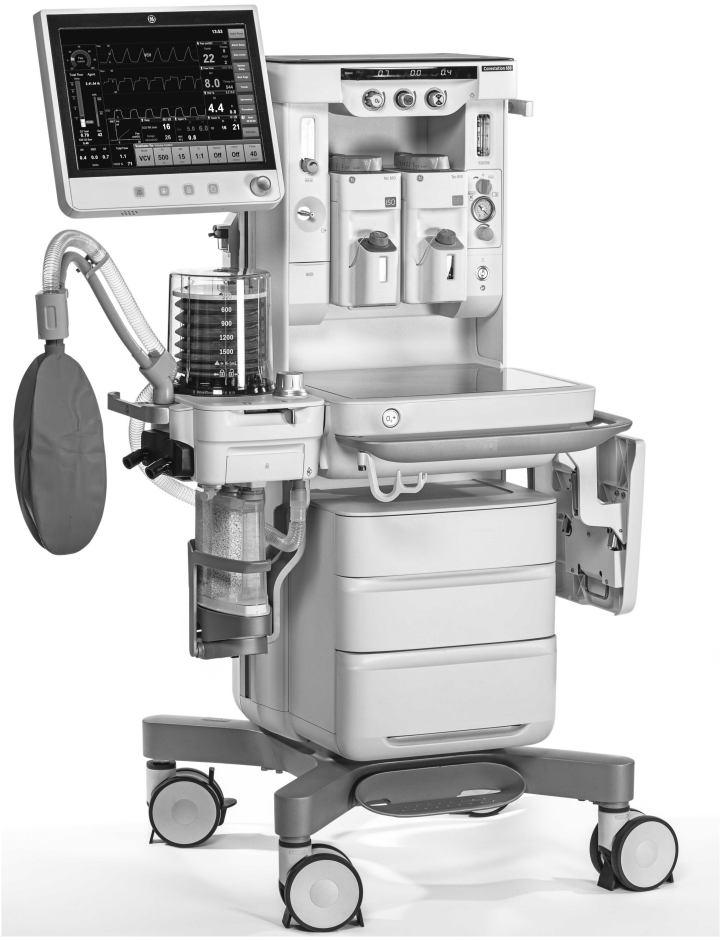
Carestation™ 620/650/650c (A1)

User's Reference Manual

Software Revision 01



User responsibility

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, the manufacturer recommends that a telephonic or written request for service advice be made to the nearest manufacturer Customer Service Center. This product or any of its parts should not be repaired other than in accordance with written instructions provided by the manufacturer and by the manufacturer trained personnel. The product must not be altered without the prior written approval of the manufacturer. 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 the manufacturer.

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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1 Introduction

In this section

Intended use

The Carestation™ 620/650/650c anesthesia systems combine advanced anesthesia delivery, patient monitoring, and care information management. The contemporary, compact design allows for easy mobility and addresses many ergonomic considerations including an effective cable management solution, aesthetic covers, and an expandable work surface area. Optional integrated features include auxiliary common gas outlet, auxiliary O2 outlet, auxiliary O2+Air outlet, suction control and respiratory gas monitoring. The system provides integration of ventilation and gas delivery, on a 15-inch color touchscreen interface.

This anesthesia system is designed for mixing and delivering inhalation anesthetics, Air, O2, and N2O.

This anesthesia system uses electronic flow valve ventilation technology offering Volume Control Ventilation with tidal volume compensation and electronic PEEP. This 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 MR unsafe. This system is not suitable for use in a magnetic resonance imaging (MRI) environment.

Indications for use

The Carestation 620/650/650c anesthesia systems are intended to provide general inhalation anesthesia and ventilatory support to a wide range of patients (neonate, pediatric, and adult). The anesthesia systems are suitable for use in a patient environment, such as hospitals, surgical centers, or clinics. The systems are intended to be operated by a clinician qualified in the administration of general anesthesia.

Clinical benefits

Clinical benefit of the anesthesia system to the patient is to help Health Care Professional provide a general inhalation anesthesia and ventilator support to a wide range of patients.

Residual risks

The anesthesia machines include a mechanical ventilator. All mechanical ventilators are associated with potential complications such as ventilator induced lung injury, hypoxia and hypercarbia. Anesthesia delivery which exceeds or falls short of settings could cause patient harm like awareness or excessive hemodynamic changes. Users must abide by the intended use and the instructions for use to make sure that the benefits of the Anesthesia machine's use outweigh the inherent risks associated with the potential delivery of anesthesia and ventilation modes used.

Contraindications

The device has no product-specific contraindications. It is the responsibility of the user to select the appropriate treatment for the patient's underlying disease. Patient status must be continuously monitored for potential changes.

Note The device administers medical gases such as O2, N2O, or volatile anesthetic agents. For contraindications to the applied medical gases, strictly observe the instructions for use of the medical gas.

Safe disposal

Dispose of the system, accessories, and packaging according to local, state, or country disposal and recycling laws.

Dispose of this product and packaging according to facility disposal practices and local environmental and waste disposal regulations. Components and accessories of the system which have come into direct or indirect contact with the patient may be bio-hazardous. These parts should be disposed of according to facility guidelines for bio-hazardous material.

General information

This anesthesia system uses the Compact Breathing System (CBS). This compact breathing system is removable and autoclavable.

Note The O2 cell is not autoclavable.

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 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. The user documents also could be obtained online "*https://www.gehealthcare.com/documentationlibrary*". Visit *Customer Documentation Portal* site, select *Modality* to *Anesthesia (ARC)* and *Products* to related products you want. Download the PDF manuals you need.

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 power 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 and photographs in this manual are just for reference and may not represent all configurations of the product. This manual does not cover the operation of every accessory, and not all accessories and options are included with every system. Refer to the accessory documentation for further information.

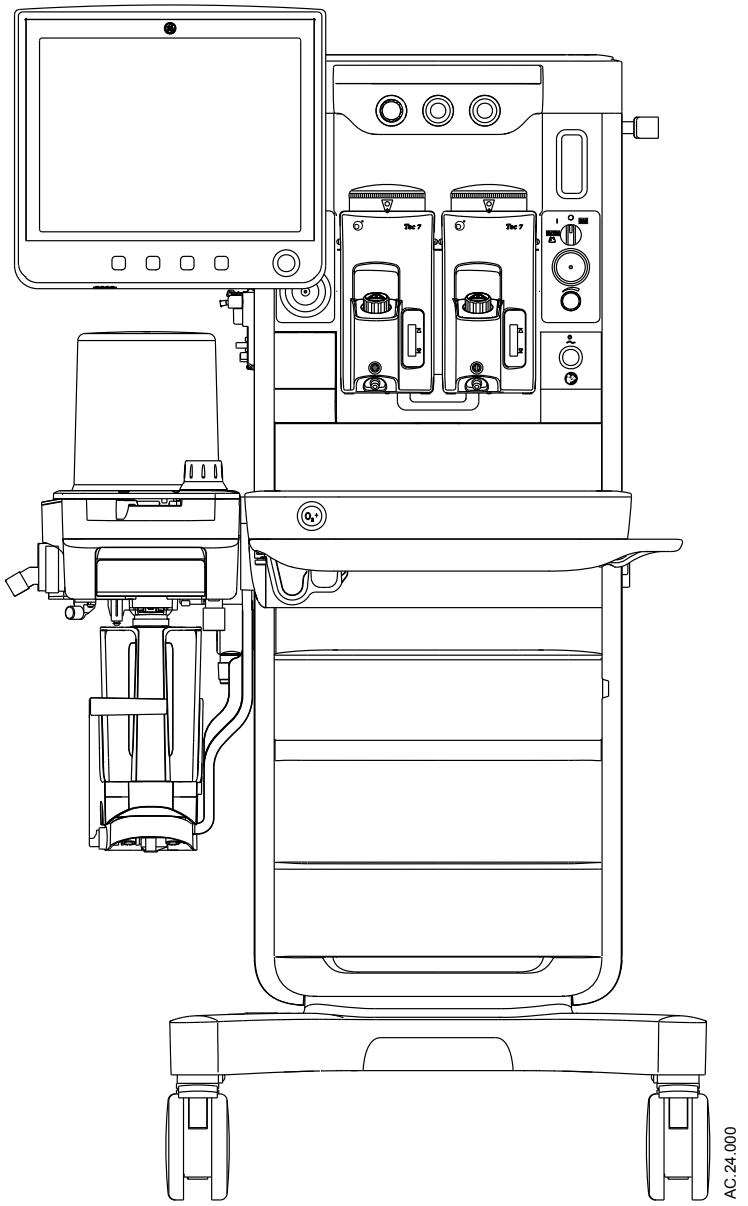


Figure 1-1 • Front view

Serial numbers

Products have unit serial numbers with coded logic which indicates a product group code, the year of manufacture, the week of manufacture, a sequential unit number for identification, manufacture location, and product type.

XXX YY FW 0000 S M
The XXX represents product codes: SM6 = Carestation 620, SM7 = Carestation 650, and SM8 = Carestation 650c. The YY represents a number indicating the year the product was manufactured: 10 = 2010, 11 = 2011, and so on. The FW represents a number indicating the week the product was manufactured. The 0000 represents the serial number assigned to the machine. The S represents the production location: W = Wuxi, China; M = Madison, USA. The M represents the product type: A = Mass production A1.

Trademarks

Carestation, ***CARESCAPE***, ***D-fend***, ***D-lite***, ***PSVPro***, ***Tec***, and ***Selectatec*** are trademarks of General Electric Company or one of its subsidiaries.

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

Feature overview

Hardware feature	**Carestation 620 A1**	**Carestation 650 A1**	**Carestation 650c A1**
Frame	Trolley	Trolley	Pendant or Wall mount
Anesthesia display arm	1 - pivot, no tilt 2 - pivots, with tilt	2 - pivots, with tilt	2 - pivots, with tilt
Flip shelf	Optional	Optional	Pendant: Optional Wall mount: Not available
Front handle	Not available	Included	Pendant: Included Wall mount: Not available
Drawers	Optional (0, 3)	Included (3)	Included (2)
Central brake	Not available	Included	Not available
Wheels	~5 in / 125 mm	~5 in / 125 mm	Pendant: ~3 in / 80 mm Wall mount: Not available
Caster guards	Not available	Included	Not available
Worksurface metallic insert	Not available	Included	Included
Bag arm	Optional	Optional	Optional

Hardware feature	Carestation 620 A1	Carestation 650 A1	Carestation 650c A1
Top shelf color	White	Black	Black

Integrated monitoring	Carestation 620 A1	Carestation 650 A1	Carestation 650c A1
Integrated Airway module slot	Optional	Optional	Optional
O2 cell, breathing system	Optional	Optional	Optional

Patient monitor mounting	Carestation 620 A1	Carestation 650 A1	Carestation 650c A1
Top shelf post mount	Optional	Optional	Optional
Vertical mount, configured monitor (above anesthesia display)	Optional	Optional	Optional
CARESCAPE B850 mounting			
Display (above anesthesia display)	Not available	Optional	Optional
F5 Frame (top shelf post mount)	Not available	Optional	Optional
CPU (lower right)	Not available	Optional	Not available (mount separately to Medi-rail or Wall)
Long cable management arm	Optional	Optional	Optional
Short cable management arm	Optional	Optional	Optional

Cylinders	Carestation 620 A1	Carestation 650 A1	Carestation 650c A1
In-board, cylinder yokes	Optional (0 - 2)	Optional (0 - 2)	Not available
In-board, cylinder yoke cover	Optional	Optional	Not available
Out-board, 3rd cylinder	Optional	Optional	Not available
Large cylinders (O2/N2O)	Optional (0 - 2)	Optional (0 - 2)	Not available

AC outlets	Carestation 620 A1	Carestation 650 A1	Carestation 650c A1
3 AC outlets	Optional	Optional	Not available
AC isolation transformer	Optional	Optional	Not available

Pneumatic Options	Carestation 620 A1	Carestation 650 A1	Carestation 650c A1
Drive gas	Air or O2	Air or O2	Air or O2
Fresh gas options (O2, Air, N2O)	2 or 3	2 or 3	2 or 3

Pneumatic Options	Carestation 620 A1	Carestation 650 A1	Carestation 650c A1
Pipeline inlets	2 or 3 (2nd O2 optional)	2 or 3 (2nd O2 optional)	2 or 3 (2nd O2 optional)
User guidance lighting	Included	Included	Included
Fresh gas flow, LED display (above control knobs)	Not available	Included	Included
Aux Common Gas Outlet (ACGO)	Optional	Optional	Optional
Integrated Aux O2 (independent flow meter)	Optional	Optional	Optional
Integrated Aux O2+Air (system fresh gas controls)	Not available	Optional	Optional
Integrated suction	Optional	Optional	Optional

Software features	Carestation 620 A1	Carestation 650 A1	Carestation 650c A1
VCV	Included	Included	Included
Additional vent modes	Some optional	All optional	All optional
Spirometry	Optional	Included	Included
VCV cardiac bypass	Optional	Optional	Optional
Auto alarm limits	Not available	Included	Included
EcoFlow	Not available	Optional	Optional
Pause gas	Not available	Optional	Optional
Cycling	Not available	Optional	Optional
Vital capacity	Not available	Optional	Optional

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

O_2+	O2 Flush button	$O_2\%$	O2 concentration
Air	Air	AIR	Air
≃cm H_2O	APL settings are approximate	AGSS	Anesthetic Gas Scavenging System
MAX	Maximum	Vacuum	Vacuum
SN	Serial number	REF	Stock number
Exhaust	Exhaust	≃ V_T (mL)	Bellows volumes are approximate
+	Plus, positive polarity	-	Minus, negative polarity
NOM	Nominal mass weight	℞ ONLY	Caution: federal law prohibits dispensing without prescription.
134˚C	Autoclavable	≥ Tec 6 Plus	Selectatec™ Series Vaporizers Tec™ 6 Plus or greater
I	On (power)	O	Off (power)
	Standby		Non-ionizing electromagnetic radiation
	Type BF equipment		Type B equipment
	Dangerous voltage		Frame or chassis ground
	Protective earth ground		Earth ground
	Direct current		Alternating current


Caution


Operating instructions


Electrical input/output


Pneumatic inlet


Equipotential


Control with variable function


Suction bottle outlet

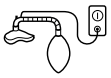

Bag position/manual ventilation


Inspiratory flow


Lock


Read to center of float


CO2 absorber on


ACGO active

Auxiliary O2


Start/end case

European Union Declaration of Conformity.
First CE marked in 2015.


Date of manufacture


Refer to instruction manual or booklet (blue background)


General warning (yellow background)

Sample gas inlet to scavenging


Pneumatic outlet


Lamp, lighting, illumination


Fuse


Off (for a part of the machine)


Mechanical ventilation

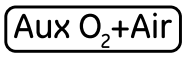

Expiratory flow


Unlock

CO2 absorber off

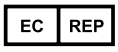
Total flow

Auxiliary Common Gas Outlet



Auxiliary O2 and Air


Home screen



Authorized representative in the European Community


Manufacturer

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.

Do not lift

MR unsafe
MRI not compatible
(red circle and slash)

This way up

Keep dry

Temperature limitation

Do not turn over

Protect from heat and radioactive sources

Humidity limitation

USB port

Not a USB port

Serial connection

Atmospheric limitation

GOST R Russian certification

When moving or transporting anesthesia machine, place the display arm and shelf in the transport position as shown. Make sure that the arm and shelf remain in position while moving the system.

Single use device

Stacking limit by mass

Do not stack

Fragile, handle with care

Do not clamp

Recyclable material

Electrical test certification

Network

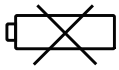
VGA connection

Do not use hook

Not autoclavable

	Ukraine national conformity		Unique device identifier
	Eurasian conformity		Need tools and refer to installation instruction.
	Harmful		China RoHS symbol
	Electrical test certification		Medical device

Symbols used on the user interface

	Lock Indicates the touchscreen is locked.		Lock/unlock button Button label to lock or unlock the touchscreen.
	Audio Pause		Submenu
	No battery/battery failure		Battery in use. Bar indicates amount of battery power remaining.
	Airway module indicator		Manual ventilation
	Drop-down menu		Lung procedure performed (trends)
	Pediatric		Adult
	Timer		Alarm off
	Pipeline		Cylinder
	Test indicator: red for failure, yellow for conditional outcome, and green for pass, gray for incomplete.		Alarm low and alarm high limit indicator

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
A	
AA	Anesthetic agent
ACGO	Auxiliary common gas outlet
AGSS	Anesthesia gas scavenging system
APL	Adjustable pressure-limiting
APN	Apnea
ATPD	Ambient temperature and pressure, dry humidity conditions
Aux Gas	Auxiliary Gas
Aux O2+Air	Auxiliary O2+Air
B	
BTPS	Body temperature, ambient pressure, saturated humidity conditions
C	
CBS	Compact breathing system
CO	Carbon monoxide
CO2	Carbon dioxide
Compl	Compliance
CPAP + PSV	Continuous positive airway pressure + pressure support ventilation
E	
EMC	Electromagnetic Compatibility
ET	End-tidal concentration
EtCO2	End-tidal carbon dioxide
EtO2	End-tidal oxygen
Exp	Expiratory
F	
FGO2	Fresh Gas Oxygen
FI	Fraction of inspired gas
FiCO2	Fraction of inspired carbon dioxide
FiO2	Fraction of inspired oxygen
Flow-Vol	Flow-volume loop
I	
I:E	Inspiratory-expiratory ratio
Insp	Inspiratory
Insp Pause	Inspiratory pause time
K	
kg	Kilogram

Abbreviation	Definition
M	
MAC	Minimum alveolar concentration
MV	Minute volume
MVexp	Expired minute volume
MVinsp	Inspired minute volume
N	
N2	Nitrogen
N2O	Nitrous oxide
O	
O2	Oxygen
P	
P-ACGO	Pressure - Auxiliary common gas outlet
Paw	Airway pressure
PCV	Pressure control ventilation
PCV-VG	Pressure control ventilation - volume guaranteed
Pedi	Pediatric
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
R	
Raw	Airway resistance
RF	Radio frequency
RR	Respiratory rate
S	
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
T	
Texp	Expiratory time
Tinsp	Inspiratory time
Tpause	Time where breath is paused with no flow

Abbreviation	Definition
TV	Tidal volume
TVexp	Expired tidal volume
TVinsp	Inspired tidal volume
V	
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 ISO 21647.
- 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.
- O2 monitor (optional O2 cell).
- Anesthesia ventilator.
- Breathing system.
- Anesthesia Gas Scavenging System.

Not integral system components

These devices are not integral to this anesthesia system:

- CO2 monitor.
- Anesthetic agent monitor.
- O2 monitor (when O2 cell is not installed).
- Suction regulator.
- Anesthetic vapor delivery device.

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 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.
  - O2 monitoring.
  - CO2 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.
- 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 vaporizers are locked in position and contain 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 O2 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.

- The anesthesia system or other equipment does not block the wall mains outlet.
- If an optional suction regulator is present, ensure there is adequate suction.

Electrical safety

Any non-medical equipment used with the system must be supplied by a power source using a separating transformer. Failure to do so may increase enclosure leakage current above levels allowed by IEC 60601-1 in normal conditions and under single-fault conditions. This may cause 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 national and international standards) 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.

