium	Air pipeline pressure is less than 252 kPa (36 psi) and the air cylinder pressure dropped below 2633 kPa (381 psi) for one second.	Ensure the air pipeline and cylinder are properly connected.
Apnea	Medium	Apnea time delay (10-30 seconds) has passed without a measured breath.  Apnea time delay (20-30 seconds) has passed without a change in the measured CO2 by at least 1%	Check for leaks in the patient circuit. Check for patient disconnection.
Apnea >120 s	High	Apnea time exceeds 120 seconds.	Check for leaks or blockages in the breathing circuit. Ensure the Bag/Vent switch is in the Vent position. Check the patient.

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<b>Message</b>	<b>Priority</b>	<b>Cause</b>	<b>Action</b>
Backup Mode active	Low	No spontaneous breaths in set period of time (Backup Time) since starting PSVPro mode.	Select a new ventilation mode. The number of consecutive patient triggered breaths reaches the Exit Backup setting.
Breathing system loose	Low	The breathing system is not latched.	Push the breathing system onto the frame and ensure it latches.
Calibrate (remove) flow sensors	Low	Flow sensor calibration failure.	Calibrate the flow sensors.
Calibrate O2 sensor	Low	Calibration failure or measured O2 is greater than 110%.	Calibrate the O2 cell. Replace O2 cell if calibration fails.
Calibrate, dry, or replace flow sensors	Low	Patient volume mismatch occurred during the last case.	Calibrate, dry or replace the flow sensors. Start a new case.
Cannot deliver agent setting at set flow	Low	Cassette output flow is 6 l/min or at maximum for more than 10 seconds.	Reduce the flow.
Cannot identify cassette	Medium	The identification coding of the cassette cannot be interpreted.	Try another cassette. Contact an authorized service representative.
Cannot monitor Air pipeline	Medium	Air pipeline pressure is invalid.	Check pipeline supply pressure.
Cannot monitor gas supplies	Low	Hardware failure.	Contact an authorized service representative.
Cannot monitor O2 pipeline	Medium	O2 pipeline pressure is invalid.	Check pipeline supply pressure.
Cannot read gas supply pressures	Medium	Transducer failure.	Contact an authorized service representative.
Cass. overfilled. Replace cassette	Medium	Agent level sensor indicates the cassette is overfilled.	Try another cassette. Contact an authorized service representative.
Check agent. Do not fill vap in use.	Low	Cassette reporting a value of empty.	Fill the cassette.
Check cassette. Set agent.	Medium	Cassette pressure is out of range. Agent flow interrupted or control failure.	Try another cassette. Remove and reinsert the cassette. Set the agent to the desired concentration.
Check circuit connections	Medium	Breaths detected in the circle circuit while non-circuit is selected.	Check circle circuit connections and settings.
Check D-Fend	Medium	Water trap not attached.	Check that the water trap is properly attached to the airway module.
Check flow sensors	Medium	System has detected an improper flow pattern in the breathing circuit.	Ensure the flow sensors are connected correctly.
Check sample gas out	Medium	Possible blockage in airway module sample gas outlet.	Check for blockage in the airway module sample gas outlet. Remove blockage.
Circuit leak	Medium	Vent TVexp is less than half of vent TV insp for at least 30 seconds.	Check for leaks in the patient circuit. Calibrate flow sensors. If problem persists, replace flow sensors.

## 7 Alarms and troubleshooting

<b>Message</b>	<b>Priority</b>	<b>Cause</b>	<b>Action</b>
Circuit leak silenced	Low	Setting on Alarm Setup menu. Vent TVexp is less than 50% of vent TVinsp for at least 30 seconds and Leak Audio is changed from On to Off.	Check the patient. Make sure Leak Audio Off is the appropriate setting for the case. Check for leaks in the patient circuit. Calibrate flow sensors. If problem persists, replace flow sensors.
Circuitry > 75C. Shutdown possible.	Medium	Power supply temperature exceeds 75 degrees C.	Shut down system as soon as possible. Then, check cooling fans and filters.
Cooling fan needs service. System OK.	Medium	Fan reporting error.	Shut down system as soon as possible. Then, check cooling fans and filters.
Cooling fans failed. May overheat.	Medium	Fan reporting error. May also be caused by a display unit or CPU temperature sensor reporting error.	Shut down system as soon as possible. Then, check cooling fans and filters.
Display panel controls failure	Medium	Communication lost between panel and key pad.	Turn the system off and back on.
EtCO2 high	High	EtCO2 is greater than high alarm limit.	Check the patient and EtCO2 settings. Check if absorbent needs to be changed.
EtCO2 low	Medium	EtCO2 is less than alarm limit.	Ensure that patient is properly intubated. Check for leaks or blockages in the patient circuit.
EtDes high	Medium	EtDes is greater than alarm limit. The alarm priority escalates to High if the alarm is not resolved after 2 minutes.	Set the alarm limits appropriately. Check agent setting.
EtDes low	Low	EtDes is less than alarm limit.	Check the fill level of the vaporizers. Set alarm limit appropriately. Check agent setting.
EtEnf high	Medium	EtEnf is greater than alarm limit. The alarm priority escalates to High if the alarm is not resolved after 2 minutes.	Set the alarm limits appropriately. Check agent setting.
EtEnf low	Low	EtEnf is less than alarm limit.	Check the fill level of the vaporizers. Set alarm limit appropriately. Check agent setting.
EtHal high	Medium	EtHal is greater than alarm limit. The alarm priority escalates to High if the alarm is not resolved after 2 minutes.	Set the alarm limits appropriately. Check agent setting.
EtHal low	Low	EtHal is less than alarm limit.	Check the fill level of the vaporizers. Set alarm limit appropriately. Check agent setting.
EtIso high	Medium	EtIso is greater than alarm limit. The alarm priority escalates to High if the alarm is not resolved after 2 minutes.	Set the alarm limits appropriately. Check agent setting.
EtIso low	Low	EtIso is less than alarm limit.	Check the fill level of the vaporizers. Set alarm limit appropriately. Check agent setting.
EtO2 high	Medium	EtO2 is greater than the high alarm limit.	Check the O2 concentration.
EtO2 low	Medium	EtO2 is less than the low alarm limit.	Check the O2 concentration.

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<b>Message</b>	<b>Priority</b>	<b>Cause</b>	<b>Action</b>
EtSev high	Medium	EtSev is greater than alarm limit. The alarm priority escalates to High if the alarm is not resolved after 2 minutes.	Set the alarm limits appropriately. Check agent setting.
EtSev low	Low	EtSev is less than alarm limit.	Check the fill level of the vaporizers. Set alarm limit appropriately. Check agent setting.
FiCO2 high. Absorbent OK?	High	FiCO2 is greater than alarm limit.	Check if absorbent needs to be changed.
FiDes high	Medium	FiDes is greater than alarm limit. The alarm priority escalates to High if the alarm is not resolved after 2 minutes.	Set the alarm limits appropriately. Check agent setting.
FiDes low	Low	FiDes is less than alarm limit.	Check the fill level of the vaporizers. Set alarm limit appropriately. Check agent setting.
FiEnf high	Medium	FiEnf is greater than alarm limit. The alarm priority escalates to High if the alarm is not resolved after 2 minutes	Set the alarm limits appropriately. Check agent setting.
FiEnf low	Low	FiEnf is less than alarm limit.	Check the fill level of the vaporizers. Set alarm limit appropriately. Check agent setting.
FiHal high	Medium	FiHal is greater than alarm limit. The alarm priority escalates to High if the alarm is not resolved after 2 minutes	Set the alarm limits appropriately. Check agent setting.
FiHal low	Low	FiHal is less than alarm limit.	Check the fill level of the vaporizers. Set alarm limit appropriately. Check agent setting.
Filso high	Medium	Filso is greater than alarm limit. The alarm priority escalates to High if the alarm is not resolved after 2 minutes	Set the alarm limits appropriately. Check agent setting.
Filso low	Low	Filso is less than alarm limit.	Check the fill level of the vaporizers. Set alarm limit appropriately. Check agent setting.
FiO2 high	Medium	FiO2 is greater than high alarm limit.	Check the O2 setting. Recalibrate the O2 cell and the airway module.
FiO2 low	High	FiO2 is less than low alarm limit.	Check O2 setting. Check for leaks or blockages in the patient circuit.
FiSev high	Medium	FiSev is greater than alarm limit. The alarm priority escalates to High if the alarm is not resolved after 2 minutes	Set the alarm limits appropriately. Check agent setting.
FiSev low	Low	FiSev is less than alarm limit.	Check the fill level of the vaporizers. Set alarm limit appropriately. Check agent setting.
For mech vent, set Bag/Vent switch	Low	Bag/Vent switch is set to Bag and the ACGO switch is set to Circle.	Move switch to Vent position to start mechanical ventilation.
Gas monitoring not available	Medium	Airway module hardware failure.	Replace airway module. Then, turn power off and back on between cases to clear the alarm and receive module data.

## 7 Alarms and troubleshooting

<b>Message</b>	<b>Priority</b>	<b>Cause</b>	<b>Action</b>
Increase low MV limit	Medium	Low MV limit is off in SIMV VCV, SIMV PCV, SIMV PCV-VG, CPAP + PSV, or PSVPro modes.	Increase low MV alarm limit to improve patient disconnection detection.
Insert cassette	Low	Cassette removal detected during active delivery.	Reinsert the cassette.
Inspiration stopped	Medium	High airway pressure.	Check system for blockages.
Internal failure. System may shut down.	High	Power controller software failure.	Contact an authorized service representative.
Internal failure. System may shut down.	Medium	Power controller software failure.	Contact an authorized service representative.
Low gas sample flow	Low	Sample flow is less than 80% of nominal flow for 20 seconds.	Check for blockage in the airway module sample gas line.
Memory (EEPROM) failure	Low	Software error.	Contact an authorized service representative.
Module fail. No CO <sub>2</sub> , AA, O <sub>2</sub> data.	Medium	Airway module hardware failure.	Replace module.
Module not compatible	Low	The monitoring module detected is not compatible with system software.	Remove the incompatible module. Use a compatible module.
Move Bag/Vent switch to Bag	Medium	Bag/Vent switch was in the Vent position when the case was started.	Move switch to the Bag position.
MVexp high	Medium	MVexp is greater than MVexp high alarm limit (for nine breaths and one minute has elapsed).	Set the alarm limits appropriately. Check the ventilation settings.
MVexp low	Medium	MVexp is less than MVexp low alarm limit (for nine breaths and one minute has elapsed).	Set the alarm limits appropriately. Check the ventilation settings.
N <sub>2</sub> O supply pressure low	Medium	N <sub>2</sub> O pipeline pressure is less than 252 kPa (36 psi) and the N <sub>2</sub> O cylinder pressure is less than 2633 kPa (381 psi).	Ensure the N <sub>2</sub> O pipeline and cylinder are properly connected.
Negative airway pressure	High	Paw is less than -10 cmH <sub>2</sub> O.	Check for blockages in the patient circuit.
No battery backup	Medium	Battery or charging failure.	Between cases turn the system circuit breaker off, then back on after 15 seconds to reset the system.
No exp flow sensor	Medium	Electrical signals show the flow sensor is not connected.	Connect the flow sensor. Replace the flow sensor if necessary.
No fresh gas flow!	High	Possible patient detected while system is in checkout state.	Disconnect the patient or start the case.
No fresh gas flow?	High	Possible fresh gas flow occlusion or loss of gas pressure.	Switch to circle circuit or bag the patient. Check pipeline supply connection.
No insp flow sensor	Medium	Electrical signals show the flow sensor is not connected.	Connect the flow sensor. Replace the flow sensor if necessary.
O <sub>2</sub> flush stuck on?	Low	Switch detected "on" continuously for more than 30 seconds.	Check flush valve. Ensure flush valve is not sticking.

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<b>Message</b>	<b>Priority</b>	<b>Cause</b>	<b>Action</b>
O2 monitoring not connected	Medium	O2 cell not connected.	Install airway gas module or connect the O2 cell.
O2 supply pressure low	High	O2 pipeline pressure is less than 252 kPa (36 psi) and the O2 cylinder pressure dropped below 2633 kPa (381 psi) for one second.	Ensure the O2 pipeline and cylinder are properly connected.
PEEP high. Blockage?	High	Paw greater than or equal to sustained limit for 15 seconds. See "Sustained pressure threshold" section for more information.	Check for blockages in the patient circuit.
Plug in power cable. On battery.	Medium	The mains supply is not connected or has failed and the system is using battery power.	Ventilate manually to save power. Make sure the power cable is plugged in and system breaker is on.
Peak high	High	Paw is greater than Pmax alarm limit.	Check for blockages in the patient circuit.
Peak low. Leak?	Medium	Peak airway pressure is less than low Pmin + 4 cmH <sub>2</sub> O for 20 consecutive seconds if the set respiratory rate is four or higher and 35 seconds if the set respiratory rate is less than four breaths/min.	Checks for leaks in the patient circuit.
Pressure limit reached	Medium	In PCV-VG or SIMV PCV-VG inspiratory pressure limit is reached.	Reset the pressure limit setting to an appropriate setting.
Replace D-Fend	Medium	Buildup in airway module sample line.	Replace D-Fend.
Replace exp flow sensor	Low	EEPROM calibration data read failure.	Replace the expiratory flow sensor.
Replace insp flow sensor	Low	EEPROM calibration data read failure.	Replace the inspiratory flow sensor.
Replace O2 sensor	Low	Measure O2 is less than 5%.	Calibrate the O2 cell. Replace the O2 cell if necessary.
Reverse exp flow. Check valves OK?	Medium	Flow toward the patient seen in the expiratory flow sensor during inspiration for six breaths in a row.	Calibrate the flow sensors.
Reverse insp flow. Check valves OK?	Medium	Flow away from the patient seen in the inspiratory flow sensor during expiration for six breaths in a row.	Calibrate the flow sensors.
RR high	Medium	RR is greater than high alarm limit.	Set the alarm limits appropriately or adjust the RR setting.
RR low	Medium	RR is less than low alarm limit.	Set the alarm limits appropriately or adjust the RR setting.
Sample line blocked	Medium	Airway module sample line is blocked.	Replace airway module sample line.
Service calibration advised	Low	Calibration data is corrupt.	Contact an authorized service representative.
Set Alt O2 flow! Agent delivery off!	Medium	Multiple possible causes for the failure.	Contact an authorized service representative.
Set Alt O2 flow! Check agent setting!	Medium	Software or hardware failure prevents mixed gas delivery.	Contact an authorized service representative.

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<b>Message</b>	<b>Priority</b>	<b>Cause</b>	<b>Action</b>
System leak?	Low	Leak detected between ventilator and patient circuit.	Check for leaks in the breathing system.
System shutdown in < 5 minutes	High	Remaining battery power is between zero and five minutes.	Plug in the power cable. Check that the system circuit breaker is on.
Touchscreen failure	Medium	Touchscreen interface is not working.	Contact an authorized service representative.
Try another cassette. Contact service.	Medium	Vaporizer detected a cassette temperature failure, cassette temperature data read error, or a software compatibility failure.	Insert a different cassette. Contact an authorized service representative.
Turn power Off and On for self tests	Low	System has been operating for longer than 12 hours without a power-up self test.	Turn power off and back on between cases to perform a self test.
Turn switch On to continue use	High	System is in therapy when System switch is turned to Standby.	Turn the System switch to On to continue therapy. The system will return to normal function. If System switch is not turned to On within 8 seconds, the system will shut down.
TV not achieved	Low	Measured tidal volume is less than set tidal volume.	Check for leaks in the patient circuit. Check for leaks in the breathing system.
TVexp high	Medium	TVexp is greater than TVexp high alarm limit (for nine breaths).	Set the alarm limits appropriately. Check ventilation settings.
TVexp low	Medium	TVexp is less than TVexp low alarm limit (for nine breaths).	Set the alarm limits appropriately. Check ventilation settings.
Unable to drive bellows	Low	Bellows is collapsed.	Check the drive gas. Increase fresh gas flow (or push the O2 flush button) to fill the bellows.
Using battery. Power Controller fail.	Medium	Mains supply is OK, but the system is running on the battery.	Shut down the system as soon as possible.
Vap leak? Try another cassette.	Medium	Cassette leak. Agent filling attempted during delivery. Internal issue with agent delivery hardware.	Try another cassette. Do not attempt to fill agent cassette while delivering agent. Contact an authorized service representative.
Vaporizer failure	Medium	Internal issue with agent delivery hardware.	Change anesthesia method or use an alternate machine. Shut down the system as soon as possible and contact an authorized service representative.
Vaporizer internal temp out-of-range	Medium	Manifold temperature reading or cassette temperature reading is outside of the limit.	Change the agent setting.
Ventilate manually!	High	Software or hardware failure prevents mechanical ventilation. No pressure, no flow, and no volume monitoring from ventilator.	Use a manual bag to ventilate the patient or use an alternate machine. Shut down the system as soon as possible and contact an authorized service representative.
Ventilate manually!	Medium	Software or hardware failure prevents mechanical ventilation.	Use a manual bag to ventilate the patient or use an alternate machine. Shut down the system as soon as possible and contact an authorized service representative.

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<b>Message</b>	<b>Priority</b>	<b>Cause</b>	<b>Action</b>
Ventilator has no drive gas	High	Drive gas supply is not sufficient to mechanically ventilate.	Check drive gas supply. Use a manual bag to ventilate the patient until drive gas supply is restored.
Vol and Apnea monitoring off	Low	Non circle circuit is selected.	Message will clear when circle circuit is selected.
Vol vent only. No PEEP or PSV.	Medium	Manifold pressure error. Pressure control unavailable. Bag/Vent switch is in Vent and running PCV, PSVPro, SIMV PCV, CPAP + PSV, PCV-VG, or SIMV PCV-VG mode.	Use volume control ventilation mode. Shut down the system as soon as possible and contact an authorized service representative.
Vol vent only. No PEEP or PSV.	Low	Manifold pressure error. Pressure control unavailable. Bag/Vent switch is in Vent and running VCV or SIMV VCV mode, Bag/Vent switch is in Bag, or Non-circle circuit or ACGO is selected.	Use volume control ventilation mode. Shut down the system as soon as possible and contact an authorized service representative.
Volume sensors disagree	Low	TVexp is greater than TVinsp for six breaths.	Calibrate the flow sensors. Replace the flow sensors if the message does not clear.

## Sustained pressure threshold

The sustained pressure threshold is calculated from the maximum pressure (Pmax) setting. The sustained limit is calculated as follows:

- |                                       |  |
|---------------------------------------|--|
| Mechanical Ventilation with PEEP Off: | For Pmax less than 30 cmH <sub>2</sub> O, the sustained pressure limit is 6 cmH <sub>2</sub> O.<br>For Pmax between 30 and 60 cmH <sub>2</sub> O, the sustained pressure limit is 20% of Pmax.<br>For Pmax greater than 60 cmH <sub>2</sub> O, the sustained pressure limit is 12 cmH <sub>2</sub> O.  |
| Mechanical Ventilation with PEEP On:  | For Pmax less than 30 cmH <sub>2</sub> O, the sustained pressure limit is 6 cmH <sub>2</sub> O plus "set PEEP" minus 2 cmH <sub>2</sub> O.<br>For Pmax between 30 and 60 cmH <sub>2</sub> O, the sustained pressure limit is 20% of Pmax plus "set PEEP" minus 2 cmH <sub>2</sub> O.<br>For Pmax greater than 60 cmH <sub>2</sub> O, the sustained pressure limit is 12 cmH <sub>2</sub> O plus "set PEEP" minus 2 cmH <sub>2</sub> O. |
| Mechanical Ventilation Off:           | For Pmax between 12 and 60 cmH <sub>2</sub> O, the sustained pressure limit is 50% of Pmax.<br>For Pmax greater than 60 cmH <sub>2</sub> O, the sustained pressure limit is 30 cmH <sub>2</sub> O.   |

## Alarm ranges

The alarm names are listed in the **Primary Limits** and **More Limits** tabs on the **Alarm Setup** menu. See the "Super user mode" section for more information on the alarm default settings.

Alarm	Range	Increment
Pmax (only high)	12-100 cmH2O 1.2 - 9.8 kPa 12 - 98 mbar, hPa 9-73 mmHg	1 cmH2O 0.1 kPa 1 mbar, 1 hPa 1 mmHg
MV High	0.5 - 30.0, Off l/min	0.5 l/min
MV Low	Off, 0.1 - 10.0 l/min	0.1 l/min
TV High	20 -1600, Off ml	20 ml
TV Low	Off, 1 - 5 ml 5 - 20 ml 20 - 1500 ml	1 ml 5 ml 20 ml
RR High	2 - 100, Off /min	1 /min
RR Low	Off, 1 -99 /min	1 /min
EtCO2 High	0.1 - 15%, Off 0.1 - 15, Off kPa 1 - 115, Off mmHg	0.1% 0.1 kPa 1 mmHg
EtCO2 Low	Off, 0.1 - 14.9% Off, 0.1 - 14.9 kPa Off, 1 - 114 mmHg	0.1% 0.1 kPa 1 mmHg
FiCO2 High	0.1 - 15%, Off 0.1 - 15, Off kPa 1 - 115, Off mmHg	0.1% 0.1 kPa 1 mmHg
FiO2 High	19 - 100%, Off	1%
FiO2 Low	18 - 99%	1%
EtO2 High	19 - 100%, Off	1%
EtO2 Low	Off, 1 - 99%	1%
Filso High	0.1 - 7.0%	0.1%
Filso Low	Off, 0.1 - 6.9%	0.1%
FiSev High	0.1 - 10.0%	0.1%
FiSev Low	Off, 0.1 - 9.9%	0.1%
FiDes High	0.1 - 20.0%	0.1%
FiDes Low	Off, 0.1 - 19.9%	0.1%
FiEnf High	0.1 - 7.0%	0.1%
FiEnf Low	Off, 0.1 - 6.9%	0.1%
FiHal High	0.1 - 7.0%	0.1%
FiHal Low	Off, 0.1 - 6.9%	0.1%
Etlso High	0.1 - 7.0%, Off	0.1%

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<b>Alarm</b>	<b>Range</b>	<b>Increment</b>
EtIso Low	Off, 0.1 - 6.9%	0.1%
EtSev High	0.1 - 10.0%, Off	0.1%
EtSev Low	Off, 0.1 - 9.9%	0.1%
EtDes High	0.1 - 20%, Off	0.1%
EtDes Low	Off, 0.1 - 19.9%	0.1%
EtEnf High	0.1 - 7.0%, Off	0.1%
EtEnf Low	Off, 0.1 - 6.9%	0.1%
EtHal High	0.1 - 7.0%, Off	0.1%
EtHal Low	Off, 0.1 - 6.9%	0.1%

## Alarm tests

Test the system to verify that alarms are functioning.

**Note** If an airway module is installed, the FiO<sub>2</sub> readings are taken from the module instead of from the O<sub>2</sub> cell. A sample line must be connected from the airway module to the breathing circuit to test the O<sub>2</sub> alarms.

1. Connect a test lung to the patient connection.
2. Start a case.
3. Set the Bag/Vent switch to Vent.
4. Set the O<sub>2</sub> concentration to 30%, and allow the O<sub>2</sub> reading to stabilize.  
For machines configured to individual gas control, set the 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:
  - 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 back 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.
  - Make sure the ***FiO<sub>2</sub> high*** alarm occurs.
  - Set the ***FiO<sub>2</sub> High*** alarm limit back to 100%. Make sure that the ***FiO<sub>2</sub> high*** alarm cancels.
6. Test the ***MVexp low*** alarm:
  - 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 ***Pmax*** to less than the peak airway pressure.
  - Make sure that the ***Ppeak high*** alarm occurs.
  - Set ***Pmax*** to the desired level.
8. Test the ***PEEP high. Blockage?*** alarm:
  - Close the APL valve.
  - Set the Bag/Vent switch to Bag. Mechanical ventilation stops.
  - 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?*** alarm:

- 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?*** alarm occurs.
10. Set all alarm limits to approved clinical values.

## Breathing system problems

Symptom	Problem	Solution
Gas scavenging flow is too low or too high.	Scavenging extract flow problem.	Use a different scavenging extraction system. Verify flow is within specification.
	Filter blockage. Active systems have a flow indicator.	Replace the filter. Refer to "Remove the AGSS receiver filter" in the "Advanced Breathing System Cleaning and Sterilization" User's Reference manual.
The bellows fills when the Bag/Vent switch is set to Bag or the bag fills when the switch is set to Vent.	Leak through Bag/Vent switch.	Contact an authorized service representative to repair the system.
The ventilator does not read the position of the Bag/Vent switch.	Ventilator or absorber malfunction.	Ventilate manually. Contact an authorized service representative to repair the system.
APL valve does not operate correctly.	APL valve problem.	Replace APL valve seal and diaphragm.
Large breathing system leak.	Bag hose not connected properly.	Make sure the bag hose is connected to the bag port (below the APL valve).
	Absorber canister not installed correctly.	Reinstall the absorber canister. Make sure both pins are engaged.
Bellows falls below top of indicator during the Bellows assembly test.	Leak in the breathing system.	Check, clean, or reposition the pressure relief valve. If the problem persists, replace the pressure relief valve, bellows base, or bellows assembly.
During PCV-VG mode, measured tidal volume is less than set.	Inspiratory pressure is limited to Pmax minus 5 cmH <sub>2</sub> O.	Increase the Pmax setting.

## Electrical problems

**WARNING** If a circuit breaker opens frequently, do not use the system. Contact an authorized service representative to repair the system.

Symptom	Problem	Solution
Mains indicator is not on.	The electrical power cable is not connected.	Connect the power cable.
	The system circuit breaker (switch) is off.	Turn the circuit breaker on.
	The power cable is damaged.	Replace the power cable.
	The electrical socket the power cable connects to has no power.	Use a different electrical socket.
	An internal fuse is open.	Contact an authorized service representative to repair the system.
One electrical outlet does not have power.	The outlet circuit breaker is off.	Turn the circuit breaker on.
A circuit breaker opens frequently.	Equipment connected to the outlet(s) uses more current than the circuit breaker rating.	Use a different power supply for some of the equipment.
	The equipment connected to the outlet has a short.	Contact an authorized service representative to repair the system.
The real time clock on the anesthesia display does not maintain accurate time and date.	The battery in the anesthesia display needs to be replaced.	Contact an authorized service representative to repair the system.
Audible alarm sounds. The system function stops. The screen is blank.	Internal power converter failure.	Turn the system off. Contact an authorized service representative to repair the system.

## Pneumatic problems

Symptom	Problem	Solution
High-pressure leak test fails.	Controls are not set correctly.	Make sure no gas is flowing, turn off the auxiliary flow meter, and repeat the test.
	Incorrect cylinder connection.	Make sure that there is only one cylinder gasket, the gasket is in good condition, and the connection is tight.
Low-pressure leak.	Anesthesia machine problem.	Contact an authorized service representative.