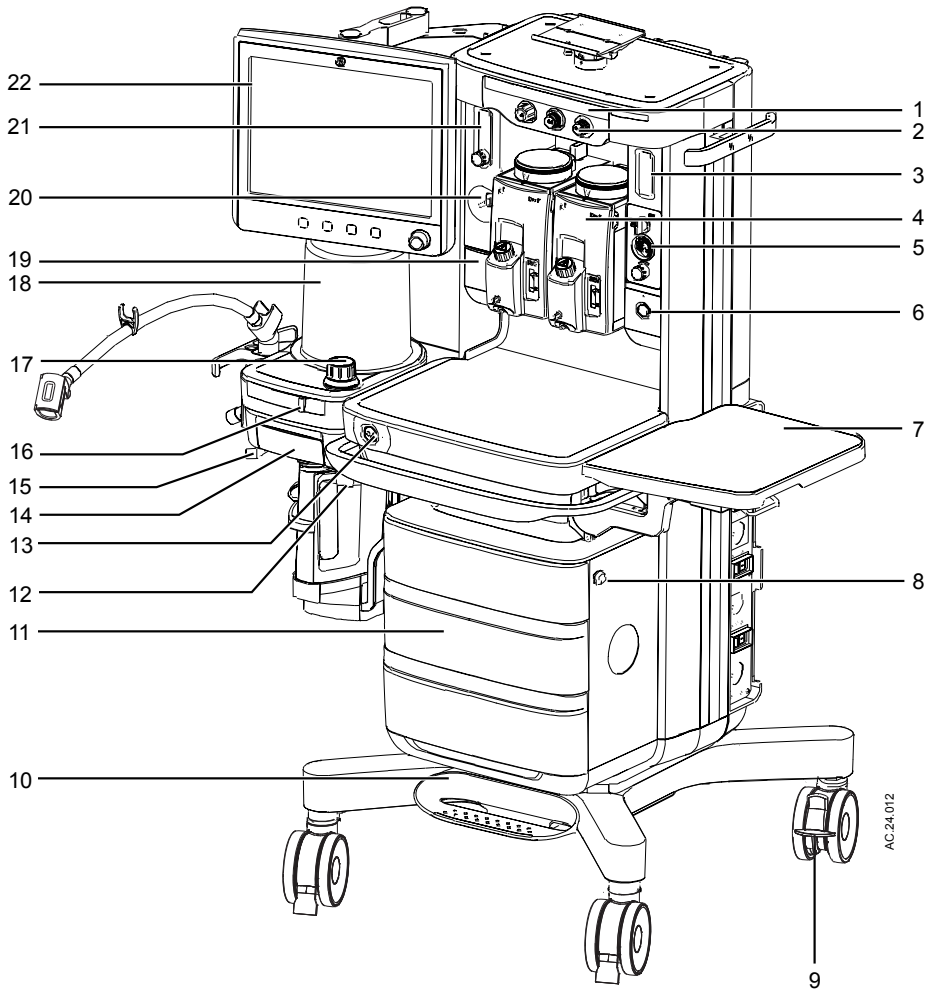
- An operator of the medical electrical system must not touch non-medical electrical equipment and the patient simultaneously. This may cause an unsafe electrical shock to the patient.
- An operator of the medical electrical system must not touch the contacts of electrical connectors and the patient 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

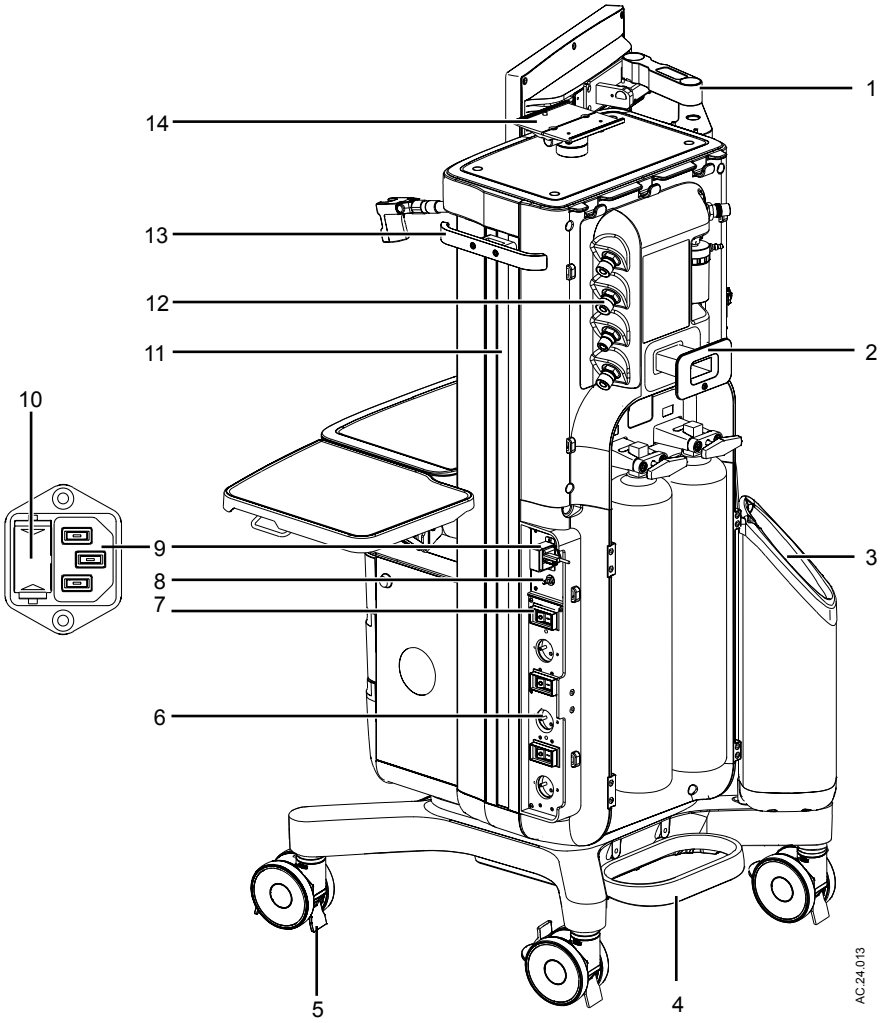
In this section

System overview



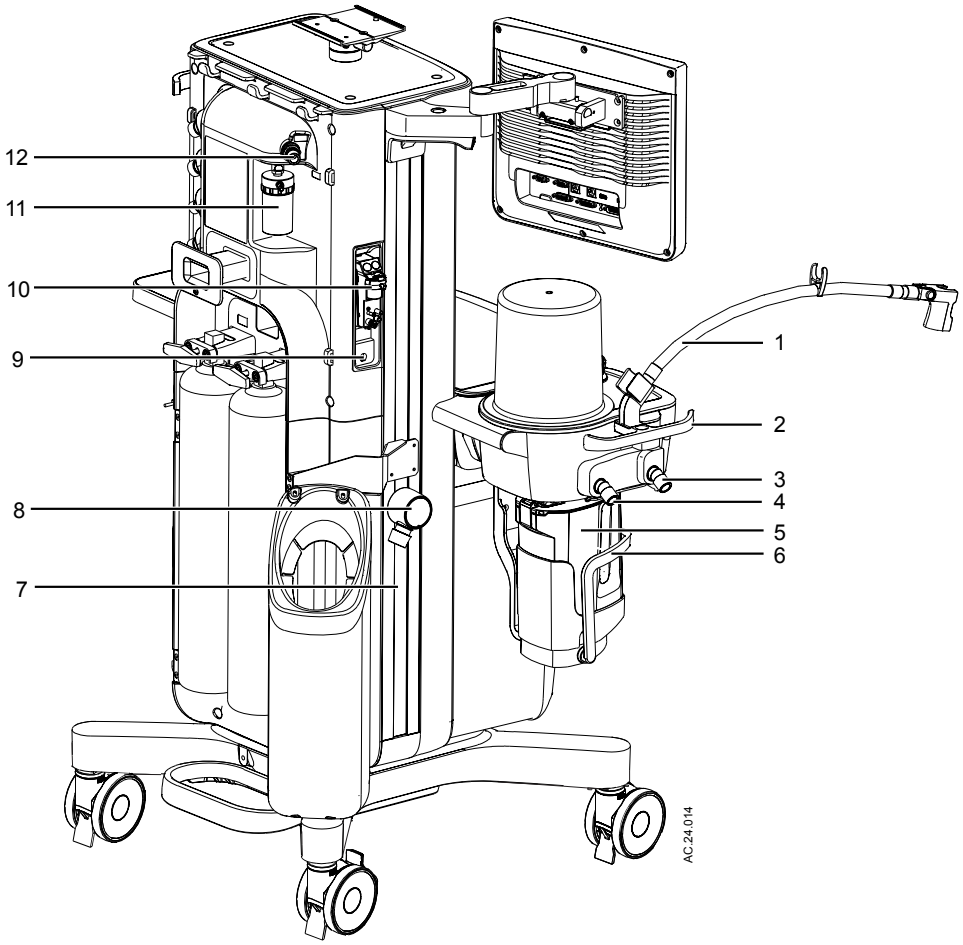
1. Digital fresh gas display
2. Fresh gas control knob
3. Total fresh gas flow meter
4. Vaporizer
5. Suction regulator and control
6. On/Standby switch
7. Flip-up shelf
8. Drawer lock
9. Caster brake
10. Central brake
11. Drawers
12. Bag hose connection
13. O2 flush
14. Breathing system door
15. Leak test plug
16. Bag/Vent switch
17. Adjustable pressure-limiting (APL) valve
18. Bellows assembly
19. Auxiliary Common Gas Outlet (ACGO) switch and port
20. Auxiliary O2 outlet
21. Auxiliary O2 flowmeter
22. Anesthesia display

Figure 2-1 • Front View



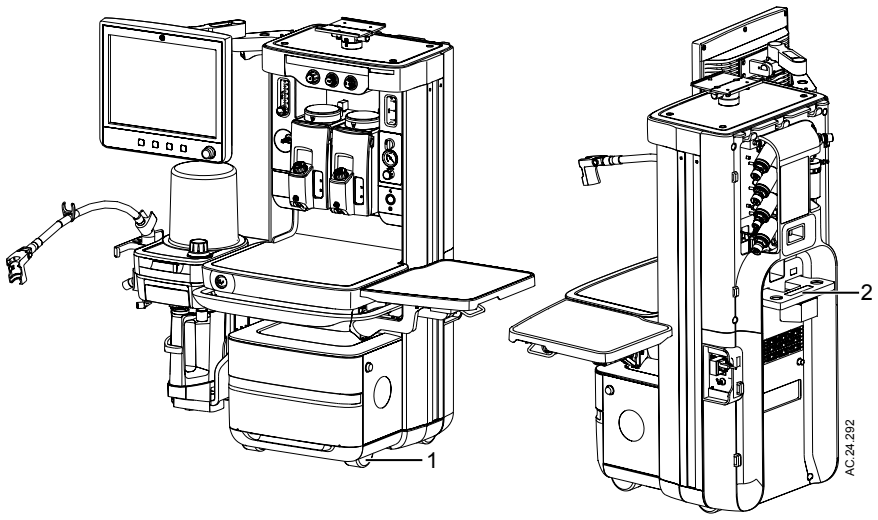
1. Display arm
2. Cable hook
3. Third cylinder mount
4. Cylinder guard
5. Caster guard
6. Electrical outlets
7. Outlet circuit breakers
8. Equipotential stud
9. Mains inlet
10. Mains power fuses (inside)
11. Right dovetail
12. Pipeline connections
13. Side rail
14. Top shelf monitor mount

Figure 2-2 • Rear view (Left)



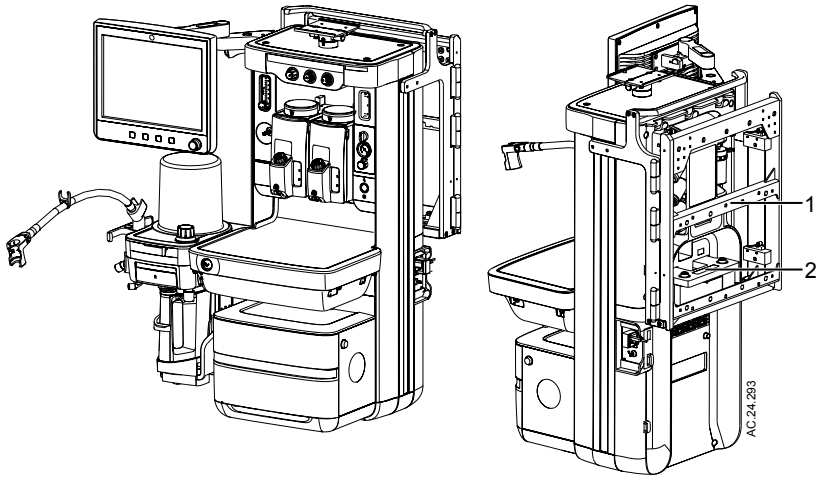
1. Bag support arm
2. Breathing system guard
3. Inspiratory port
4. Expiratory port
5. Absorber canister
6. Absorber canister lifter handle
7. Left dovetail
8. Anesthesia Gas Scavenging System (AGSS) port
9. Sample gas return port
10. Airway module
11. Suction trap
12. Suction fitting

Figure 2-3 • Rear view (Right)



1. Casters
2. Pendant mount interface

Figure 2-4 • Front and rear view of pendant system



1. Wall-mounting rack
2. Wall-mounting interface

Figure 2-5 • Front and rear view of wall mount system

Note See "*Feature overview*" for more information on product specific offerings.

Using the brake

The system has two brake options that hold the system in place.

- The system has an option of one central brake with two brakes on the rear casters.
- The system has an option of brakes on the four casters.

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 the brake pedal to lock the system in place.
2. Push up the brake pedal to release the brake.

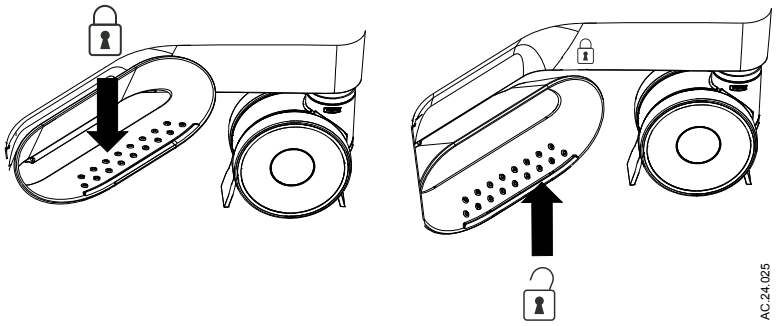


Figure 2-6 • Central brake

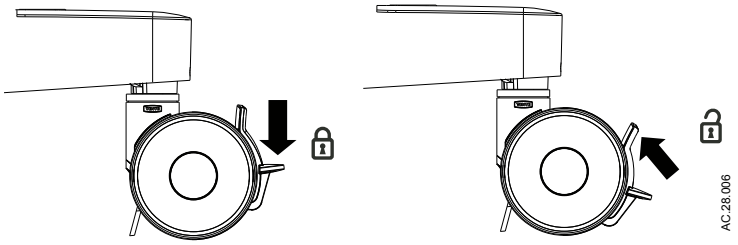


Figure 2-7 • Brake on rear casters

3. Push down on the lower portion of the brake pedal to lock the system in place.
4. Push down on the upper portion of the brake pedal to release the brake.

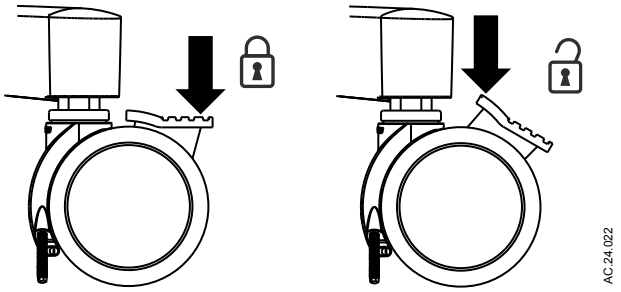


Figure 2-8 • Brake on four casters

Using flow controls

The flow controls regulate the amount of gas flow to the breathing circuit. The System switch must be On for the gas to flow.

1. Turn the knob counterclockwise to increase gas flow.
2. Turn the knob clockwise to decrease gas flow.

Using the O2 flush button

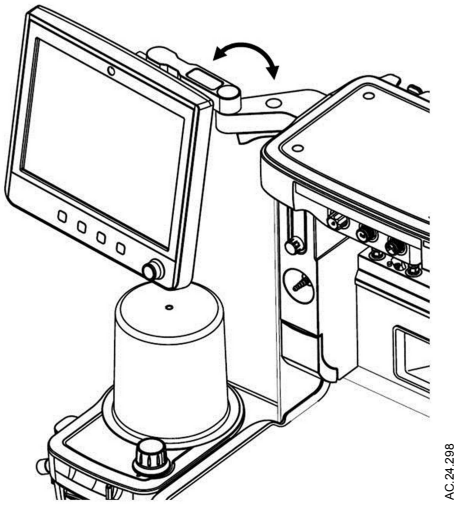
The O2 flush button supplies a high flow of O2 to the breathing system.

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.

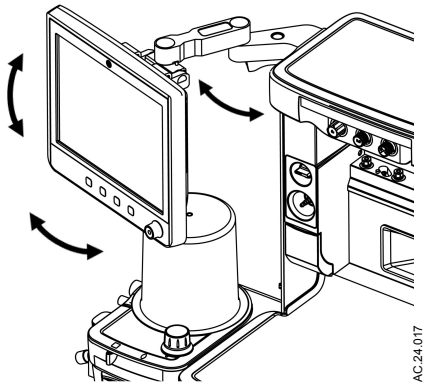
Positioning the display

The display can be moved for optimal viewing with two display arm options.

- The display can be positioned closer to or further from the system, with only one pivot point and no tilt available.

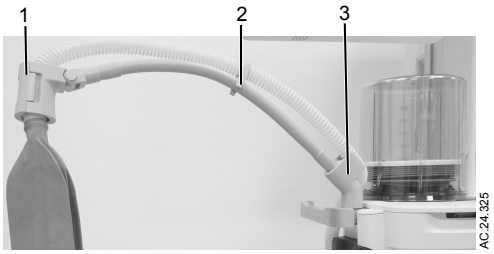


- The display can be positioned closer to or further from the system, can be tilted up or down, and can be rotated with two pivot points.



Connecting the breathing system bag hose

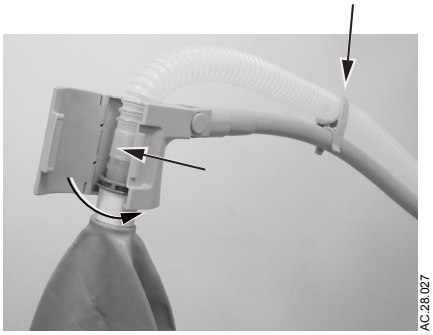
1. Connect the bag to the end of the hose.



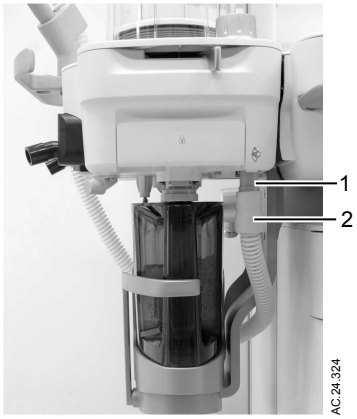
1. Holder
2. Clip
3. Bag arm base

Figure 2-9 • Bag hose holder

2. Open cover of the holder at the end of the bag arm and insert the hose into the holder.



3. Close the cover of the holder.
4. Push the hose into the clip on the bag arm.
5. Bring the hose down through the base of the bag arm and around the back of the breathing system.
6. Route the hose between the canister and the system frame.
7. Attach the hose to the port under the breathing system.



1. Bag hose port
2. Bag hose connection

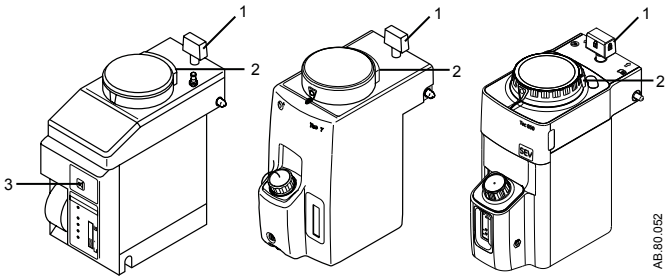
Figure 2-10 • Bag hose connection

Using the bag support arm

Use the optional bag support arm to hold the breathing circuit bag. The bag support arm can be moved up or down and left or right.

Vaporizer controls

Refer to the vaporizer User's Reference manual for more detailed information on the vaporizer.



1. Lock lever
2. Concentration control and release
3. Audio pause touch key

Figure 2-11 • Vaporizer controls

Display controls

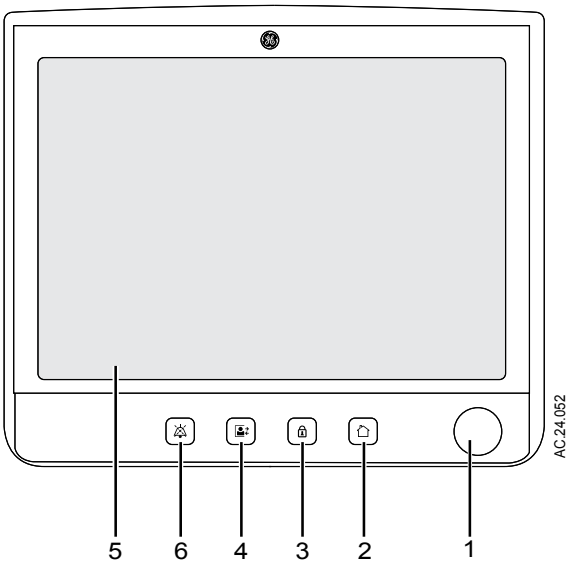
The system uses touchscreen technology, hard keys, and a ComWheel to access system functions, menus, and settings.

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.

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.

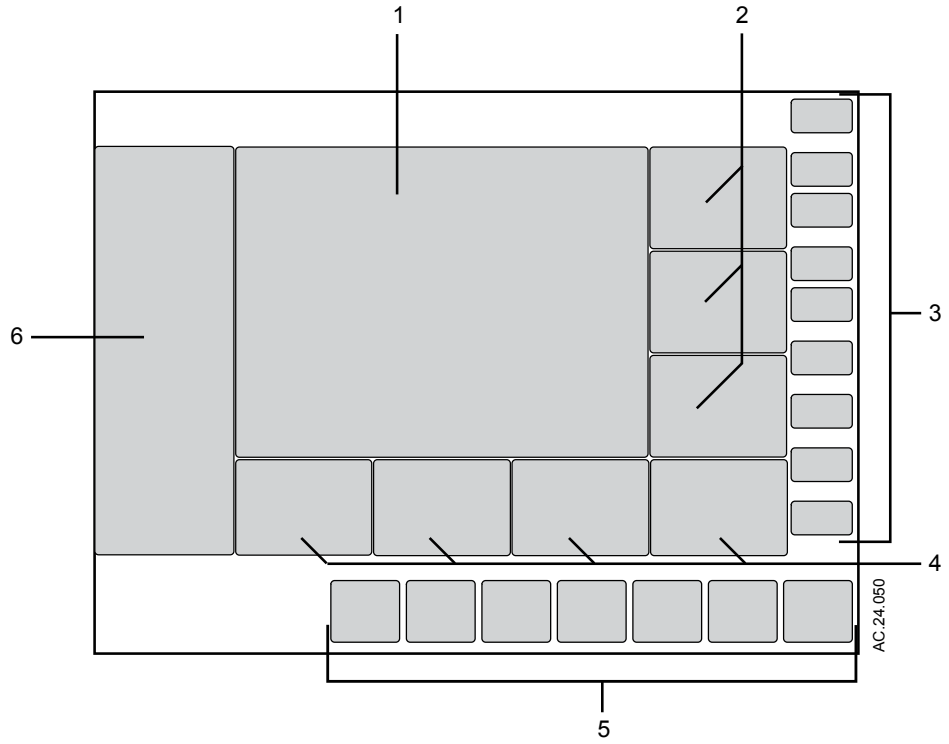


1.	ComWheel	Selects a menu item or confirms a setting. Turn clockwise or counterclockwise to scroll through menu items or change settings.
2.	Home key	Removes all menus from the screen.
3.	Screen Lock/Unlock key	Locks the touchscreen. Toggles between lock and unlock functions.
4.	Start/End Case key	Initiates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

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 2-12 • Display controls

Touch points



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

Figure 2-13 • 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.

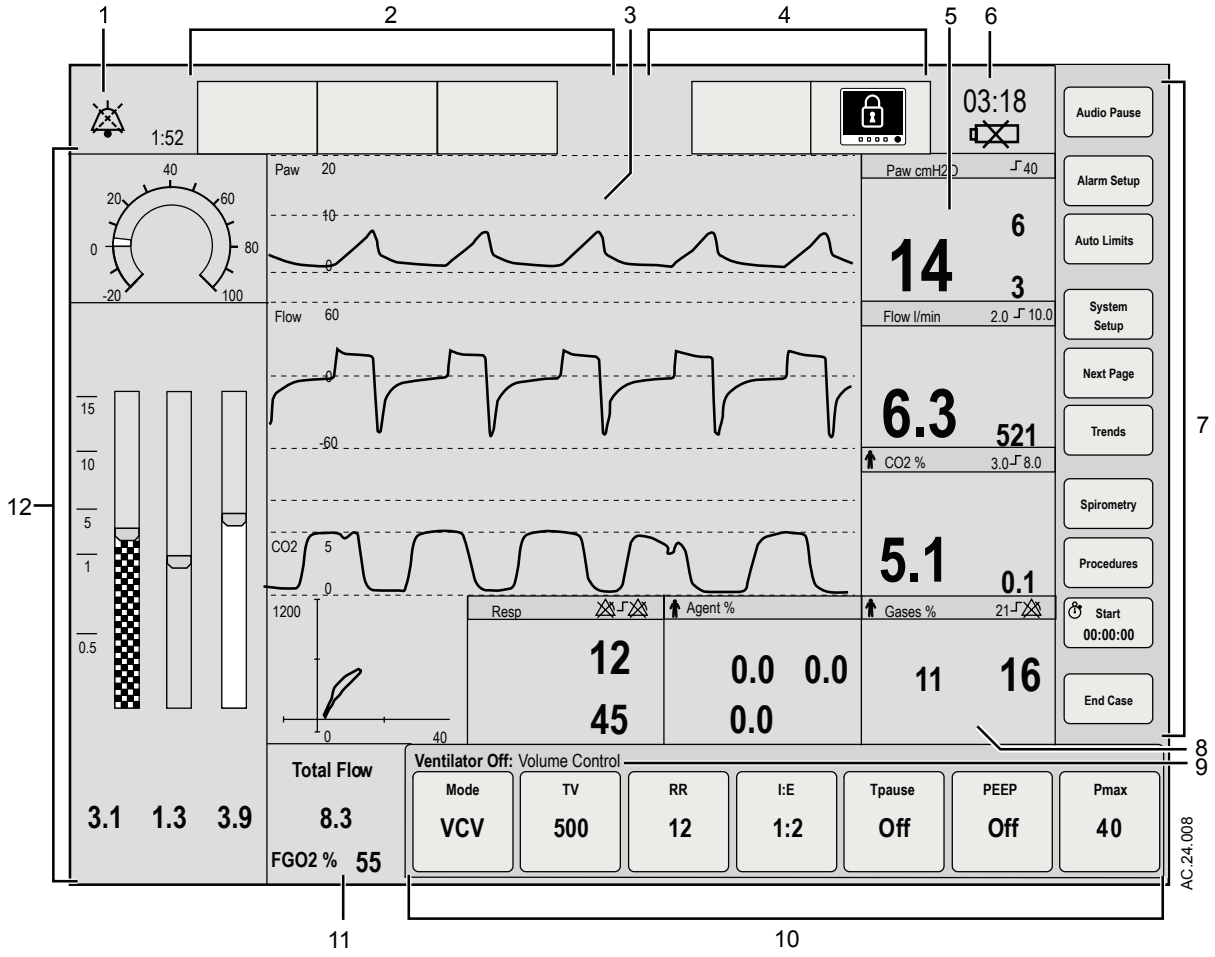
1. Touch the measured value to access the ***Alarm Setup*** menu.
2. The ***Alarm Setup*** menu displays.
3. Select the alarm limit and set it to the correct value. Touch the value on the touchscreen or push the ComWheel to confirm the desired setting.
4. Push the Home key, touch the waveform area of 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	Indicates when alarm audio is paused and the countdown clock until audio is on.
2.	Alarm message fields	Displays the active alarms.
3.	Waveform fields	Displays the waveforms of measured values. For example: Paw, Flow, and CO2.
4.	General message fields or lock touchscreen indicator	Displays general messages and the touchscreen lock indicator.
5.	Measured values fields	Displays the measured values. For example: Paw, Flow, and CO2.
6.	Clock	Displays the current time.
7.	Function keys	Functions available are: Audio Pause, Alarm Setup, Auto Limits, System Setup, Next Page, Trends, Spirometry, Procedures, Timer, Start, and End Case.
8.	Digit fields	Contains information for Loops, Resp, Agent, Gas Supplies, Flow, and Gases.
9.	Ventilation mode	Displays the selected ventilation mode. For example: Ventilator Off and Volume Control.

10. Ventilator quick keys	Displays Mode, associated ventilation parameters, and More Settings. For example: Mode, TV, RR, I:E, Tpause PEEP, and Pmax.
11. Total Flow	Contains information for Total Flow and FGO2 %.
12. Split screen	Contains airway pressure, gas flow values, compliance, trends, spirometry and optional ecoFLOW information.

Figure 2-14 • 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.

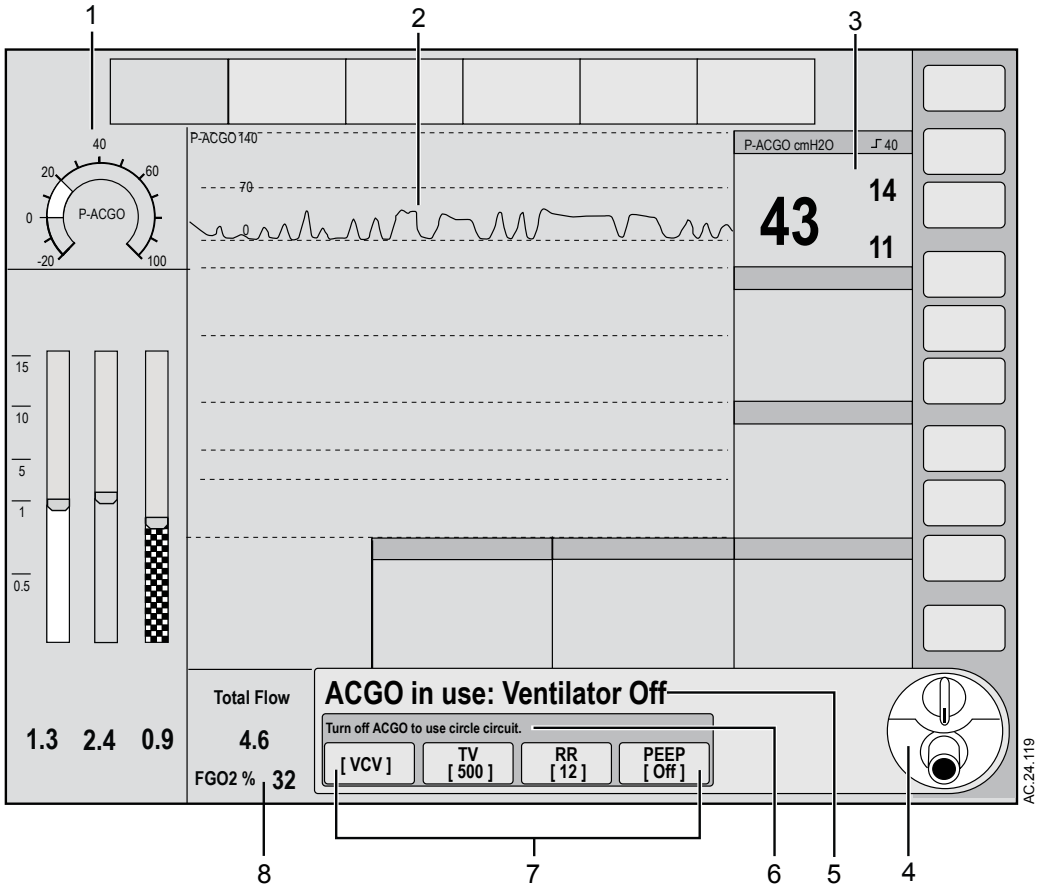
Split screen field

The split screen field can be set to show gas 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 spilt screen field to directly open the ***Screen Setup*** menu.

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

ACGO display



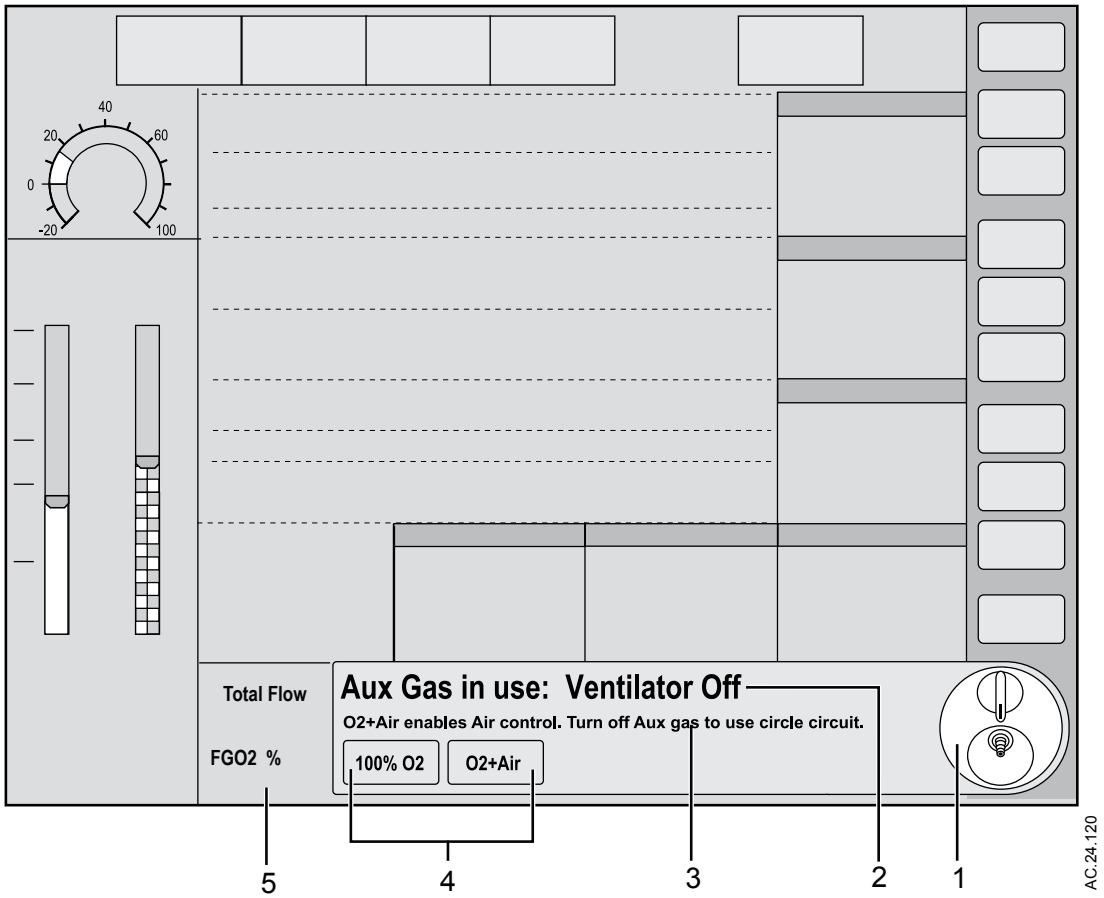
1.	Split screen	Shows P-ACGO, gas flow values, compliance, trends and optional ecoFLOW information. For example: P-ACGO.
2.	Waveform fields	When pressure waveform is selected, displays the measured values for pressure through the ACGO port.
3.	Measured values fields	When pressure waveform is selected, displays the meassured values for pressure through the ACGO port.
4.	ACGO status	Shows that the ACGO switch is set to the ACGO position.
5.	Status field	Shows the ACGO status and alarm or status messages. For example: ACGO in use: Ventilator Off.
6.	Message fields	Displays ventilation mode or messages. For example: Turn off ACGO to use circle circuit.
7.	Ventilator quick keys	Displays preset ventilation parameters. For example: VCV, TV, RR, and PEEP.
8.	Total flow	Shows information for Total Flow and FGO2 %.

Figure 2-15 • ACGO typical full view

Note View and change ventilator parameters when in ACGO mode. When the ACGO switch is set to ventilation mode, the system starts mechanical ventilation using the parameters set in ACGO mode.

Note When the ACGO is used with an open patient circuit, the only available source for spirometry is the CARESCAPE™ Airway module. Ventilator spirometry is not available.

Aux O2+Air display

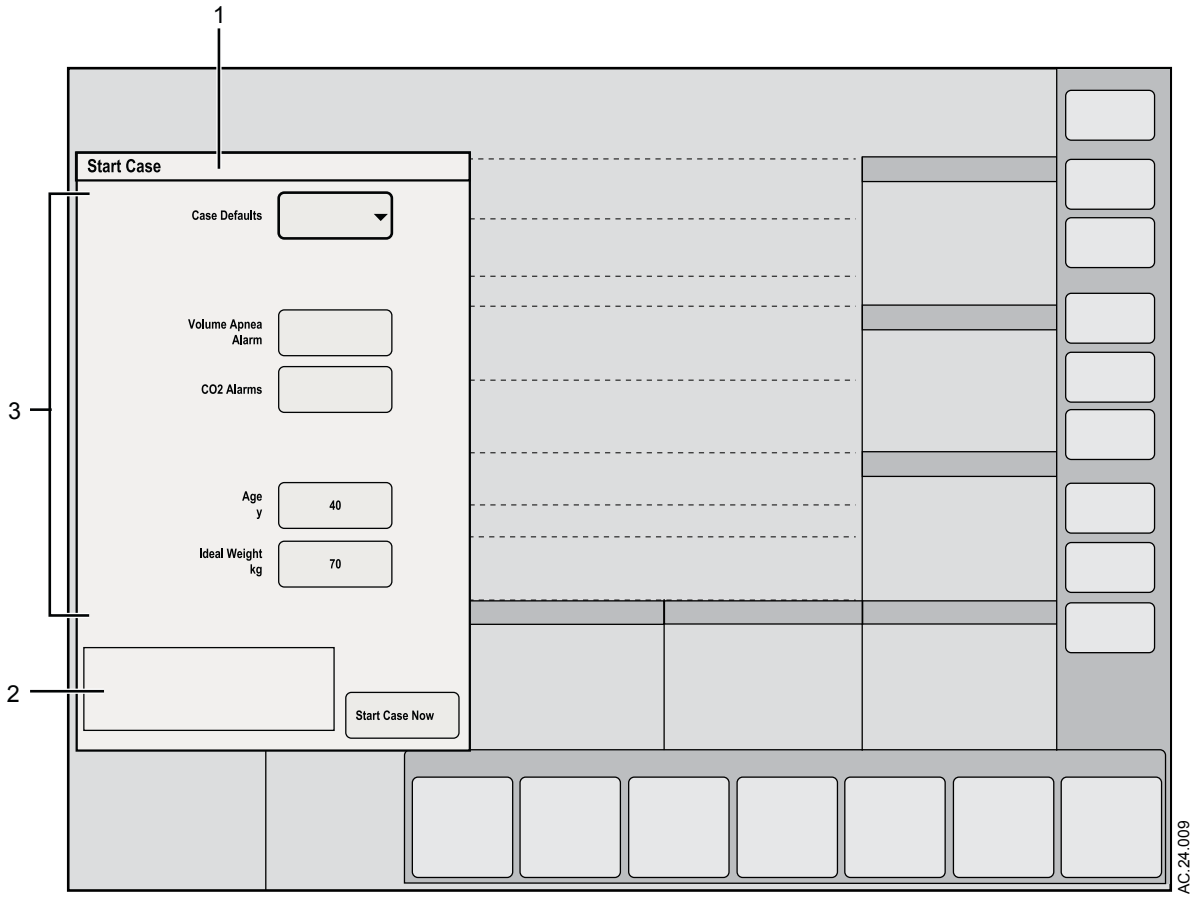


1. Auxiliary Gas status — Shows that the Aux O2+Air switch is set to Aux O2+Air position.
2. Status field — Shows Aux O2+Air status and alarm or status messages. For example: Aux Gas in use: Ventilator Off.
3. Message field — Displays the message: O2+Air enables Air control. Turn off Aux gas to use circle circuit.
4. Quick keys — Shows gas selections: 100% O2 or O2+Air.
5. Total flow — Shows information for Total Flow and FGO2 % from the Aux O2+Air port.

Figure 2-16 • Aux O2+Air full view

Display navigation

Use the touchscreen and ComWheel to navigate the display.



1.	Menu	Displays the title of the open menu. For example: Start Case.
2.	Instructions or help information	This shows any additional instructions or help messages.
3.	Menu items	Shows Case Defaults, Volume Apnea Alarm, CO2 Alarms, Age, Ideal Weight, and Start Case Now.

Figure 2-17 • 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 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 ***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

In this section

System operation safety

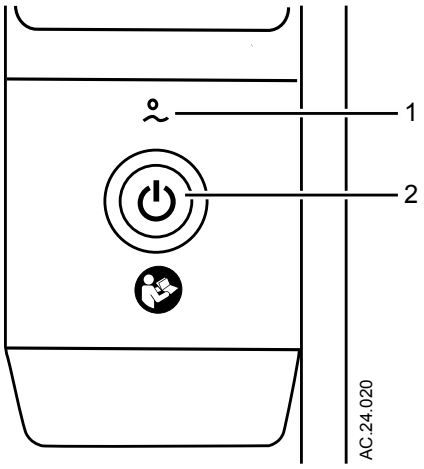
WARNING Do not use antistatic or electrically-conductive breathing tubes or masks. They can cause burns if used near high-frequency surgical equipment

- The manufacturer recommends the use of filter(s) that protect both the inspiratory and expiratory ports to reduce the risk of cross-contamination. Failure to properly install and use bacterial or viral filters in a way that protects the inspiratory and expiratory ports will result in additional required cleaning and sterilization procedures. If filters are not used, perform the cleaning and sterilization procedures specified in the "*Cleaning and sterilization*" manual before each patient to avoid cross-contamination between patients.
- 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 25 kg (55 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.
- The system does not meet the ISO 80601-2-13 and IEC 60601-1 stability requirements when removed from a ceiling mount or a wall mount. Special caution must be taken when moving the system.

Turning on the system

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



1. Mains indicator
2. On/Standby switch

Figure 3-1 • Mains indicator and On/Standby 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. Push the On/Standby switch for 1 second to turn on the system.

   The Total flow indicator shows total fresh gas flow and the display shows the power-up screen.

   The system does a series of automated self tests.

   In case of emergency, during power-up, O2 and agent delivery is possible in bag mode.
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.

Note Wait a minimum of 5 seconds after the display keypad lighting turns off before restarting the system.

Starting manual ventilation

1. Connect a manual breathing circuit.
2. Make sure the APL valve is set to a clinically appropriate value.
3. Set the Bag/Vent switch to Bag.

Starting mechanical ventilation

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.

1. Set the ACGO switch to the circle circuit position.
2. Set the Bag/Vent switch.

   If Bag/Vent switch is set to Bag, move to Vent position to start mechanical ventilation.
3. If needed, push the O2 flush button to inflate the bellows.

Start a case

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

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 In case of a patient emergency, the ***Full Test*** may be bypassed by selecting ***Start Case*** and then selecting ***Bypass***. 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. The messages ***Checkout has not passed.*** and ***Checkout bypass will be recorded to the system log.*** will be displayed in ***Checkout*** menu when checkout is bypassed.

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 Minimum Alveolar Concentration (MAC) concept is based on the assumption that in a steady state condition, the alveolar partial pressure of a gas is equal to the partial pressure in the effector organ of the central nervous system. MAC values are used to estimate the level of anesthesia caused by volatile anesthetics. The MAC value display range is 0.0 to 9.9.

The MAC age value is shown when using a CARESCAPE™ airway module. The MAC age value is calculated from the exhaled gas concentration and the related affects based on the age of the patient. The MAC age calculation used is based on the Eger formula. When two agents are detected, the MAC values of each agent are added together. MAC age takes patient's age into account. Typically, younger patients have better liver function and can clear a drug faster, resulting in a higher MAC value. The patient age is 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 shown when using an Airway Gas option module, which is calculated from the exhaled gas concentration and only shows the MAC value for the primary agent detected.

The MAC or MAC age value shows on several areas of the screen including 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. 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.
2. Verify or change the ***Case Defaults*** selected.
3. Verify the settings are clinically appropriate.
4. Select ***Start Case Now***. Start gas flow by turning on the gas flow knobs.

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 and ***Alarm Setup*** menu.

1. 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.
2. 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.
3. 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.
4. To change alarm settings, select ***Alarm Setup***. Make the change.
5. From the ***Start Case*** menu, select ***Start Case Now***. Start gas flow by turning on the gas flow knobs.

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

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

End a case

Use the ***End Case*** menu to end the patient alarms.

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

Standby

When in Standby, most of the alarms are disabled. The ***Standby*** screen shows after ***End Case*** is selected.

If the fresh gas flow is more than 300 ml/min, a medium priority alarm ‘Turn off gas flow’ occurs reminding the user to turn off the fresh gas flow.

From the ***Standby*** menu:

- A case can be started using the default settings by increasing the fresh gas flow, setting Bag/Vent switch to vent, turning on Aux O2+Air switch, or by turning on ACGO switch.
- Select ***System Setup*** to open the ***System Setup*** menu.
- Select ***Checkout*** to open the ***Checkout*** menu.
- Select any other active function key to open the ***Start Case*** menu.

Turning off the system

1. Perform the "*End a case*" procedure, if appropriate.
2. Push and hold the On/Standby switch for 1 second.
3. Select ***Confirm*** or push the ComWheel within 10 seconds to turn off the system.