# 8 Setup and connections

<b>In this section</b>	
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Moving and transporting the system.....	8-4
Setting up the absorber canister.....	8-5
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## Setup safety

- WARNING** The manufacturer strongly recommends the use of O<sub>2</sub> monitoring and anesthetic agent monitoring with this equipment. Failure to use monitoring could result in injury to the patient. Refer to local standards for mandatory monitoring.
- Always make sure the pipeline supply hoses and the breathing circuit components are not toxic and will not:
    - Cause an allergic reaction in the patient.
    - React with the anesthetic gases or agent to produce dangerous by-products.
  - Use only GE Healthcare approved cables, hoses, and tubing. Other manufacturer's cables, hoses, and tubing could cause incorrect values or equipment malfunction.
  - Do not exceed electrical interference levels specified in IEC 60601-1-2. Electrical interference can cause nuisance alarms that may stop mechanical ventilation. This system operates correctly at the electrical interference levels of IEC 60601-1-2.
  - To help prevent false alarms from devices with high-intensity electrical fields:
    - Keep the electrosurgical leads away from the breathing system, the flow sensors, and the oxygen cell.
    - Do not allow the electrosurgical leads to contact any part of the anesthesia system.
    - Do not use cell phones near the anesthesia system.
  - To protect the patient when electrosurgical equipment is used:
    - Monitor the correct operation of all life support and monitoring equipment.
    - Keep backup manual ventilation available in case the electrosurgical equipment prevents safe use of the ventilator.
  - Use only reservoir bags that comply with EN1820 or ISO 5362 on this system.

- Use only breathing tubes that comply with EN12342 or ISO 5367 on this system.
- A malfunction of the medical gas central supply system may cause all connected devices to stop.
- All gases supplied to the system must be medical grade. Use of non-medical grade gases could result in equipment damage.
- Do not modify this equipment without authorization from the manufacturer. Unauthorized modifications could result in damage to the equipment and/or cause patient injury.

See "*System information*" in the "*Introduction*" section for information on specific monitoring requirements.

## Moving and transporting the system

**WARNING** The system may overbalance or tip if tilted more than 10 degrees.

- Do not exceed specified load ratings when mounting equipment on the top of the machine or on any of the side rails.

See "*Attaching equipment to the top of the machine*" and "*Specifications and theory of operation*" for system load ratings.

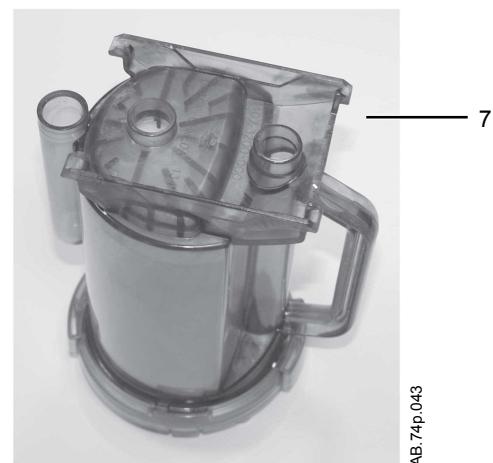
Before transporting or moving the system, fold all display arms into the system and put the flip-up shelf in the down position. Tighten the horizontal-positioning lock on the display arm. When using the brake on an incline, be sure to lock the brake with the machine facing down the slope.

## Setting up the absorber canister

The absorber canister is available in two versions: Disposable Multi Absorber and Reusable Multi Absorber. Both are removed and installed on the breathing system the same way.

Each canister holds 800 grams of loose absorbent. The manufacturer recommends Medisorb TM absorbent.

Both absorber versions should only be used with mixtures of air, oxygen, nitrous oxide, halothane, enflurane, isoflurane, desflurane and sevoflurane.



1. Canister support pin
2. Canister handle
3. Disposable Multi Absorber canister
4. Absorbent
5. Expiratory water reservoir
6. Canister release latch

7. Reusable Multi Absorber canister

*Figure 8-1 • Canister*

- WARNING** Obey applicable safety precautions:
- Do not use the absorber with chloroform or trichlorethylene.
  - The Disposable Multi Absorber is a sealed unit which should not be opened or refilled.
  - Avoid skin or eye contact with the contents of the absorber. In the event of skin or eye contact, immediately rinse the affected area with water and seek medical assistance.
  - Do not remove the absorber canister to change the canister or to change the absorbent while ventilating a patient unless the system is equipped with the EZchange canister module.
  - Change absorbent often to prevent buildup of non-metabolic gases when the system is not in use.
  - Inspect absorbent color at the end of a case. During non-use, absorbent can go back to the original color. Refer to the absorbent labeling for more information about color changes.
  - If the absorbent completely dries out, it may give off carbon monoxide (CO) when exposed to anesthetic agents. For safety, replace the absorbent.
  - Desiccated (dehydrated) absorbent material may produce dangerous chemical reactions when exposed to inhalation anesthetics. Adequate precautions should be taken to ensure that absorbent does not dry out. Turn off all gases when finished using the system.

## When to change the absorbent

A gradual color change of the absorbent in the canister indicates absorption of carbon dioxide. The color change of the absorbent is only a rough indicator. Use carbon dioxide monitoring to determine when to change the canister.

Immediately discard the absorbent if it has changed color. If left standing for several hours, absorbent may regain its original color giving a misleading indication of effectiveness.

Read the absorbent manufacturer's instructions completely before using the product.

## Removing a canister

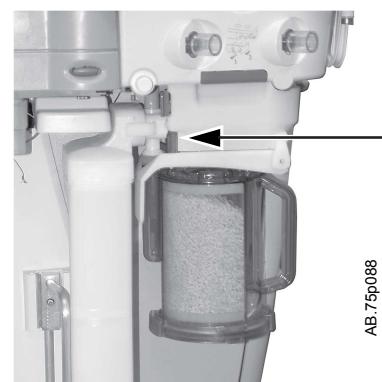
1. Hold the canister by the handle and push on the release latch to unlock the canister.



2. Remove the canister by tilting it downward and off the two support pins.

## Removing an EZchange canister

1. Hold the canister by the handle and push the canister cradle release latch to unlock the canister cradle.



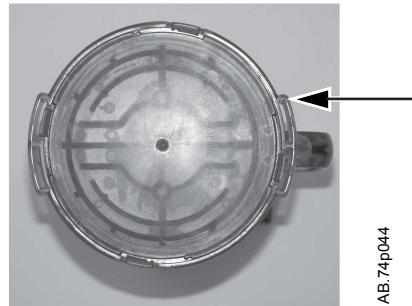
2. Slide the canister up and out of the cradle.



AB.75p089

## Filling the Reusable Multi Absorber canister

1. Turn the canister upside down and, using your thumbs, turn the cover locking ring counterclockwise to unlock it.



AB.74p044

2. Push up to release the seal.
3. Lift off the cover to remove it.

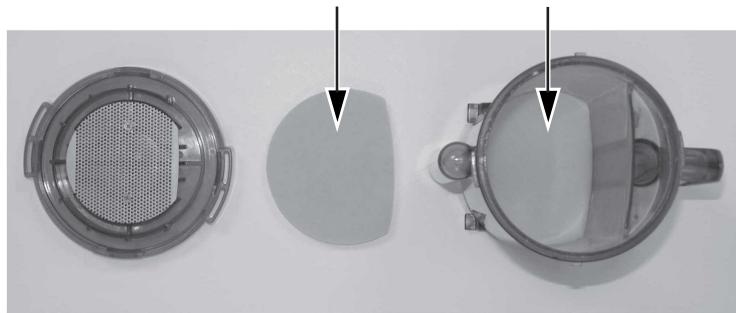


AB.74p046

4. Remove and properly discard the foam filters, the absorbent, and any water in the reservoir.

### **WARNING**

Be careful when draining condensate from the absorber. The liquid is caustic and may burn skin.



AB-74p047

5. To clean and disinfect the canister, refer to "Absorbent canister cleaning" in the "Cleaning and Sterilization" manual.
6. Place a new filter in the bottom of the canister, pour absorbent into the canister and place a new filter over the absorbent before closing and locking the cover. Wipe off any absorbent dust.
7. Align the cover slots with the canister locking tabs and press the cover down into place. Turn the cover locking ring clockwise to lock the cover in place. Ensure the cover is properly sealed to prevent leaks and spillage. Alignment of the arrows helps to indicate correct assembly.



AB-82p001

**WARNING**

The filters must be in place to help prevent dust and particles from entering the breathing circuit.

8. When replacing the canister, make sure that it is seated properly on the support pins or in the EZchange canister module before latching it into place.

## Electrical connections

### Mains inlet

The arrow shows the mains power inlet and cord.



### Equipotential stud

The equipotential stud is used to connect the anesthesia machine to an equipotential grounding system by attaching a potential equalization conductor. Equipotential grounding is used in some hospitals to enhance electrical safety in critical care areas by attempting to keep the conductive surfaces of all equipment in the patient care area at the same ground potential, thereby minimizing unwanted current flow.

### Outlets

Labels show outlet voltage ratings and circuit breaker amp ratings. These are isolated outlets. Regularly test the leakage current.



AB.75p134

## Serial port

The system has a Universal Serial Bus (USB) port on the back of the display unit. This port is for use by authorized service personnel to load software and access log files. It should not be used for other purposes.

**CAUTION** Only insert USB memory sticks powered solely by the USB port. Do not plug in devices with batteries, or connect to an external power source.



AB.75p133

## Pneumatic connections

**CAUTION** Use only medical grade gas supplies. Other types of gas supplies may contain water, oil, or other contaminants which could affect the operation of the pneumatic system.

The gas supplies provide gas to these devices through internal connections:

- Venturi suction regulator (optional)
- Auxiliary O<sub>2</sub> flowmeter (optional)

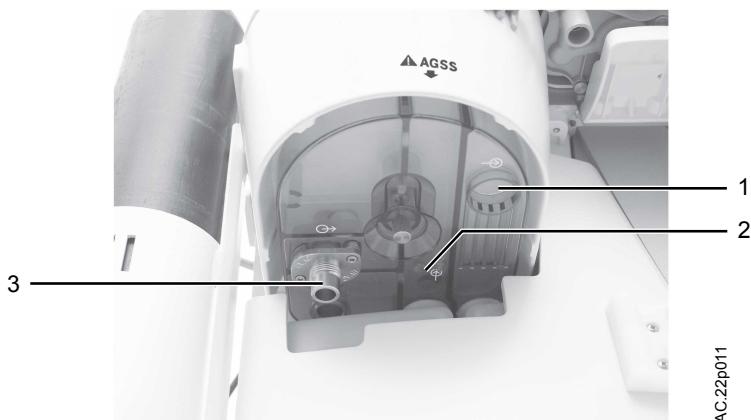
## Pipeline inlets



## Scavenging

The AGSS assembly is located below the bellows on the breathing system. Adapters may be necessary to interface to the scavenging connector.

See "*Passive AGSS*" and "*Active AGSS*" for more scavenging information.



1. Auxiliary inlet
2. Sample gas scavenging port
3. Outlet connection

*Figure 8-2 • AGSS connections*

### Scavenging the ACGO sample flow

When the ACGO port is in use, a sample of the fresh gas is diverted to the airway module or the O2 cell in the breathing system. This sample is then measured and displays the O2 numerics on the screen. This sample flow should be scavenged when N2O or volatile anesthetics are delivered through the ACGO. If scavenging is not connected, the sample flow will enter the room through the breathing system. To connect the scavenging:

1. Attach a circle breathing circuit to the inspiratory and expiratory ports.
2. Occlude the breathing circuit by connecting the wye-piece, or patient connection, to the leak test plug located behind the expiratory port.
3. Check for clinically correct settings.
4. Check the position of the Bag/Vent switch.
  - If the Bag/Vent switch is set to mechanical ventilation mode, the bellows fills slowly with the sample flow. When the bellows is full, the sample gas flow goes to the AGSS. (Mechanical ventilation does not start when the ACGO switch is set to ACGO.)
  - If the Bag/Vent switch is set to the bag mode, set the APL valve to MIN, and attach a bag to the manual bag port. The bag fills slowly with the sample flow. When the bag is full, the sample flow goes to the AGSS.

## Scavenging from an auxiliary manual breathing circuit

Scavenge the exhaust if an auxiliary manual circuit is used with N2O or volatile anesthetics.

An auxiliary inlet is available on the AGSS. It provides a female connection for use with a 30 mm - 30 mm male connector (or 30 mm - 19 mm male connector) under the breathing system. Do not use these connectors as an outlet for exhaust flow.

A separate hose is needed to connect the exhaust from the auxiliary manual breathing circuit to the auxiliary inlet on the AGSS.

## Scavenging a gas monitor sample flow

Sample gas from a gas monitor can be scavenged by connecting the exhaust from the monitor to either the sample gas return port located on the front of the machine or the tubing connector provided on the AGSS.

- To scavenge from a gas monitor using the sample gas return port, connect the exhaust from the monitor to the sample gas return port located on the front of the machine.
- To scavenge from a gas monitor using AGSS, connect tubing from the monitor to the tubing connector on the bottom of the AGSS underneath the breathing system.

## Sample gas return port

Connect the sample gas exhaust tube to the gas return port. Exhaust gas will be directed to the scavenging system.



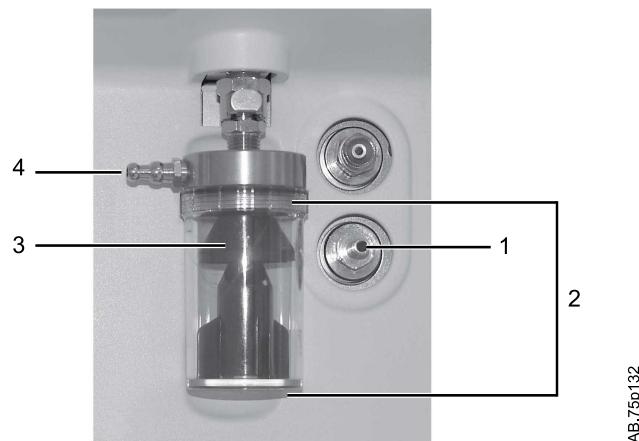
AB.75p127

## Pneumatic power outlet



## Vacuum suction regulator (optional)

The vacuum suction regulator uses an external vacuum supply. Connect the vacuum connection to the source vacuum supply. Connect the collection bottle connection to the collection bottle.

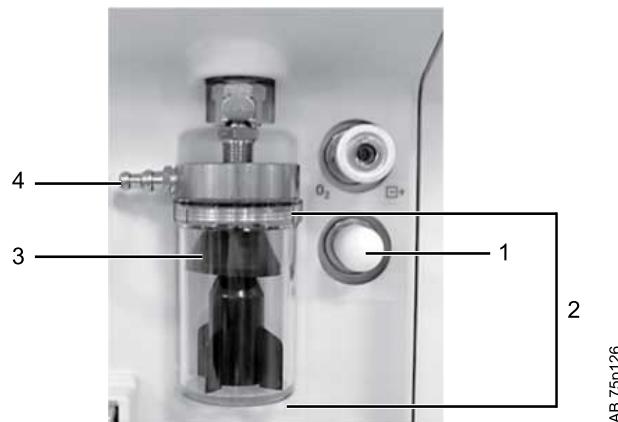


1. External vacuum connection
2. Overflow safety trap
3. Splash guard
4. Collection bottle connection

*Figure 8-3 • External vacuum suction*

## Venturi suction regulator (optional)

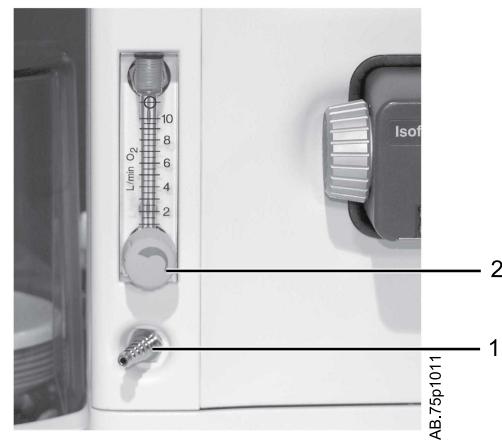
The venturi suction regulator uses the system air or O<sub>2</sub> supply source. Connect the collection bottle connection on the overflow safety trap to the collection bottle.



1. Venturi muffler
2. Overflow safety trap
3. Splash guard
4. Collection bottle connection

Figure 8-4 • Venturi suction

## Auxiliary O<sub>2</sub> flowmeter (optional)



1. Auxiliary O<sub>2</sub> outlet

## 8 Setup and connections

### 2. Auxiliary O2 flow control

*Figure 8-5 • Auxiliary O2 flowmeter*

## Installing gas cylinders

**CAUTION** 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.

### Installing cylinders with pin indexed yokes

1. Locate the cylinder wrench.
  2. Close the cylinder valve on the cylinder to be replaced.
  3. Loosen the tee handle.
  4. Open the cylinder yoke.
  5. Remove the used cylinder and the used gasket.
  6. Remove the cap (if equipped) from the cylinder valve on the new cylinder.
- WARNING** Make sure there is only one gasket on the cylinder connection. No gasket or more than one gasket can cause a leak.
7. Install a new gasket.
  8. Align the cylinder post with the index pins.
  9. Close the yoke gate and tighten the tee handle.
  10. Make sure there is a cylinder plug and gasket in any empty cylinder yokes.
  11. Complete "*Performing a high-pressure leak test*".

### Installing cylinders with DIN connections

1. Close the cylinder valve on the cylinder to be replaced.
2. Loosen the adapter and remove the cylinder.
3. Remove the cap from the cylinder valve on the new cylinder.
4. Install the cylinder.
5. Complete "*Performing a high-pressure leak test*".

### Performing a high-pressure leak test

1. Turn on the system.
2. Disconnect pipeline supplies.

## 8 Setup and connections

3. Turn off the auxiliary O2 flowmeter and venturi suction.
4. Open the cylinder.
5. Record the cylinder pressure.
6. Close the cylinder.  
If the cylinder pressure decreases more than 690 kPa (100 psi) in one minute there is a significant leak.
7. To repair a leak, install a new cylinder gasket and tighten the adapter.
8. Repeat the leak test. If the leak continues, do not use the system.

## Attaching equipment to the top of the machine

**WARNING** The top of the machine has a weight limit of 45 kg (100 lb).

- Check the stability of the system in its final configuration. Make sure the weight is evenly distributed throughout the system.
  1. Locate the clips or straps.
  2. Install the straps. See the "Parts" section for strap ordering information.
  3. Fully tighten the straps.
  4. Make sure the straps hold the equipment in position.

**WARNING** Fully tighten the straps. If straps are not fully tightened, equipment can fall off the top of the machine.

## Passive AGSS

**WARNING** Always verify the proper operation of any gas scavenging system. Make sure that the scavenging system is not occluded.

The optional passive anesthesia gas scavenging system (AGSS) is for use in operating room environments that do not have an active gas extraction system for waste gas disposal. The passive AGSS contains both positive and negative pressure relief valves to protect the breathing system and the patient.

Passive AGSS may be used with a non-recirculating ventilation system for waste gas disposal. The tube connection from passive AGSS to the non-recirculating ventilation system should be an open connection, essentially at atmospheric pressure. For example, to an exhaust grill.

### Connecting passive AGSS

1. Connect a large diameter tube to the 30-mm tapered connector on the bottom of the AGSS receiver.
2. Route the large diameter tube from the passive AGSS to exterior of the building or to a non-recirculating ventilation system.  
The tube should be as large in diameter and as short as possible.

## Active AGSS

**WARNING** Always verify the proper operation of any gas scavenging system. Make sure the scavenging system is not occluded.

There are several versions of the optional active Anesthesia Gas Scavenging System (AGSS) available depending on the hospital's type of waste gas disposal system.

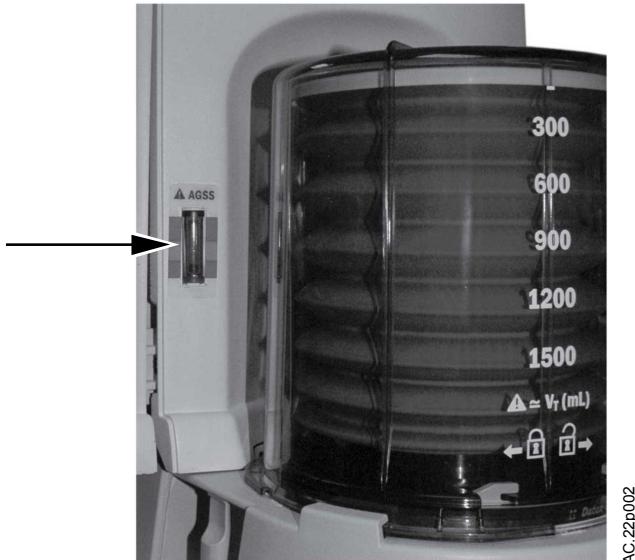
Each version has a two-liter reservoir to capture peak exhaust flows that briefly exceed the extract flow. The disposal system normally entrains room air through an air brake (located in a receiver underneath the breathing system), but will spill from this port during extended periods of high exhaust flow. Its effectiveness is limited by the extract flow of the particular active AGSS device.

- The active low flow system is for use with high vacuum disposal systems. It requires a vacuum system capable of a continuous nominal flow of 36 l/min and 300 mmHg (12 inHg) or greater vacuum pressure. A flow indicator on the system indicates when the unit is in operation.
- The active high flow system is for use with low vacuum (blower type) disposal systems. This requires a system capable of providing a continuous nominal flow of 50 l/min. A flow indicator on the system indicates when the unit is in operation.
- The active adjustable flow system provides the ability to adjust the flow with a needle valve (located in a receiver underneath the breathing system) and a visual indicator bag which should be properly inflated. It requires a vacuum system capable of a continuous nominal flow of 30 l/min and 300 mmHg (12 inHg) or greater vacuum pressure.
- The active low flow system with a 12.7 mm hose barb connector is for use with low vacuum disposal systems. It requires an external system with flowmeter.
- The active low flow system with a 25 mm barb connector is for use with low vacuum disposal systems. It requires an external venturi/ejector system with 40 to 50 l/min extract flow. A flow indicator on the system indicates when the unit is in operation.
- The active low flow system with 30 mm ISO taper is for use with low vacuum disposal systems. It requires an external venturi/ejector system with 40 to 50 l/min extract flow. A flow indicator on the system indicates when the unit is in operation.

### Connecting active AGSS with a flow indicator

To use the optional active AGSS on a system that has a flow indicator, connect it as follows.

1. Connect the proper hose to the AGSS outlet connector on the bottom of the AGSS underneath the breathing system.
2. Attach the other end of the hose to the hospital disposal system.
3. With the AGSS operating, verify that the ball on the flow indicator rises to the green zone, indicating adequate flow.



**Note** The ball in the upper red zone indicates excessively high extraction flow. The ball in the lower red zone indicates extraction flow rate is too low or a blocked filter.

4. Complete the tests in the "Preoperative tests" section of this manual.

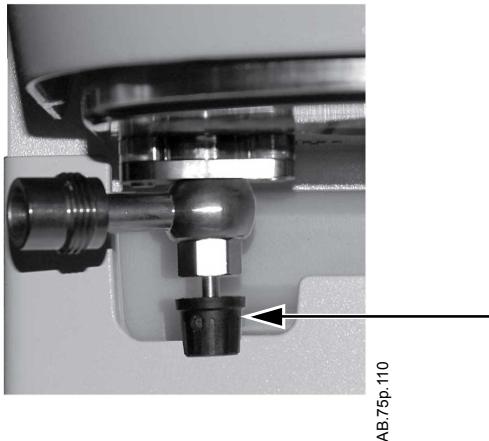
## Connecting active adjustable AGSS

The active adjustable AGSS option flow rate is limited to 30 l/min with this option.

To use the optional active AGSS installed on the system which uses the three-liter bag as a visual indicator, connect it as follows:

1. Connect a disposal hose to the DISS connector on the needle valve on the bottom of the AGSS (underneath). The hose should be flexible and reinforced to help prevent kinking and crushing.
2. Attach the other end of the hose to the hospital disposal system.
3. Attach the three-liter bag to the 30 mm auxiliary 1 port on the bottom of the AGSS.
4. Adjust the flow rate to match the amount of gas being scavenged. Use the bag as a visual indicator when adjusting the

flow rate. The bag should remain partially inflated when the flow rate is adequate.



AB.75p.110

5. Complete the tests in the "*Preoperative tests*" section.

# 9 User maintenance

<b>In this section</b>	Maintenance safety. . . . .	9-2
	Repair policy. . . . .	9-3
	Maintenance summary and schedule. . . . .	9-4
	Circuit O2 cell replacement. . . . .	9-5
	Calibration menu. . . . .	9-6

## Maintenance safety

**WARNING** To help prevent fires:

- Do not use lubricants that contain oil or grease. They may burn or explode in high O<sub>2</sub> concentrations.
- All covers used on the system must be made from antistatic (conductive) materials. Static electricity can cause fires.
- Desiccated (dehydrated) absorbent material may produce dangerous chemical reactions when exposed to inhalation anesthetics. Adequate precautions should be taken to ensure that absorbent does not dry out. Turn off all gases when finished using the system.
- Obey infection control and safety procedures. Used equipment may contain blood and body fluids.
- Moveable parts and removable components may present a pinch or a crush hazard. Use care when moving or replacing system parts and components.

## Repair policy

Do not use malfunctioning equipment. Make all necessary repairs or have the equipment serviced by an authorized service representative. After repair, test the equipment to ensure that it is functioning properly, in accordance with the manufacturer's published specifications.

To ensure full reliability, have all repairs and service done by an authorized service representative. If this cannot be done, replacement and maintenance of those parts listed in this manual may be undertaken by a competent, trained individual having experience in the repair of devices of this nature.

**CAUTION** Do not attempt to repair this device without appropriate training in the repair of devices of this nature. Equipment damage could occur.

Replace damaged parts with components manufactured or sold by GE Healthcare. Then test the unit to ascertain that it complies with the manufacturer's published specifications.

Contact the local authorized Field Service Representative for service assistance.

## Maintenance summary and schedule

These schedules indicate the minimum frequency of maintenance based on typical usage of 2000 hours per year. Service the equipment more frequently if it is used more than the typical yearly usage.

**Note** Local policies or regulations may require that maintenance be performed more frequently than stated here.

Minimum Frequency	Maintenance
Daily	<ul style="list-style-type: none"> <li>• Clean the external surfaces.</li> <li>• Perform a flow and pressure calibration.</li> <li>• Empty the water reservoir and replace the absorbent in the canister.</li> </ul>
Monthly	<ul style="list-style-type: none"> <li>• Perform 21% and 100% O<sub>2</sub> cell calibrations.</li> </ul>
During cleaning and setup	<ul style="list-style-type: none"> <li>• Inspect the parts for damage. Replace or repair as necessary.</li> </ul>
As necessary	<ul style="list-style-type: none"> <li>• Install new cylinder gaskets on cylinder yokes.</li> <li>• Empty the water reservoir and replace the absorbent in the canister.</li> <li>• Empty and clean the overflow trap on the optional suction regulator.</li> <li>• Replace the circuit O<sub>2</sub> cell. (Under typical use the cell meets specifications for 1 year.)</li> <li>• Replace the disposable flow sensor (plastic). (Under typical use the sensor meets specifications for a minimum of 3 months.)</li> <li>• Replace the autoclavable flow sensors (metal). (Under typical use the sensor meets specifications for a minimum of 1 year.)</li> <li>• Replace the receiver filter (active gas scavenging only).</li> <li>• Calibrate the airway modules every 6 months or when there are indications of errors in the gas readings. Calibrate airway modules that get extensive usage every 2 months.</li> <li>• Inspect and clean the fan filters (display, lower electrical enclosure, and airway module).</li> </ul>

### Authorized service personnel

This is the minimum level of maintenance recommended. Local regulations may contain additional maintenance requirements. Comply with all local regulations which meet or exceed this minimum level of maintenance.