   If no action is performed within 10 seconds, the screen automatically returns to the previous display.

Note When the system is in a complete system failure state, the On/Standby switch may be pushed and held in for 10 seconds to shut down the system. If On/Standby switch does not shut down the system, unplug the AC power cord from the electrical outlet to force the system to shut down, and contact an authorized service representative.

Note Wait a minimum of 5 seconds after the keypad lighting turns off before restarting the system.

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 ‘EtCO2’ 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.

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, CO2, 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 trends, spirometry loops, Paw gauge, airway compliance, and optional ecoFLOW information.

See "*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.

Note When using the Airway Gas Option, only ***Vent*** is available for the ***Data Source***.

Note If no airway module is installed, all settings will default back to ***Vent***.

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***.

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 alarms for manual ventilation

The following alarms can be turned off to reduce nuisance alarms during manual ventilation if clinically appropriate:

- ***CO2 Alarms***
- ***Vol Apnea Alarm***
- ***MV/TV Alarms***

Note ***Vol Apnea Alarm*** selection will not be visible unless enabled in ***Super User*** mode.

Note ***CO2 Alarms*** and ***Vol Apnea Alarm*** can only be turned off while in manual ventilation.

Note Once mechanical ventilation begins by setting the Bag/Vent switch to Vent, the alarms will be set to ***On***.

Use the ***Alarm Setup*** menu to set ***CO2 Alarms***, ***Vol Apnea Alarm***, and ***MV/TV Alarms*** to ***Off***, if clinically appropriate.

Use the ***Alarms On/Off*** function key to quickly disable the ***CO2 Alarms*** and ***MV/TV Alarms*** limits during manual ventilation, if clinically appropriate.

Instructions for setting the ***CO2 Alarms***, ***Vol Apnea Alarm***, and ***MV/TV Alarms*** can be found in "*Setting CO2 alarms*", "*Setting volume apnea alarm*", and "*Setting MV/TV alarms*".

If experiencing frequent apnea alarms due to small tidal volumes, apnea alarm filtering can be enabled in ***Super User*** mode. Apnea alarm filtering uses CO2 breaths to filter the volume apnea alarms when ***Patient Weight*** is set to the minimum. ‘Volume Apnea Off’ shows in the message field when the apnea alarm filter conditions are met.

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 alarm off symbol 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 alarm off symbol 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

WARNING Set alarm volume loud enough to be heard over surrounding noise. If the volume is not loud enough, the user may not hear the alarm.

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***.

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.

Note Any changes that were made to the screen layout are replaced with the selected preset screen view.

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

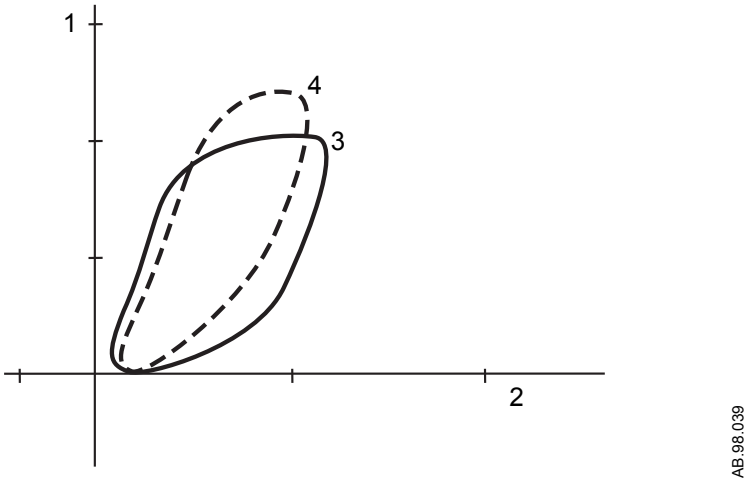
1. Select ***Trends***.
2. Select the desired view.
3. Select ***Scroll*** to move through the current trend view.
4. Select ***Time Scale*** to select the desired scale from the drop-down menu.
5. Select ***Next Page*** to view additional parameters.
6. Select ***Close***.

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 axis are dependent on the set patient type of adult or pediatric.

- ***Auto*** automatically adjusts the volume, Paw, and flow axis 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 axis 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 axis of the loop graph to be changed separately for the volume, Paw, and flow axis.

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.

Note When using the Airway Gas Option, only ***Vent*** is available for the ***Data Source***.

Note If no airway module is installed, all settings will default back to ***Vent***.

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 cmH2O.

   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 cmH2O.
   - Set ***Hold Time*** to between 10 and 40 seconds.
   - Set ***PEEP on Exit*** to Off or between 4 and 30 cmH2O.

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.

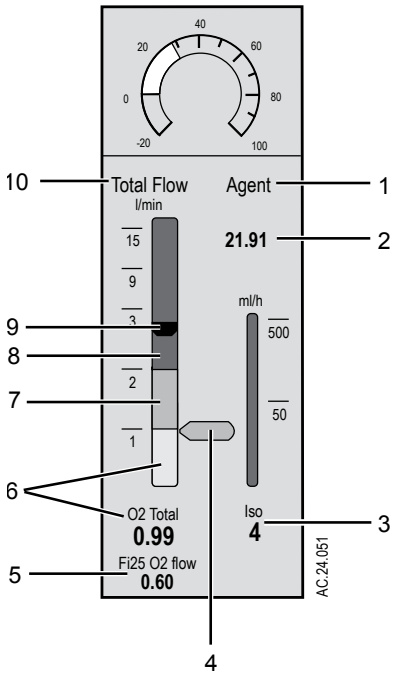
   If ***Start*** is selected, the clock will resume operation.

   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 O2 flow to maintain a preset inspired O2 concentration. Also shown is the approximate agent used per hour and the cost.

The ecoFLOW functionality is only available when an airway module is installed and the system is delivering mechanical ventilation.



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.	FiO2 flow marker	The graphical representation on the flow tube of the FiO2 flow value. This marker can be removed by disabling it in Super user mode.
5.	FiO2 flow	The minimum O2 flow needed to maintain the set inspired O2 flow. This item can be disabled in Super user mode. For example: Fi25 O2 flow.
6.	O2 total	O2 total equals the set of O2 flow. If N2O is the balance gas, this equals the set O2 flow. If Air is the balance gas, this is the set of O2 flow plus 21% of the Air flow.
7.	N2O total	N2O total equals the set N2O flow.
8.	N2 total	N2 total equals the N2 in the Air flow.
9.	Flow bobbin	The height of this represents the total fresh gas flow delivered to the breathing system.
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***.

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. Fresh gas delivered through the ACGO port may contain O2, Air, N2O, and anesthetic agent, depending on user settings.

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 CO2 absorber are not part of the external circuit. Volume monitoring is not available.

O2 monitoring of fresh gas is available when the ACGO is selected if the system has the airway module option. Systems with the airway module option display the patient circuit O2 value obtained from the airway module.

Delivered fresh gas O2 concentration is calculated and displayed based on fresh gas flow control settings.

WARNING 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.

- Volume monitoring is not available through the system when using the ACGO port, but pressure monitoring is available. Monitor the patient using other methods.
- Do not use an external ventilator on the ACGO. Do not use the ACGO to drive external ventilators or for jet ventilation.
- The maximum pressure at the ACGO can be up to 12.25 kPa (1.78 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 12.25 kPa (125 cmH2O) or to the maximum pressure required by local standards.

Using the ACGO

1. Open the ACGO switch cover.

2. Set the ACGO switch to the ACGO position.

   Fresh gas flows through the ACGO port.

   Fresh gas oxygen concentration is displayed on the screen if the system has the airway module option.
3. Set the alarm limits to clinically appropriate settings.
4. To stop fresh gas flow through the ACGO port, set the ACGO switch to the circle circuit position.

WARNING Displayed fresh gas oxygen concentration may not reflect FiO2 during spontaneous breathing or in rebreathing circuits. Use an external O2 monitor if using a rebreathing circuit on ACGO.

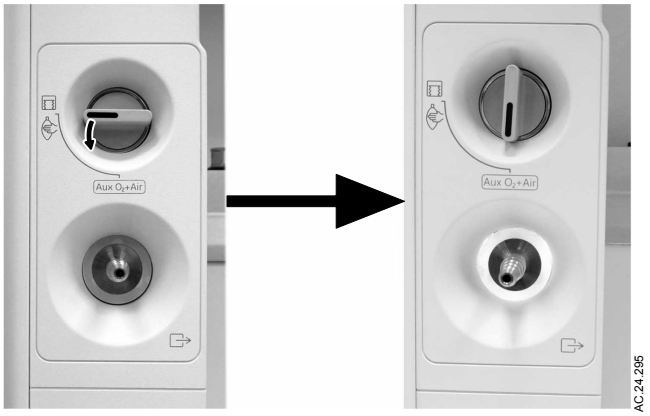
Auxiliary O2+Air

Use the optional Auxiliary O2+Air (Aux O2+Air) switch to deliver O2 and Air through the Aux O2+Air outlet on the front of the system. No anesthetic agent is delivered through the Aux O2+Air outlet. When the switch is set to the Aux O2+Air position during a case, the outlet indicator is lit and N2O flow is automatically shut off.

The Aux O2+Air outlet provides 100% O2 or a mixture of O2 and Air. The delivery default is ***100% O2***. Selecting the ***O2+Air*** quick key enables both O2 and Air. Adjust the O2 and Air individually using the flow control knobs.

Using the Aux O2+Air

1. Set the Aux O2+Air switch to the Aux O2+Air position.



2. Select either ***100% O2*** or ***O2+Air*** on the display. See "*Aux O2+Air display*" for more information.
3. Adjust O2 and Air individually using the flow control knobs.
4. Set the switch to the circle circuit position to stop fresh gas flow through the Aux O2+Air outlet.

4 Preoperative checkout

In this section

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 vaporizer installation:
  - Make sure that the top of each vaporizer is horizontal (not on crooked).
  - Make sure each vaporizer is locked and cannot be removed.
  - Make sure the alarms and indicators operate correctly (Tec™ 6 Plus vaporizer).
  - Make sure that more than one vaporizer cannot be turned on at the same time.
  - Make sure that the vaporizers are adequately filled.
- ☐ Check that the breathing circuit and bag are correctly connected, not damaged, and the breathing system contains sufficient absorbent in the canister.
- ☐ Turn the System on.
- ☐ Perform a ***Full Test*** from the ***Checkout*** menu.
- ☐ Check that an adequate reserve O2 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 cmH2O.
  - Set the gas flow to the minimum settings.
  - Start a case.
  - Set the Bag/Vent switch to Vent.
  - Fill the bellows using O2 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.
- ☐ Unplug the AC power cord from the electrical outlet and check that mechanical ventilation continues while the system is running on battery power. After completing the check, plug the AC power cord into the electrical outlet. 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.
- ☐ Check vaporizer installation:
  - Make sure that the top of each vaporizer is horizontal (not on crooked).
  - Make sure each vaporizer is locked and cannot be removed.
  - Make sure the alarms and indicators operate correctly (Tec 6 Plus vaporizer).
  - Make sure that more than one vaporizer cannot be turned on at the same time.
  - Make sure that the vaporizers are adequately filled.
- ☐ Check that an adequate reserve O2 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 cmH2O.
  - Set the gas flow to the minimum settings.
  - Start a case.
  - Set the Bag/Vent switch to Vent.
  - Fill the bellows using O2 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.
  - Make sure that the alarms function. See the "*Alarm tests*".
- ☐ Set the appropriate controls and alarm limits for the case.

5 Preoperative tests

In this section

Vaporizer installation

WARNING Use only Selectatec™ series vaporizers Tec™ 6 Plus or greater.

- Do not use a vaporizer that lifts off of the manifold when the lock lever is in the locked position.
- Do not use this anesthesia system if more than one vaporizer can be turned on at the same time.
- Electronic vaporizers with power cables will not align correctly unless the power cable goes through the channel on the bottom of the vaporizer.

Checking vaporizer installation

1. Make sure the top of the vaporizer is horizontal (not on crooked). If a vaporizer is crooked, remove the vaporizer and reinstall it.
2. Set each vaporizer lock lever to the locked position.
3. Try to lift each vaporizer straight up off the manifold rather than pulling forward. Do not rotate the vaporizer on the manifold.
4. If a vaporizer lifts off of the manifold, install it again and repeat steps 1, 2, and 3. If the vaporizer lifts off a second time, do not use the system.
5. For a Tec 6 Plus vaporizer:
   - Make sure that the vaporizer is connected to an electrical outlet.

Note If the vaporizer is not connected to an electrical outlet and the plug does not fit through the opening in the frame, disconnect the power cord from the vaporizer. Route the vaporizer end of the power cord through the opening from the back of the system. Connect the power cord to the vaporizer. Route the power cord through the channel on the bottom of the vaporizer. Mount the vaporizer on the manifold and repeat steps 1, 2, and 3.

   - Hold down the Auditory Alarm Mute (Audio Pause) button for a minimum of 4 seconds.
   - Make sure all indicators turn on and the alarm speaker starts.
   - Release the Auditory Alarm Mute (Audio Pause) button.
   - Do not continue until the operational indicator turns on. The concentration control will not turn if the operational indicator is off.

6. Try to turn on more than one vaporizer at one time:

- Test each possible combination.
- If more than one vaporizer turns on at the same time, remove the vaporizers, install them again, and repeat the test.

Flow and pressure calibration

Calibrate the flow sensors by opening the breathing circuit. On-screen instructions are available through the ***Checkout*** menu or ***System Setup*** - ***Calibration*** - ***Flow and Pressure***.

1. Pull down the canister lifter handle and remove the absorber canister.
2. Open the breathing system door. Push the release button to unlock the breathing system.
3. Lower the breathing system, and select ***Confirm***.

Note The breathing system should be completely disconnected from the system (fully rotated down) to obtain an accurate calibration.

4. Lift and reattach the breathing system.
5. Close the breathing system door.
6. Place the canister onto the canister base.
7. Pull the canister lifter handle up to lock the canister into the breathing system.

Circuit compliance compensation

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

- 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 measured after ***Vaporizer Leak*** test during the ***Checkout*** - ***Full Test*** or when the ***Ventilator Leak*** 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 "*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.

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. It is recommended that a test be conducted prior to use with each patient.

WARNING Perform a ***Full Test*** or the individual ***Ventilator Leak*** test after changing the patient tube type. Changing the patient breathing circuit after completing a ***Full Test*** or the individual ***Ventilator Leak*** test affects the volume measurements in all modes.

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 the color of the test indicator changes when the test is finished or if user action is required.

Perform a ***Full Test*** when any component of the system is changed (breathing system, vaporizers, pipeline inlets).

The ***Full Test*** does the following tests: ***Ventilator Leak***, ***Vaporizer Leak***, ***Gas Controls***, and ***Circuit leak***. 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. Before the test results are shown, the following checklist is shown for confirmation:
   - 'Verify O2 flush operates correctly.'
   - 'Connect respiratory gas monitor to the patient circuit.'
   - 'Check that patient monitor settings are correct.'
   - 'Check that backup ventilation is available and operational.'
   - 'Check that patient suction is set up correctly.'
   - 'Check the pressure of the backup O2 supply.'
4. When the ***Full Test*** is completed, start a case.

Note Make sure that a backup ventilation method (not integrated into the system) is available and operational. For example, a bag and mask respirator.

Note Contact a trained service representative to add checklist items. Four checklist items can be added to match unique facility procedures.

Note In case of a patient emergency, the ***Full Test*** may be bypassed by selecting ***Start Case*** and then selecting ***Bypass***. 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. The messages ***Checkout has not passed.*** and ***Checkout bypass will be recorded to the system log.*** will be displayed in ***Checkout*** menu when checkout is bypassed.

Note The general message ***Redo Gas Controls Checkout*** shows if the N2O is reconnected to the system after a ***Full Test*** was done without the N2O connected. Perform a ***Gas Controls*** test to remove the message.

Note The airway module sampling flow is paused during the checkout when an airway module is installed within the system. If an airway module is installed on an external monitor outside of the system, disconnect the gas sampling line from the patient circuit and close the sample port before performing the checkout.

Ventilator leak

The ***Ventilator Leak*** test checks the ventilator, bellows, gas supplies, and breathing circuit for gas leaks in the mechanical ventilation mode.

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

Vaporizer leak

The ***Vaporizer Leak*** test checks for leaks in the vaporizers. The patient circuit compliance is also measured during this test.

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

Gas controls

The ***Gas Controls*** test checks the flow control valves and gas flows.

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

WARNING The Link-25 system does not replace an O2 monitor. Sufficient O2 in the fresh gas may not prevent hypoxic mixtures in the breathing circuit.

- Nitrous oxide (N2O), if available, flows through the system during this test. Use a safe and approved procedure to collect and remove the N2O.
- Incorrect gas mixtures can cause patient injury. If the Link-25 system does not supply O2 and N2O in the correct proportions, do not use the system.

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.

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.

Note The airway module sampling flow is paused during the checkout when an airway module is installed within the system. If an airway module is installed on an external monitor outside of the system, disconnect the gas sampling line from the patient circuit and close the sample port before performing the checkout.

Ventilator leak

The ***Ventilator Leak*** test checks the ventilator, bellows, gas supplies, and breathing circuit for gas leaks in the mechanical ventilation mode. The patient circuit compliance is also measured in this test.

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

Vaporizer leak

The ***Vaporizer Leak*** test is a two-step test. The test first checks the ventilator, bellows, gas supplies, and then checks for leaks in each vaporizer.

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

Gas controls

The ***Gas Controls*** test checks the flow control valves and gas flows.

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

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.

Note Make sure the bag is connected to the bag hose connection.

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

Vaporizer back pressure test

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

- Agent mixtures from the vaporizer back pressure test stay in the system. Always flush the system with O2 after the vaporizer back pressure test (1 l/min for at least one minute).

The vaporizer back pressure test is performed to check the proper function of the vaporizer actuator pins that activate the Selectatec™ manifold port valves. Perform this test every time a vaporizer is attached to the system.

1. Start a case.
2. Set the O2 flow to 6 l/min.
3. Slowly adjust the vaporizer concentration from 0 to 1%.
    - Make sure that the O2 flow stays constant.
    - Verify that the system continues to operate without issuing any related alarms.
4. Repeat this test for each vaporizer position.
5. Set the O2 flow to 1 l/min and continue flow for one minute to flush out any residual agent.

Low pressure leak test (with ACGO)

This is an alternate manual test for low pressure leaks on systems with an ACGO.

WARNING Do not use a system with a low-pressure leak. If there is a low-pressure leak anesthetic gas will go into the atmosphere instead of the breathing system.

1. Check the leak test device.
   - Put your hand on the inlet of the leak test device. Push hard for a good seal.
   - Squeeze the bulb to remove all air from the bulb.
   - If the bulb completely inflates in less than 60 seconds, replace the leak test device.
2. Turn off the system.
3. Set the ACGO switch to the ACGO position.
4. Turn off all vaporizers.
5. Test the anesthesia machine for low-pressure leaks:
   - Turn all flow controls fully clockwise (closed). Do not overtighten.
   - Connect the leak test device to the ACGO outlet.
   - Squeeze the bulb repeatedly until it is empty.
   - If the bulb completely inflates in 30 seconds or less, there is a leak in the low-pressure circuit.
6. Test each vaporizer for low-pressure leaks:
   - If testing a Tec 7, Tec 820 or Tec 850 vaporizer set to 1%.
   - If testing a Tec 6 Plus vaporizer set to 12%.
   - Repeat step 5.
   - If the bulb completely inflates in 30 seconds or less, there is a leak in the vaporizer tested.
   - Set the vaporizer to Off.
   - Test the remaining vaporizers.
7. Remove the test device from the ACGO port.

WARNING Make sure all vaporizers are turned off at the end of the low-pressure leak test.

- Agent mixtures from the low-pressure leak test stay in the system. Always flush the system with O2 after the low pressure leak test (1 l/min for one minute).

8. Flush the system with O2.

- Set the System switch to On.
- Set the O2 flow to 1 l/min.
- Continue the O2 flow for one minute.
- Turn the O2 flow control fully clockwise (closed).

9. Set the ACGO switch to the breathing circle position.

6 Airway modules

In this section

Airway modules

The optional 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 CO2, N2O, and anesthetic agents.
- A paramagnetic O2 sensor.
- A gas sampling system with D-fend™ Pro water separation system.

Systems with both an airway module and an O2 cell will display the patient inspired O2 value obtained from the airway module.

Respiratory rate is the frequency of peak (end tidal) CO2 measurements per minute. A breath is defined as a change in the CO2 signal that exceeds 1% (8 mmHg). All concentrations are measured and displayed breath by breath.

Note The ventilator can be set to automatically compensate for the gas module sample flow. See section "*Ventilator settings*" in "*Super user mode*" for more information.

WARNING In the ***Spirometry*** menu, if the ***Data Source*** is set to ***Patient***, no Agent or CO2 waveforms or numeric information is displayed during the airway gas module warm-up period (approximately 2 minutes). The Paw and Flow waveforms and numeric information come from the ventilator during the airway gas module warm-up period.

Use only airway modules that have anesthetic agent monitoring and O2 monitoring on this system. The following modules can be used on this system:

- Airway Gas Option: N-CAiO (without Spirometry connector)
- CARESCAPE™ series: E-sCAiO and E-sCAiOV.

Letters in the airway module name indicate:

- E-s - CARESCAPE series plug-in gas module.
- N - Airway Gas Option plug-in gas module.
- C - CO2 and N2O.
- A - anesthetic agents.
- i - agent identification.
- O - patient O2.
- V - patient spirometry.

Safety information

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.

WARNING Leaks in the gas sampling circuit (water trap and sampling line) may cause inaccurate readings.

WARNING Make sure that the airway adapter is properly connected before attaching it to the patient. A leak in the connection may occur if the connection is not tight.

WARNING The D-fend Pro water trap may contain body fluid. Obey infection control and safety procedures.