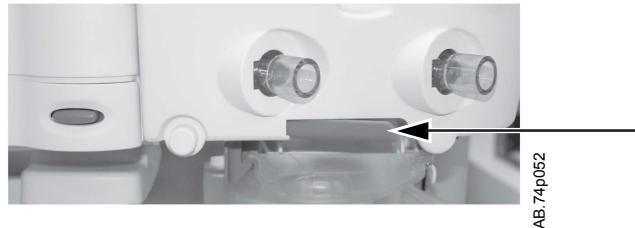
Minimum Frequency	Maintenance
12 months	Have an authorized service representative complete the scheduled service maintenance checks, tests, calibrations, and parts replacements as defined in the Technical Reference manual.

## Circuit O2 cell replacement

**WARNING** Handle and dispose of O2 cells according to site biohazard policies. Do not incinerate.

**Note** It may take a new O2 cell 90 minutes to stabilize. If the O2 cell calibration fails after a new O2 cell had been installed, wait 90 minutes and repeat the calibration.

1. Pull the latch to unlock the flow sensor module from the breathing system.



2. Pull the flow sensor module from the breathing system.
3. Remove the O2 cell cable connector from the O2 cell and unscrew the cell counterclockwise.



4. Make sure the o-ring is on the cell. Install the replacement O2 cell. Reconnect the O2 cell cable.



5. Replace the flow sensor module on the system and push the latch closed to secure the module.
6. Calibrate the new O2 cell according to the "Circuit O2 cell" procedure.

## Calibration menu

Access the **Calibration** menu by selecting the **System Setup** button. Follow the instructions on the screen.

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

See "*Calibrating the airway module*" in the "*Airway modules*" section for information on calibrating the airway modules.

## Flow and pressure calibration

**Important** Room temperature fluctuations of more than 5°C may affect sensor measurements. Recalibrate the flow sensors if the room temperature changes by more than 5°C.

Calibrate the flow sensors by removing the flow sensor module from the system. On-screen instructions are available through **System Setup - Calibration - Flow and Pressure**.

1. Set the Bag/Vent switch to Bag.
2. Remove the flow sensor module.
3. Wait for 'No insp flow sensor' and 'No exp flow sensor' alarms to occur.
4. Reinsert the flow sensor module. Make sure the flow sensors are securely latched when they are reinserted. Wait for alarms to clear.
5. Start mechanical ventilation when ready.

## Circuit O2 cell

### 21% O2 calibration

1. Select **System Setup**.
2. Select **Calibration** on the **System Setup** menu.
3. Select **Circuit O2 Cell 21%**.
4. Follow the instructions on the screen.

### 100% O2 calibration

1. Ensure the wye-piece, or patient connection, is not plugged or there is no patient tubing connected to the system.
2. (ACGO option only.) Set the ACGO switch to Circle.
3. Set the Bag/Vent switch to Vent.
4. Select **Circuit O2 Cell 100%**.

5. Follow the instructions on the screen.

## Airway gas calibration

The airway gas selection is only available on the Calibration menu when the system detects an airway module and the module has completed the warm up phase. See the "*Airway modules*" section for calibration instructions.

## Water buildup

Small beads of water or a foggy appearance in the flow sensors is okay. Pooled water in the flow sensors or water in the sensing lines may cause false alarms.

Water results from exhaled gas and the chemical reaction between CO<sub>2</sub> and the absorbent that takes place within the absorber canister.

At lower fresh gas flows more water builds up because less gas is scavenged and:

- More CO<sub>2</sub> stays in the absorber to react and produce water.
- More moist, exhaled gas stays in the patient circuit and the absorber.

### How to help prevent water buildup

Suggested ways to prevent water buildup include:

- Equip systems with the optional condenser. See the "*Parts*" section for information.
- Empty the water reservoir in the canister when changing the absorbent.
- Ensure the water condensing in the breathing circuit tubes is kept lower than the flow sensors and is not allowed to drain back into the flow sensors.
- Water condensation in the breathing circuit tubing might be lessened by using a Heat and Moisture Exchange (HME) filter at the airway connection.

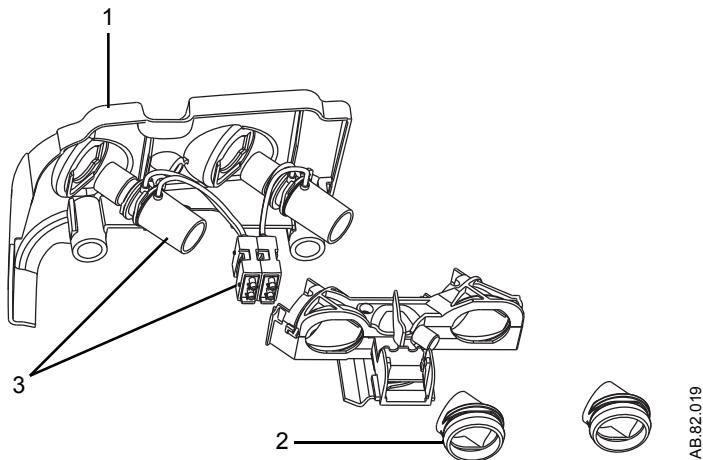


# 10 Parts

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**Note** This section lists user replaceable parts only. For other components, refer to the Technical Reference manual.

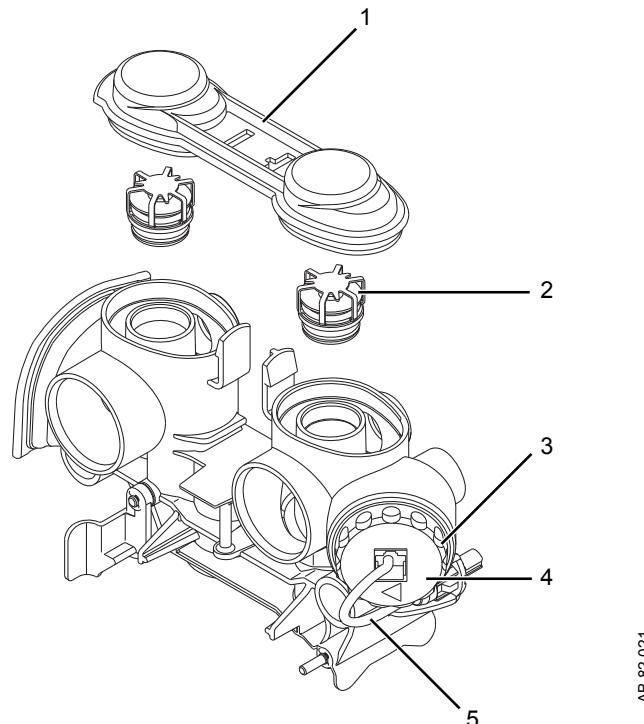
## Flow sensor module



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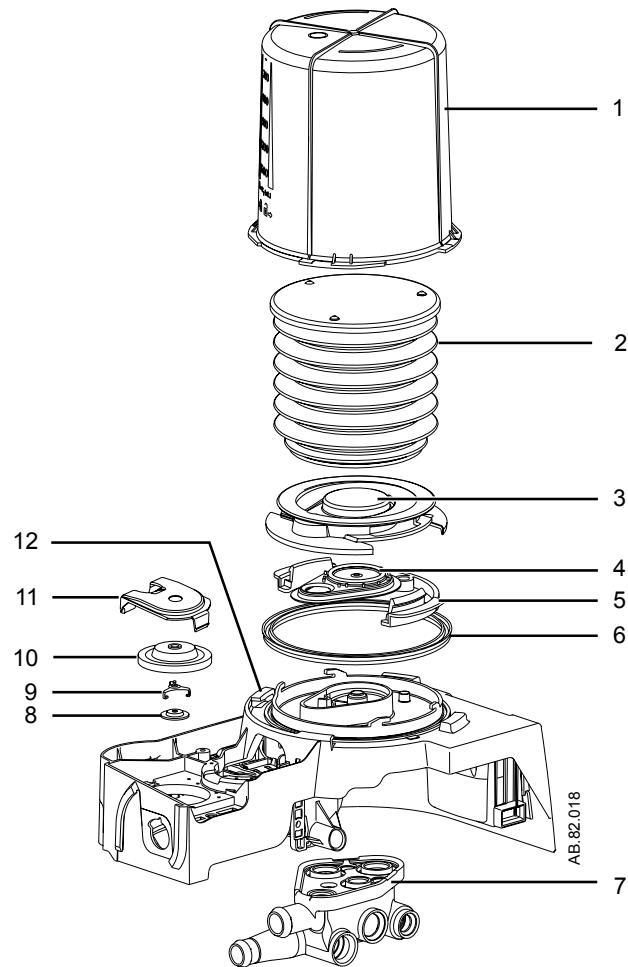
Item	Description	Stock number
-	Flow sensor module (does not include flow sensors)	1407-7022-000
1	Flow sensor cover	1011-3283-000
2	Flow sensor cuff	1407-3004-000
3	Flow sensor, disposable (plastic)	1503-3858-000
-	Flow sensor, autoclavable (metal)	1503-3244-000

## Breathing circuit module



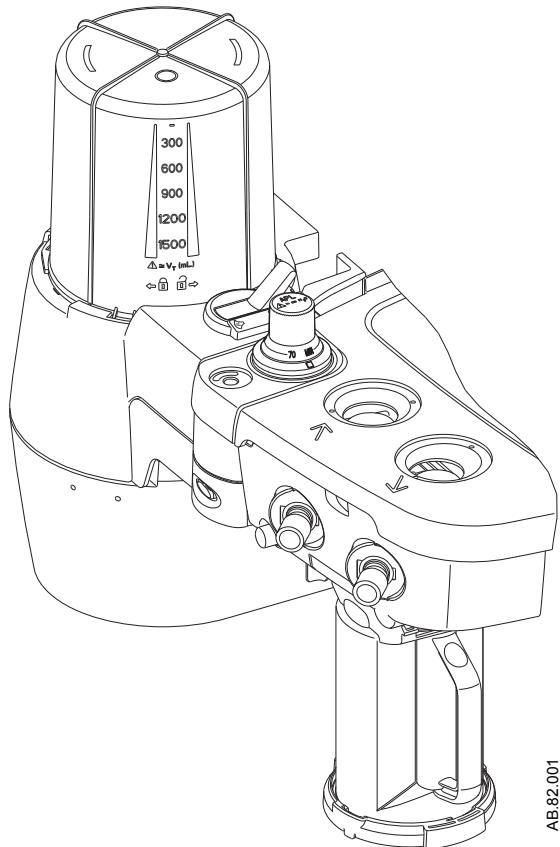
Item	Description	Stock number
-	Breathing circuit module (does not include O2 cell or plug, o-ring, or cable)	1407-7002-000
1	Check valves circuit lens	1407-3101-000
2	Check valve assembly	1406-8219-000
3	O-ring for O2 cell or plug	1406-3466-000
4	O2 cell (includes o-ring)	6050-0004-110
5	Cable, O2 cell	1009-5570-000
-	Plug (includes o-ring; for systems without O2 sensing)	1503-3857-000

## Bellows



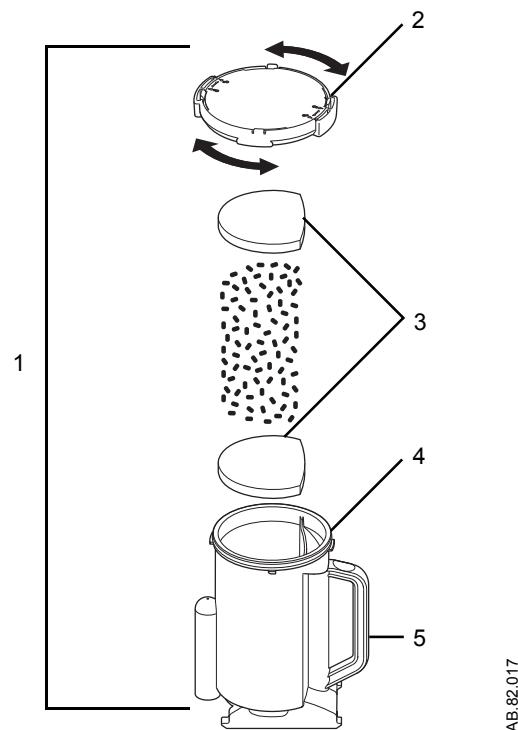
Item	Description	Stock number
1	Bellows housing	M1239264
2	Bellows	1500-3378-000
3	Rim	1500-3351-000
4	Pressure relief valve assembly	1500-3377-000
5	Latch, rim	1500-3352-000
6	Seal, base	1500-3359-000
7	Manifold, bellows base	1407-3702-000
8	Poppet, APL valve	1406-3332-000
9	Cage, APL	1406-3333-000
10	Diaphragm, APL	1406-3331-000
11	Ramp, APL	1407-3400-000
12	Bellows base with latch, green	M1213265

## Complete advanced breathing system



Description	Stock number
Complete breathing assembly includes:	
<ul style="list-style-type: none"><li>• Flow sensor module (does not include flow sensors).</li><li>• Breathing circuit module (does not include APL valve, O2 cell or plug, o-ring, or cable).</li><li>• Complete bellows base.</li><li>• Canister not included.</li></ul>	
Autoclavable breathing assembly, green	M1234213
Autoclavable breathing assembly, Australia, green	M1234214

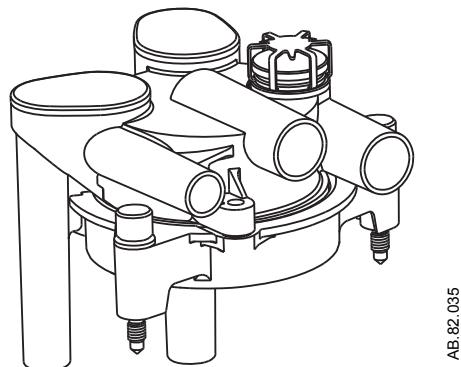
## Absorber canister



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Item	Description	Stock number
1	Multi absorber, reusable (includes 40 pack of foam; does not include absorbent)	1407-7004-000
2	Cover assembly, CO2 canister	1009-8240-000
3	Foam, CO2 canister (pack of 40)	1407-3201-000
4	O-ring	1407-3204-000
5	Canister, CO2 with handle	1407-3200-000
-	Multi absorber, disposable, white to violet (pack of six)	8003138
-	Multi absorber, disposable, pink to white (pack of six)	8003963

## Exhalation valve assembly



Description	Stock number
Exhalation valve assembly	1407-7005-000

**AGSS**

Description	Stock Number
<b>Common</b>	
Cap 3.18 barb silicone	1406-3524-000
Connector, inlet 30 mm male to 19 mm male	M1003947
Connector, inlet 30 mm male to 30 mm male	M1003134
O-ring for connector, 21.95 ID	1406-3558-000
O-ring for receiver, 22 ID	1407-3104-000
O-ring for thumbscrews, 4.47 ID	1407-3923-000
Reservoir scavenger	1407-3903-000
Seal, down tube scavenger	1407-3904-000
Seal, receiver scavenger	1407-3901-000
Thumbscrew M6 X 28.5	1406-3305-000
Thumbscrew M6 X 43	1406-3304-000
Valve, unidirectional (complete assembly)	1406-8219-000

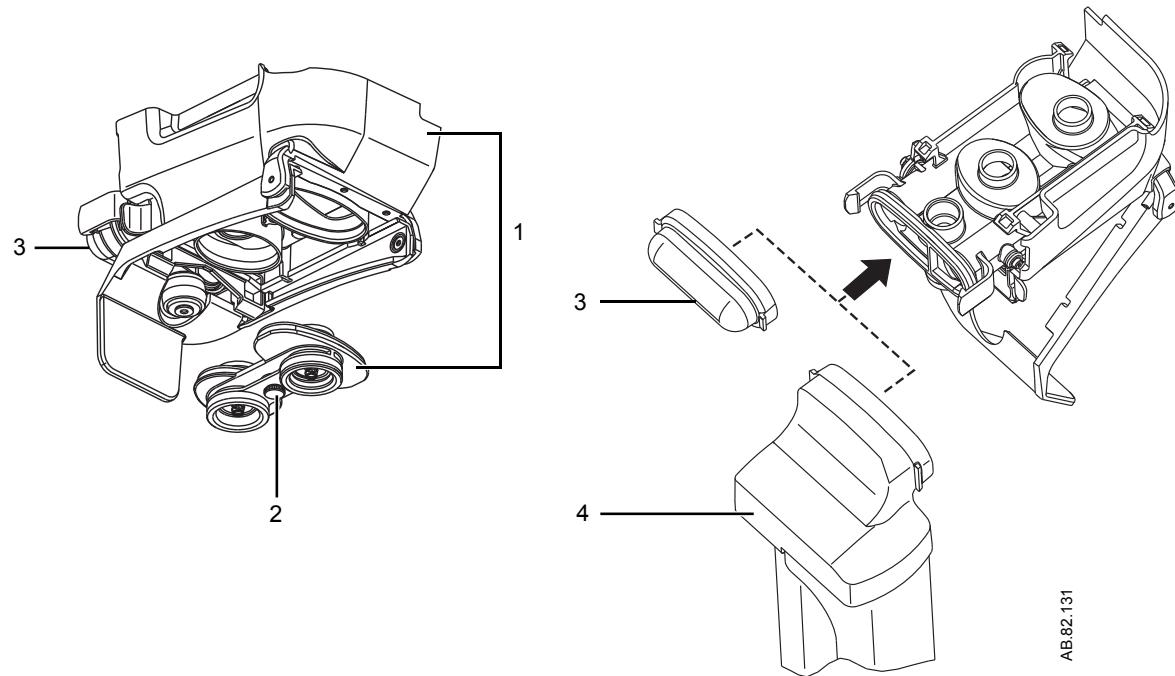
Description	Stock Number
<b>Passive AGSS</b>	
Adapter, outlet 30 mm female to 19 mm male (pack of five)	1500-3376-000
Exhaust hose	8004461
Plug assembly 30 mm ISO	1407-3909-000
Screw, shoulder 4 diameter X 4 L M3 X 0.5 sst	1407-3915-000

Description	Stock Number
<b>Active AGSS, adjustable flow</b>	
Bag with 30 mm male connector	8004460
Plug assembly 30 mm ISO	1407-3909-000

Description	Stock Number
<b>Active AGSS, high flow</b>	
Filter, 225 micrometer nylon screen AGSS	1406-3521-000
Seal, filter scavenger	1407-3902-000

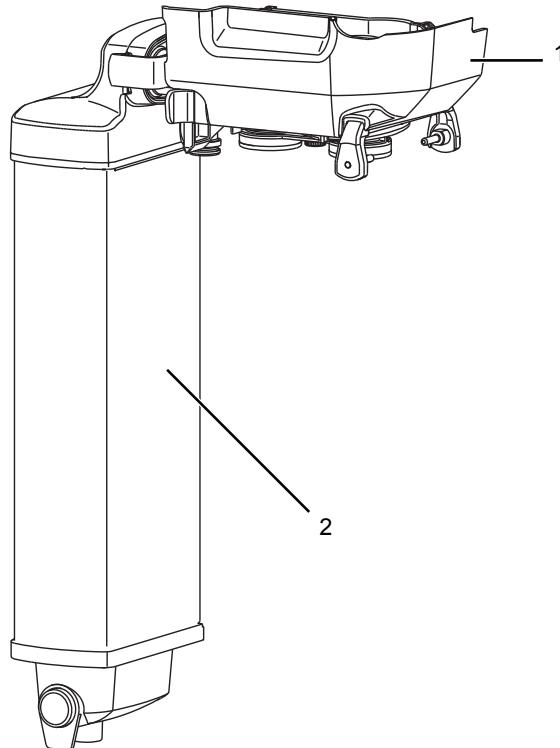
Description	Stock Number
<b>Active AGSS, low flow</b>	
Filter, 225 micrometer nylon screen AGSS	1406-3521-000
Seal, filter scavenger	1407-3902-000

## EZchange canister system



Item	Description	Stock number
1	EZchange canister module, includes valve and cap	1407-7021-000
2	Valve	1407-7023-000
3	Cap	1407-3130-000
4	Condenser	1407-7024-000
-	EZchange canister module with condenser	1407-7027-000

## Condenser



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Item	Description	Stock number
-	Condenser assembly (includes module and condenser)	1407-7026-000
1	Condenser module	1407-7025-000
2	Condenser	1407-7024-000

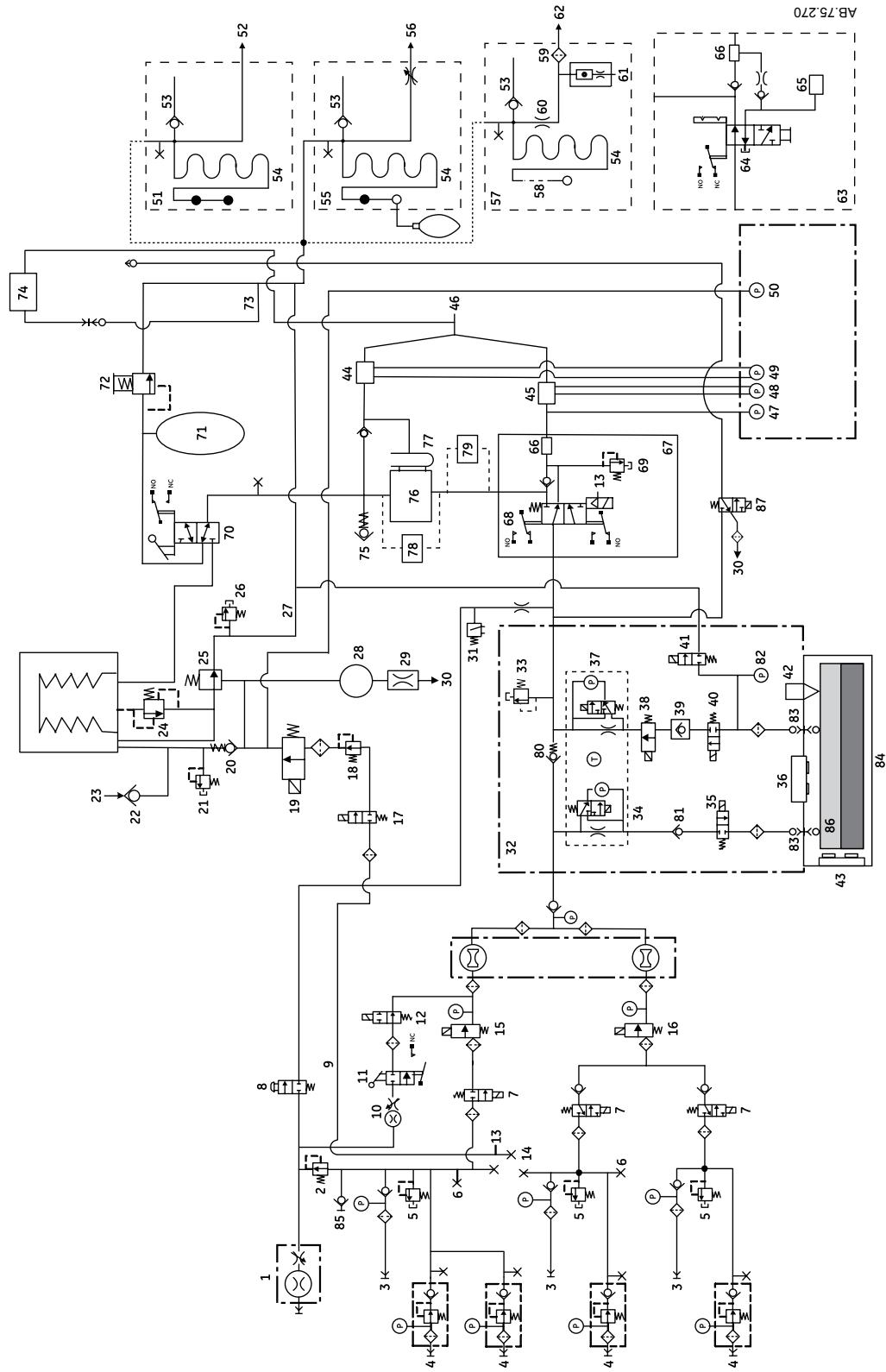
## Test tools and system parts

Description	Stock number
Airway module calibration gas	755583
Airway module calibration gas (U.S. variant only)	755571
Airway module exhaust line	8004463
Calibration gas regulator	755534
Calibration gas regulator (U.S. variant only)	M1006864
Cylinder gasket (pin indexed cylinders only)	0210-5022-300
Cylinder wrench (DIN477 and high-pressure hose)	1202-3651-000
Cylinder wrench for pin-indexed cylinder	0219-3415-800
DIN O2 plug (cylinder connection)	1202-7146-000
Handle for yoke tee	0219-3372-600
Negative low pressure leak test device	0309-1319-800
Positive low pressure leak test device (BSI)	1001-8975-000
Positive low pressure leak test device (ISO)	1001-8976-000
Positive pressure leak test adapter	1009-3119-000
Ring, sealing gasket (for DIN 477 and O2 high-pressure hose)	1001-3812-000
Ring, sealing gasket (for N2O high-pressure hose)	1202-3641-000
Test lung	0219-7210-300
Test plug	M1210946
Yoke plug	0206-3040-542
Shelf mounting straps	0203-1481-300
Filter, dust, display (10 pack)	M1220155
Cable management arm	M1229718
Display cable wrap	M1231281
Aladin2 bottle adapter Easy-Fil isoflurane	1100-3025-000
Aladin2 bottle adapter Easy-Fil enflurane	1100-3027-000
Aladin2 bottle adapter Easy-Fil sevoflurane	1100-3028-000
Aladin bottle adapter keyed halothane	1100-3003-000
Aladin bottle adapter keyed enflurane	1100-3001-000
Aladin bottle adapter keyed isoflurane	1100-3002-000
Aladin bottle adapter keyed sevoflurane	1100-3007-000

# 11 Specifications and theory of operation

<b>In this section</b>	
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<b>Note</b>	All specifications are nominal and subject to change without notice.