WARNING Sample gas may contain anesthetic agents. Do not release sample gas into the room. Connect exhaust to a scavenging system to prevent exposure to anesthetic agents.

WARNING Route all tubing away from the patient's throat. Patient injury could occur.

WARNING Sample gas may contain infectious diseases. Do not allow the sample gas to discharge into the room.

WARNING Use of airway modules during volume controlled ventilation at low tidal volumes may reduce the amount of gas delivered to the patient. Make sure that there is appropriate gas delivery to the patient.

WARNING The size and fit of accessories may impact the measured gas concentration values during ventilation at low tidal volume. Always ensure the correct size and fit of accessories according to patient type and application.

WARNING Gas module sample flow may reduce the tidal volume by 120 ml/min. Make sure to compensate for possible reduction of tidal volume.

WARNING Do not apply pressurized air or gas to any outlet or tubing connected to the airway modules. Excessive air or gas pressure may destroy sensitive airway modules.

WARNING EtCO2 values displayed on the screen may differ from blood gas readings.

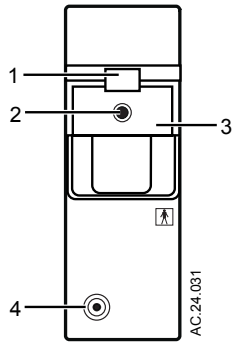
CAUTION Use only cables and accessories approved by GE Healthcare Finland Oy. Other cables and accessories

may damage the system or interfere with measurement. Single-use accessories are not designed to be reused.

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

WARNING Do not connect the gas sampling line to the patient spirometry connectors as this may damage the spirometry unit. Only the patient spirometry tube should be connected to the patient spirometry connectors.

Airway Gas Option module



1. Water trap latch
2. Gas sample connector
3. D-fend Pro water trap
4. Sample gas outlet

Figure 6-1 • Airway Gas Option module

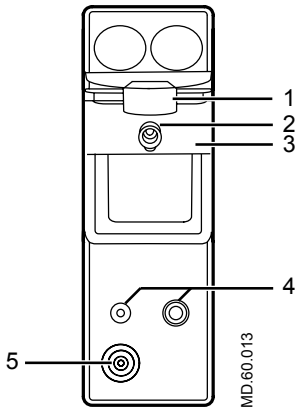
Indications for use

The Airway Gas Option is indicated for use with a host device for monitoring respiratory parameters (CO2, O2, N2O, anesthetic agents, anesthetic agent identification, and respiratory rate) of adult, pediatric, and neonatal patients.

When monitoring neonatal or other patients that have high respiration rate or low tidal volume these modules shall be used within the limits of respiration rates and tidal volumes to ensure specified measurement accuracy.

This module is intended for use by qualified medical personnel only.

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)

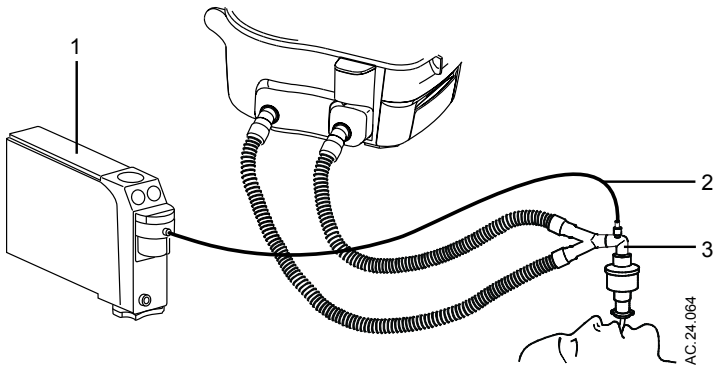
Connecting the airway module

1. Check that the airway 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 Pro container fills in 24 hours.

WARNING Before connecting the exhaust line to the sample gas outlet on the 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 airway module

Connecting the Pedi-lite and D-lite sensors

WARNING Use the Pedi-lite sensor for patients with tidal volumes up to, and including 200 ml.

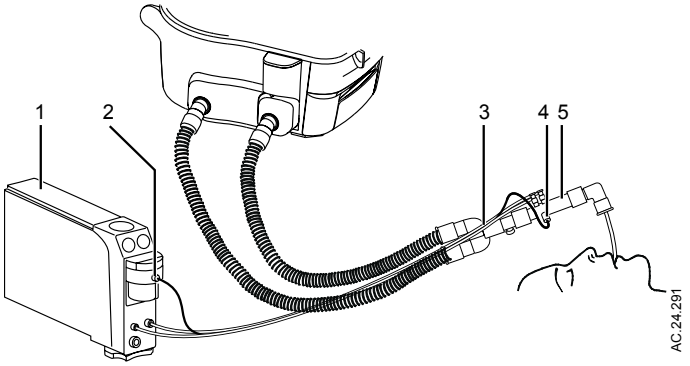
- Use the D-lite™ sensor for patients with tidal volumes greater than 200 ml.
- To ensure patient safety, make sure that the gas sampling connectors are connected as described in these instructions and are not interchanged with connectors on other equipment.

The D-lite and Pedi-lite sensors have a port to provide gas samples to the airway module. Both sensors are available as reusable (yellow) or disposable (clear).

Place all D-lite ports upwards with a 25 to 35° tilt to prevent condensed water from entering the sensor interior and the tubings.

Use manufacturer approved gas sampling lines (PVC/ PE) when anesthetic agents are used.

1. Connect the spirometry tubes from the Pedi-lite or D-lite sensor to the airway module.
2. Connect the gas sampling line from the Pedi-lite or D-lite sensor to the D-fend Pro water trap on the airway module.



1. Airway module
2. Gas sampling line connector on the water trap
3. Gas sampling and spirometry tubes
4. Gas sampling line
5. Pedi-lite or D-lite sensor

Figure 6-4 • Airway gas connection to airway module with spirometry

Parameters setup

Use the ***Spirometry*** menu to change the monitoring settings of the data source, CO2, O2, 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 6-5 • 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 using the Airway Gas Option, only ***Vent*** is available for the ***Data Source***.

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.

CARESCAPE modules identify two agents simultaneously and display them as primary and secondary agents. Airway Gas Option modules identify and display only one primary agent.

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.

- Calibration gas contains anesthetic agents. Make sure that there is sufficient ventilation in the room during airway module calibration.
- Use of an airway module that has failed calibration may cause inaccurate readings. Do not use airway modules that fail calibration.

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

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

1. Turn on the 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 ***Connect the calibration gas and feed gas.*** appears on the anesthesia display.
    - If an error occurs during calibration or if no gas is fed, the calibration shows ‘Fail’. Select ***Back*** to perform a new calibration.
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 ***End gas feed. Match the values with the calibration gas. Confirm each.*** 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. Close the regulator.
11. Compare the measured values shown on the screen, by gas, against the calibration gas cylinder value. 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.
12. After all values are confirmed, the calibration result is displayed.

7 Alarms and troubleshooting

In this section

Alarms

Alarms may be high priority, medium priority, or low priority. 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 43 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’, ‘EtCO2 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 O2 pipeline supply pressure drops to less than 252 kPa (36 psi), O2 supply information is displayed.

Some patient parameter alarms such as ‘Ppeak high’ and ‘FiO2 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 60 minutes.
- Yellow indicates between 60 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 43 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.

Alarm history

Use ***Alarm History*** to view a list of the 12 most recent high and medium alarms that occurred since system power up. The most recent alarm shows on the top of the list. If more than 12 alarms have occurred, the oldest alarms are deleted as new ones are logged.

The alarm history clears when the system is shut down or when a new case is started. All alarm information and operation steps are saved in service log. All logs can be accessed using in ***Super User*** mode or service mode.

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	When using a CARESCAPE™ series airway module, two different agents are detected by the airway module and the MAC age calculation is greater than or equal to 3. When using an Airway Gas Option airway module, two different agents are detected by the airway module.	Make sure only one agent is on. Wait approximately two minutes for the first agent to wash out of the system.
Agent mixture	Low	When using a CARESCAPE series airway module, two different agents are detected by the airway module and the MAC age 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.
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. Ensure facility gas supply pressure is within specification and the back up cylinder is full and open.
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. Check ventilation mode.
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.

Message	Priority	Cause	Action
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.	Lift the lower breathing system and ensure it latches. Close breathing system door.
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.
Confirm to shutdown	High	On/Standby button is pushed during a patient case.	Select Confirm within 10 seconds and the system will shut down. If Confirm is not selected within 10 seconds, the system reverts to the screen showing before the On/Standby button was pushed.
Cannot monitor Air pipeline	Medium	Air pipeline pressure is invalid.	Check pipeline supply pressure.
Cannot monitor O2 pipeline	Medium	O2 pipeline pressure is invalid.	Check pipeline supply pressure.
Cannot monitor N2O pipeline	Medium	N2O pipeline pressure is invalid.	Check pipeline supply pressure.
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.
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.

Message	Priority	Cause	Action
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. Check TV settings.
EtCO2 low	Medium	EtCO2 is less than alarm limit.	Ensure that patient is properly intubated. Check for leaks or blockages in the patient circuit. Check TV settings.
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.
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.

Message	Priority	Cause	Action
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.
FiIso high	Medium	FiIso 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.
FiIso low	Low	FiIso 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.
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.
Gas controls failure, O2 only	High	System communication failure.	Contact an authorized service representative.
Gas controls failure, O2 only	Medium	Frame interface board and power management board failure.	Contact an authorized service representative.
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.
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.

Message	Priority	Cause	Action
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 CO2, AA, O2 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 changed from Aux O2+Air to circle mode.	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.
N2O supply pressure low	Medium	N2O pipeline pressure is less than 252 kPa (36 psi) and the N2O cylinder pressure is less than 2633 kPa (381 psi).	Ensure the N2O pipeline and cylinder are properly connected. Ensure facility gas supply pressure is within specification and the back up cylinder is full and open.
N2O flow in Aux Gas mode	Medium	N2O flow is lager than 100 ml/min when system is in Aux gas mode.	Adjust N2O flow to less than 100 ml/min.
Negative airway pressure	High	Paw is less than -10 cmH2O.	Check for blockages in the patient circuit.
No battery backup	Medium	Battery or charging failure.	Between cases turn the system 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 insp flow sensor	Medium	Electrical signals show the flow sensor is not connected.	Connect the flow sensor. Replace the flow sensor if necessary.
O2 flow low	Low	The O2 flow is less than 150 ml/min.	Adjust the O2 flow.
O2 flush stuck on?	Low	Switch detected “on” continuously for more than 30 seconds.	Check flush valve. Ensure flush valve is not sticking.
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. Ensure facility gas supply pressure is within specification and the back up cylinder is full and open.
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.

Message	Priority	Cause	Action
Plug in power cable. On battery.	Low	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.
Power switched to Battery	Medium	The output power from Power Management Board reports over or under voltage condition. The power supply switched from AC mains to backup power.	Disconnect and reconnect the AC mains power.
Ppeak high	High	Paw or P-ACGO is greater than Pmax alarm limit.	Check for blockages in the patient circuit.
Ppeak low. Leak?	Medium	Peak airway pressure is less than low Pmin + 4 cmH2O 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	Water trap is full or sample line may contain droplets. Water trap is partially occluded.	Replace D-Fend water trap and/or sample line.
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. Check valves.
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. Check valves.
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	Water trap is full or sample line may contain droplets. Water trap is partially occluded.	Replace airway module D-fend and/or sample line.
Scavenging flow is too high.	Low	Scavenging flow is too high.	Adjust the flow of hospital disposal system or adjust the scavenging flow on the anesthesia machine (if applicable). Contact an authorized service representative if the problem continues.
Scavenging flow is too low.	Low	Scavenging flow is too low.	Adjust the flow of hospital disposal system or adjust the scavenging flow on the anesthesia machine (if applicable). Check the facility vacumm source and the connections (if applicable). Contact an authorized service representative if the problem continues.

Message	Priority	Cause	Action
Service calibration advised	Low	Calibration data is corrupt.	Contact an authorized service representative.
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.
Touchscreen failure	Medium	Touchscreen interface is not working.	Contact an authorized service representative.
Turn off gas flow	Medium	The gas flow is greater than 300 ml in Standby.	Turn off the gas flow.
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.
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.
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.
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. Auxiliary gas is turned on.	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 cmH2O, the sustained pressure limit is 6 cmH2O. For Pmax between 30 and 60 cmH2O, the sustained pressure limit is 20% of Pmax. For Pmax greater than 60 cmH2O, the sustained pressure limit is 12 cmH2O.
Mechanical Ventilation with PEEP On:	For Pmax less than 30 cmH2O, the sustained pressure limit is 6 cmH2O plus “set PEEP” minus 2 cmH2O. For Pmax between 30 and 60 cmH2O, the sustained pressure limit is 20% of Pmax plus “set PEEP” minus 2 cmH2O. For Pmax greater than 60 cmH2O, the sustained pressure limit is 12 cmH2O plus “set PEEP” minus 2 cmH2O.
Mechanical Ventilation Off:	For Pmax between 12 and 60 cmH2O, the sustained pressure limit is 50% of Pmax. For Pmax greater than 60 cmH2O, the sustained pressure limit is 30 cmH2O.

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%
FiIso High	0.1 - 7.0%	0.1%
FiIso 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%
EtIso High	0.1 - 7.0%, Off	0.1%

Alarm	Range	Increment
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 FiO2 readings are taken from the module instead of from the O2 cell. A sample line must be connected from the airway module to the breathing circuit to test the O2 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 O2 concentration to 30%, and allow the O2 reading to stabilize.

   For machines configured to individual gas control, set the O2 flow to approximately 500 ml/min and Air flow to approximately 5 l/min.
5. Test the O2 alarms:

   - Set the ***FiO2 Low*** alarm limit to 50%. Make sure an ***FiO2 low*** alarm occurs.
   - Set the ***FiO2 Low*** alarm limit back to 21% and make sure that the ***FiO2 low*** alarm cancels.
   - Set the ***FiO2 High*** alarm limit to 50%.
   - Push the O2 flush.
   - Make sure the ***FiO2 high*** alarm occurs.
   - Set the ***FiO2 High*** alarm limit back to 100%. Make sure that the ***FiO2 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:

   - Set the APL valve to 70 cmH2O.
   - Set the Bag/Vent switch to Bag. Mechanical ventilation stops.
   - Block the patient connection and push the O2 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.
	Pressure sensor problem.	Contact an authorized service representative to repair the pressure sensor on anesthesia control board.
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 the canister is placed correctly on the canister lifter base.
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 cmH2O.	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 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.
	The power management board does not work. The cables between mains and the power management board or the power management board and the anesthesia control board are disconnected.	Contact an authorized service representative to repair the system.
One electrical outlet does not have power.	The outlet circuit breaker is off. The electrical outlet is damaged.	Turn the circuit breaker on. Contact an authorized service representative to repair the system.
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.
Tec™ 6 Plus vaporizer has no power.	Not plugged into outlet.	Connect power cable.
	The outlet circuit breaker is off.	Turn the circuit breaker on.
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.
Display does not function.	Display is broken.	Contact an authorized service representative to repair the system.
Task light does not function	Task light is broken.	Contact an authorized service representative to repair the system.
On/Standby switch does not work	System does not have electrical or battery power. On/Standby switch is broken.	Confirm power cable is connected. Contact an authorized service representative to repair the system.
Touch screen does not function.	Touch screen is locked, dirty or broken.	Make sure there is no liquid or other dirt on the touch screen and that the screen is unlocked. Contact an authorized service representative to repair the system if the problem continues.

Symptom	Problem	Solution
Indication lights are not on	The gas port is not active. The LED or power management board has failed.	Contact and 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.
Vaporizer leak test fails or low-pressure leak test fails with a vaporizer on.	The vaporizer is not correctly installed.	Correctly install the vaporizer.
	The vaporizer filler port cap is loose (fill port type vaporizer).	Tighten the filler port cap.
	Vaporizer port o-rings (external) are damaged or not installed.	Install new o-rings.
	A vaporizer malfunction (the leak stops if you use a different vaporizer in the same position).	Send the vaporizer to an authorized service representative for repair.
	A port valve malfunction (the leak continues if you use a different vaporizer in the same manifold position).	Contact an authorized service representative to repair the vaporizer manifold.
Low-pressure leak with vaporizer off.	Anesthesia machine problem.	Contact an authorized service representative.
Vaporizer control dial can not be rotated.	Vaporizer is not locked on the manifold or another vaporizer is turned on	Make sure the vaporizer is properly installed and locked. Make sure the other vaporizer (if present) is off.
Low-pressure leak.	Anesthesia machine problem.	Contact an authorized service representative.

Reporting of serious incidents

Any serious incident related to the use of this device, should be reported to both the manufacturer and the health authority/competent authority where the device is installed.

To report to the manufacturer:

- Either contact your local service representative.
- Or report to: in-box.complaints@ge.com.

Please provide the following information:

- The catalogue number or the model designation of the device as stated on its identification plate affixed on the device
- The System ID/serial number/lot number of the device
- Date of incident
- Description of incident, including any patient or user impact/ injury
- Your contact information (facility, address, contact name, title, and telephone number)

8 Setup and connections

In this section

Setup safety

WARNING The system should always be used with an oxygen monitor, a CO2 monitor, an anesthetic agent monitor, and an exhaled volume monitor. Refer to local standards for mandatory monitoring requirements.

- 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 General Electric 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.
- If an external pressurized pipeline gas source is not capable of supplying the peak gas flow and continuous gas flow, the ventilator may not be able to achieve the full range of ventilation settings.

  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 moving or transporting the anesthesia machine, place the display arm and shelf in the transport position. Make sure that the arm and shelf remain in position while moving the system.

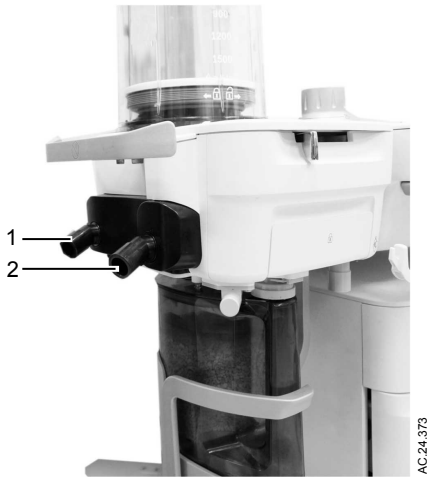
  The system may tip if the display arms are not in the transport position while moving the machine on an incline. Remove the patient monitor or hold the display in the transport position while moving the machine.

  Before removing the system from ceiling mount or wall mount, remove any extra load attached to the system.

  When using the brake on an incline, be sure to lock the brake with the machine facing down the slope.

Connecting the breathing system

1. Attach the patient circuit to the inspiratory and expiratory ports on the system.
2. Perform the individual "*Ventilator leak*" test to set proper circuit compliance.



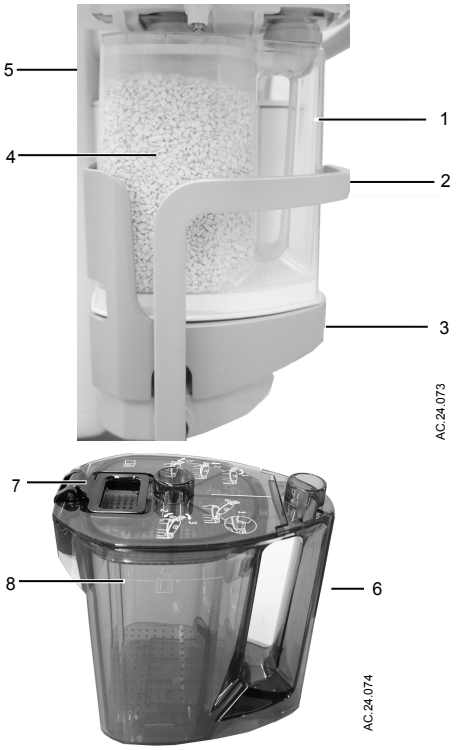
1. Expiratory port
2. Inspiratory port

Figure 8-1 • Breathing system connection

Setting up the absorber canister

The absorber canister is available in two versions: disposable absorber and reusable absorber. Both are removed and installed on the breathing system the same way.

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



1. Canister handle
2. Canister lifter handle
3. Canister lifter base
4. Absorbent
5. Disposable absorber canister
6. Reusable absorber canister
7. Canister lid latch mechanism
8. Maximum absorbent capacity level

Figure 8-2 • Canister

WARNING Obey applicable safety precautions:

- Do not use the absorber with chloroform or trichlorethylene.

- The disposable 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.
- 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.

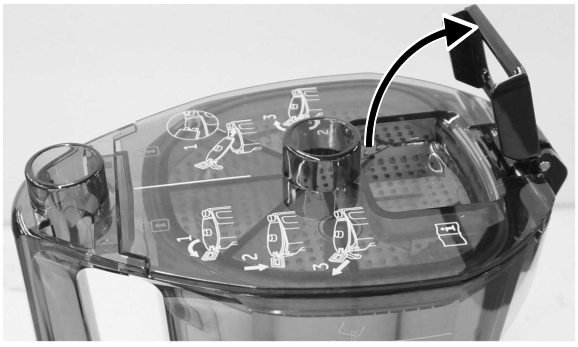
Removing absorber canister

1. Pull down the canister lifter handle to unlock the canister from the breathing system.

2. Lift the canister and remove it from the canister lifter base.

Filling the reusable absorber canister

1. To open the canister cover, lift the latch handle up.



2. Push the latch handle down to release the cover.

3. Pull the latch hook away from the canister and lift the cover off the canister.

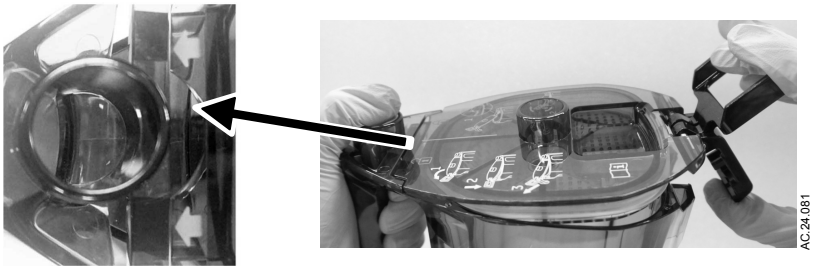
4. Remove and properly discard the absorbent and any water in the canister body.

WARNING Be careful when emptying the absorber canister. The liquid is caustic and may burn skin.

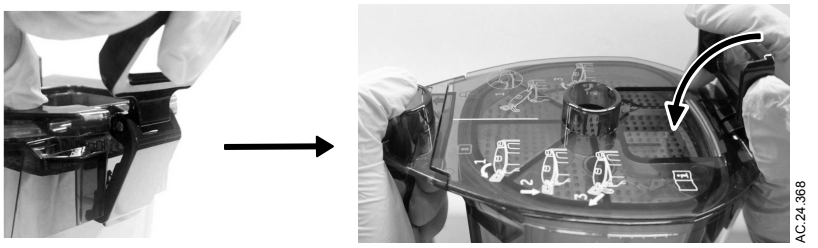
5. To clean and disinfect the canister, refer to "*Automated washer*" in the "*Cleaning and sterilization*" manual.
6. Pour fresh absorbent into the canister.
7. Gently shake the canister from side to side to level the top of the absorbent. Make sure the absorbent in the canister does not exceed the fill line.
8. Wipe off any absorbent dust on the top cover wiper seal and the canister sealing area.

Note The top cover wiper seal may discolor over time, however color change alone has no effect on seal function.

9. Insert the cover into the groove on the canister handle so that the arrows get covered by the black zone.



10. Attach the cover latch hook to the canister body. Push the latch handle down until it is flush with the canister cover.



WARNING Failure to properly lock the canister cover could cause canister malfunction and breathing circuit leaks. The locking tab of the canister cover must be in the downward position and flush with the cover.

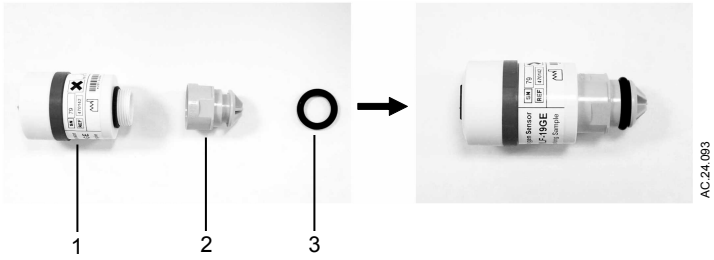
11. Place the canister onto the canister lifter base.
12. Pull the canister lifter handle up to lock the canister into the breathing system.
13. Always perform a "*Preoperative checkout*" after reassembly before using the anesthesia system.

Circuit O2 cell installation

Use the following instructions to add an O2 cell to the system.

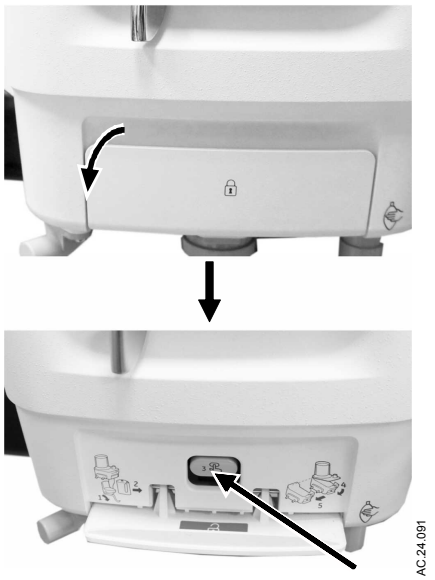
Note If an O2 cell is already in the system and needs replacement, see the "*Circuit O2 cell replacement*" section.

1. Install the O-ring onto the adapter and screw the adapter onto the O2 cell.



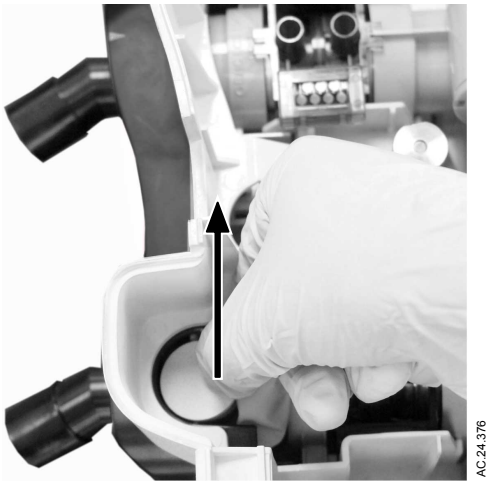
1. O2 cell
2. Adapter
3. O-ring

2. Pull down the canister lifter handle to unlock the canister from the breathing system.
3. Lift the canister and remove it from the canister lifter base.
4. Open the breathing system door. Push the release button to unlock the breathing system.

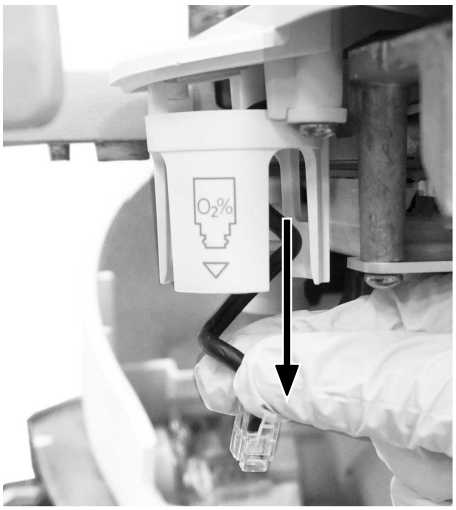


5. Lower the breathing system.

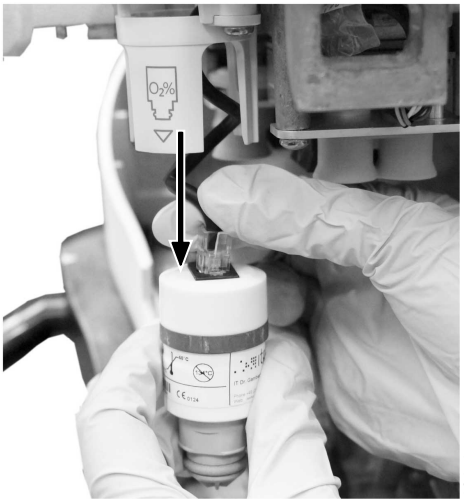
6. Remove the O2 cell plug from the patient port assembly (if present).



7. Pull the cable out of the O2 cell bracket.



8. Plug the cable connector into the O2 cell.



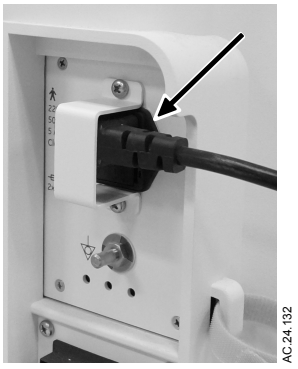
Note Make sure the O2 cell plug is removed before reattaching the breathing system.

9. Lift and reattach the breathing system base. A click sound will be heard when attached properly.
10. Close the breathing system door.
11. Place the canister onto the canister lifter base.
12. Pull the canister lifter handle up to lock the canister into the breathing system.
13. Calibrate the O2 cell according to the procedure.

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. An optional, integrated isolation transformer is available when outlets are configured on the system.

WARNING Equipment connected to electrical outlets that are not isolated outlets can increase the leakage current. Regularly test the leakage current.

1. Circuit breaker
2. Outlet socket

Serial port

The system has a Universal Serial Bus (USB) port on the back of the display unit. This port is for use by super user or authorized service personnel to access log files, and for authorized service personnel to load software. 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.

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 O2 flowmeter (optional)
- Auxiliary O2+Air (optional)
- ACGO (optional)

Pipeline inlets

The pipeline inlets accept up to three different gases: O2, Air, and N2O. A fourth pipeline inlet is available for a secondary, backup low-pressure O2 supply connection.

Scavenging

The AGSS port is located behind the breathing system. An adapter may be necessary to interface to the scavenging connector.

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

Figure 8-3 • AGSS connection

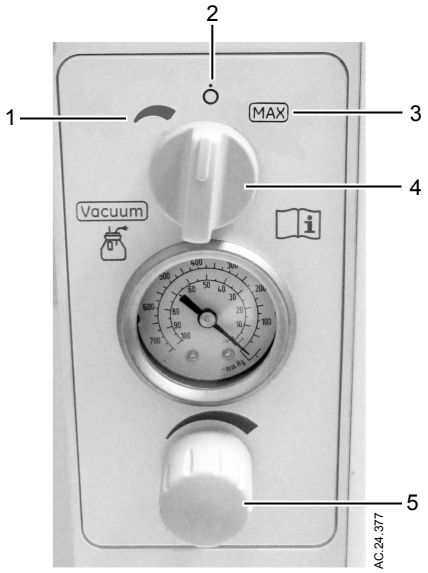
Scavenging a gas monitor sample flow

Sample gas from a gas monitor can be scavenged by connecting the exhaust from the monitor to the sample gas return port on the left side of the machine.

Sample gas return port

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

Suction control panel

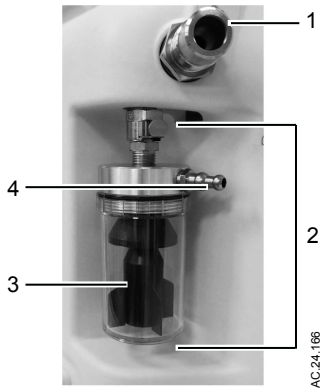


1. Suction switch variable control position
2. Suction switch Off position
3. Suction switch maximum position
4. Suction mode selection switch
5. Suction variable pressure control knob

Figure 8-4 • Suction control panel

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.

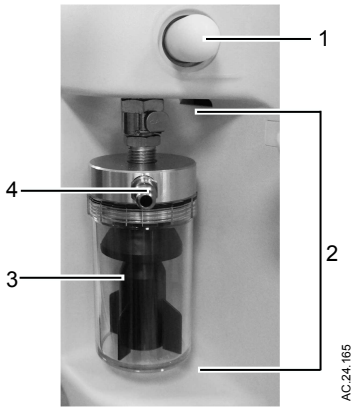


1. External vacuum connection
2. Overflow safety trap
3. Splash guard
4. Collection bottle connection

Figure 8-5 • External vacuum suction

Venturi suction regulator (optional)

The venturi suction regulator uses the system air supply source. Connect the collection bottle connection on the overflow safety trap to the collection bottle.

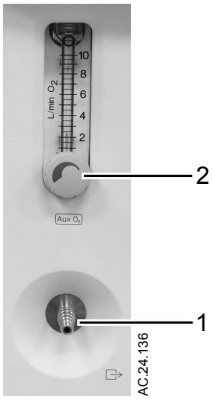


1. Venturi muffler
2. Overflow safety trap
3. Splash guard
4. Collection bottle connection

Figure 8-6 • Venturi suction

Auxiliary O2 flowmeter (optional)

The auxiliary O2 port is available to provide supplemental oxygen to patients undergoing surgical procedures.

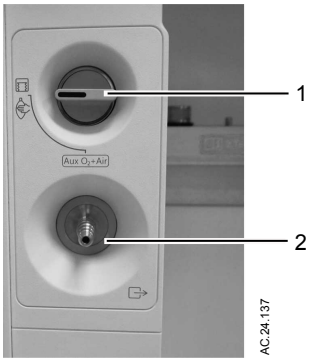


1. Auxiliary O2 outlet
2. Auxiliary O2 flow control

Figure 8-7 • Auxiliary O2 flowmeter

Auxiliary O2+Air (optional)

The optional auxiliary O2+Air port provides supplemental O2 or a mixture of O2 and Air to patients undergoing surgical procedures.

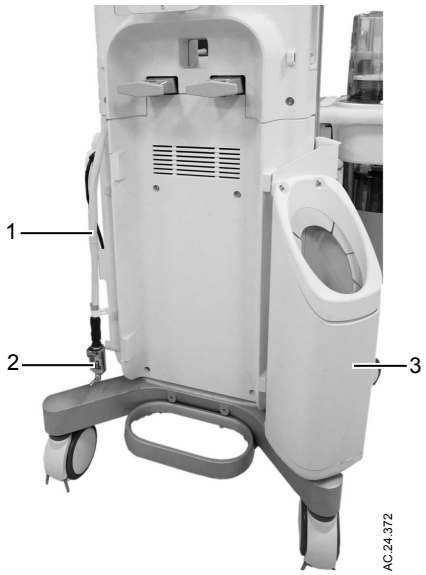


1. Auxiliary O2+Air switch
2. Auxiliary O2+Air outlet

Figure 8-8 • Auxiliary O2+Air

Third cylinder supply (optional)

The third cylinder supply option is used to connect a third high pressure cylinder. See "*Installing cylinders with pin indexed yokes*" in the "*Installing gas cylinders*" section for installation instructions.



1. High pressure hose
2. Pin index cylinder interface
3. Third cylinder mount kit

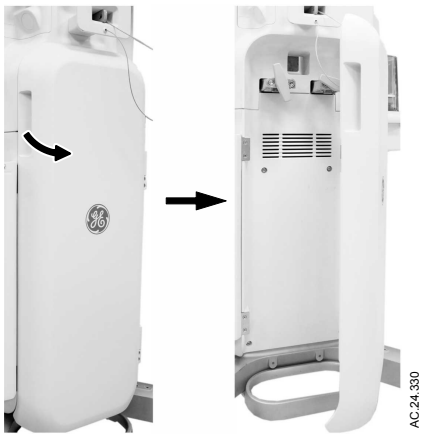
Figure 8-9 • Third cylinder supply option

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.

Cylinder cover

Some systems have an optional cylinder cover. The cover needs to be opened before installing or removing cylinders.



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*".

Installing large cylinders

1. Close the cylinder valve on the cylinder to be replaced.
2. Loosen and remove the hose connection from the cylinder.
3. Loosen the cylinder strap.
4. Remove the used cylinder.
5. Install the new cylinder.
6. Tighten the cylinder strap.
7. Remove the cap from the cylinder valve on the new cylinder.
8. Attach the hose connection to the cylinder.
9. Complete "*Performing a high-pressure leak test*".

Performing a high-pressure leak test

1. Turn on the system.
2. Disconnect pipeline supplies.
3. Turn off the auxiliary O2 flowmeter and venturi suction.
4. Select the ***Circuit Leak*** test in the ***Checkout*** menu.
5. Open the cylinder.
6. Observe the cylinder pressure.
7. Close the cylinder.

   If the cylinder pressure decreases more than 690 kPa (100 psi) in one minute there is a significant leak.
8. To repair a leak, install a new cylinder gasket and tighten the adapter.
9. Repeat the leak test. If the leak continues, do not use the system.

Passive AGSS

WARNING To avoid possible exposure to anesthetic agent, always verify the proper operation of any gas scavenging system. Make sure 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 dovetail behind the breathing system.
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 To avoid possible exposure to anesthetic agent, 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 1.2 liter reservoir to capture peak exhaust flows that briefly exceeds the extract flow rate. The disposal system normally entrains room air through an air brake, 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 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. An alarm shows on the display when the flow is out of range. If the alarm shows high flow, the AGSS flow may be adjusted down to eliminate the alarm condition. If the alarm shows low flow, the AGSS flow may be increased to eliminate the alarm condition if the hospital extract system is able to meet the AGSS flow needs.
- The active low flow system with the vacuum DISS connector is for use with high vacuum disposal systems. It requires a vacuum system capable of a continuous nominal flow of 25 l/min at 300 mmHg (12 inHg) or greater vacuum pressure. An alarm shows on the display when the flow is out of range. If the alarm shows high flow, the AGSS flow may be adjusted down to eliminate the alarm condition. If the alarm shows low flow, the AGSS flow may be increased to eliminate the alarm condition if the hospital extract system is able to meet the AGSS flow needs.
- The active low flow system with SIS EVAC connector is for use with high vacuum disposal systems. It requires a vacuum system capable of a continuous nominal flow of 25 l/min at 300 mmHg (12 inHg) or greater vacuum pressure. An alarm shows on the display when the flow is out of range. If the alarm shows high flow, the AGSS flow may be adjusted down to eliminate the alarm condition. If the alarm shows low flow, the AGSS flow may be increased to eliminate the alarm condition if the hospital extract system is able to meet the AGSS flow needs.
- 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 25 to 50 l/min extract flow. An alarm shows on the display when the flow is out of range. If the alarm shows high flow, the AGSS flow may be adjusted down to eliminate the alarm condition. If the alarm shows low flow, the AGSS flow may be increased to eliminate the alarm condition if

the hospital extract system is able to meet the AGSS flow needs.

- The active low flow system with 30 mm ISO taper, or 12.7 mm hose barb connector, is for use with low vacuum disposal systems. It requires an external venturi/ejector system with 25 to 50 l/min extract flow. An alarm shows on the display when the flow is out of range.

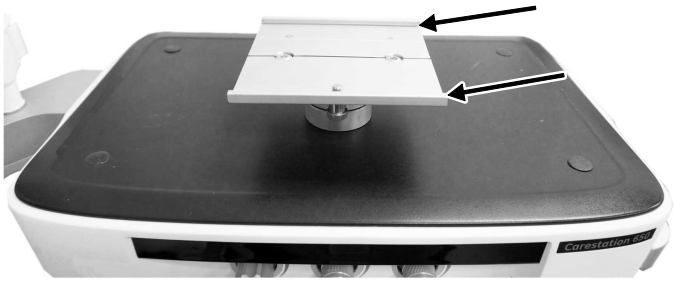
Figure 8-10 • Active AGSS adjustable knob

Attaching equipment to the top of the machine

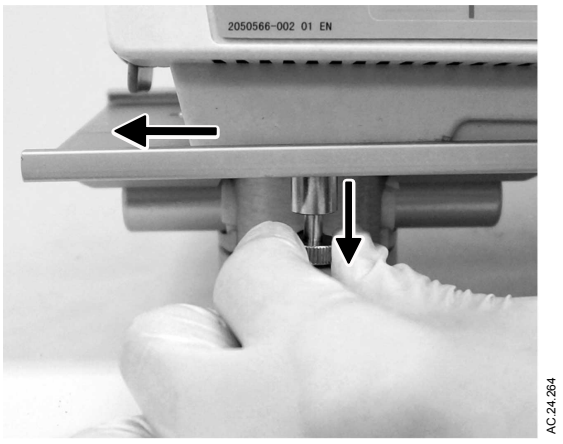
WARNING The top of the machine has a weight limit of 25kg (55 lb).

- Check the stability of the system in its final configuration. Make sure the weight is evenly distributed throughout the system.
- Make sure the plunger pin is locked into the device interface and the thumb screws are fully tightened. If not properly fastened, the device may fall.
- The top shelf patient monitor mount is only for use with General Electric channel mount adapter interface monitors.

1. Align the device interface with the grooves of the top shelf monitor mount.



2. Pull down the plunger pin and push the device interface horizontally along the grooves. Release the plunger and continue to slide the device until the plunger pin locks into the device interface.



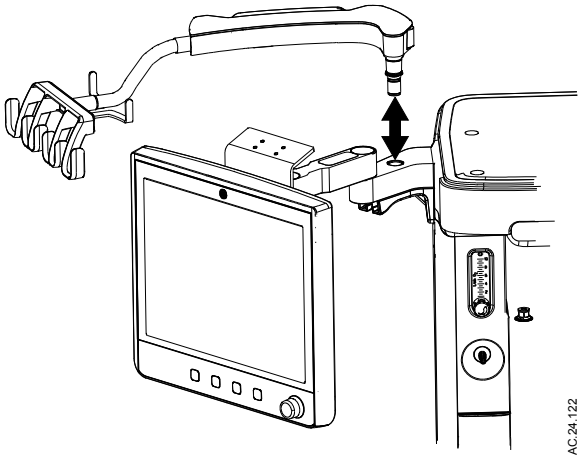
3. Tilt the device forward and rotate to ensure device interface is properly installed in both grooves.

4. Tighten all thumb screws on the rear of the mounting plate.

Cable management arm (optional)

If necessary, the cable management arm can be removed when moving the anesthesia system through narrow openings.

1. Remove any monitoring cables from the cable management arm.
2. Lift up on the cable management arm by grasping near the mounting post.

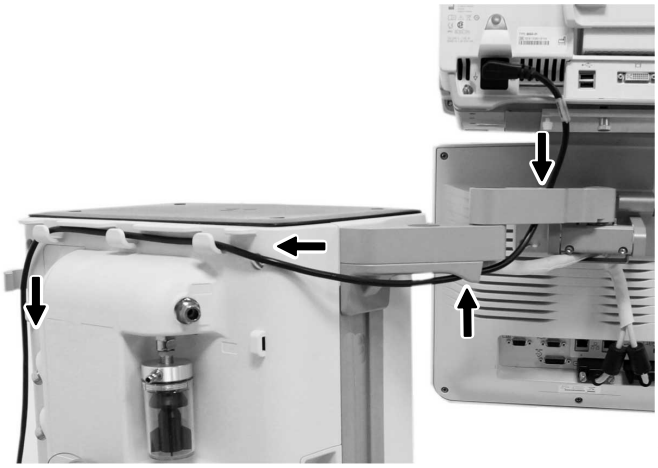


3. When replacing the cable management arm, make sure the o-ring and split bearing are in place on the mounting post and that the mounting post is fully seated into the mounting hole after insertion.

Cable routing groove

Use the cable routing groove to organize cables attached to the patient monitoring display.

1. Route the cable through the hole on the display arm.
2. Push the cable into the groove under the display arm.
3. Place the cable in the cable routing groove.
4. Use straps to bundle any excess cable length.