## System pneumatic circuit



## 11 Specifications and theory of operation

1. Auxiliary O<sub>2</sub>, 0-10 l/min (optional)
2. 241 kPa (35 psi) secondary O<sub>2</sub> regulator
3. Pipeline: O<sub>2</sub>, Air, N<sub>2</sub>O
4. Cylinder: O<sub>1</sub>, Air, N<sub>2</sub>O
5. 758 kPa (110 psi) relief
6. Venturi drive gas connection
7. Selector valve, O<sub>2</sub>, Air, N<sub>2</sub>O
8. O<sub>2</sub> flush
9. 0-120 l/min flow
10. Alternate O<sub>2</sub>
11. System switch
12. Alternate O<sub>2</sub> disable valve
13. ACGO/non-circle port
14. Vent drive gas select
15. O<sub>2</sub> flow controller
16. Balance flow controller
17. Gas inlet valve
18. Vent drive gas regulator 172 kPa (25 psi) at 15 l/min
19. Inspiratory flow control valve
20. Drive gas check valve (3.5 cmH<sub>2</sub>O bias)
21. Mechanical over pressure valve (110 cmH<sub>2</sub>O)
22. Free breathing check valve
23. Atmosphere
24. Pressure relief valve
25. Exhalation valve (2 cmH<sub>2</sub>O bias)
26. Relief valve 10 cmH<sub>2</sub>O
27. 0-10 l/min drive gas, 0-10 l/min patient and fresh gas, 0-10 l/min total typical flow
28. 200 ml reservoir
29. Control bleed to ambient approximately 1 l/min at 3 cmH<sub>2</sub>O if continuous (rate dependent)
30. Vent to ambient
31. Flush switch 37.2 kPa (5.4 psi)
32. Electronic vaporizer
33. ACGO port relief valve
34. Cassette inflow measure
35. Cassette inflow valve
36. Cassette identification
37. Cassette outflow measure
38. Cassette flow control valve
39. Liquid flow prevention valve
40. Cassette outflow valve
41. Scavenging valve
42. Cassette temperature sensor
43. Liquid level indicator (not available on all cassettes)
44. Expiratory flow sensor
45. Inspiratory flow sensor
46. Patient wye (patient connection)
47. Airway transducer
48. Inspiratory flow transducer
49. Expiratory flow transducer
50. Manifold pressure transducer
51. Passive gas scavenging interface
52. 30 mm male to disposal system
53. 0.3 cmH<sub>2</sub>O entrainment
54. Reservoir
55. Adjustable gas scavenging interface
56. DISS EVAC connector
57. Active gas scavenging interface
58. Room air
59. Filter
60. High or low flow restrictor
61. Flow indicator
62. To disposal system
63. ACGO variant
64. Circle or ACGO mode switch
65. 22 mm ACGO port
66. O<sub>2</sub> cell
67. Non-circle variant
68. Circle or non-circle mode switch
69. Non-circle circuit pressure limiting valve
70. Bag/Vent switch
71. Bag
72. APL valve 0-70 cmH<sub>2</sub>O
73. Default factory connection
74. Gas monitor
75. Negative pressure relief valve
76. Absorber
77. Drain
78. EZchange canister
79. Condenser
80. Bypass back-pressure valve
81. Inflow check valve
82. Cassette pressure sensor
83. Cassette connection valve
84. Aladin cassette
85. Pneumatic power outlet
86. Embedded temperature sensor (not available on all cassettes)
87. Fresh gas sample relief valve

## Gas supplies

Pressurized gas supplies enter the system through a pipeline or cylinder connection. All connections have indexed fittings, filters, and check valves.

A regulator decreases the cylinder pressures to the appropriate system pressure. A pressure relief valve helps protect the system from excessive high pressures.

To help prevent problems with the gas supplies:

- Install yoke plugs on all empty cylinder connections.
- When a pipeline supply is connected, keep the cylinder valve closed.
- Disconnect the pipeline supplies when the system is not in use.

### **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.

## O<sub>2</sub> flow

Pipeline or regulated cylinder pressure supplies O<sub>2</sub> directly to the O<sub>2</sub> channel of the gas mixer and to the ventilator if O<sub>2</sub> is configured as drive gas. If the pressure is too low, an alarm appears on the display. A second regulator decreases the pressure for the flush valve and the auxiliary O<sub>2</sub> flowmeter.

The flush valve supplies high flows (between 25 and 75 l/min) of O<sub>2</sub> to the fresh gas outlet when the O<sub>2</sub> flush button is pushed. The flush switch uses pressure changes to monitor the position of the flush valve.

## Air and N<sub>2</sub>O

Pipeline or regulated cylinder pressure supplies Air directly to the air channel of the gas mixer and to the ventilator if Air is configured as drive gas. If the pressure is too low, an alarm appears on the display.

Pipeline or regulated cylinder pressure supplies N<sub>2</sub>O directly to the N<sub>2</sub>O channel of the gas mixer. If the pressure is too low, an alarm appears on the display.

## Mixed gas

Either Air or N<sub>2</sub>O can be selected as the balance gas. The balance gas flow is controlled by the mixer. When Alternate O<sub>2</sub> control is in use, only O<sub>2</sub> is flowing and balance gas is disabled.

The mixed gas goes from the mixer outlet through the vaporizer to the fresh gas outlet and into the breathing system. A pressure-relief valve sets the maximum outlet pressure.

- Note** When the total is adjusted toward the lower flow limit and the calculated O<sub>2</sub> flow is required to go below 100 ml, a message shows in the gas settings area of the screen. The anesthesia system calculates the required O<sub>2</sub>% to maintain the user-set total flow.

## EZchange canister

When installed, EZchange provides a CO<sub>2</sub> bypass mode that permits continued ventilation during absorber canister change.

## Condenser

The condenser removes water in the system that is produced from the reaction of CO<sub>2</sub> gas with the absorbent. When fresh gas flow settings of less than the patient minute volume are used during ventilation, the amount of re-breathed gases increases. More CO<sub>2</sub> flows through the breathing system increasing the absorbent consumption. The moisture buildup in the breathing system is also increased.

The condenser is connected between the outlet of the absorber canister and the inlet of the circuit module. Moisture in the gas is condensed into water droplets, which run into the condenser's reservoir.

## Pneumatic specifications

**CAUTION** All gases supplied to the system must be medical grade.

### Gas supplies

Pipeline gases	O2, Air, N2O
Cylinder gases	O2, Air, N2O (3 cylinder maximum)
Cylinder connections	Pin indexed Nut and gland DIN-477 Large cylinder kit available for O2 and N2O
Primary regulator output pressure	Pin indexed: The primary regulator is set to pressure less than 345 kPa (50 psi). DIN-477: The primary regulator is set to pressure less than 414 kPa (60 psi).
Pressure-relief valve	Approximately 758 kPa (110 psi)
Pipeline connections (filtered)	DISS-Male; DISS-Female; DIN 13252; AS 4059 (Australian); S90-116 (French Air Liquide); BSPP 3/8 (Scandinavian) or NIST (ISO 5359). All fittings available for O2, Air, and N2O.
Pressure displays	On system display.
Pipeline inlet pressure	280-600 kPa (41-87 psi)
Flush flow	25 l/min to 75 l/min
Internal O2 supply pressure at which N2O shutoff	O2 pipeline less than 252 kPa (36 psi). O2 cylinder less than 2633 kPa (381 psi).

### ACGO port relief

A relief valve on the vaporizer manifold limits the fresh gas pressure at the ACGO port to 55 kPa (8 psi) at 45 l/min.

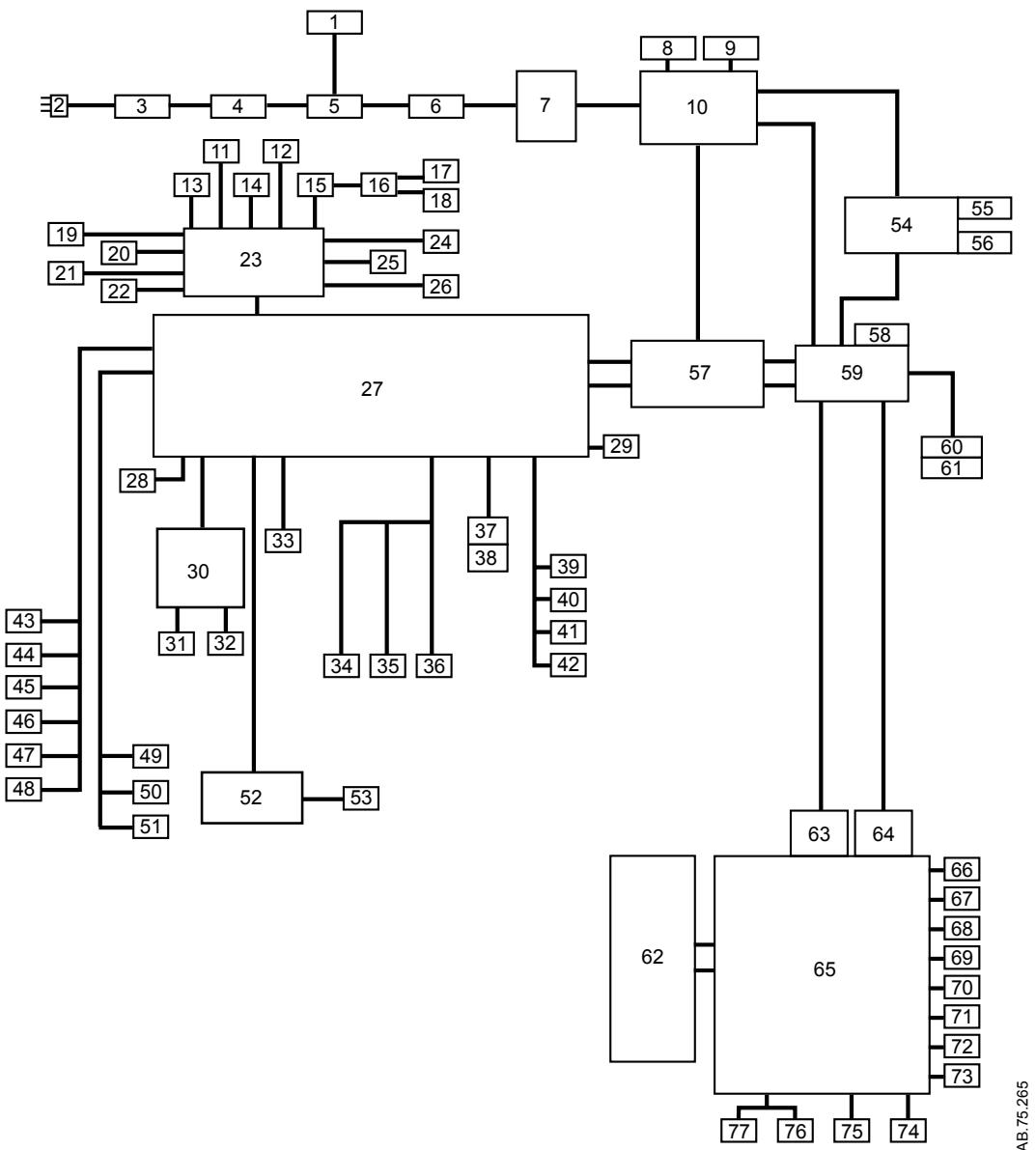
### Non-circle circuit relief

A relief valve limits the fresh gas pressure at the inspiratory port to 27 kPa (4 psi) at 55 l/min when non-circle circuit is selected.

## Pneumatic power outlet

The pneumatic outlet is supplied with the same gas supply pressure as the attached oxygen medical gas pipeline supply. The anesthesia system is rated for supply pressures between 280 kPa - 600 kPa. The anesthesia system is designed to function normally with a maximum flow of 8 l/min from the pneumatic outlet. Higher flows from this connection are possible and may result in decreased anesthesia system performance.

## Electrical block diagram



- 1. Power cord
- 2. AC inlet and breaker
- 3. Inrush board
- 4. Transformer
- 5. Fuse block
- 6. Outlet box with breakers
- 7. Agent delivery board
- 8. Power controller board
- 9. power supply fan with cable
- 10. Power supply with batteries
- 11. Display connector board
- 12. Anesthesia control board
- 40. Flow control valve with cable
- 41. Gas inlet valve with cable
- 42. Expiratory and inspiratory flow sensors
- 43. O<sub>2</sub> cell
- 44. Light strip boards
- 45. Light strip switch
- 46. CGO valve
- 47. ACGO/non-circle circuit switch
- 48. CGO switch
- 49. Bag/vent switch
- 50. ABS connected switch
- 51. EZchange canister switch

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## 11 Specifications and theory of operation

- 13. Airway module power supply board
- 14. Airway module
- 15. Display carrier board and CPU
- 16. Speaker 1
- 17. Speaker 2
- 18. Display unit fan with cable
- 19. Network I/O port - 1 (Ethernet)
- 20. Keypad
- 21. USB I/O port (software upgrade only)
- 22. USB I/O port
- 23. Network I/O port - 2 (Ethernet)
- 24. Patient monitoring on/standby
- 25. Serial I/O port
- 26. Consolidated Ventilator Interface board
- 27. Electronic gas mixer board
- 28. I/O port
- 29. Pan fan with cable
- 30. Air cylinder pressure transducer
- 31. N<sub>2</sub>O cylinder pressure transducer
- 32. O<sub>2</sub> cylinder pressure transducer
- 33. Air pipeline pressure transducer
- 34. N<sub>2</sub>O pipeline pressure transducer
- 35. O<sub>2</sub> pipeline pressure transducer
- 36. Second O<sub>2</sub> cylinder pressure transducer
- 37. Alternate O<sub>2</sub> switch
- 38. On/Standby switch
- 39. Vent engine board
- 52. LCD with touch screen
- 53. O<sub>2</sub> flush switch
- 54. DC power in
- 55. Communication to system
- 56. ComWheel encoder
- 57. Cassette temperature sensor board
- 58. Inflow zero valve
- 59. Outflow zero valve
- 60. Inflow pressure sensor board
- 61. Outflow pressure sensor board
- 62. Inflow shutoff valve
- 63. Outflow shutoff valve
- 64. Cassette
- 65. Scavenging valve
- 66. Cassette pressure sensor
- 67. Proportional valve
- 68. Cassette interface board
- 69. Universal power supply
- 70. Auxiliary connector board
- 71. I/O port
- 72. Battery backup for monitor
- 73. AC mains LED
- 74. Manifold temperature sensor board
- 75. Liquid level sensor (not available on all cassettes)
- 76. Embedded temperature sensor (not available on all cassettes)
- 77. VGA Output

## Electrical power

Supply voltage	100-120, 220-240, or 120/220-240 Vac +/- 10% at 50 or 60 Hz		
Inlet circuit breakers	100-120 Vac	220-240 Vac	120/220-240 Vac
	15 A	8 A	8 A
Outlet circuit breakers	110-120 Vac	Japan	220-240 Vac
	(3) 2 A (1) 3 A	(2) 2 A (1) 4 A	(3) 1 A (1) 2 A
System leakage current limit - do not exceed	UL and CSA rated systems (U.S.A. and Canada): less than 300 µamps for the system and all systems connected to electrical outlets.		
	IEC rated systems (not U.S.A. and Canada): less than 500 µamps for the system and all systems connected to electrical outlets.		
	Note: Products connected to electrical outlets may increase the leakage current above these limits.		
Resistance to ground	Less than 0.2 Ω		

## Power cord

Length	5 meters
Voltage rating	100 to 240 Vac
Current capacity	10 A for 220-240 Vac 15 A for 100-120 Vac 10 A for 120/220-240 Vac
Type	Three conduction power supply cord (medical grade where required).

**WARNING** This equipment must be connected to a supply mains with a protective earth to avoid the risk of electric shock.

## Battery information

The system is not a portable unit. A sealed lead acid battery supplies backup power in the event of a power failure.

- Capacity to operate for 50 minutes under typical operating conditions and 30 minutes under extreme conditions.

## 11 Specifications and theory of operation

- The system functions to specifications through the transition to battery power. The system will automatically switch over to the battery supply when adequate system supply cannot be maintained from the mains input.
- The system functions to specifications while the battery is recharging.
- Electrical outlets (if provided) will not function during a power failure.
- Electrical outlets (if provided) will not function on battery power.

Only trained service representatives are to replace the battery. Batteries must be disposed of in accordance with applicable regulatory requirements in effect at the time and place of disposal. Contact a trained service representative to disconnect the battery if the equipment is not likely to be used for an extended time.

## Flow specifications

<b>Alternate O2</b>	
Minimum flow	500 ml/min to 700 ml/min
Maximum flow	10 l/min to 13 l/min
Indicator	Flow tube
Indicator accuracy	+/- 5% full scale

<b>Fresh gas</b>	
Flow range	0 and 200 ml/min to 15 l/min Minimum total flow O2 and balance gas is 200 ml/min
Total flow accuracy	+/- 10% or +/- 40 ml/min of setting (whichever is larger)
O2 flow accuracy	+/- 5% or +/- 20 ml/min of setting (whichever is larger)
Balance gas flow accuracy	+/- 5% or +/- 20 ml/min of setting (whichever is larger) Air/N2O
O2 concentration range	21%, 25% to 100%
O2 concentration accuracy	+/- 2.5% of setting for total flow of greater than or equal to 1 l/min and less than or equal to 15 l/min +/- 5% of setting for total flow of greater than or equal to 0.4 l/min and less than 1 l/min +/- 6.5% of setting for total flow of greater than or equal to 0.2 l/min and less than 0.4 l/min
Electronic mixer response time	500 ms (10% to 90% flow step)
Compensation	Temperature and atmospheric pressure compensated to standard conditions of 20°C and 101.3 kPa (14.7 psi)
Hypoxic guard	Electronic
Note: Leakage from one gas inlet to another gas inlet is less than 10 ml per hour.	
Note: The stated flow accuracy may not be met for total flows between 200 and 400 ml/min. The total flow will maintain a minimum of 21% O2.	

## Breathing system specifications

Volume	Ventilator side 2730 ml; bag side 1215 ml With EZchange canister system and condenser: ventilator side 3145 ml; bag side 1630 ml
Absorbent	1250 ml canister
Connections	Auxiliary Common Gas Outlet: ISO 5356 type connector on the front of the system (standard 22 mm OD or 15 mm ID conical friction fit connectors).
System leakage	Less than or equal to 150 ml/min total at 3 kPa (30 cmH <sub>2</sub> O) with EZchange canister system and condenser (both in absorber mode and with canister removed).
System compliance	Volume of gas lost due to internal compliance (bag mode only): 1.82 ml/0.098 kPa (1 cmH <sub>2</sub> O) 55 ml/3 kPa (30 cmH <sub>2</sub> O) With EZchange canister system and condenser: 2.67 ml/0.098 kPa (1 cmH <sub>2</sub> O) 80 ml/3 kPa (30 cmH <sub>2</sub> O)
Pressure required to open inspiratory or expiratory valves	Dry: 0.49 cmH <sub>2</sub> O Wet: 0.91 cmH <sub>2</sub> O
Pressure generated by a wet unidirectional valve	0.81 cmH <sub>2</sub> O
APL valve	Approximately 0 to 70 cmH <sub>2</sub> O
Negative pressure relief	Minimum 30 l/min at -20 cmH <sub>2</sub> O
Mechanical over-pressure valve	25 l/min at 115 +/- 10 cmH <sub>2</sub> O

<b>Inspiratory Breathing resistance in bag mode*</b>		
<b>l/min</b>	<b>kPa</b>	<b>cmH<sub>2</sub>O</b>
5	0.06	0.6
30	0.22	2.2
60	0.56	5.7
EZchange canister system and condenser, absorber mode		
5	0.06	0.6
30	0.24	2.4
60	0.57	5.8
EZchange canister system and condenser, canister removed		

<b>Inspiratory Breathing resistance in bag mode*</b>		
<b>l/min</b>	<b>kPa</b>	<b>cmH<sub>2</sub>O</b>
5	0.06	0.6
30	0.21	2.1
60	0.49	5.0

\*Values include patient circuit tubing and wye-piece 0.049 kPa (0.5 cmH<sub>2</sub>O) at 60 l/min. Patient circuit tubing and breathing system configurations affect resistance.

<b>Expiratory Breathing resistance in bag mode*</b>		
<b>l/min</b>	<b>kPa</b>	<b>cmH<sub>2</sub>O</b>
5	0.05	0.5
30	0.15	1.5
60	0.37	3.8

EZchange canister system and condenser, absorber mode

<b>l/min</b>	<b>kPa</b>	<b>cmH<sub>2</sub>O</b>
5	0.06	0.6
30	0.19	1.9
60	0.44	4.5

EZchange canister system and condenser, canister removed

<b>l/min</b>	<b>kPa</b>	<b>cmH<sub>2</sub>O</b>
5	0.06	0.6
30	0.19	1.9
60	0.44	4.5

\*Values include patient circuit tubing and wye-piece 0.03 kPa (0.3 cmH<sub>2</sub>O) at 60 l/min. Patient circuit tubing and breathing system configurations affect resistance.

<b>Pressure flow data (APL valve completely open)</b>		
<b>Flow (l/min)</b>	<b>Flow (l/s)</b>	<b>APL pressure cmH<sub>2</sub>O</b>
3	0.05	0.93
30	0.51	1.70
60	1.0	2.44
70	1.17	3.30

## Gas scavenging

<b>All scavenging</b>	
Positive pressure relief	10 cmH <sub>2</sub> O

<b>Passive scavenging</b>	
Negative pressure relief	0.3 cmH <sub>2</sub> O
Outlet connector	30 mm male taper ISO

<b>Active scavenging</b>			
<b>Disposal system type</b>	<b>Outlet connector*</b>	<b>Flow range</b>	<b>Pressure</b>
Adjustable	DISS EVAC	Up to 30 l/min	not applicable
High flow, low vacuum	BSI 30 mm threaded	50 to 80 l/min	not applicable
Low flow, high vacuum	DISS EVAC	36 +/- 4 l/min	305 mmHg (12 inHg) minimum vacuum
Low flow, low vacuum	12.7 mm hose barb	36 +/- 4 l/min	not applicable
Low flow, low vacuum	25 mm hose barb	40 to 50 l/min	not applicable
Low flow, low vacuum	30 mm ISO taper	40 to 50 l/min	not applicable

\*Other market-specific connectors may be available.  
Particle filter at the outlet has a pore size of 225 microns. All flow data uses a new filter.

## Physical specifications

All specifications are approximate values and can change without notice.

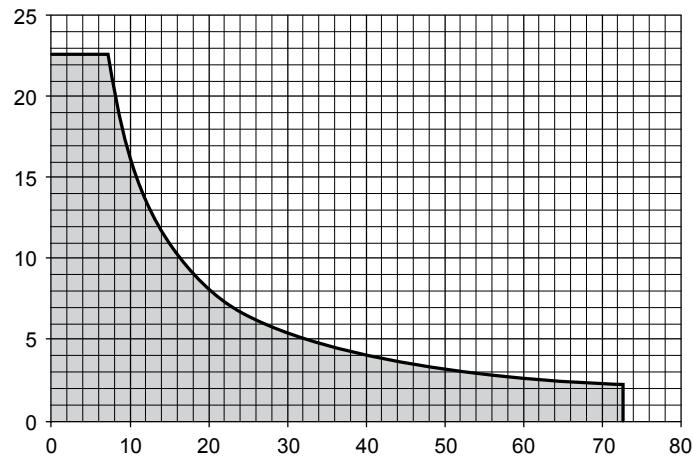
- CAUTION** Do not subject the system to excessive shock and vibration.
- Do not place excessive weight on flat surfaces or drawers.
- WARNING** Maintain system balance. When using rails or dovetails, distribute equipment on each side of the system. Uneven system balance could cause the system to tip.

System Height	151 cm
System Width	80 cm
System Depth	89 cm
Nominal machine mass (including three cassettes)	190 kg
Maximum configured mass (includes external cylinders and maximum loads on all mounting and storage locations)	500 kg
Top of machine weight limit	45 kg
Optional top shelf weight limit, includes top of machine weight	45 kg
Machine drawer weight limit	8 kg
Casters	13 cm
LCD and touchscreen display	304 x 228 mm (38 cm diagonal)

## Lower dovetail loading

Maximum allowable lower dovetail loading is 22.7 kg and 16.2 Nm.

See "System overview" for the location of the lower dovetail.

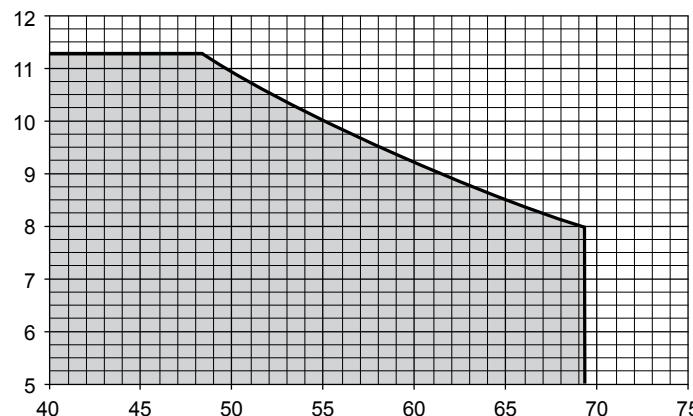


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Figure 11-1 • Lower dovetail load in kg (vertical) versus load distance from the lower dovetail in cm (horizontal).

## Upper dovetail loading

Maximum allowable upper dovetail loading is 11.3 kg and 54 Nm.  
See "System overview" for the location of the upper dovetail.



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Figure 11-2 • Upper dovetail load in kg (vertical) versus load distance from the upper dovetail in cm (horizontal).

## Environmental requirements

	<b>Operation</b>	<b>Storage and Transport</b>
Temperature	10 to 35°C Oxygen cell 10 to 40°C	-25 to 60°C Oxygen cell storage is -15 to 50°C, 10 to 95% RH, 500 to 800 mmHg LCD display storage is -20 to 60°C Aladin cassette storage is -25 to 50°C
Humidity	15 to 95% RH, non-condensing	15 to 95%, non-condensing
Altitude	537 to 800 mmHg (3000 to -440 meters)	425 to 800 mmHg (4880 to -440 meters)

## Airway module specifications

Use only airway modules that have anesthetic agent monitoring and O<sub>2</sub> monitoring on this system. The following modules can be used on this system:

- E-series: E-CAiO, E-CAiOV, E-CAiOVX (software version 4.5 and above)
- M-series: M-CAiO, M-CAiOV, M-CAiOVX (software version 3.2 and above)
- CARESCAPE series: E-sCAiO and E-sCAiOV

## Gas specifications for E-, M-series modules

<b>E- and M-series</b>	
Airway humidity	0 to 100% condensing
Sampling delay	2.5 seconds typical with a 3 m sampling line
Total system response time	2.9 seconds typical with a 3 m sampling line, including sampling delay and rise time
Warm-up time	2 minutes for operation with CO <sub>2</sub> , O <sub>2</sub> , and N <sub>2</sub> O 5 minutes for operation of anesthetic agents 30 minutes for full specifications
Respiration rate	4 to 60 breaths/min
Diversion flow	200 ml/min +/- 20 ml/min
Airway pressure	-20 cmH <sub>2</sub> O to 100 cmH <sub>2</sub> O

<b>E- and M-series airway modules: Accuracy under different conditions</b>		
Ambient temperature: 10 to 40°C		
Ambient pressure: 500 to 800 mmHg, +/- 50 mmHg of calibration		
Ambient humidity: 10 to 98% RH, +/- 20% RH of calibration		
Automatic compensation for ambient pressure		
Full module accuracy for Respiration rate of 4 to 35 breaths/min		
	During warm-up 10 to 30 minutes, under normal conditions	During warm-up 2 to 10 minutes (anesthetic agents 5 to 10 minutes), under normal conditions
CO <sub>2</sub>	+/- (0.3 vol% + 4% of reading)	+/- (0.4 vol% + 7% of reading)
O <sub>2</sub>	+/- (2 vol% + 2% of reading)	+/- (3 vol% + 3% of reading)
N <sub>2</sub> O	+/- (3 vol% + 3% of reading)	+/- (3 vol% + 5% of reading)
Hal, Enf, Iso, Sev, Des	+/- (0.2 vol% + 10% of reading)	+/- (0.3 vol% + 10% of reading)

## Gas specifications for CARESCAPE modules

<b>CARESCAPE</b>	
Airway humidity	0 to 100% condensing
Sampling delay	3.0 seconds typical with a 3 m sampling line
Total system response time	Less than 3.8 seconds with a 3 m sampling line
Warm-up time	1 minute for operation with CO <sub>2</sub> , O <sub>2</sub> , and N <sub>2</sub> O 5 minutes for operation of anesthetic agents
Respiration rate	4 to 100 breaths/min
Diversion flow	120 +/- 20 ml/min
Airway pressure	-20 cmH <sub>2</sub> O to 100 cmH <sub>2</sub> O

<b>CARESCAPE airway modules: Accuracy under different conditions</b>			
Ambient temperature: 10 to 40°C			
Ambient pressure: 495 to 795 mmHg			
Ambient Humidity: 10 to 98% RH, non-condensing			
Automatic compensation for ambient pressure			
Full module accuracy for Respiration rate of 4 to 70 breaths/min			
	During stable condition	During warm-up 1 to 10 minutes (anesthetic agents 5-10 minutes)	During warm-up 10-20 minutes
CO <sub>2</sub>	+/- (0.2 vol% + 2% of reading)	+/- (0.4 vol% + 7% of reading)	+/- (0.3 vol% + 4% of reading)
O <sub>2</sub>	+/- (1 vol% + 2% of reading)	+/- (3 vol% + 3% of reading)	+/- (2 vol% + 2% of reading)
N <sub>2</sub> O	+/- (2 vol% + 2% of reading) between 0 and 85 vol% +/- (2 vol% + 8% of reading for N <sub>2</sub> O between 85 and 100 vol%	+/- (3 vol% + 5% of reading)	+/- (3% vol% + 3% of reading)
Hal, Enf, Iso, Sev, Des	+/- (0.15 vol% + 5% of reading)	+/- (0.3 vol% + 10% of reading)	+/- (0.2 vol% + 10% of reading)

## Typical performance

	M- and E-series	CARESCAPE*
CO2	<p>Measurement range 0 to 15 vol% (0 to 15 kPa, 0 to 113 mmHg).</p> <p>Measurement rise time less than 400 ms typical.</p> <p>Accuracy +/- (0.2 vol% + 2% of reading).</p> <p>6 hour drift less than 0.1 vol%</p> <p>Gas cross effects less than 0.2 vol% (O2, N2O, anesthetic agents).</p>	<p>Measurement range 0 to 15 vol% (0 to 15 kPa, 0 to 113 mmHg).</p> <p>Measurement rise time less than 260 ms typical.</p> <p>Accuracy +/- (0.2 vol% + 2% of reading).</p> <p>6 hour drift less than 0.1 vol%</p> <p>Gas cross effects less than 0.2 vol% (O2, N2O, anesthetic agents).</p>
O2	<p>Measurement range 0 to 100 vol%.</p> <p>Measurement rise time less than 400 ms typical.</p> <p>Accuracy +/- (1 vol% + 2% of reading).</p> <p>6 hour drift less than 0.2 vol%</p> <p>Gas cross effects less than 1 vol% anesthetic agents, less than 2 vol% N2O.</p>	<p>Measurement range 0 to 100 vol%.</p> <p>Measurement rise time less than 260 ms typical.</p> <p>Accuracy +/- (1 vol% + 2% of reading).</p> <p>6 hour drift less than 0.3 vol%</p> <p>Gas cross effects less than 1 vol% anesthetic agents, less than 2 vol% N2O.</p>
N2O	<p>Measurement range 0 to 100 vol%.</p> <p>Measurement rise time less than 450 ms typical.</p> <p>Accuracy +/- (2 vol% + 2% of reading).</p> <p>6 hour drift less than 0.1 vol%</p> <p>Gas cross effects less than 2 vol% anesthetic agents.</p>	<p>Measurement range 0 to 100 vol%.</p> <p>Measurement rise time less than 320 ms typical.</p> <p>Accuracy +/- (2 vol% + 2% of reading).</p> <p>6 hour drift less than 0.3 vol%</p> <p>Gas cross effects less than 2 vol% anesthetic agents.</p>
Anesthetic agents	<p>Measurement range Hal, Enf, Iso 0 to 6% vol %.</p> <p>Measurement range Sev 0 to 8 vol%.</p> <p>Measurement range Des 0 to 20 vol%.</p> <p>Measurement rise time less than 400 ms typical.</p> <p>Accuracy +/- (0.15 vol% + 5% of reading).</p> <p>6 hour drift for Hal, Enf, Iso, Sev less than 0.1 vol%</p> <p>6 hour drift for Des less than 0.2 vol%</p> <p>Gas cross effects less than 0.15 vol% N2O.</p>	<p>Measurement range Hal, Enf, Iso 0 to 6% vol %.</p> <p>Measurement range Sev 0 to 8 vol%.</p> <p>Measurement range Des 0 to 20 vol%.</p> <p>Measurement rise time Des, Enf, Iso, Sev less than 420 ms typical.</p> <p>Measurement rise time Hal less than 800 ms typical.</p> <p>Accuracy +/- (0.15 vol% + 5% of reading).</p> <p>6 hour drift for Hal, Enf, Iso, Sev less than 0.1 vol%</p> <p>6 hour drift for Des less than 0.3 vol%</p> <p>Gas cross effects less than 0.15 vol% N2O.</p>

\*The effects caused by N2O to the measurement of CO2, O2, and anesthetic agents are automatically compensated for. The effects caused by anesthetic agents to the measurement of CO2 and N2O are automatically compensated for.

## Suction regulators (optional)

<b>Venturi Suction Regulator</b>	
Performance Category	Pharyngeal Suction
Supply	Air or O <sub>2</sub> from system gas supply
Drive Gas Consumption*	28 l/min with pipeline drive gas at 280 kPa 52 l/min with pipeline drive gas at 600 kPa
Maximum Vacuum*	600 mmHg with pipeline drive gas at 280 kPa 550 mmHg with pipeline drive gas at 600 kPa
Maximum Flow*	29 l/min with pipeline drive gas at 280 kPa 32 l/min with pipeline drive gas at 600 kPa
Vacuum Gauge Accuracy	+/- 5% of full scale
*Values are approximate.	

<b>Continuous Suction Regulator</b>	
Performance Category	Pharyngeal Suction
Supply	External vacuum
Maximum Vacuum*	540 mmHg with external vacuum applied of 540 mmHg and 40 l/min free flow
Maximum Flow*	39 l/min with external vacuum applied of 540 mmHg and 40 l/min free flow
Vacuum Gauge Accuracy	+/- 5% of full scale
*Values are approximate.	

## Ventilator theory

The ventilator pneumatics are at the rear of the breathing system. A precision valve controls gas flow to the patient. During inspiration, this gas flow closes the exhalation valve and pushes the bellows down. During expiration, a small flow pressurizes the exhalation diaphragm to supply PEEP pressure. If the maximum pressure (pmax) is reached during inspiration, the ventilator will cycle to expiration.

Volume and flow measurements come from flow sensors in the flow sensor module. Two tubes from each sensor connect to a transducer that measures the pressure change across the sensor, which changes with the flow. A third transducer measures airway pressures at the inspiratory flow sensor.

The ventilator uses the data from the flow sensors for volume-related numerics and alarms. The ventilator also uses the flow sensors to adjust its output for changes in fresh gas flow, small leaks, and gas compression upstream of the breathing circuit. There is adjustment for compression in the patient circuit.

In volume ventilation modes, certain alarm conditions prevent the automatic adjustment of ventilator delivery based on measured flow values. In these cases, 'TV accuracy decreased. Adjust manually.' displays above the ventilator setting area of the screen. When this message shows, the ventilator may not be able to deliver within the accuracy range specified. When this occurs, the tidal volume must be manually adjusted until the volume delivered reaches the desired level. If compensation stops for a number of breaths, the condition causing the hold shows as an alarm. Automatic volume compensation resumes when the alarm conditions are resolved.

For better precision a small quantity of gas bleeds through a resistor to keep pressure on the exhalation valve constant. At high airway pressures, this can cause a slight hiss during inspiration.

### **WARNING**

Always connect the expiratory flow sensor. If it is not connected, the patient disconnect alarm cannot operate correctly.

## O<sub>2</sub> monitoring theory of operation

O<sub>2</sub> monitoring measures O<sub>2</sub> concentration in the patient circuit. The O<sub>2</sub> concentration measured from the O<sub>2</sub> cell is shown on the ventilator display.

The O<sub>2</sub> cell is an electrochemical device (galvanic cell). Oxygen diffuses through a membrane into the cell and oxidizes a base metal electrode. This oxidation produces an electrical current proportional to the partial pressure of the oxygen at the electrodes sensing surface. The base metal electrode gradually wears out from the oxidation process.

The voltage from the cell cartridge is affected by the temperature of the monitored gas mixture. A thermistor in the cell's housing automatically compensates for temperature changes in the cell.

O<sub>2</sub> monitoring uses signal processing and analyzing circuitry to convert the cell signal into a corresponding percent oxygen value. The system displays this value and compares it to saved alarm limits. If the value falls outside the limits, the monitor produces the appropriate alarms.

## ecoFLOW theory of operation

The ecoFLOW option provides a split screen view that shows the approximate minimum O<sub>2</sub> flow to maintain a preset FiO<sub>2</sub> value. It also shows the approximate agent used per hour and the cost. Some information associated with the ecoFLOW option is not provided when the airway module is warming up, not present, or non-functional.

The split screen shows the Paw gauge in the upper area and the ecoFLOW gauge in the lower portion of the screen. The ecoFLOW gauge consists of a fresh gas flow tube, an agent flow indicator, and related parameters.

The fresh gas flow tube is a stacked flow tube showing the total O<sub>2</sub> flow on the bottom and the remaining gas (N<sub>2</sub> or N<sub>2</sub>O) on top. These gases determine the total fresh gas flow setting. Below the fresh gas flow tube is the measured total O<sub>2</sub> flow to the patient and the calculated FiO<sub>2</sub> flow value. The FiO<sub>2</sub> flow value is based on the **FiO<sub>2</sub> Setting** specified in Super User mode. This is the minimum O<sub>2</sub> flow needed to deliver a preset inspired O<sub>2</sub> concentration. The FiO<sub>2</sub> flow value is specific to each patient and case. It is calculated using the fresh gas settings, the patient O<sub>2</sub> uptake, the dilution effect of agent being delivered, and the effects of the circle breathing system.

The agent flow indicator shows the amount of liquid agent flow as related to the fresh gas setting. The calculated cost of the agent shows above this indicator. This cost is based on agent flow and the values entered in the **Agent Costs** menu set in Super User mode.

## Ventilation modes

The system has the following standard mode of mechanical ventilation:

- Volume control ventilation (VCV)

The system offers the following optional modes of mechanical ventilation:

- Pressure control ventilation (PCV)
- Pressure control ventilation - volume guaranteed (PCV-VG)

- Synchronized intermittent mandatory ventilation - volume control ventilation (SIMV VCV)
- Synchronized intermittent mandatory ventilation - pressure control ventilation (SIMV PCV)
- Synchronized intermittent mandatory ventilation - pressure control ventilation - volume guaranteed (SIMV PCV-VG)
- Pressure support ventilation with apnea backup (PSVPro)
- Continuous positive airway pressure + pressure support ventilation (CPAP + PSV)

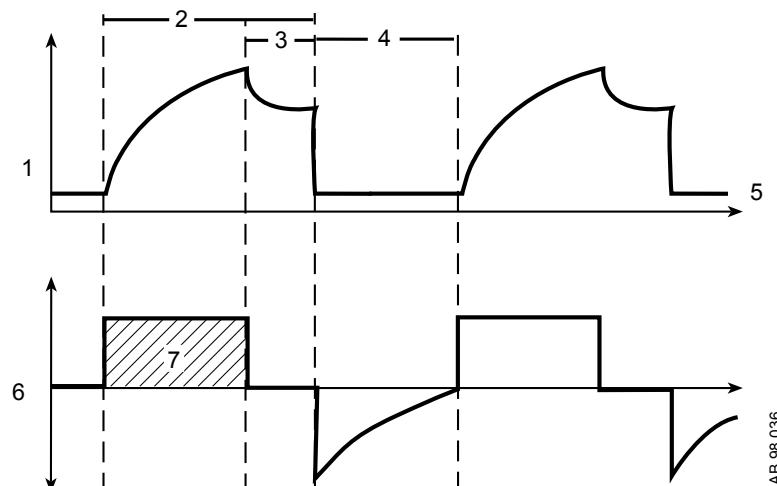
### Volume control mode (VCV)

Volume control ventilation supplies a set tidal volume. The ventilator calculates a flow based on the set tidal volume and the length of the inspiratory time to deliver that tidal volume. It then adjusts that output by measuring delivered volumes at the flow sensors. Since the ventilator adjusts output, it can compensate for breathing system compliance, fresh gas flow, and moderate breathing system leaks.

A typical volume-control pressure waveform increases throughout the entire inspiratory period, and rapidly decreases at the start of expiration. An inspiratory pause is available to improve gas distribution.

VCV mode settings:

- TV
- RR
- I:E
- Tpause
- PEEP
- Pmax



1. Paw waveform
2. Tinsp
3. Insp Pause

4.  $T_{exp}$
5. PEEP
6. Flow waveform
7. TV

Figure 11-3 • Volume control waveform

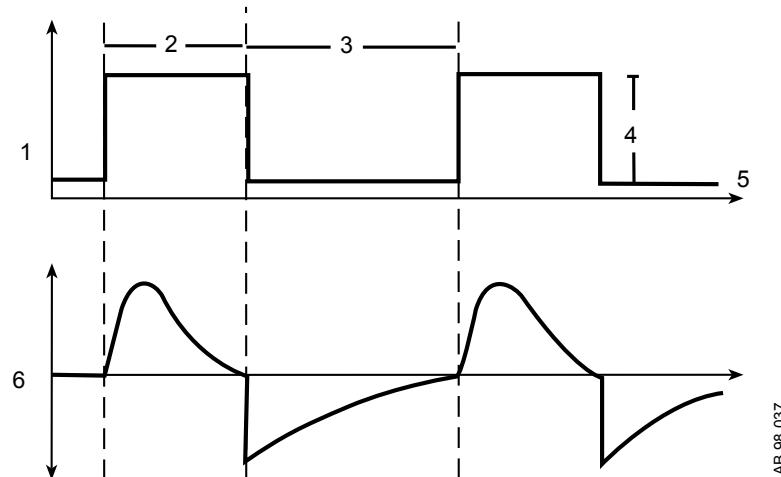
### Pressure control mode (PCV)

Pressure control ventilation supplies a constant set pressure during inspiration. The ventilator calculates the inspiratory time from the frequency and I:E ratio settings. A high initial flow pressurizes the circuit to the set inspiratory pressure. The flow then decreases to maintain the set pressure ( $P_{insp}$ ).

Pressure sensors in the ventilator measure patient airway pressure. The ventilator automatically adjusts the flow to maintain the set inspiratory pressure.

PCV mode settings:

- $P_{insp}$
- RR
- I:E
- PEEP
- Pmax
- Rise Rate



1. Paw waveform
2.  $T_{insp}$
3.  $T_{exp}$
4.  $P_{insp}$
5. PEEP

## 6. Flow waveform

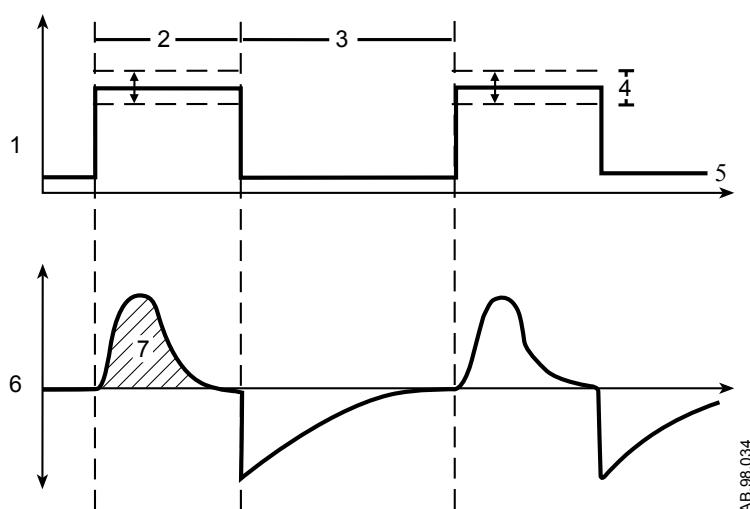
*Figure 11-4 • Pressure control waveform***PCV-VG mode**

In PCV-VG, a tidal volume is set and the ventilator delivers that volume using a decelerating flow and a constant pressure. The ventilator will adjust the inspiratory pressure needed to deliver the set tidal volume breath-by-breath so that the lowest pressure is used. The pressure range that the ventilator will use is between the PEEP + 2 cmH<sub>2</sub>O level on the low end and 5 cmH<sub>2</sub>O below Pmax on the high end. The inspiratory pressure change between breaths is a maximum of +/- 3 cmH<sub>2</sub>O. If a high airway pressure alarm is active due to the current breath, the next breath's target will be 0.5 cmH<sub>2</sub>O less than the current breath's pressure target.

This mode will deliver breaths with the efficiency of pressure controlled ventilation, yet still compensate for changes in the patient's lung characteristics. PCV-VG begins by first delivering a volume breath at the set tidal volume. The patient's compliance is determined from this volume breath and the inspiratory pressure level is then established for the next PCV-VG breath.

PCV-VG mode setting:

- TV
- RR
- I:E
- PEEP
- Pmax
- Rise Rate



1. Paw waveform

2. Tinsp

AB.98.034

3. Texp
4. Variable pressure to deliver desired TV
5. PEEP
6. Flow waveform
7. TV

*Figure 11-5 • PCV-VG waveforms*

### **SIMV VCV mode**

Synchronized intermittent mandatory ventilation with volume control is a mode in which periodic volume breaths are delivered to the patient at preset intervals (time-triggered). Between the machine delivered breaths, the patient can breathe spontaneously at the rate, tidal volume, and timing that the patient desires.

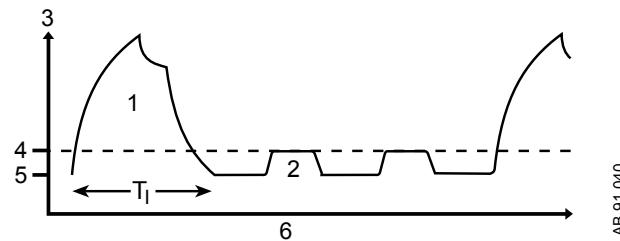
At the specified time interval, the ventilator will not wait for the next inspiratory effort from the patient. The sensitivity of this effort is adjusted using the flow trigger level. When the ventilator senses the beginning of inspiration within the Trigger window it synchronously delivers a volume breath using the set tidal volume, and the inspiratory time (Tinsp) that is set on the ventilator. If the patient fails to make an inspiratory effort during the trigger window time interval, the ventilator will deliver a machine breath to the patient. The ventilator will always deliver the specific number of breaths per minute that the clinician has set.

In SIMV VCV, the spontaneous breaths can be pressure supported to assist the patient in overcoming the resistance of the patient circuit and artificial airway. When the Psupport level is set, the ventilator will deliver the pressure support level to the patient during inspiration. PEEP can also be used in combination with this mode.

Spontaneous breaths that occur during this mode are indicated by a color change in the waveform.

SIMV VCV mode settings:

- TV
- RR
- Tinsp
- Tpause
- Psupport
- PEEP
- Pmax
- Trig Window
- Flow Trigger
- End of Breath
- Rise Rate



1. Mandatory SIMV breath
2. Spontaneous pressure supported breath
3. Paw
4. Psupport
5. PEEP
6. Time

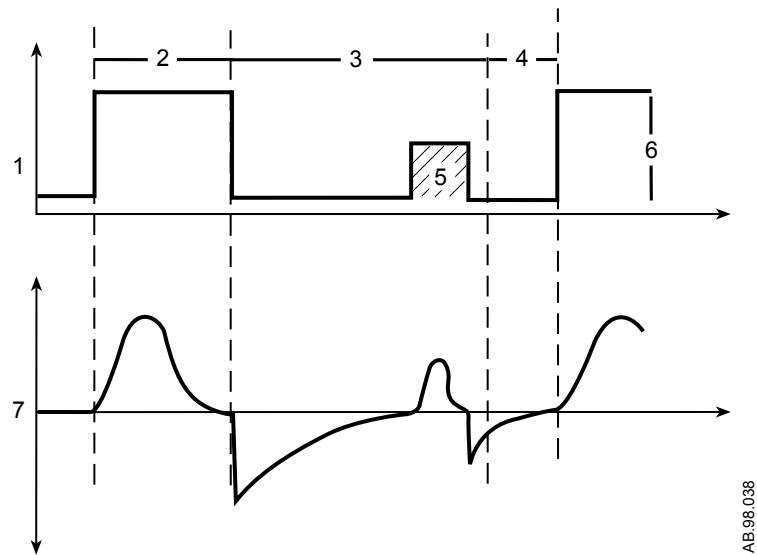
*Figure 11-6 • SIMV VCV waveform*

### SIMV PCV mode

Synchronized intermittent ventilation with pressure control ventilation (SIMV PCV) delivers a relatively slow breathing rate with pressure-controlled breathing. This mode combines mandatory breaths with spontaneous breath support. If a trigger event occurs within the synchronized window, a new pressure-controlled breath is initiated. If a trigger event occurs elsewhere during the expiratory phase, a support for a spontaneous breath is provided with pressure support added as set by the clinician.

SIMV PCV mode settings:

- Pinsp
- RR
- Tinsp
- Psupport
- PEEP
- Pmax
- Trig Window
- Flow Trigger
- End of Breath
- Rise Rate
- Exit Backup



1. Paw waveform
2. Tinsp
3. Spontaneous breathing period
4. Trigger window
5. Pressure supported breath
6. Pinsp
7. Flow waveform

*Figure 11-7 • SIMV PCV waveforms*

### SIMV PCV-VG mode

Synchronized intermittent mandatory ventilation with pressure control volume guaranteed (SIMV PCV-VG) delivers a set rate of pressure controlled breaths with a guaranteed volume to the patient. The patient can breathe spontaneously between mandatory breaths. Pressure support can be used to support the spontaneous breaths.

The mandatory breaths will deliver the set tidal volume using a decelerating flow and a constant pressure. The ventilator will adjust the inspiratory pressure needed to deliver the set tidal volume breath-by-breath so that the lowest pressure is used. The pressure range that the ventilator will use is between the PEEP + 2 cmH<sub>2</sub>O level on the low end and 5 cmH<sub>2</sub>O below Pmax on the high end. The inspiratory pressure change between breaths is a maximum of +/- 3 cmH<sub>2</sub>O. If a high airway pressure alarm is active due to the current breath, the next breath's target will be 0.5 cmH<sub>2</sub>O less than the current breath's pressure target.

SIMV PCV-VG begins by delivering a volume controlled breath. The patient's compliance is determined from the volume controlled ventilation breath and the inspiratory pressure level is then established for the next PCV-VG breath. The remaining mandatory

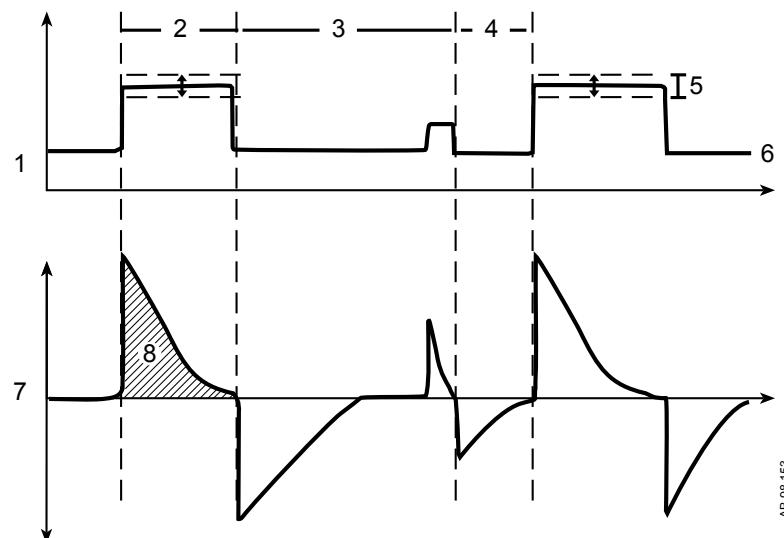
breaths will be pressure controlled with a guaranteed volume at the inspiratory limb.

A portion of the exhalation phase is defined as the trigger window. If a spontaneous breath is detected in this window, a new mandatory PCV-VG breath is initiated. If a spontaneous breath is detected outside of this window, support for this breath is provided according to the set pressure support. The remainder of the trigger window is added to the next non-triggering phase.

The inspiratory phase of supported breaths will end if the set End of Breath is reached, if the airway pressure exceeds (PEEP + Psupport + 3 cmH<sub>2</sub>O). Supportive breaths have a maximum inspiratory time of 4 seconds.

SIMV PCV-VG mode settings:

- TV
- RR
- Flow Trigger
- Psupport
- PEEP
- Tinsp
- Pmax
- Trig Window
- End of Breath
- Rise Rate
- PSV Rise Rate



1. Paw waveform
2. Tinsp
3. Spontaneous breathing period
4. Trig Window
5. Variable pressure to deliver desired TV

6. PEEP
7. Flow waveform
8. TV

*Figure 11-8 • SIMV PCV-VG waveforms*

### **PSVPro mode**

PSVPro is pressure supported ventilation with apnea backup. PSVPro is a spontaneous mode of ventilation that provides a constant support pressure once the ventilator senses that the patient has made an inspiratory effort. In this mode, the clinician sets the Pressure Support (Psupport) and PEEP levels. The patient establishes the rate, inspiratory flow, and inspiratory time. The tidal volume is determined by the pressure, lung characteristics, and patient effort.

PSVPro uses an inspiration termination level that establishes when the ventilator will stop the pressure-supported breath and cycle to the expiratory phase. The inspiration termination level is user adjustable from 5 to 75%. This parameter sets the percent of peak inspiratory flow that the ventilator uses to end the inspiratory phase of the breath and to cycle into the expiratory phase. If the inspiration termination is set to 30% then the ventilator will stop inspiration when the flow decelerates to a level equal to 30% of the measured peak inspiratory flow. The lower the setting, the shorter the inspiratory phase.