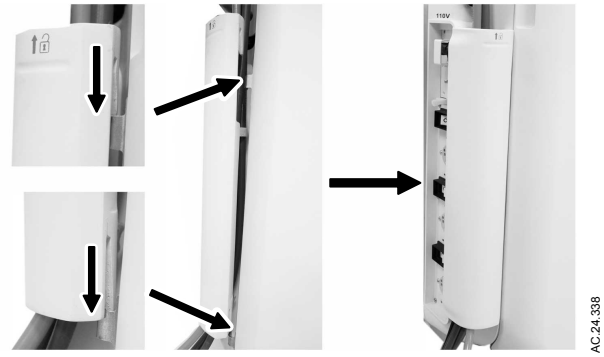


Cable cover

1. Lift up the cable cover at the rear of the machine.

2. Connect the gas pipelines to the pipeline inlets. Use straps to bundle the pipelines and electrical cable.

3. Insert the hook on the cover into the grooves, and push down the cover to lock it.



9 User maintenance

In this section

Maintenance safety

WARNING To help prevent fires:

- Do not use lubricants that contain oil or grease. They may burn or explode in high O2 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 General Electric Company. 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.

Please contact an authorized representative of the manufacturer for information concerning the decommissioning of equipment. Equipment and accessories must be disposed of in accordance with applicable regulatory and hospital requirements in effect at the time and place of disposal.

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

Note An additional level of disinfection is available. Contact an authorized service representative to replace bacterial filters and to remove the ventilator waste gas passage (gas to the system AGSS) for disinfection.

CAUTION Do not wipe the surfaces or clean the system using organic, halogenated, or petroleum-based solvents, anesthetic agents, glass cleaners, acetone, or other harsh cleaning agents. Doing so can damage the labels or the system. Refer to the “Cleaning and Sterilization” manual for additional cleaning information.

Minimum Frequency	Maintenance
Daily	• Clean the external surfaces. • Replace the absorbent in the canister (as needed).
Weekly	• Perform weekly O2 cell calibration.
Monthly	• Perform monthly O2 cell calibration. • Perform a flow and pressure calibration.
During cleaning and setup	• Inspect the parts for damage. Replace or repair as necessary.

Minimum Frequency	Maintenance
As necessary	• Install new cylinder gaskets on cylinder yokes. • Replace the absorbent in the canister. • Empty and clean the overflow trap on the optional suction regulator. • Replace the circuit O2 cell. (Under typical use the cell meets specifications for 2 years.) • Replace the autoclavable flow sensors. (Under typical use the sensor meets specifications for a minimum of 1 year.) • 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. • Inspect and clean the fan filters (display unit, rear side of the machine and airway module). • Empty D-fend Pro water trap on the airway module. • Drain the vaporizers and discard the agent as instructed in the vaporizer User's Reference Manual (This is not necessary for the Tec™ 6 series vaporizers.).

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.

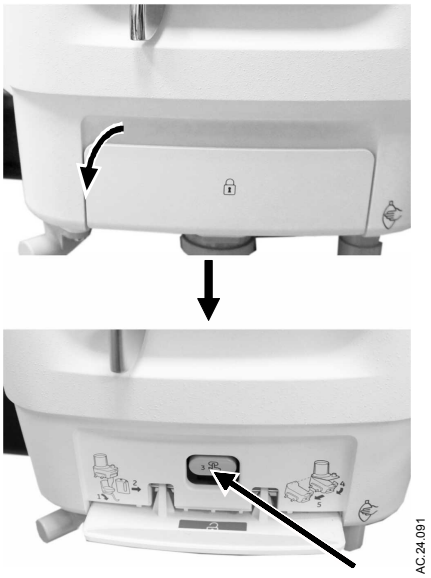
Circuit O2 cell replacement

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

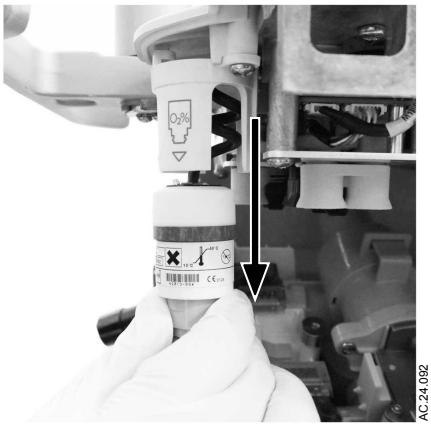
Note It may take a new O2 cell 90 minutes to stabilize. If the O2 cell calibration fails after a new O2 cell is installed, wait 90 minutes and repeat the calibration.

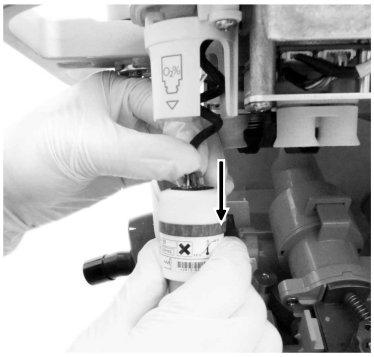
Note Make sure O2 cell plug is removed if adding an O2 cell to the system (see section "*Circuit O2 cell installation*").

1. Pull down the canister lifter handle to unlock the canister from the breathing system.
2. Lift the canister and remove it from the canister lifter base.
3. Open the breathing system door. Push the release button to unlock the breathing system.

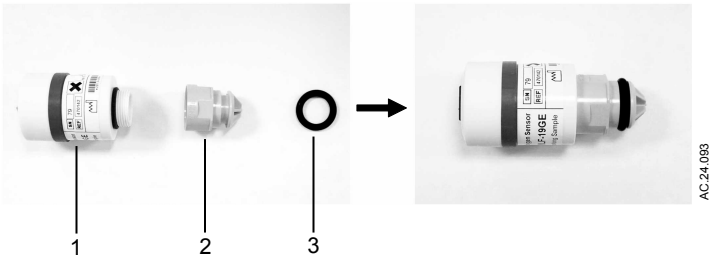


4. Lower the breathing system.
5. Pull out the O2 cell. Remove the cable connector from the O2 cell.





6. Replace the O2 cell. Install the O-ring onto the adapter and screw the adapter onto the new O2 cell.



1. O2 cell
2. Adapter
3. O-ring

7. Reconnect the cable connector to the O2 cell and reinstall into holder.
8. Rotate up and push the breathing system base to lock it into place. A click sound will be heard when attached properly.
9. Close the breathing system door.
10. Place the canister onto the canister lifter base.
11. Pull the canister lifter handle up to lock the canister into the breathing system.

12. Calibrate the new O2 cell according to the "*Circuit O2 cell*" procedure.

Flow control test

Note The Link-25 system is tested during the "*Gas controls*" part of the checkout procedure. This procedure is an alternate manual test for significant malfunction of the Link-25 system.

WARNING This procedure tests for significant malfunction of the Link-25 system. It does not confirm the proper calibration of the Link-25 system. Perform periodic calibrations using an accurate and properly calibrated O2 monitor as recommended in the "*Circuit O2 cell*" procedure in the "*User maintenance*" section.

1. Connect the pipeline supplies or slowly open the cylinder valves.
2. Turn all flow controls fully clockwise for minimal flow.
3. (ACGO option only.) Set the ACGO switch to circle circuit position.
4. (Aux O2+Air only.) Set the Aux O2+Air switch to circle circuit position.
5. Set the system to On.

Note Do not use the system if the Low battery or any ventilator failures occur.

WARNING Keep the Link-25 system engaged. Adjust only the test control for the following steps.

- Test N2O first and then O2.
- The O2 cell must be correctly calibrated.

6. Test the Link-25 system by increasing the N2O flow.
   - Slowly turn the N2O flow control counterclockwise.
   - Increase the N2O flow as specified in the following table and make sure the O2 flow is as specified.

N2O flow l/min	O2 flow greater than l/min
0.8	0.2
2	0.5
4	1.0
10	2.5

7. Test the Link-25 system with O2 flow decreasing.
   - Set the N2O flow to 9 l/min.

- Set the O2 flow to 3 l/min.
- Slowly turn the O2 flow control clockwise, until the N2O flow is decreased to the rates shown in the following table and make sure the O2 flow is as specified.

N2O flow l/min	O2 flow greater than l/min
8	2
4	1
0.8	0.2

8. Adjust the flow of all gases through the full range and make sure that the flow tubes adjust accordingly.
9. Disconnect all available O2 pipeline supplies or close the O2 cylinder valve.
10. Make sure that:

    - The low O2 supply alarm occurs.
    - The N2O and the O2 flows stop. The O2 flow should stop last.
    - The air flow continues (if equipped).
    - The gas supply alarms occur on the ventilator if the ventilator uses O2 as the drive gas.
    - Turn all the flow controls fully clockwise for minimum flow.
    - Reconnect all available O2 pipeline supplies.

Calibration menu

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

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

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

Flow and pressure calibration

1. Select ***Checkout*** or ***System Setup***.
2. Select ***Calibration*** on the ***Checkout*** or ***System Setup*** menu.
3. Select ***Flow and Pressure***.
4. Follow the instructions on the screen.

Circuit O2 cell

Weekly O2 cell calibration

Weekly O2 cell calibration will calibrate the O2 cell to 21% O2, through exposure to room air.

1. Select ***Checkout*** or ***System Setup***.
2. Select ***Calibration*** on the ***System Setup*** menu.
3. Select ***Weekly O2 Cell***.
4. Follow the instructions on the screen.

Monthly O2 cell calibration

Monthly O2 cell calibration will calibrate the O2 cell to 21% O2, through exposure to room air, and to 100% O2, through exposure to 100% O2 supply.

1. Make sure the 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. (Aux O2+Air option only.) Set the Aux O2+Air switch to Circle.
4. Set the Bag/Vent switch to Vent.
5. Select ***Monthly O2 Cell***.
6. 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

Water results from exhaled gas and the chemical reaction between CO2 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 CO2 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:

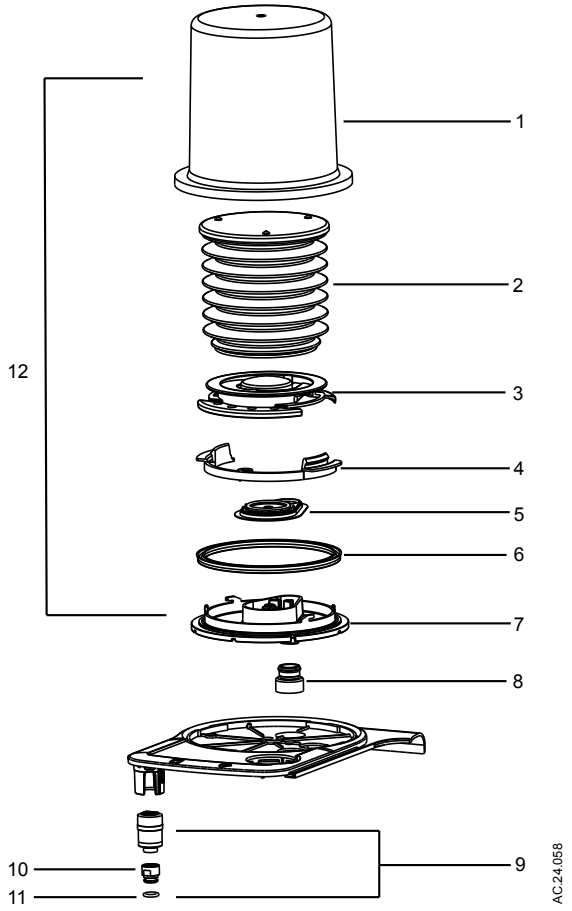
- Ensure the water condensing in the breathing circuit tubes is kept lower than the patient circuit ports and is not allowed to drain back into the flow sensors.
- Water condensation in the breathing circuit tubing might be lessened by using a Heat and Moisture Exchange (HME) filter at the airway connection.

10 Parts

In this section

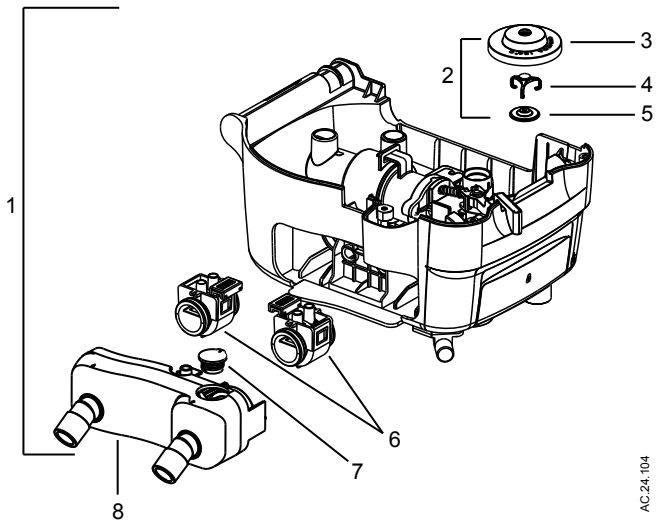
Note This section lists user replaceable parts only. For other components, refer to the Technical Reference manual.

Top breathing system assembly



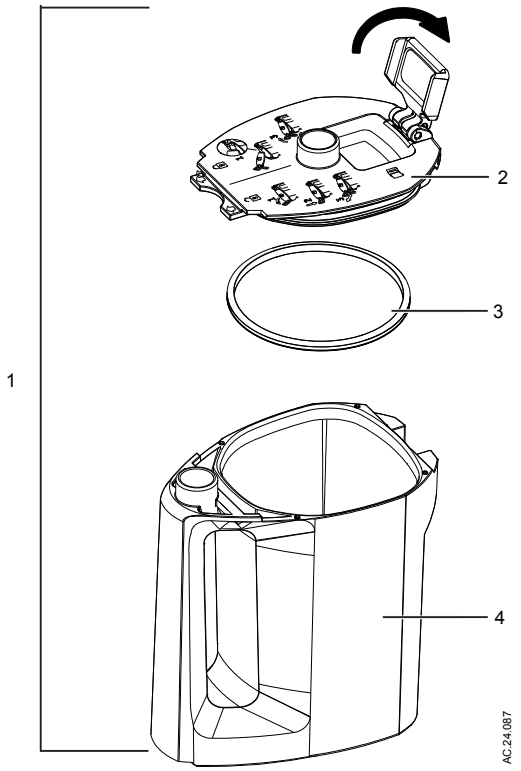
Item	Description	Stock number
1	Bellows housing	2102707-001-S
2	Bellows	1500-3378-000
3	Rim	1500-3351-000
4	Latch, rim	1500-3352-000
5	Pressure relief valve assembly	1500-3377-000
6	Seal, base	1500-3359-000
7	Manifold, bellows base	2070996-001-S
8	Ventilator port	2071005-001-S
9	O2 cell (includes O2 cell, adapter and o-ring), optional	2071018-001-S
10	Adapter, O2 cell	2071016-001-S
11	O-ring for adapter, O2 cell	2078627-001-S
12	Bellows assembly	2096295-001

Bottom breathing system assembly



Item	Description	Stock number
1	Breathing system assembly, bottom	M1803994-S
2	APL diaphragm assembly	2079638-001-S
3	Diaphragm, APL	1406-3331-000
4	Cage, APL	1406-3333-000
5	Poppet, APL valve	1406-3332-000
6	Flow sensor	2069358-001-S
7	O2 cell plug (required if optional O2 cell is not available)	2076290-001-S
8	Patient port assembly	2071007-001-S
-	Breathing system assembly, bottom, Australia and New Zealand	M1803993-S

Absorber canister



Item	Description	Stock number
1	Absorber canister assembly, reusable (does not include absorbent)	2071165-001-S
2	Cover assembly, with wiper seal	2078337-001-S
3	Wiper seal	2071173-001-S
4	Canister body, CO2 with handle	2071166-001-S
-	Absorber canister, disposable, white to violet, Medisorb (pack of six)	2079796-001
-	Absorber canister, disposable, white to violet, Medisorb EF (pack of six)	2079797-001
-	Absorber canister, disposable, white to violet, AMSORB PLUS (pack of eight)	2105489-006
-	Medisorb, bulk, white to violet (pack of two)	8570043
-	AMSORB PLUS, bulk Jerican (pack of two)	2105489-007

Test tools and system parts

Description	Stock number
Airway module calibration gas	755583-HEL
Airway module calibration gas (U.S. variant only)	755571-HEL
Airway module exhaust line, long	8004462
Airway module exhaust line, short	8004463
Calibration gas regulator	755534-HEL
Calibration gas regulator (U.S. variant only)	M1006864
D-fend Pro, dark steel blue	M1182629
Cylinder gasket (pin indexed cylinders only)	0210-5022-300
Cylinder wrench, small cylinders (DIN477 and high-pressure hose)	M1804666-S
Cylinder wrench for pin-indexed cylinder	5815676-001-S
DIN O2 plug (cylinder connection)	1202-7146-000
Negative low pressure leak test device	0309-1319-800
Ring, sealing gasket (for DIN 477 O2, Air, N2O Conn 12 and O2 high-pressure hose)	1009-3356-000
Ring, sealing gasket (for DIN 477 N2O Conn 11, and N2O high-pressure hose)	1202-3641-000
Test plug	M1210946
Vaporizer port o-rings, external (six pack)	1102-3016-000
Yoke plug	0206-3040-542
Long cable management arm	M1808033
Cleaning cassette	2081163-001
Cable On-Standby RS232	1009-5935-000
Cable On-Standby	M1187043
Suction bottle dovetail mounting bracket	M1809335
Suction mounting post	1006-8082-000
Worksurface overlay, with logo	M1807201-S
Caster guards, 12.7 cm/5 in grey, set of four	1001-3269-000
Dovetail 12 in x 12 in shelf with mounting arm	0216-6812-800
Clip for bag arm	2071081-001-S
Touch-up paint, Neutral Gray N9 (Light), 18 ml	1006-4200-000

Anesthesia system accessories

ISO 80601-2-13:2011 requires the manufacturer test the system using accessories that may impact essential performance and basic safety. This list of accessories demonstrates compliance to the standard.

Some items may not be available in every country. Some items may have country specific variants. Contact a sales representative for accessory availability and part numbers.

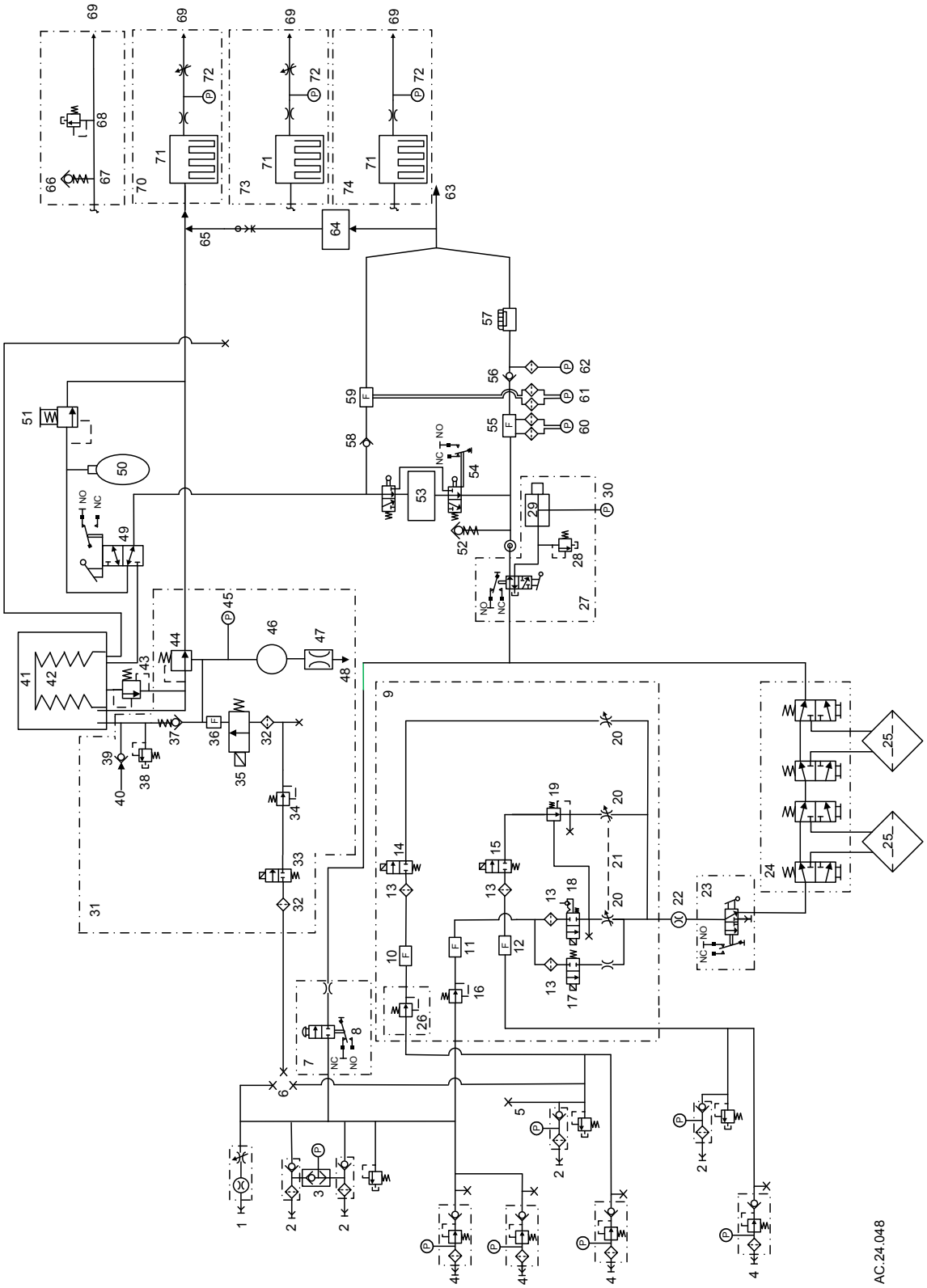
Description	Part Number
Reusable Absorber canister	2071165-001-S
Disposable Absorber canister	2079796-001 (Medisorb) 2079797-001 (Medisorb EF) 2105489-006 (AMSORB PLUS)
Absorbent (white to violet)	8570043 (Medisorb) 2105489-007 (AMSORB PLUS)
Flow sensor	2069358-001-S
O2 cell	(Optional) 2071018-001-S
CARESCAPE respiratory modules	(Optional) E-sCAiO E-sCAiOV
Airway Gas Option	(Optional) N-CAiO
Airway module exhaust line	8004463
Airway module water trap	D-Fend Pro M1182629
Gas sampling line, disposable, PVC/PE, 2 m/7 FT, 10/PKG	2097307-001
Gas sampling line, disposable, PVC/PE, 3 m/10 FT, 10/PKG	2097307-002
Gas sampling line, disposable, PVC/PE, 6 m/20 FT, 5/PKG	2097307-003
Reusable adult patient circuit kit	Circuits compliant with ISO 5367
Disposable adult patient circuit start-up kit	Circuits compliant with ISO 5367
Filters and Heat Moisture Exchange/Filtration(single use)	Filters and HMEs compliant with ISO 9360-1
Vaporizers	Tec 6 Plus (DES) Tec 7 (ISO/SEVO/HAL/EN) Tec 820/850 (ISO/SEVO)
Gas supply hoses (connects device to facility supplies)	Hoses compliant with ISO 5359

11 Specifications and theory of operation

In this section

Note All specifications are nominal and subject to change without notice.