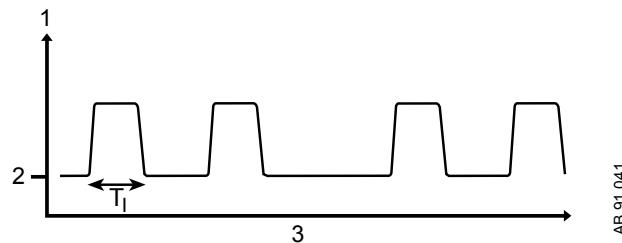
An apnea backup mode is provided if the patient stops breathing. When setting this mode the clinician adjusts the inspiratory pressure (Pinsp), respiratory rate (RR), and the inspiratory time (Tinsp). As long as the patient is triggering the ventilator and the apnea alarm does not activate, the patient will get pressure-supported breaths and the ventilator will not deliver machine breaths.

If the patient stops triggering the ventilator for the set apnea delay time, the apnea alarm will activate and the ventilator will automatically switch to the backup mode that is SIMV PCV. Once in this mode the ventilator will begin delivering machine pressure controlled breaths at the inspiratory pressure level, inspiratory time, and rate that the user has set. If, during this time, the patient takes spontaneous breaths in between the machine breaths, the patient will receive pressure supported breaths.

PSVPro mode settings:

- Psupport
- PEEP
- Trig Window
- Flow Trigger
- End of Breath
- Pmax
- Backup Time

- Pinsp
- RR
- Tinsp
- Rise Rate
- Exit Backup



1. Paw
2. PEEP
3. Time

*Figure 11-9 • PSVPro waveform*

When the ventilator switches to the backup mode, the ‘Backup Mode active’ alarm shows until PSVPro is reinstated or until another ventilation mode is selected. PSVPro mode automatically resumes when the ventilator registers the number of consecutive patient-triggered breaths set for the Exit Backup setting. The factory default setting for Exit Backup is 2. When Exit Backup is set to Off, the user must reselect the PSVPro mode to reactivate PSVPro. Upon returning to PSVPro the ventilator immediately begins providing pressure supported breaths to the patient using the established settings.

Spontaneous breaths that occur during this mode are indicated by a color change in the waveform.

### CPAP + PSV mode

Continuous positive airway pressure + pressure support ventilation mode is used on spontaneously breathing patients. This mode of ventilation provides a constant support pressure once the ventilator senses that the patient has made an inspiratory effort. In this mode, the clinician sets the Pressure support (Psupport) and PEEP levels. The patient establishes the rate, inspiratory flow, and inspiratory time. The tidal volume is determined by the pressure, lung characteristics, and patient effort.

CPAP + PSV uses an inspiration termination level that establishes when the ventilator will stop the pressure supported breath and cycle to the expiratory phase. The inspiration termination level is user adjustable from 5 to 75%. This parameter sets the percent of the peak inspiratory flow that the ventilator uses to end the inspiratory phase of the breath and to cycle into the expiratory phase. If the

inspiration termination is set to 30% then the ventilator will stop inspiration when the flow decelerates to a level equal to 30% of the measured peak inspiratory flow. The lower the setting the longer the inspiratory time and conversely, the higher the setting the shorter the inspiratory phase.

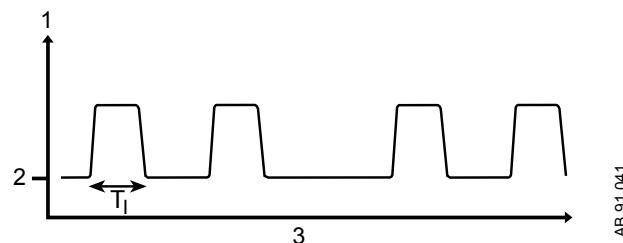
If the spontaneous inspiratory effort does occur within the delay period, the ventilator delivers pressure controlled breaths with the preset inspiratory pressure to bring the breath rate up to the minimum rate. The delay period calculation is  $60\text{ s}/\text{minimum rate} + ([60\text{ s}/\text{minimum rate}] - \text{previous measured breath period})$ .

The inspiratory support pressure and the inspiratory pressure settings are linked at the start of each case. When the inspiratory support pressure setting is changed, the inspiratory pressure setting is automatically adjusted to match the inspiratory pressure setting. The link can be broken by changing the Pinsp setting through the **Vent Mode** menu during the case.

Spontaneous breaths that occur during this mode are indicated by a color change in the waveform.

CPAP + PSV settings:

- Psupport
- PEEP
- Flow Trigger
- End of Breath
- Pmax
- Pinsp
- Minimum RR
- Tinsp
- Rise Rate



AB91041

1. Paw
2. PEEP
3. Time

Figure 11-10 • CPAP + PSV waveform

## Ventilation modes factory default settings

The ventilation mode factory default settings for the ADULT case default show in the following table. An \* indicates the setting is not used for the ventilation mode. See the "*Super user mode*" section for all other case default values.

Setting	Range	Mode							
		VCV	PCV	PCV-VG	SIMV VCV	SIMV PCV	SIMV PCV-VG	PSVPro	CPAP +PSV
TV	20-1500 ml	500	*	500	500	*	500	*	*
RR	4-100 bpm	12	12	12	*	*	*	*	*
RR	2-60 bpm	*	*	*	12	12	12	12	*
Minimum RR	4-60 /min	*	*	*	*	*	*	*	12
I:E	2:1 - 1:8	1:2	1:2	1:2	*	*	*	*	*
Tpause	Off, 5-60% of Tinsp	Off	*	*	Off	*	*	*	*
PEEP	Off, 4-30 cmH2O	Off	Off	Off	Off	Off	Off	Off	Off
Pmax	12-100 cmH2O	40	40	40	40	40	40	40	40
Pinsp	5-60 cmH2O	*	5	*	*	5	*	5	5
Psupport	Off, 2-40 cmH2O	*	*	*	2	2	2	2	2
Tinsp	0.2-5 seconds	*	*	*	1.7	1.7	1.7	1.7	1.7
Rise Rate	Auto, 1-10	*	Auto	*	Auto	Auto	*	Auto	Auto
Rise Rate	1-10	*	*	5	*	*	5	*	*
PSV Rise Rate	Auto, 1-10	*	*	*	*	*	Auto	*	*
Trig Window	Off, 5-80% of Texp	*	*	*	25	25	25	25	*
Flow Trigger	0.2-10 l/min	*	*	*	2.0	2.0	2.0	2.0	2.0
End of Breath	5-75% of peak inspiratory flow	*	*	*	30	30	30	30	30
Backup Time	10-30 seconds	*	*	*	*	*	*	30	*
Exit Backup	Off, 1-5 spontaneous breaths	*	*	*	*	*	*	2	*

## Ventilation mode transition

Ventilation settings selectable through the quick keys and **More Settings** are set to the factory default settings at start up of the system and at the end of each case. The ventilation settings remain at the factory default until changed by the user. If a ventilation setting is changed, the new setting remains active in all applicable modes until the setting is changed again. Exceptions include:

- For modes that use RR 4 to 100, the RR transfers to the new mode at the set RR or 60 whichever is smaller. For example, if the mode in use has a RR of 75 and the new mode does not support a RR of 75, the RR is set to 60.
- For modes that use RR 2 to 60, the RR does not transfer to modes that use RR 4 to 100. The RR is set to the factory default or the last set if previously used during the case. For example, if during the first case the RR (2 to 60) is set to 2 and the new mode uses RR 4 to 100, the RR is set to the factory default.
- For modes that use I:E, when transferring to a mode that uses Tinsp, the Tinsp is set to a calculation of I:E or 5 seconds whichever is lower.
- For CPAP + PSV mode, Psupport and Pinsp settings are linked during the patient case. When the Psupport setting is changed, the Pinsp setting changes to the same value. The Pinsp setting shows in the ventilation mode information above the ventilator settings. To break the link during a case, change the Pinsp setting using the Pinsp key.

## Ventilator operating specifications

Based on the ventilator settings in use, the setting ranges may be constrained so that the specifications stated are met.

### Pneumatics

Gas source	Anesthesia system
Gas composition	Medical Air or O <sub>2</sub>
Nominal supply pressure	350 kPa (50 psi)
Pressure range at inlet	240 to 700 kPa (35 to 102 psi)
Peak gas flow	120 l/min at 240 kPa (35 psi), 0.75 seconds
Continuous gas flow	80 l/min at 240 kPa (35 psi)
Flow valve range	1 to 120 l/min at 240 kPa (35 psi)

### Fresh gas compensation

Flow compensation range	0.20 to 15 l/min
Gas composition	O <sub>2</sub> , N <sub>2</sub> O, Air, anesthetic agents

### Pressure

Patient airway pressure range	-20 to 120 cmH <sub>2</sub> O, +/- 1 cmH <sub>2</sub> O resolution
High pressure alarm set range	12 to 100 cmH <sub>2</sub> O, 1 cm increment
Sustained pressure alarm range	6 to 40 cmH <sub>2</sub> O, 1 cm increment
Display range	-20 to 120 cmH <sub>2</sub> O

### Volume

Tidal volume display range	less than 1 to 9999 ml, 1 ml resolution
Setting range	20 to 1500 ml

## Aisys CS<sup>2</sup>

Minute volume	less than 0.1 to 99.9 liters, 0.1 liter resolution
Breath rate	4 to 100 bpm (non-spontaneous) 2 to 60 bpm (spontaneous) 1 bpm resolution
Volume sensor type	Variable flow orifice

## Oxygen

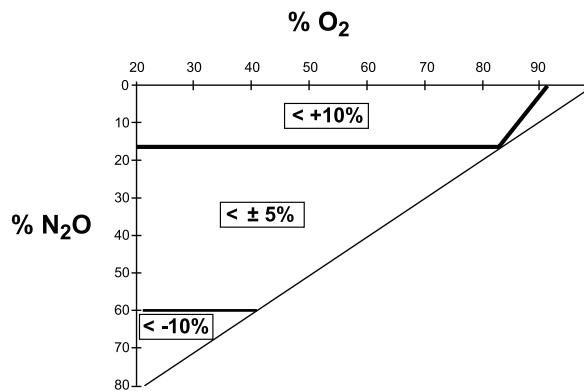
Display range	5 to 110% O <sub>2</sub>
Display resolution	1% increments
Sensor type	Galvanic fuel cell
Measurement range	0 to 100% O <sub>2</sub>
Measurement accuracy	Better than +/- 3% of full scale
Cell response time	35 seconds Note: Response time of cell and adapters is measured using the test method described in ISO 7767 (1997).
Low O <sub>2</sub> alarm range	18% to 99%
High O <sub>2</sub> alarm setting	19% to 100% or Off Note: Low O <sub>2</sub> limit may not be set above high O <sub>2</sub> limit. High O <sub>2</sub> limit may not be set below the low O <sub>2</sub> limit.
Expected cell life	Four months of shelf life (23°C room air) and one year of normal operation.

## Ventilator accuracy data

The following accuracy data is based on patient conditions and settings described in ASTM F1101. The ventilator is assumed to be operating in volume mode. For the following to be true, the ventilator is operating with 100 percent oxygen in the breathing system, or it is connected to an anesthesia gas analyzer. If the ventilator is operating without being connected to an anesthesia gas analyzer, or at a temperature that differs from when it was calibrated, additional errors may occur.

The minimum detectable breath size is 5.0 ml.

<b>Delivery accuracy</b>	
Volume delivery accuracy	Greater than 210 ml tidal volume - accuracy better than 7%. Less than or equal to 210 ml but greater than or equal to 60 ml tidal volume - accuracy better than 15 ml. Less than 60 ml tidal volume - accuracy better than 10 ml.
Volume monitoring accuracy	Greater than 210 ml tidal volume - accuracy better than 9%. Less than or equal to 210 ml but greater than or equal to 60 ml tidal volume - accuracy better than 18 ml. Less than 60 ml tidal volume - accuracy better than 10 ml.
Inspiratory pressure delivery accuracy	Greater of +/- 10% or +/- 3 cmH <sub>2</sub> O
PEEP delivery accuracy	+/- 1.5 cmH <sub>2</sub> O
Pressure monitoring accuracy	Greater of +/- 5% or +/- 2 cmH <sub>2</sub> O
Note: Gas composition errors may be in additions to the above normalized accuracy. When adding errors, positive errors can have the effect of nulling out negative errors.	
Note: Use of anesthetic agent could affect the errors by approximately -0.95%/% volume agent in normal mode.	
Note: Temperatures greater than or less than 24°C may decrease BTPS accuracy.	



AC.22.029

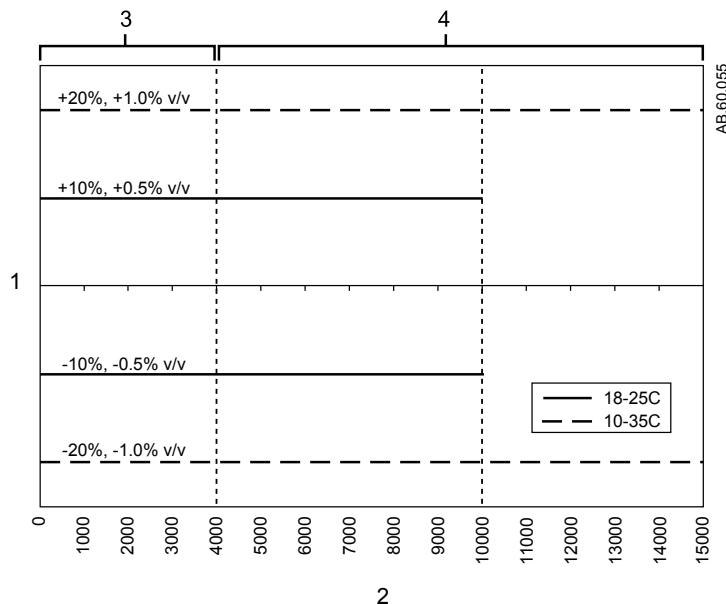
Figure 11-11 • Gas composition related errors

## Electronically controlled vaporizer and Aladin cassette

Electronically controlled vaporizer for delivery of five agents: halothane, isoflurane, enflurane, sevoflurane, and desflurane. The cassettes can be handled safely without excessive leakage of anesthetic agent to the environment. The electronically controlled vaporizer is calibrated using 100% O<sub>2</sub> at multiple flows.

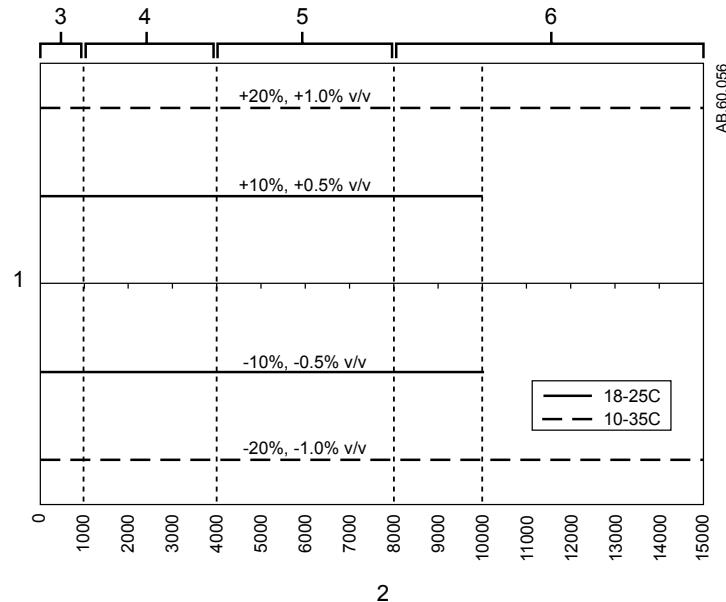
Agent setting ranges	
Halothane, enflurane, isoflurane	Off, 0.2 to 5% in fresh gas flow, resolution 0.1%
Sevoflurane	Off, 0.2 to 8% in fresh gas flow, resolution 0.1%
Desflurane	Off, 1 to 18% in fresh gas flow, resolution 0.2%

Response time	
To 90% of step; measured at fresh gas outlet	Less than 7 seconds at fresh gas flow of 2 l/min



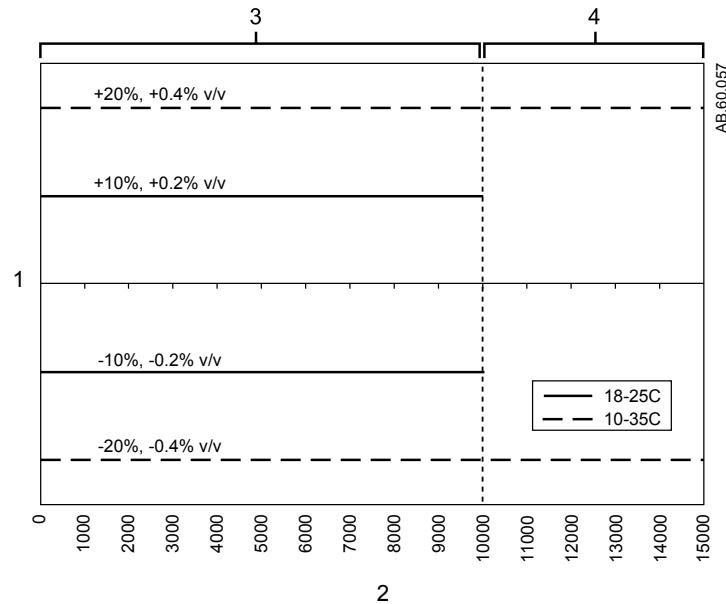
1. Accuracy is greater of percent of setting (%) or volumetric percent (% v/v)
2. Fresh gas flow ml/min
3. All settings
4. Settings equal to or less than 9.0%

Figure 11-12 • Desflurane accuracy Aladin and Aladin2 Enhanced Temperature Sensing



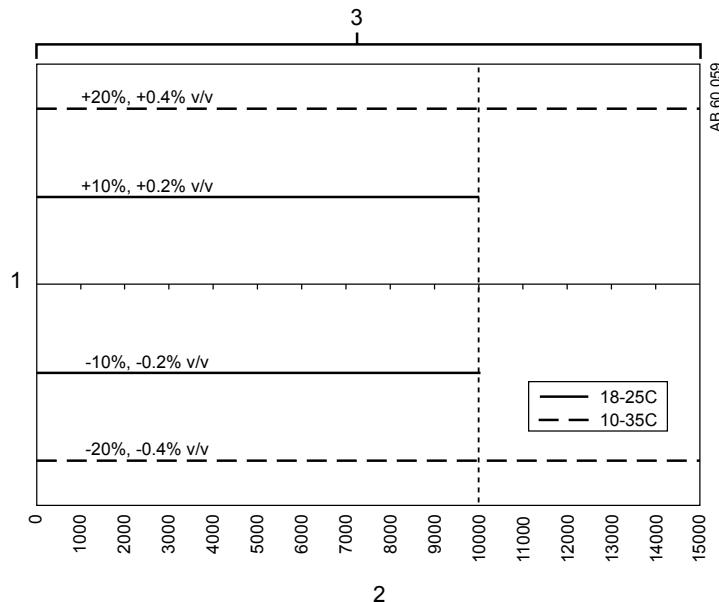
1. Accuracy is greater of percent of setting (%) or volumetric percent (% v/v)
2. Fresh gas flow ml/min
3. All settings
4. Settings equal to or less than 13.4%
5. Settings equal to or less than 9%
6. Settings equal to or less than 3.6%

Figure 11-13 • Desflurane accuracy Aladin2



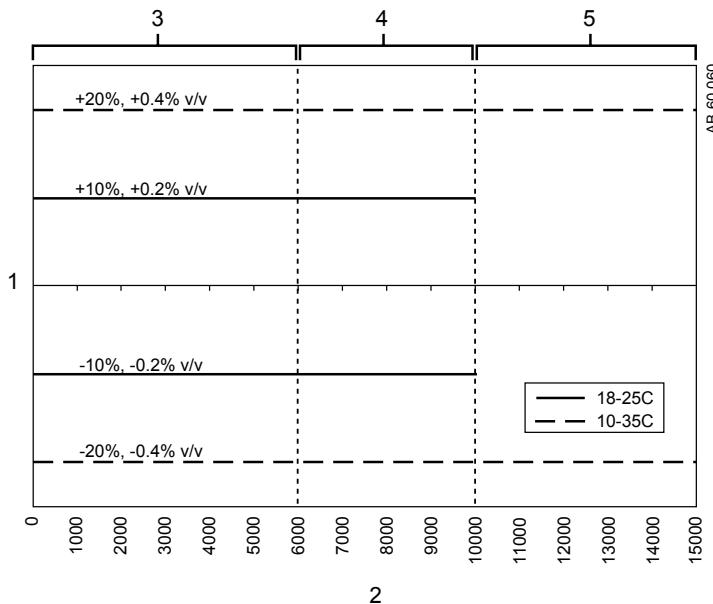
1. Accuracy is greater of percent of setting (%) or volumetric percent (% v/v)
2. Fresh gas flow ml/min
3. All settings
4. Settings equal to or less than 3.8%

Figure 11-14 • Enflurane accuracy



1. Accuracy is greater of percent of setting (%) or volumetric percent (% v/v)
2. Fresh gas flow ml/min
3. All settings

Figure 11-15 • Halothane and Isoflurane accuracy



1. Accuracy is greater of percent of setting (%) or volumetric percent (% v/v)
2. Fresh gas flow ml/min
3. All settings
4. Settings equal to or less than 4.0%
5. Settings equal to or less than 1.6%

*Figure 11-16 • Sevoflurane accuracy*

- Note** Accuracy specifications apply after a period of temperature stabilization with output averaged at the common gas outlet over the latter minute of a 2 minute delivery at setting.
- Note** For a choice of settings and conditions, inaccuracy is the larger amount of each specified pair percent setting (%) or volumetric percent (% v/v). Applicable flow setting is inclusive of the right-hand boundary.
- Note** The effect of the fresh gas composition, back pressure (including ventilation), and ambient pressure on the agent concentration are included in the accuracy specifications.
- Note** The system delivers the same output in volumetric percent (% v/v) within the specified altitude range.
- Note** For Aladin2 desflurane, if not operating in enhanced temperature sensing mode, the output accuracy may be reduced.

## Aladin2 cassettes

Filling		
Filling system	Easy-Fil: Adapter filler system for isoflurane, enflurane, and sevoflurane. Quick-Fil: Filler system compatible to Abbot's system for sevoflurane. Saf-T-Fill: Filler system compatible to the Datex-Ohmeda Saf-T-Fil bottle for desflurane.	
Filling speed	Greater than 2 ml/s	
Overfilling protection	Overfilling prevention systems built into the cassettes.	

Liquid capacity	Enf, Iso, Sev	Des
Maximum	220 ml	240 ml
Normal fill when indicator shows empty	125 ml (residual volume 95 ml)	140 ml (residual volume 100 ml)

Cassette	
Empty weight	2.8 kg
Height	7 cm
Depth	24 cm
Width	14 cm

## Aladin cassettes

Filling	
Filling system	Adapter filling: Rectangular keyed adapter filler system for halothane, isoflurane, enflurane, and sevoflurane. Quik-Fil: filler system compatible to Abbot's system for sevoflurane. Cylindrical keyed adapter: Filler system compatible to the Datex-Ohmeda Saf-T-Fil bottle for desflurane.
Filling speed	Greater than 2 ml/s
Overfilling protection	Overfilling prevention systems built into the cassettes.

Liquid capacity	
Maximum	250 ml

## 11 Specifications and theory of operation

Liquid capacity	
Normal fill when indicator shows empty	150 ml (residual volume 100 ml)

Cassette	
Empty weight	2 kg: enflurane, isoflurane, sevoflurane with keyed filler 2.5 kg: halothane with keyed filler, sevoflurane with Quik-Fil 3 kg: desflurane
Height	7 cm
Depth	23 cm
Width	14 cm 16 cm with keyed filler

## Electromagnetic compatibility (EMC)

**WARNING** Changes or modification to this equipment not expressly approved by the manufacturer could cause EMC issues with this or other equipment. Contact the manufacturer for assistance. This device is designed and tested to comply with applicable regulations regarding EMC as follows.

- Use of portable phones or other radio frequency (RF) emitting equipment (that exceed electromagnetic interference levels specified in IEC 60601-1-2) near the system may cause unexpected or adverse operation. Monitor operation when RF emitters are in the vicinity.
- Use of other electrical equipment adjacent to or stacked with this system may cause interference. Verify normal operation of equipment in the system before use on patients.

## Cables

Cables used to obtain system electromagnetic emission and immunity results are described below.

**WARNING** Use of any cables other than those specified by the manufacturer may result in increased emissions or decreased immunity of the anesthesia system.

Display optional output ports	Cables used for EMC testing
Ethernet	Standard 8-pin RJ45 connector with unshielded Ethernet cable - 7.6 m maximum length.
Ethernet	Standard 8-pin RJ45 connector with unshielded Ethernet cable - 7.6 m maximum length.
Universal Serial Bus (USB)	Standard Type A connector USB cable with foil shield - 1.8 m maximum length.
Universal Serial Bus (USB)	The visible USB connector can be populated with a memory stick.
Video Graphics Array (VGA)	Standard VGA 15-pin D-subminiature three row connector with shielded cable - 1.8 m maximum length.
RS-232 Serial with On/STBY	Part number M1023823.

Display optional output ports	Cables used for EMC testing
Monitor On/STBY	Standard 9-pin D-subminiature male connector with shielded cable - 1.8 m maximum length.

## Guidance and manufacturer's declaration - electromagnetic emissions

The system is suitable for use in the specified electromagnetic environment. The customer and/or user of the system should assure that it is used in an electromagnetic environment as described below.

Emissions test	Compliance	Electromagnetic environment guidance
RF emissions CISPR 11	Group 1	The system uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11	Class A	The system is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions IEC 61000-3-2	Class A	The system is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Voltage fluctuations/flicker emissions IEC 61000-3-3	Complies	The system is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.

## Guidance and manufacturer's declaration - electromagnetic immunity

The system is suitable for use in the specified electromagnetic environment. The customer and/or user of the system should assure that it is used in an electromagnetic environment as described below.

## Power immunity

<b>Power immunity</b>			
<b>Immunity test</b>	<b>IEC 60601-1-2 test level</b>	<b>Compliance level</b>	<b>Electromagnetic environment guidance</b>
Electrostatic discharge (ESD) IEC 61000-4-2	+/- 6 kV contact +/- 8 kV air	+/- 6 kV contact +/- 8 kV air	Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	+/- 2 kV for power supply lines +/- 1 kV for input/output lines	+/- 2 kV for power supply lines +/- 1 kV for input/output lines	Mains power quality should be that of a typical commercial and/or hospital environment.
Surge IEC 61000-4-5	+/- 1 kV line(s) to line(s) +/- 2 kV line(s) to earth	+/- 1 kV differential mode +/- 2 kV common mode	Mains power quality should be that of a typical commercial and/or hospital environment.
Voltage dips, short interruptions, and voltage variations on power supply input lines IEC 61000-4-11	<5% UT (>95% dip in UT) for 0.5 cycle 40% UT (60% dip in UT) for 5 cycles 70% UT (30% dip in UT) for 25 cycles <5% UT (>95% dip in UT) for 5 seconds	<5% UT (>95% dip in UT) for 0.5 cycle 40% UT (60% dip in UT) for 5 cycles 70% UT (30% dip in UT) for 25 cycles <5% UT (>95% dip in UT) for 5 seconds	Mains power quality should be that of a typical commercial and/or hospital environment. If the user of the system requires continued operation during power mains interruptions, it is recommended that the system be powered from an uninterruptible power supply or battery.
Power frequency (50/60 Hz magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.

Note: UT is the AC mains voltage prior to application of the test level.

## Radiated immunity

<b>Radiated immunity</b>			
<b>Immunity test</b>	<b>IEC 60601-1-2 test level</b>	<b>Compliance level</b>	<b>Electromagnetic environment guidance recommended separation distance</b>
			Portable and mobile RF communications equipment should be used no closer to any part of the system, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.

<b>Radiated immunity</b>			
<b>Immunity test</b>	<b>IEC 60601-1-2 test level</b>	<b>Compliance level</b>	<b>Electromagnetic environment guidance recommended separation distance</b>
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz outside ISM bands	10 Vrms (V1)	$D=0.35\sqrt{P}$
	10 Vrms 150 kHz to 80 MHz in ISM bands	10 Vrms (V2)	$D=1.2\sqrt{P}$
Radiated RF IEC 61000-4-3	10 V/m 80 MHz to 2.5 GHz	10 V/m (E1)	<p><math>D=1.2\sqrt{P}</math> 80 MHz to 800 MHz  <math>D=2.3\sqrt{P}</math> 800 MHz to 2.5 GHz  Where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and D is the recommended separation distance in meters (m).</p> <p>Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, should be less than the compliance level in each frequency range.</p> <p>Interference may occur in the vicinity of equipment marked with the following symbol:</p> 
<ul style="list-style-type: none"> <li>The ISM (industrial, scientific, and medical) bands between 150 kHz and 80 MHz are 6.765 MHz to 6.795 MHz, 13.553 MHz to 13.567 MHz, 26.957 MHz to 27.283 MHz, and 40.66 MHz to 40.70 MHz.</li> <li>The compliance levels in the ISM frequency bands between 150 kHz and 80 MHz and in the frequency range 80 MHz to 2.5 GHz are intended to decrease the likelihood that a mobile/portable communications equipment could cause interference if it is inadvertently brought into patient areas. For this reason, an additional factor of 10/3 has been incorporated into calculating the recommended separation distance for transmitters in these frequency ranges.</li> <li>Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast, and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the system is used exceeds the applicable RF compliance level above, the system should be observed to verify normal operation. If abnormal performance is observed, additional measures may not be necessary, such as re-orienting or relocating the system.</li> <li>Over the frequency range of 150 kHz to 80 MHz, field strengths should be less than 10 V/m.</li> </ul> <p>Note: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.</p>			

## Recommended separation distances

The system is intended for use in the electromagnetic environment in which radiated RF disturbances are controlled. The customer and/or user of the system can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the system as recommended below, according to the maximum power of the communications equipment.

<b>Separation distance in meters (m) according to frequency of the transmitter</b>				
<b>Rated maximum output power of transmitter watts (W)</b>	<b>150 kHz to 80 MHz outside ISM bands</b>	<b>150 kHz to 80 MHz in ISM bands</b>	<b>80 MHz to 800 MHz</b>	<b>800 MHz to 2.5 GHz</b>
	$D = \left[ \frac{3.5}{V1} \right] \sqrt{P}$	$D = \left[ \frac{12}{V2} \right] \sqrt{P}$	$D = \left[ \frac{12}{E1} \right] \sqrt{P}$	$D = \left[ \frac{23}{E1} \right] \sqrt{P}$
0.01	0.035	0.12	0.12	0.23
0.1	0.11	0.38	0.38	0.73
1	0.35	1.2	1.2	2.3
10	1.1	3.8	3.8	7.3
100	3.5	12	12	23
For transmitters rated at a maximum output power not listed above, the recommended separation distance D in meters (m) can be determined using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.				
Note 1: At 80 MHz to 800 MHz the separation distance for the higher frequency range applies.				
Note 2: The ISM (Industrial, Scientific, and Medical) bands between 150 kHz and 80 MHz are 6.765 MHz to 6.795 MHz, 13.553 MHz to 13.567 MHz, 26.957 MHz to 27.283 MHz, and 40.66 MHz to 40.70 MHz.				
Note 3: An additional factor of 10/3 is used in calculating the recommended separation distance for transmitters in the ISM frequency bands between 150 kHz and 80 MHz and in the frequency range of 80 MHz to 2.5 GHz to decrease the likelihood that mobile/portable communications equipment could cause interference if it is inadvertently brought into patient areas.				
Note 4: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.				

# 12 Super user mode

<b>In this section</b>	
Super user mode.	12-2
Gas usage.	12-3
System configuration.	12-5
Case defaults.	12-10
Gas controls.	12-15
Procedures setup.	12-16

## Super user mode

**WARNING** Do not enter Super User mode when a patient is connected to the system. Gas flow will cease, and the system must be powered down in order to restart gas flow.

- Changes made in Super User mode affect the system configuration. All changes made are permanent and preserved until changed again.

Several settings can be changed in Super User mode. These changes should only be made by the person responsible for the configuration of the system.

To access the Super User mode, select **System Setup** and then **Super User**. The Super User mode is password protected. Contact the sales representative to obtain the password.

The system must be turned off to exit Super User mode.

**Note** Menu items are dependant on system configuration. Inactive menu items are gray and are not selectable.

**Note** The menu selections shown in the examples are the factory default values. The available settings are shown to the right of the menu.

## Gas usage

Use the **Gas Usage** menu to view the total fresh gas usage since the last reset, to reset the gas usage to zero, and view optional ecoFLOW and agent cost information.

### Resetting cumulative gas usage

1. From Super User mode, select **Gas Usage** and then **Cumulative Gas Usage**. Gas and agent usage since the last reset will show.
2. Select **Reset Usage**. Notice that the gas and agent usage totals will reset to zero and that **Last Reset** shows the current date.
3. Select **Back** to return to the **Gas Usage** menu.

## Setting ecoFLOW

Use the **ecoFLOW** menu to set the split screen defaults for **FiO2 Setting**, **FiO2 Line**, and **Agent Cost**. This menu item is only available on systems with the ecoFLOW option installed.

1. From Super User mode, select **Gas Usage** and then **ecoFLOW**.
2. Select the item to change. Make the change.  
For **FiO2 Setting**, set the numeric value for FiO2 on the split screen.  
For **FiO2 Line**, select whether to show or hide the FiO2 line on the split screen.  
For **Agent Cost**, select whether to show or hide the agent delivered costs on the split screen.
3. Select **Back** to return to the **Gas Usage** menu.

## Setting agent costs

Use the **Agent Costs** menu to modify the currency and agent cost defaults used to show the cost of agent delivered on the split screen. This menu item is only available on systems with the ecoFLOW option installed.

1. From Super User mode, select **Gas Usage** and then **Agent Costs**.
2. Select the **Currency** from the drop-down list.
3. Set the cost for each agent.

4. Select **Back** to return to the **Gas Usage** menu.

## System configuration

Use the **System Config.** menu to set default information for the system. Use the **System Config.** menu to access menus and settings for **Colors**, **Units**, **Ventilator Settings**, **Alarm Settings**, **Parameter Settings**, **Trends Setup**, and **Pages Setup**.

### Display settings

Use the **Colors** menu to set the default colors for waveforms, digit fields, and trends.

Use the **Units** menu to set the default units for parameters and currency.

#### Setting colors

Set **Paw**, **Flow**, **Respiratory**, and **CO2** parameters.

1. From Super User mode, select **System Config.** and then **Colors**.
2. For each parameter, select the desired color from the drop-down list.
3. Select **Back** to return to the **System Config.** menu.

#### Setting units

Set **Patient Weight**, **CO2**, **Gas Supply Pressure**, **Paw**, and **Currency** to the desired units. **Currency** is only available for systems with the ecoFLOW option installed.

1. From Super User mode, select **System Config.** and then **Units**.
2. For each parameter, select the desired unit from the drop-down list.
3. Select **Back** to return to the **System Config.** menu.

## Ventilator settings

Use the **Ventilator Settings** menu to set the default user settings for **VCV Cardiac Bypass**, **Circuit Compliance**, **Sample Compensation**, and **TV for Ideal Body Weight**.

#### Setting ventilator defaults

1. From Super User mode, select **System Config.** and then **Ventilator Settings**.

2. Select the item to change.  
Set **VCV Cardiac Bypass** to **Yes** to enable alveolar support during cardiac bypass. This menu item is only available on systems with the VCV Cardiac Bypass option installed.  
Set **Circuit Compliance** to **On** to allow tidal volume compensation for circuit compliance.  
Set **Sample Compensation** to **On** to allow tidal volume compensation for gas module sampling.  
Set the **TV for Ideal Body Weight** value to compute RR and TV on a case.
3. Select **Back** to return to the **System Config.** menu.

## Alarm settings

Use the **Alarm Settings** menu to set **External Gas Monitor**, **Apnea Alarm Filter**, and **Show Alarm Limits** default settings.

### Setting alarm defaults

1. From Super User mode, select **System Config.** and then **Alarm Settings**.
2. Select the item to change.  
Set **External Gas Monitor** to **Yes** only if the system uses a stand-alone monitor for O2, agent, and CO2. Selecting **Yes** disables the O2 limit alarms and the 'O2 monitoring not connected' alarm when there is no O2 cell or airway module detected in the system. The 'AA, CO2 monitoring not connected' alarm is also disabled.  
Set **Apnea Alarm Filter** to **Enable** to use CO2 breaths to filter the volume apnea alarms when patient weight is set to the minimum setting. 'Volume Apnea Off' shows in the message field when the apnea alarm filter conditions are met. Set **Apnea Alarm Filter** to **Disable** to shut off the use of CO2 breaths for filtering volume apnea alarms.  
Set **Show Alarm Limits** to **Yes** to show the alarm limits for the primary parameter in the numeric and digit fields.
3. Select **Back** to return to the **System Config.** menu.

## Parameter settings

Use the **Parameter Settings** menu to set **Principal Volume**, **Principal O2**, **Principal Agent**, **TV Based on**, **CO2 Numbers**, and **Insp Flow** default settings.

## Setting principal setting defaults

1. From Super User mode, select **System Config.** and then **Parameter Settings.**
2. Select the item to change.  
For **Principal Volume**, select **MV** or **TV** from the drop-down list.  
For **Principal O2**, select **Et** or **Fi** from the drop-down list.  
For **Principal Agent**, select **Et** or **Fi** from the drop-down list.
3. Select **Back** to return to the **System Config.** menu.

## Setting volume conditions and humidity compensation

Individual volume calculation conditions are set for the ventilator and airway module.

**Note** When set to **ATPD**, the volume calculation conditions are based on ambient temperature and pressure, dry humidity conditions. When set to **BTPS**, the volume calculation conditions are based on body temperature, ambient pressure, saturated humidity conditions.

1. From Super User mode, select **System Config.** and then **Parameter Settings.**
2. Select the item to change.
  - To set the volume calculation conditions, set **Vent and Airway Gas Module TV Basis**. Set to **ATPD/ATPD**, **ATPD/BTPS**, or **BTPS/BTPS**.
  - To set the humidity compensation type, set **CO2 Numbers** to **Dry** or **Wet**.
3. Select **Back** to return to the **System Config.** menu.

## Setting inspiratory flow

1. From Super User mode, select **System Config.** and then **Parameter Settings.**
2. Select **Insp Flow** to set the graphical display for flow data.  
Select the plus symbol to graphically display inspiratory flow as a positive value.  
Select the minus symbol to graphically display the expiratory flow as a positive value.
3. Select **Back** to return to the **System Config.** menu.

## Trends setup

Use the **Trends Setup** menu to set the default trend graphical page layout for the top, middle, and bottom trends for each page shown in the user's **Trends** menu.

### Setting the default trend type

1. From Super User mode, select **System Config.** and then **Trends Setup**.
2. Select **Default Trend** and then select the trend type from the drop-down list.
  - Graphical** shows the graphical trends.
  - Measured** shows the numeric trends.
  - Settings** shows the trends for the settings.
3. See the "Setting graphical trends pages" section to continue setting up trends or select **Back** to return to the **System Config.** menu.

### Setting graphical trends pages

Use the Graphical Page section to configure the graphical trends pages for the **Trends** menu.

The table shows the factory default settings for each trend page.

Default settings for Trends on each Page					
	Page 1	Page 2	Page 3	Page 4	Page 5
Top	Pres	O2	AA2	Bal	RR + CO2
Middle	TVexp	N2O	N2O	MAC	Compl
Bottom	CO2	AA1	MAC	MVexp	Off

1. From the Super User mode, select **System Config.** and then **Trends Setup**.
2. Use the drop-down lists to set **Top Trend**, **Middle Trend**, and **Bottom Trend** to show the desired parameters.
3. Select **Next Page** to set up graphical trend defaults for another page or **Back** to return to the **System Config.** menu.

## Page setup

Use the **Pages Setup** menu to set the default screen views for waveform fields, digit fields, and split screen areas. Four default screen views can be configured.

## Setting page views

The table shows the factory default settings for each page view.

<b>Default settings for Page view setup</b>				
	<b>Page 1</b>	<b>Page 2</b>	<b>Page 3</b>	<b>Page 4</b>
Top	Paw	Paw	Paw	Off
Middle	Flow	Flow	Off	Flow
Bottom	CO2	CO2	CO2	CO2
Left	Loops	Off	Loops	Off
Middle Left	Resp	Resp	Flow	Off
Middle Right	Agent	Agent	Agent	Off
Right	Gases	Gases	Gases	Gases
Split Screen	Paw	Spiro	Paw	None

1. From Super User mode, select **System Config.** and then **Pages Setup.**
2. Select the page to set up.
3. Select an item to change. Make the change.  
Waveform fields can be set to AA, CO2, Flow, Paw, or Off.  
Digit fields can be set to Gases, Respiration, Gas supplies, Flow, Agent, Loops, or Off.  
Split screen can be set to None, Trends, Spirometry, Paw, Compliance, or optional ecoFLOW.
4. Select another item. Make the change.
5. When done, select **Back** to select another page to set up.

## Case defaults

Use the **Case Defaults** menu to set the default case types that show on the **Start Case** menu and access the **Volume Apnea Setup** menu.

### Configuring case defaults

Set the case defaults for the case types that are selectable from the **Start Case** menu. In each case type, the name, patient defaults, gas defaults, screen layout defaults, alarm defaults, and ventilator settings for each available ventilation mode can be preset.

1. From Super User mode, select **Case Defaults**.
2. Select the case name to enter the adjustment window.
3. Select an item to change. Make the change.
4. Continue to select items and make changes.
5. Select **Confirm**.
6. Repeat to set the defaults for another default case.

### Setting case name

1. From Super User mode, select **Case Defaults**.
2. Select the name of the case to enter the adjustment window.
3. Select **Name**.
  - Select **Clear** to remove the existing name.
  - Select up to 10 characters from the drop-down list.
  - Select **Delete** to delete a character.
  - Select **Save** to save the name and close the drop-down list.
  - Select **Reset** to return the name to the factory default name.
  - When the 10 character maximum is reached, the name is automatically saved. The drop-down list closes.
4. Select **Confirm** when done.

### Setting volume apnea defaults

Use the **Volume Apnea Setup** menu to enable or disable the user's ability to turn the volume apnea alarms off during manual ventilation.

1. From Super User mode, select **Case Defaults**.

2. Select **Volume Apnea Setup**.
3. Set **Volume Apnea Selection** to **Enable** or **Disable**.
 

Set to **Enable** to allow the user to turn the volume apnea alarm on or off from the **Start Case** menu.

Set to **Disable** to set the volume apnea alarms as always on during manual ventilation.
4. Set the Volume Apnea for each case default.
5. Select **Back** to return to the **Case Defaults** menu.

**Note** When the **Volume Apnea Selection** is set to **Disable**, the **Volume Apnea Alarm** menu selection does not show on the user's **Start Case** menu and the **Vol Apnea Alarm** selection does not show on the **Alarm Setup** menu.

## Default case type settings

Each case has multiple settings. The default settings for the default case types are shown in the following table. An \* indicates that the setting is not used for the default ventilation mode in the case type. Use the empty columns to write in facility changes.

**Note** VCV ADULT settings are used as the default if the system does not have an optional ventilation mode shown.

Page 1 Default settings for default case types								
Settings	ADULT		PEDIATRIC		LOCAL		CUSTOM 1	
Name	ADULT		PEDIATRIC		LOCAL		CUSTOM 1	
Patient and Sensor	Adult		Pedi		Adult		Adult	
Ideal Weight	70		18		70		70	
Age	40		5		40		40	
Other Gas	Air		Air		Air		Air	
Circuit	Circle		Circle		Circle		Circle	
Data Source	Vent		Vent		Vent		Vent	
O2%	100		100		100		100	
Total Flow	6		6		0.2		6	
Auto MV Limits	Off		Off		Off		Off	
Alarm Volume	3		3		1		3	
MV/TV Alarms	On		On		On		On	

# Aisys CS<sup>2</sup>

## Page 1 Default settings for default case types

Settings	ADULT	PEDIATRIC	LOCAL	CUSTOM 1
Volume Apnea	On	On	On	On

## Page 2 Default settings for default case types

Settings	ADULT	PEDIATRIC	LOCAL	CUSTOM 1
Vent Mode	VCV	PCV	VCV	VCV
TV	500	150	500	500
RR	12	16	12	12
RR	12	16	12	12
Minimum RR	12	16	12	12
I:E	1:2	1:2	1:2	1:2
Tpause	Off	Off	Off	Off
PEEP	Off	Off	Off	Off

## Page 3 Default settings for default case types

Settings	ADULT	PEDIATRIC	LOCAL	CUSTOM 1
Pmax	40	40	40	40
Pinsp	5	5	5	5
Tinsp	1.7	1.7	1.7	1.7
Trig Window	25	25	25	25
Flow Trigger	2	2	2	2
Psupport	2	20	2	2
End of Breath	30	30	30	30

## Page 4 Default settings for default case types

Settings	ADULT	PEDIATRIC	LOCAL	CUSTOM 1
Backup Time	30	30	30	30
Rise Rate	Auto	Auto	Auto	Auto
Rise Rate	5	5	5	5
PSV Rise Rate	Auto	Auto	Auto	Auto
Exit Backup	2	2	2	2

## Page 5 Default settings for default case types

Settings	ADULT	PEDIATRIC	LOCAL	CUSTOM 1
Sweep Speed	Fast	Fast	Fast	Fast
Top Waveform	Paw	Paw	Paw	Paw
Middle Waveform	Flow	Flow	Flow	Flow

**Page 5 Default settings for default case types**

<b>Settings</b>	<b>ADULT</b>		<b>PEDIATRIC</b>		<b>LOCAL</b>		<b>CUSTOM 1</b>	
Bottom Waveform	CO2		CO2		CO2		CO2	
Split Screen	Paw		Paw		Paw		Paw	
Left Digit Field	Loops		Loops		Loops		Loops	
Middle Left Digit Field	Resp		Resp		Resp		Resp	
Middle Right Digit Field	Agent		Agent		Agent		Agent	
Right Digit Field	Gases		Gases		Gases		Gases	

**Page 6 Default settings for default case types**

<b>Settings</b>	<b>ADULT</b>		<b>PEDIATRIC</b>		<b>LOCAL</b>		<b>CUSTOM 1</b>	
MV Low	2		2		Off		2	
MV High	10		10		Off		10	
TV Low	Off		Off		Off		Off	
TV High	1000		1000		Off		1000	
RR Low	Off		Off		Off		Off	
RR High	Off		Off		Off		Off	
EtCO2 Low	3		3		3		3	
EtCO2 High	8		8		8		8	
EtO2 Low	Off		Off		Off		Off	
EtO2 High	Off		Off		Off		Off	
FiCO2 High	Off		Off		Off		Off	
FiO2 Low	21		21		21		21	
FiO2 High	Off		Off		Off		Off	

**Page 7 Default settings for default case types**

<b>Settings</b>	<b>ADULT</b>		<b>PEDIATRIC</b>		<b>LOCAL</b>		<b>CUSTOM 1</b>	
EtIso Low	Off		Off		Off		Off	
EtIso High	Off		Off		Off		Off	
Filso Low	Off		Off		Off		Off	
Filso High	5		5		5		5	
EtSev Low	Off		Off		Off		Off	
EtSev High	Off		Off		Off		Off	
FiSev Low	Off		Off		Off		Off	
FiSev High	8		8		8		8	
EtDes Low	Off		Off		Off		Off	
EtDes High	Off		Off		Off		Off	
FiDes Low	Off		Off		Off		Off	
FiDes High	15		15		15		15	

## Aisys CS<sup>2</sup>

### Page 7 Default settings for default case types

Settings	ADULT	PEDIATRIC	LOCAL	CUSTOM 1
EtEnf Low	Off	Off	Off	Off
EtEnf High	Off	Off	Off	Off
FiEnf Low	Off	Off	Off	Off
FiEnf High	5	5	5	5

### Page 8 Default settings for default case types

Settings	ADULT	PEDIATRIC	LOCAL	CUSTOM 1
EtHal Low	Off	Off	Off	Off
EtHal High	Off	Off	Off	Off
FiHal Low	Off	Off	Off	Off
FiHal High	5	5	5	5

## Gas controls

Use the **Gas Controls** menu to set the user's **Agents**, **Total Flow**, and **O2%** quick select preset values and the **Fresh Gas Controls** setting.

### Setting gas preset values

Set five preset gas values that will show on the user's **Gas Setup** menu for **Agents**, **O2%**, and **Total Flow**. Set two combinations of preset values for **O2% and Total Flow**.

1. From Super User, select **Gas Controls**.
2. Select **Agents**, **O2%**, **Total Flow**, or **O2% and Total Flow**.
3. Set the desired preset gas values.
4. Select **Back** to return to the **Gas Controls** menu.

### Setting fresh gas controls

1. From Super User mode, select **Gas Controls**.
2. Set **Fresh Gas Controls** to **O2%**, **Flow**, or **User** from the drop-down list.  
If **User** is selected, the user will be able to select either **O2%** or **Flow** for a case.
3. Select **Close** to exit.

## Procedures setup

Use the **Procedures** menu to set the procedures available to the user. From this menu select the default settings for **Vital Capacity** and **Cycling** procedures.

### Setting vital capacity defaults

1. From Super User mode, select **Procedures**.
2. Select **Vital Capacity**.
3. Set **Show Vital Capacity** to **Yes** to show this menu item on the user's **Procedures** menu. Set to **No** to hide this menu item on the user's **Procedures** menu.
4. Select **Pressure Hold** and set to the desired value.
5. Select **Hold Time** and set to the desired value.
6. Set **Show PEEP on Exit** to **Yes** to show this menu item on the user's **Vital Capacity** menu. Set to **No** to hide this menu item on the user's **Vital Capacity** menu.
7. Select **PEEP on Exit** and set to the desired value.
8. Select **Back** to return to the **Procedures** menu.

### Setting cycling controls and settings

1. From Super User mode, select **Procedures**.
2. Select **Cycling**.
3. Set **Show Cycling** to **Yes** to show this menu item on the user's **Procedures** menu. Set to **No** to hide this menu item on the user's **Procedures** menu.
4. Select the procedure to modify from the drop-down list.
5. Select **Actions** to set up the cycling procedure. There are a maximum of seven steps and a minimum of one step for a cycling procedure.  
Select **Adjust Settings** to make changes to the parameters for a step.  
Select **Insert Step** to add a step to the cycling procedure.  
Select **Delete Step** to remove a step from the cycling procedure.
6. Select **Close** to exit the menu.

# 13 Vaporizer cassettes

<b>In this section</b>	
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Filling Aladin cassettes.	13-16

## Vaporizer

The electronically controlled vaporizer consists of the internal electronic control unit and the Aladin agent cassette. The agent cassettes are color coded, have indexed filling ports, and are magnetically coded for each agent. The electronic control unit governs the flow through the agent cassette and the agent concentration in the fresh gas flow.

Both the Aladin2 and the Aladin cassettes can be used on this system.

Remove the cassette from the active bay when not administering anesthetic agent. Store cassettes in the cassette storage bay when they are not in use. Store the cassettes and agent at the same temperature as the system.

### Aladin2 cassette variants

All Aladin2 cassettes have electronic agent level sensing. The agent level shows graphically in the agent settings area of the screen. If the electronic agent level sensing is not functioning, the agent level unknown symbol shows on the screen. In this case, refer to the liquid level indicator.

Some Aladin2 cassettes have internal temperature sensing. An enhanced temperature sensing symbol shows on the front of the cassette and the symbol shows in the agent settings area of the screen for cassettes that have internal temperature sensing.

There are three types of Aladin2 cassette filler systems. Enflurane and isoflurane use a color-coded, Easy-Fil mechanism. Sevoflurane cassettes are available with a color-coded, Easy-Fil or Quick-Fil mechanism. The desflurane cassettes have a filling mechanism that is compatible with Saf-T-Fil desflurane bottles.

**Note** Sevoflurane Quik-Fil Aladin2 cassettes are not available in all countries.

Anesthetic agent	Filling system	Color code
Enflurane	Easy-Fil	Orange
Isoflurane	Easy-Fil	Purple
Sevoflurane	Easy-Fil or Quik-Fill	Yellow
Desflurane	Compatible with Saf-T-Fill	Blue

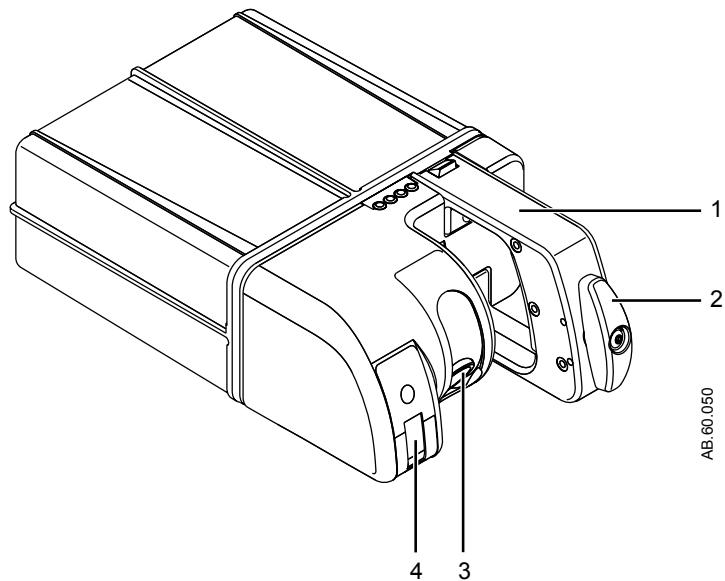


Figure 13-1 • Aladin2 desflurane cassette with Saf-T-Fil system

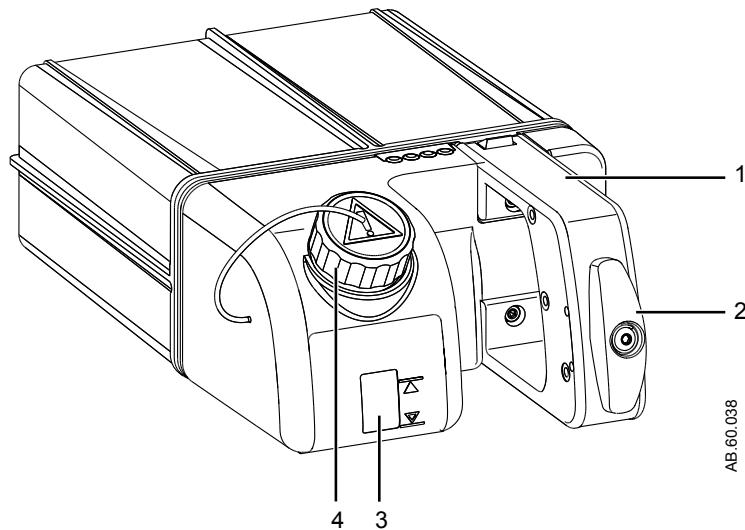


Figure 13-2 • Aladin2 cassette for enflurane, isoflurane, and sevoflurane with Easy-Fil or Quik-Fil system

## Aladin cassette variants

Aladin desflurane cassettes have electronic agent level sensing. No other Aladin cassettes have electronic level sensing. The agent level shows graphically in the agent settings area of the screen. If the electronic agent level sensing is not functioning, the agent level unknown symbol shows on the screen.

When electronic level sensing is unavailable for an Aladin cassette, the agent level unknown symbol shows in the agent settings area of the screen. In this case, refer to the liquid level indicator.

There are three types of Aladin cassette filler systems. Halothane, enflurane, and isoflurane use color-coded, keyed fillers. Sevoflurane cassettes are available with a color-coded, keyed filler or a Quik-Fil mechanism. The desflurane cassettes have a filling mechanism that is compatible with Safe-T-Fil desflurane bottles.

**Note** Sevoflurane Quik-Fil Aladin cassettes are not available in all countries.

Anesthetic agent	Filling system	Color code
Halothane	Keyed	Red
Enflurane	Keyed	Orange
Isoflurane	Keyed	Purple
Sevoflurane	Keyed or Quik-Fil	Yellow
Desflurane	Compatible with Saf-T-Fil	Blue

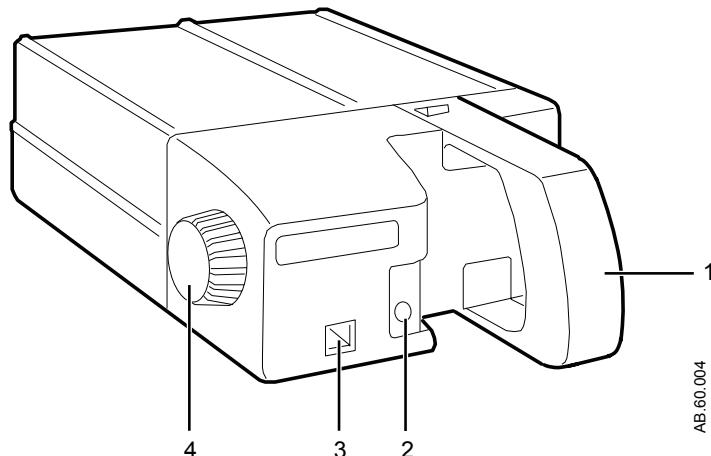


Figure 13-3 • Aladin cassette for halothane, enflurane, isoflurane, and sevoflurane with keyed filler system

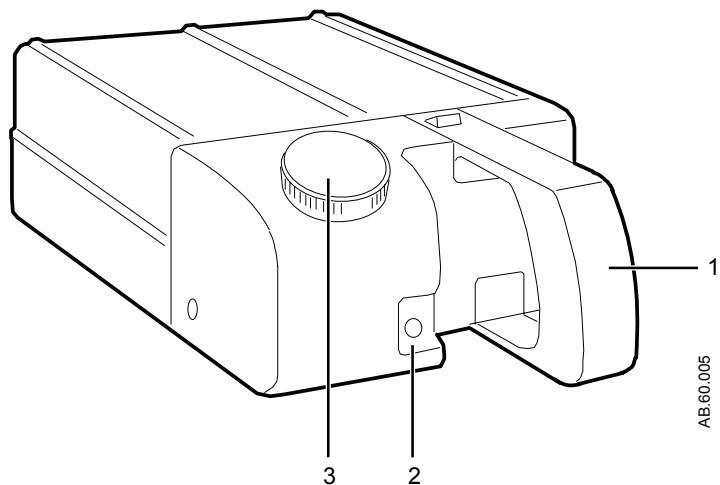


Figure 13-4 • Aladin cassette for sevoflurane with Quik-Fill system

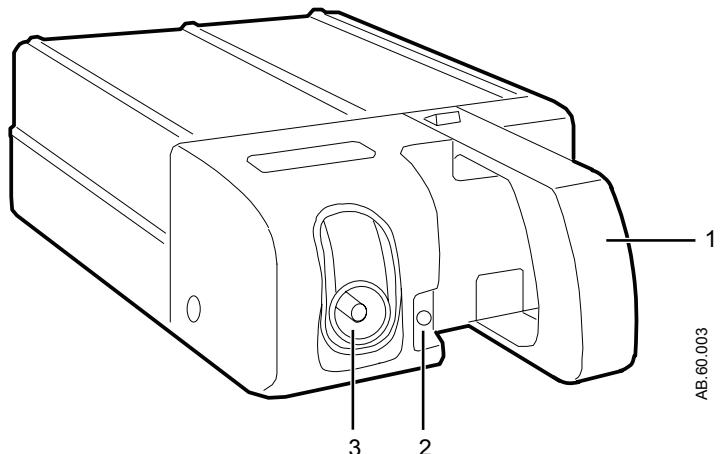


Figure 13-5 • Aladin cassette for desflurane with Saf-T-Fil compatible filler system

## Changing a cassette during a case

1. Push the Agent quick key.
2. Set agent delivery to off.
3. Turn the lock on the handle to the vertical position (Aladin2 cassettes only).
4. Remove cassette from the active bay.
  - Store the cassette in the cassette storage bay if it will not be used.
  - Fill the cassette following the appropriate filling procedure if the cassette requires filling.
5. Install a cassette following the **Installing a cassette** procedure.  
A tone sounds.  
The agent setting in the quick key area flashes.  
If cassette of same agent type is installed during a case, the last agent setting used shows the agent quick key.
6. Change or confirm the agent setting.
7. To confirm the agent setting:
  - Push the ComWheel to confirm the setting.
  - Push the Agent quick key to confirm the setting.  
If the setting is not confirmed within 30 seconds, the agent delivery is set to off.
8. To change an agent setting:
  - Turn the ComWheel to the desired setting.
  - Push the ComWheel or push the quick key to confirm the setting.

## Removing a cassette

Use the Changing a cassette during a case procedure when changing a cassette while a case is in progress.

1. Turn the lock on the handle to the vertical position (Aladin2 cassettes only).
2. Remove the cassette from the active bay.
3. Store the cassette in the cassette storage bay if it will not be used.
4. Fill the cassette following the appropriate filling procedure if the cassette requires filling.

## Installing a cassette

1. Using the liquid level indicator, check that the cassette is filled to the appropriate level.
2. If using Aladin2, unlock the cassette handle before installing it in the active bay.
3. Insert the cassette into the active bay until a click is heard, ensuring the cassette is in the correct position.
4. Turn the lock on the handle to the horizontal position (Aladin2 cassettes only).
5. The cassette is properly inserted when the agent is identified on the display. Make sure that the displayed agent matches the cassette.

**Note** Store the cassettes in the cassette storage bay when they are not in use.

## Cassette maintenance

Clean and drain the cassettes as recommended.

### Cleaning

**CAUTION** Do not wipe the cassette with alcohol or alcohol-based detergents. This may damage the surface of the cassette.

1. Remove the cassette from the system.
2. Clean the cassette surface with a cloth moistened in a mild soap solution.

### Draining cassettes

**Note** All types of Aladin cassettes must be emptied before shipping. Package the cassettes in suitable wrapping when shipping.

1. Remove the cassette from the machine, and place it on a horizontal surface.
  - Make sure that the valve pins do not come in contact with the system or any other object.
2. Connect an empty bottle with the appropriate filler type to the cassette filler port and hold the connection tight.
3. Turn the cassette so that agent flows into the bottle and wait until the cassette is empty.
4. To get the maximum amount of agent out of the cassette, rock the cassette from left to right and tip it forward and backward several times.
5. Remove the agent bottle from the cassette.
6. Return the cassette to the horizontal position.
7. After draining the cassette, dry out the cassette (except halothane cassette).
  - Insert the cassette into the active bay on a system.
  - Run the system at least 15 minutes at a high fresh gas flow and a high agent concentration.

**Note** Do not dry halothane cassettes.

## Draining halothane cassettes

The decomposition of halothane causes the release of halides, which may corrode metal components particularly in the presence of moisture. A preservative, added to halothane by its manufacturers to impede decomposition, can leave a residue which may cause cassette components to stick.

- Have the halothane cassettes drained every two weeks.
- If halothane is used infrequently, have the halothane cassette drained after use.
- Do not flow gas through the halothane cassette to dry out the cassette.

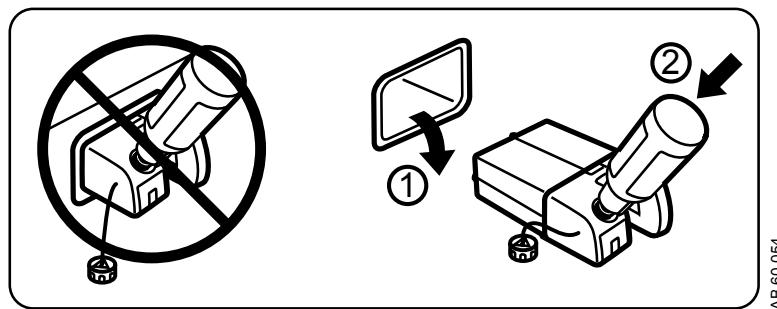
## Filling Aladin2 cassettes

Remove the cassette from the machine before filling the cassette. Make sure that the cassette remains in a horizontal position during filling. If the cassette is tilted, the flow of liquid is shut off to prevent overfilling.

Make sure that the valve pins on the back of the cassette do not come in contact with the system or any other object that could press on the valve pins and let gas out of the cassette. Observe the liquid level indicator of the cassette during filling. When the liquid level reaches the full mark, stop filling.

**CAUTION** To avoid spray from anesthetic agent after filling, slowly remove the agent bottle from the filling port.

**WARNING** Always remove the cassette from the machine and put it on a horizontal surface before filling. Never try to fill a cassette while it is in the machine.



## Filling with Easy-Fil system

The Easy-Fil system consists of three elements:

- The bottle collar.
- The bottle adapter.
- The agent filling port.

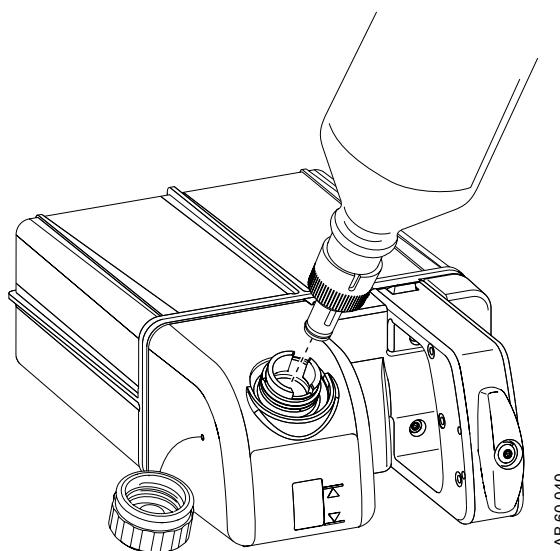


Figure 13-6 • Aladin2 cassette with Easy-Fil system

**WARNING** Do not open or press the cassette filling port or the gas connection valves with fingers or any kind of instrument. Anesthetic agent liquid or gas may squirt into the air.

1. Remove the cassette from the machine, and place it on a horizontal surface. Make sure that the valve pins on the back of the cassette do not come in contact with the machine or any other object.
2. Align the notches on the bottle adapter to the agent bottle collar, and tighten the adapter onto the bottle.

**WARNING** To avoid exposure to the anesthetic agent during filling, make sure that the bottle adapter is properly connected to the bottle.

3. Remove the filling port cap from the cassette by turning the cap counterclockwise.
4. Align the bottle adapter keys with the index slots in the filling port.
5. Push the agent bottle firmly into the filling port.
  - Let the agent flow into the cassette.
  - Keep the agent bottle aligned with the filling port to prevent leakage while filling the cassette.
6. Watch the liquid level indicator.
  - When the liquid level indicator reaches the full mark, slowly remove the bottle from the filling port.

**Note** Removing the bottle quickly may cause the agent to splash or squirt out of the filling port.

7. Put the cap back on the filling port.
8. Remove the bottle adapter from the anesthetic agent bottle. Put the cap back on the agent bottle.

## Filling with Quik-Fil system

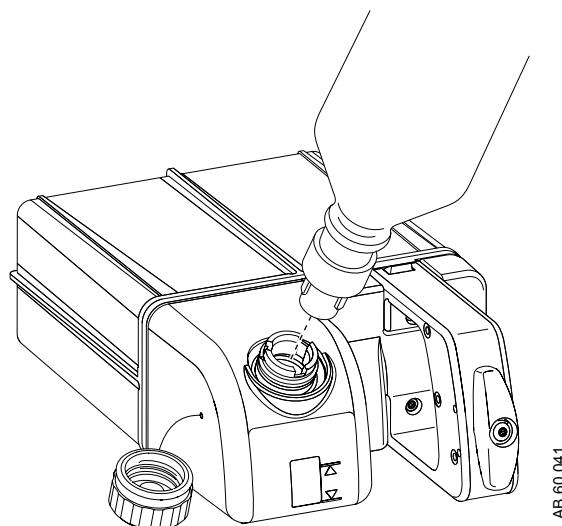


Figure 13-7 • Aladin2 cassette with Quik-Fil system

**WARNING** Do not open or press the cassette filling port or the gas connection valves with fingers or any kind of instrument. Anesthetic agent liquid or gas may squirt into the air.

1. Remove the cassette from the machine, and place it on a horizontal surface. Make sure that the valve pins on the back of the cassette do not come in contact with the machine or any other object.
2. Remove the yellow protective cap from the anesthetic agent bottle. Check that the filling mechanism on the bottle is not damaged.
3. Remove the filling port cap from the cassette by turning the cap counterclockwise.
4. Align the bottle nozzle keys with the index slots in the filling port.
5. Push the agent bottle firmly into the filling port. Let the agent flow into the cassette.
6. Watch the liquid level indicator.

- When the liquid level indicator reaches the full mark, slowly remove the bottle from the filling port.

**Note** Removing the bottle quickly may cause the agent to splash or squirt out of the filling port.

7. Put the cap back on the filling port.
8. Put the cap back on the agent bottle.

## Filling with Saf-T-Fill bottle

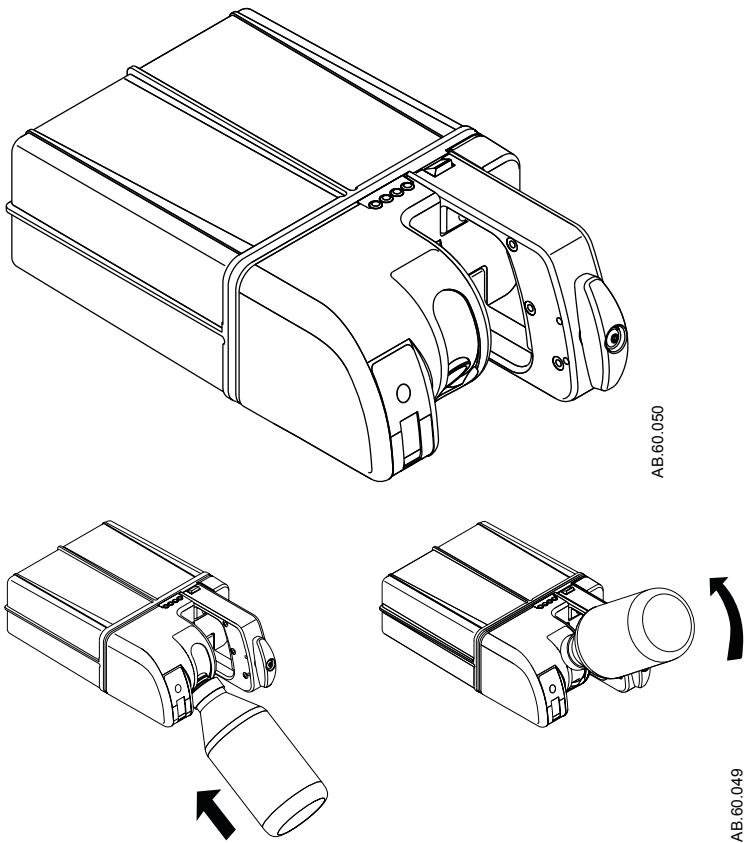


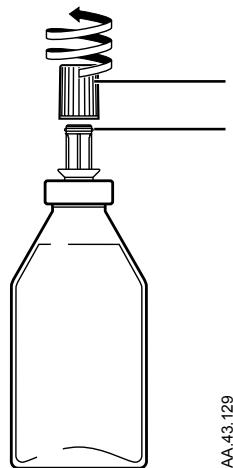
Figure 13-8 • Aladin2 cassette with Saf-T-Fil mechanism

### **WARNING**

Do not store filled or partially filled desflurane cassettes above the normal working temperature of 35C/95F. Storage at high temperature may cause the overpressure valve to vent desflurane vapor into the ambient air.

- Do not open or press the cassette filling port of the gas connection valves with fingers or any kind of instrument. Anesthetic agent liquid or gas may squirt into the air.

1. Remove the cassette from the machine, and place it on a horizontal surface. Make sure that the valve pins on the back of the cassette do not come in contact with the machine or any other object.
2. Remove the cap from the desflurane bottle. Check that the o-ring is correctly fitted on the bottle nozzle.



1. Bottle cap
2. O-ring

*Figure 13-9 • Removing the bottle cap*

3. Insert the nozzle into the filling port, and push the bottle firmly against the spring pressure until it stops.
4. Keep the bottle firmly inserted, and lift the bottle upwards.
5. Watch the liquid level indicator. Do not leave the bottle unattended while it is attached to the cassette.
6. When the liquid level reaches the full mark, lower the bottle to the lower stop position.
  - Keep the bottle firmly inserted.
  - Wait 5 seconds to allow the agent to drain from the filling port back into the bottle.
7. Slowly remove the bottle from the filling port. Removing the bottle quickly may cause the agent to splash or squirt out of the filling port.
8. Put the cap back on the agent bottle.

## Filling Aladin cassettes

Remove the cassette from the machine before filling the cassette. Make sure that the cassette remains in a horizontal position during filling. If the cassette is tilted, the flow of liquid is shut off to prevent overfilling.

Make sure that the valve pins on the back of the cassette do not come in contact with the system or any other object that could press on the valve pins and let gas out of the cassette. Observe the liquid level indicator of the cassette during filling. When the liquid level reaches the full mark, stop filling.

**CAUTION** To avoid spray from anesthetic agent after filling, slowly remove the agent bottle from the filling port.

**WARNING** Always remove the cassette from the machine and put it on a horizontal surface before filling. Never try to fill a cassette while it is in the machine.

- Inaccurate anesthetic agent dosages may temporarily occur after filling if the temperature of the liquid is considerably different from the normal operating temperature.

### Filling with keyed filler system

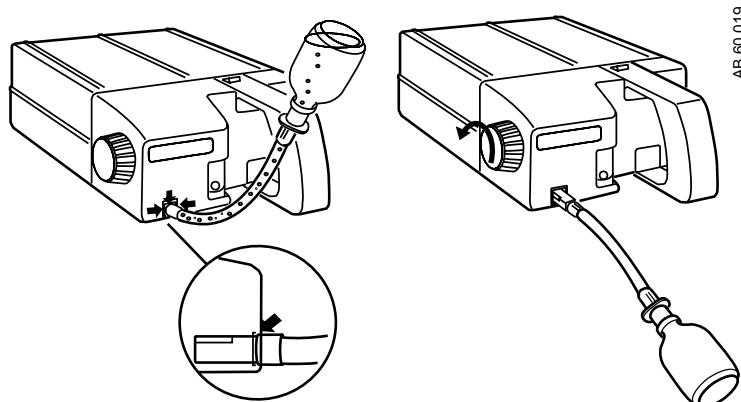


Figure 13-10 • Filling Aladin cassette with keyed filler system

**WARNING** Do not open or press the cassette filling port of the gas connection valves with fingers or any kind of instrument. Anesthetic agent liquid or gas may squirt into the air.

1. Remove the cassette from the machine, and place it on a horizontal surface. Make sure that the valve pins on the back of

the cassette do not come in contact with the machine or any other object.

2. Align the notches on the bottle adapter to the agent bottle collar and tight the adapter onto the bottle.
3. Insert the keyed filler into the agent filling port on the cassette. Make sure that the square end of the filler is flush with the cassette body as shown.
4. Lock the keyed filler by turning the lock and fill wheel fully clockwise.
5. Turn the bottle upside down.
  - Check that the liquid flows evenly into the cassette.
  - If liquid does not flow evenly into the cassette, tighten the wheel until the liquid starts to flow.
6. Watch the liquid level indicator. When the cassette is full, lower the bottle to stop the flow of liquid.
7. Turn the lock and fill wheel a half turn counterclockwise to close the filling port. Wait for the residual anesthetic agent to trickle back into the bottle.
8. Turn the lock and fill wheel fully counterclockwise, and remove the keyed filler from the filling port.
9. Remove the bottle adapter from the anesthetic agent bottle. Put the cap back on the agent bottle.

## Filling with Quik-Fil system

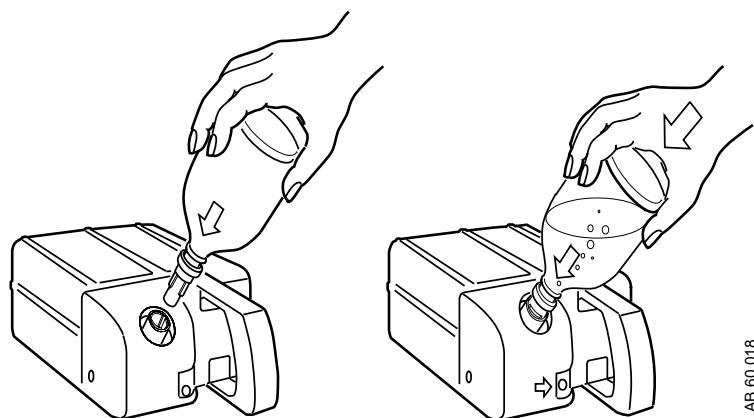


Figure 13-11 • Aladin cassette with Quik-Fil system

### **WARNING**

Do not open or press the cassette filling port or the gas connection valves with fingers or any kind of instrument. Anesthetic agent liquid or gas may squirt into the air.

1. Remove the cassette from the machine, and place it on a horizontal surface. Make sure that the valve pins on the back of the cassette do not come in contact with the machine or any other object.
2. Remove the yellow protective cap from the anesthetic agent bottle. Check that the filling mechanism on the bottle is not damaged.
3. Remove the filling port cap from the cassette by turning the cap counterclockwise.
4. Insert the nozzle of the bottle into the filling port.
5. Push the agent bottle firmly into the filling port. Let the agent flow into the cassette.
6. Watch the liquid level indicator.
  - When the liquid level indicator reaches the full mark, slowly remove the bottle from the filling port.

**Note** Removing the bottle quickly may cause the agent to splash or squirt out of the filling port.

7. Put the cap back on the filling port.
8. Put the cap back on the agent bottle.

## Filling with Saf-T-Fil bottle

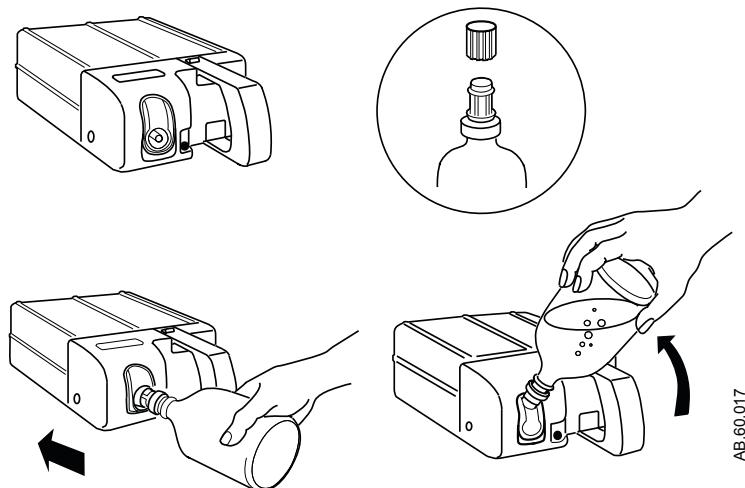


Figure 13-12 • Filling Aladin cassette with Saf-T-Fil bottle

**CAUTION** Do not attempt to fill the cassette with desflurane that is warmer than 26C/78F. The overfill prevention system may lock and prevent the filling of the cassette.

**WARNING** Do not store filled or partially filled desflurane cassettes above the normal working temperature of 35C/95F. Storage at high temperature may cause the overpressure valve to vent desflurane vapor into the ambient air.

- Do not open or press the cassette filling port or the gas connection valves with fingers or any kind of instrument. Anesthetic agent liquid or gas may squirt into the air.
1. Remove the cassette from the machine, and place it on a horizontal surface. Make sure that the valve pins on the back of the cassette do not come in contact with the machine or any other object.
  2. Remove the cap from the desflurane bottle. Check that the o-ring is correctly fitted on the bottle nozzle.

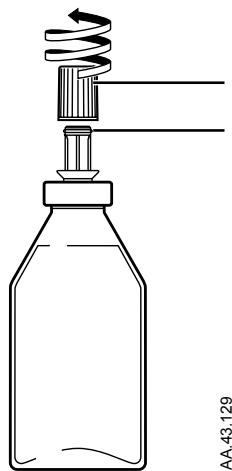


Figure 13-13 • Removing the bottle cap

3. Insert the nozzle into the filling port, and push the bottle firmly against the spring pressure until it stops.
4. Keep the bottle firmly inserted, and lift the bottle upwards.
5. Watch the liquid level indicator. Do not leave the bottle unattended while it is attached to the cassette.
6. When the liquid level reaches the full mark, lower the bottle to the lower stop position.
  - Keep the bottle firmly inserted.
  - Wait 5 seconds to allow the agent to drain from the filling port back into the bottle.
7. Slowly remove the bottle from the filling port. Removing the bottle quickly may cause the agent to splash or squirt out of the filling port.
8. Put the cap back on the agent bottle.



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## **Warranty**

This Product is sold by Datex-Ohmeda under the warranties set forth in the following paragraphs. Such warranties are extended only with respect to the purchase of this Product directly from Datex-Ohmeda or Datex-Ohmeda's Authorized Dealers as new merchandise and are extended to the Buyer thereof, other than for the purpose of resale.

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