System pneumatic circuits



1. Auxiliary O2, 0-10 l/min, optional
2. Pipeline: O2, Air, N2O
3. Shuttle valve
4. Cylinder: O2, Air, N2O
5. Venturi drive gas connection
6. Vent drive gas select
7. O2 flush
8. Microswitch
9. Gas control module
10. Air flow sensor
11. O2 flow sensor
12. N2O flow sensor
13. Filter
14. Air selector valve
15. N2O selector valve
16. O2 secondary regulator
17. O2 bypass valve
18. O2 latching valve
19. Balance regulator
20. Needle valve
21. Link-25
22. Total flowmeter, 0 - 10 l/min
23. Auxiliary O2+Air (optional)
24. Selectatec™ Manifold, two vaporizer option
25. Vaporizer
26. Air regulator, optional, 30 psi
27. ACGO, optional
28. Mechanical overpressure valve, 110 cmH2O
29. ACGO outlet port, optional
30. ACGO transducer, optional
31. Vent engine
32. Filter
33. Drive gas inlet valve
34. Regulator, 25 psi (15 LPM)
35. Inspiratory flow control valve
36. Drive gas flow sensor
37. Drive gas check valve, 3.5 cmH2O bias
38. Mechanical overpressure valve, 110 cmH2O
39. Free breathing check valve
40. Atmosphere
41. Bellows housing
42. Bellows
43. Pop-off valve
44. Exhalation, 2.0 cmH2O bias
45. Vent engine manifold pressure
46. 200 ml reservoir
47. Bleed resistor
48. Vent to ambient
49. Bag/Vent switch
50. Bag
51. APL valve, 0.5 - 70 cmH2O
52. Negative pressure relief valve
53. Absorber canister
54. CO2 bypass
55. Inspiratory flow sensor
56. Inspiratory check valve
57. O2 cell
58. Expiratory check valve
59. Expiratory flow sensor
60. Inspiratory flow transducer
61. Expiratory flow transducer
62. Paw transducer
63. Patient Y or patient connection
64. Gas monitor
65. Default factory connection
66. Passive AGSS
67. Relief valve, -0.3 cmH2O
68. Relief valve, 10 cmH2O
69. To disposal system
70. Active AGSS, High vacuum
71. Reservoir
72. To pressure sensor in ACB
73. Active AGSS, Low vacuum, BSI 30mm, SIS EVAC, DISS and 25 mm BARB
74. Active AGSS, Other low vacuum

Figure 11-1 • System pneumatic diagram

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.

O2 flow

Pipeline or regulated cylinder pressure supplies O2 directly to the O2 fresh gas control, O2 flush, and to the ventilator if O2 is configured as drive gas. If the system is configured with an auxiliary O2 flowmeter, O2 is also supplied to the auxiliary O2 port. If the pressure is too low, an alarm appears on the display.

The flush valve supplies high flows (between 25 and 75 l/min) of O2 to the fresh gas outlet when the O2 flush button is pushed. The flush switch uses pressure changes to monitor the position of the flush valve.

N2O flow

A balance regulator controls the flow of N2O to the flow control valve. Oxygen pressure at a control port adjusts the output of the regulator. This stops flow during an O2 supply failure and ensures that the hypoxic gas pressure decreases with the O2 supply pressure. Changes in O2 pressure do not affect Air.

A chain linkage (Link-25) on the N2O and O2 flow controls helps keep the O2 concentration above approximately 25% at the fresh gas outlet.

Air flow

Pipeline or regulated cylinder pressure supplies Air to the fresh gas control and to the ventilator if Air is configured as drive gas. A second regulator decreases the pressure for the fresh gas control. If the pressure is too low, an alarm appears on the display.

Pipeline or regulated cylinder pressure supplies Air directly to the fresh gas control if Air is not configured as drive gas.

Mixed gas

The mixed gas goes from the flowmeter outlet through the vaporizer that is on, to the fresh gas outlet, and into the breathing system.

Pneumatic specifications

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

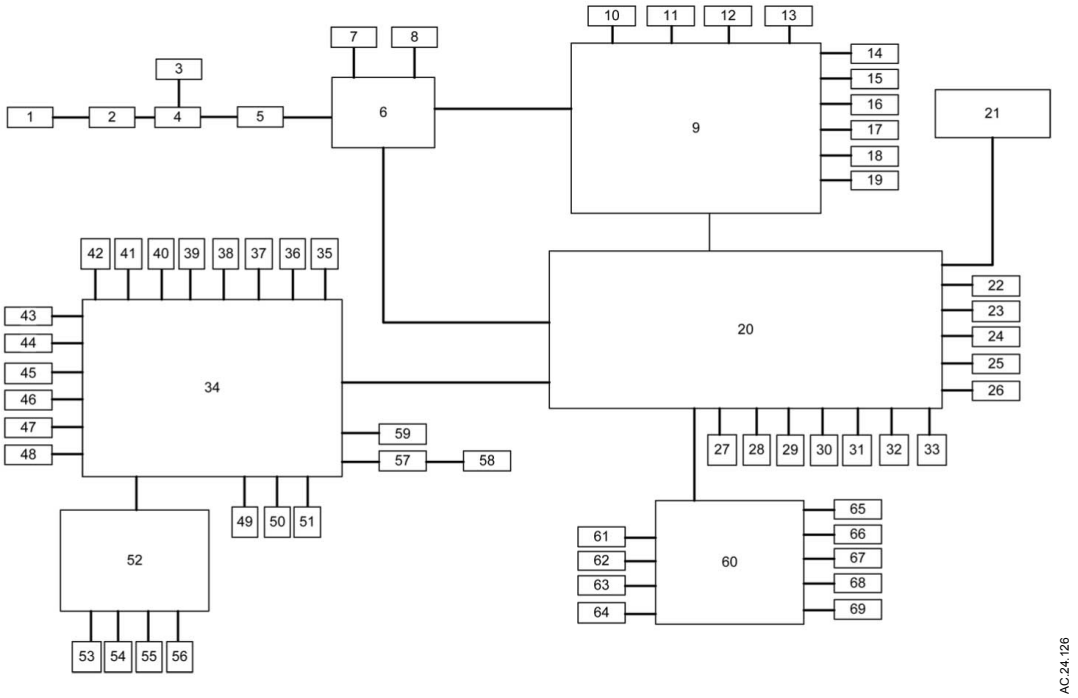
Gas supplies

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; AS 4059 (Australian); S90-116 (French Air Liquide); 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)
N2O shutoff	3.5 to 27.6 kPa (0.5 to 4 psi)

ACGO port relief

A relief valve on the ACGO outlet limits the fresh gas pressure at the ACGO port to 12.25 kPa (125 cmH2O) between 25 l/min and 75 l/min.

Electrical block diagram



1. Inlet/Fuses/Filter
2. Transient suppression board
3. AC outlets, optional
4. Isolation transformer, optional
5. AC/DC
6. Power management board
7. Fan
8. Battery
9. Carrier board and CPU
10. USB I/O port
11. USB I/O port
12. Network I/O port (Ethernet)
13. Network I/O port (Ethernet)
14. Patient monitoring On/Standby
15. Serial I/O port
16. Keypad
17. ComWheel
18. Speaker
19. LCD and touchscreen
20. Anesthesia computer board
21. Airway module
36. Auxiliary/ACGO light and switch, optional
37. Bottom task light board
38. Air control valve
39. N2O control valve
40. O2 bypass valve
41. O2 latching valve
42. O2 control flow sensor
43. N2O control flow sensor
44. Air control flow sensor
45. Air pipeline sensor board
46. N2O pipeline sensor board
47. Second O2 cylinder transducer
48. O2 pipeline sensor board
49. N2O cylinder transducer
50. O2 cylinder transducer
51. Air cylinder transducer
52. Center top vaporizer light board
53. O2 flow indicator light, optional
54. N2O flow indicator light, optional
55. Air flow indicator light, optional
56. Left top task light

22. O2 flush switch
23. Gas inlet valve
24. Flow valve
25. Drive gas flow sensor
26. AC mains LED
27. On/Standby switch
28. Standby switch backlight
29. Manifold transducer
30. Ambient pressure sensor
31. Buzzer
32. AGSS transducer
33. Debug serial port
34. Frame interface board
35. Digital LED flow board, optional
57. Right top task light
58. Dimming control rotary potentiometer
59. ACGO transducer, optional
60. Sensor interface board
61. O2 cell, optional
62. Breathing system flex board for expiratory flow sensor
63. Breathing system flex board for inspiratory flow sensor
64. Patient airway transducer
65. Expiratory transducer
66. Inspiratory transducer
67. Breathing system connected optical sensor
68. Canister release optical sensor
69. Bag to Vent optical sensor

Electrical system

The electrical system consists of two main computing units: the Display Unit and the Anesthesia Control Board (ACB). The Display Unit software runs on the WinCE 6.0 operating system with 1GB memory hard disk. The ACB runs on the Nucleus operating system.

Electrical power

Supply voltage	100-120, 220-240, or 120/220-240 Vac +/- 10% at 50 or 60 Hz			
Average power consumption	Less than 55 VA			
Note: Measured through the power cord when operated at the ventilation setting VCV, TV = 500 ml/min, RR = 12/min, I:E = 1:2 with nothing plugged into auxiliary outlets and an airway module inserted. Measurements were taken over a 15 minute time frame after system had been running for 10 minutes.				
Voltage	100-120 Vac	220-240 Vac	100-120 Vac	220-240 Vac
Outlet circuit breakers	(2) 2 A (1) 3 A	(2) 1 A (1) 2 A	None	None
Mains fused	10 A	8 A	2 A	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 conductor 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 support full system functionality and ventilation for 90 minutes when fully charged.
- 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.

WARNING Contact a trained service representative to disconnect the battery if the equipment is not likely to be used for an extended time.

Flow specifications

O2 Flush	
Flush flow	25 to 75 l/min

Fresh gas	
O2	0, 0.1 to 15.0 l/min
Air	0, 0.1 to 15.0 l/min
N2O	0, 0.1 to 10.0 l/min
Total flow tube	1 to 10 l/min
O2, Air, and N2O resolution	0.1 l/min
Measurement accuracy	O2, Air, and N2O: +/- 25 ml/min or +/- 6% of measured value (whichever is larger) at 20 - 25 °C with gas supply pressures at 480.5 kPa (69.7 psi)
	Total flow tube: +/- 5% full scale (accurate with 100% O2 into ambient pressure at 25 °C)

Note To reduce the risk of hypoxic gas mixtures at very low gas flows, the O2 fresh gas flow does not go to zero. When O2 flow is displayed as 0 lpm, there may a residual O2 flow of 25 to 125 ml per min.

Note Different breathing circuit pressures, barometric pressures, or temperatures change the total flow tube accuracy. During some conditions, these changes can be larger than specified tolerances.

Note In the unlikely case of power failure (mains and backup battery) while the machine is in use, oxygen will continue to flow. The total flow tube will indicate the total flow of oxygen to the vaporizer and patient circuit. Manual ventilation is available to complete the case.

Note When O2, Air or N2O flow is greater than 15 lpm, the display screen only shows >15 lpm.

Breathing system specifications

Compressible volume	Ventilator side	2006 ml
	Bag side	500 ml
	Reusable canister	1000 ml
	Disposable canister	1000 ml
Absorbent	Reusable canister	1370 ml
	Disposable canister	1400 ml
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).	
Breathing system leakage	Less than or equal to 150 ml/min total at 3 kPa (30 cmH2O) (both in absorber mode and with canister removed).	
Breathing system compliance	Volume of gas lost due to internal compliance of filled reusable absorber canister (bag mode only): 1.74 ml/0.098 kPa (1 cmH2O) 52.4 ml/3 kPa (30 cmH2O) Volume of gas lost due to internal compliance of filled disposable absorber canister (bag mode only): 1.81 ml/0.098 kPa (1 cmH2O) 54.56 ml/3 kPa (30 cmH2O)	
APL valve	Approximately 0 to 70 cmH2O	
Negative pressure relief	Minimum 100 ml/min at -14 cmH2O	
Mechanical overpressure valve	115 +/- 10 cmH2O	

Inspiratory breathing resistance in bag mode*		
l/min	**kPa**	**cmH2O**
Absorber canister installed		
5	0.030	0.30
30	0.172	1.72
60	0.456	4.56
Absorber canister removed		
5	0.034	0.34
30	0.159	1.59
60	0.401	4.01
*Values include patient circuit tubing and Y-piece 0.065 kPa (0.65 cmH2O) at 60 l/min. Patient circuit tubing and breathing system configurations affect resistance.		

Expiratory breathing resistance in bag mode*		
l/min	**kPa**	**cmH2O**
Absorber canister installed		
5	0.057	0.57
30	0.247	2.47
60	0.560	5.60
Absorber canister removed		
5	0.057	0.57
30	0.247	2.47
60	0.560	5.60
*Values include patient circuit tubing and Y-piece 0.065 kPa (0.65 cmH2O) at 60 l/min. Patient circuit tubing and breathing system configurations affect resistance.		

Pressure flow data (APL valve completely open)		
Flow (l/min)	**APL pressure cmH2O (dry)**	**APL pressure cmH2O (wet)**
Open	0.978	0.996
3	1.07	1.08
30	1.46	1.49
60	2.20	2.31
70	2.65	2.81

Gas scavening

Passive scavenging	
Positive pressure relief	10 cmH2O
Negative pressure relief	0.3 cmH2O
Outlet connector	30 mm male taper ISO

Active scavenging			
Disposal system type	**Outlet connector***	**Flow range**	**Disposal connection**
High flow, low vacuum	BSI 30 mm threaded	50 to 80 l/min	ISO 1 H

Active scavenging			
Disposal system type	**Outlet connector***	**Flow range**	**Disposal connection**
Low flow, low vacuum	25 mm hose barb	25 to 50 l/min	ISO 1 L
Low flow, low vacuum	12.7 mm hose barb	25 to 50 l/min	ISO 1 L
Low flow, high vacuum	DISS EVAC	25 to 30 l/min	305 mmHg (12 inHg) minimum vacuum
Low flow, high vacuum	SIS EVAC	25 to 30 l/min	305 mmHg (12 inHg) minimum vacuum
Low flow, low vacuum	12.7 mm hose barb	25 to 50 l/min	Japan Specific**
Low flow, low vacuum	30 mm ISO taper	25 to 50 l/min	ISO 1 L
*Other market-specific connectors may be available. **To be used with external flow indication and control (Japan standard).			

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.

	Carestation 620 A1	**Carestation 650 A1**	**Carestation 650c A1 Pendant**	**Carestation 650c A1 Wall Mount (without bracket)**
System height	135 cm	135 cm	101.4 cm	100.2 cm
System width	82.5 cm	82.5 cm	80 cm	74 cm
System depth	69.1 cm	75 cm	68.5 cm	62.8 cm
Nominally configured mass	145 kg	145 kg	85 kg	85 kg
Maximum configured mass	320 kg	320 kg	180 kg	160 kg
Tec™ 6 Plus mass	9 kg	9 kg	9 kg	9 kg
Tec 7 mass	7.5 kg	7.5 kg	7.5 kg	7.5 kg
Tec 820, Tec 850 mass	7.5 kg	7.5 kg	7.5 kg	7.5 kg
Top of machine weight limit	25 kg	25 kg	25 kg	25 kg
Machine drawer weight limit	9 kg / drawer	9 kg / drawer	9 kg / drawer	9 kg / drawer
Casters	12.5 cm	12.5 cm	8 cm	None
LCD and touchscreen display	304 x 225 mm (38 cm diagonal)			

Note Nominally configured mass for trolley machine includes trolley, breathing system, three pipeline inlets, two PIN index yokes, passive AGSS, AC outlet with transformer, drawers, two pivot display arm, top shelf patient monitoring mount, and central brake. Does not include drawer contents or externally mounted accessories.

Note Nominally configured mass for pendant and wall mount machine includes breathing system, three pipeline inlets, passive AGSS, drawers, two pivot display arm, and top shelf patient monitoring mount. Does not include drawer contents and externally mounted accessories.

Note Maximum configured mass includes nominal configuration, external cylinders and maximum loads on all mounting and storage locations.

System loading

Left dovetail loading

The dovetail on the left side of the machine is separated into upper and lower load ratings. Maximum allowable upper dovetail loading is 4.5 kg and 3.7 Nm. Maximum allowable lower dovetail loading is 6 kg and 10 Nm.

See "*System overview*" for the location of the left dovetail.

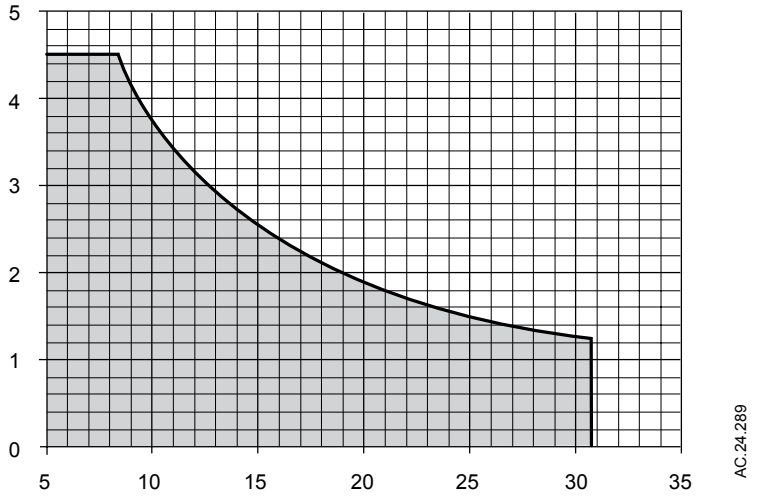


Figure 11-2 • The upper dovetail load in kg (vertical) versus load distance from the upper dovetail in cm (horizontal).

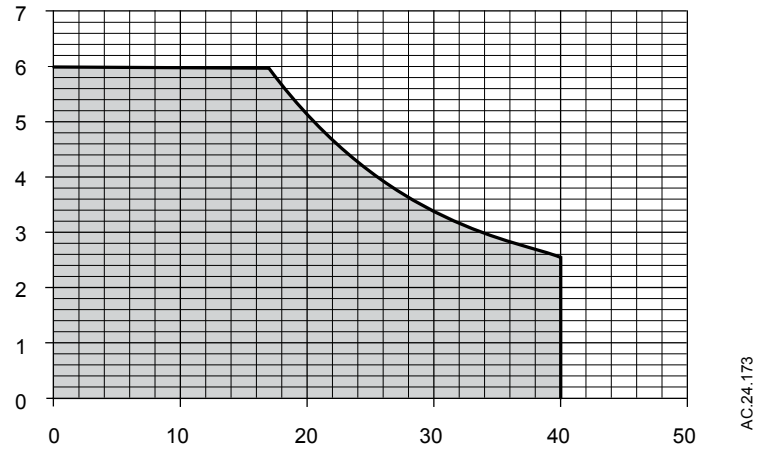


Figure 11-3 • The lower dovetail load in kg (vertical) versus load distance from the lower dovetail in cm (horizontal).

Right dovetail loading

The dovetail on the right side of the machine is separated into upper and lower load ratings. Maximum allowable upper dovetail loading is 12.1 kg and 54 Nm. Maximum allowable lower dovetail loading is 22.7 kg and 16.2 Nm.

See "*System overview*" for the location of the right dovetail.

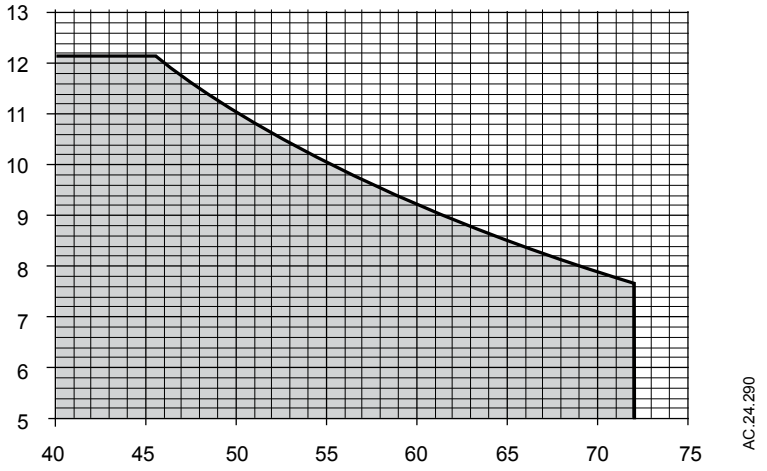


Figure 11-4 • The upper dovetail load in kg (vertical) versus load distance from the upper dovetail in cm (horizontal).

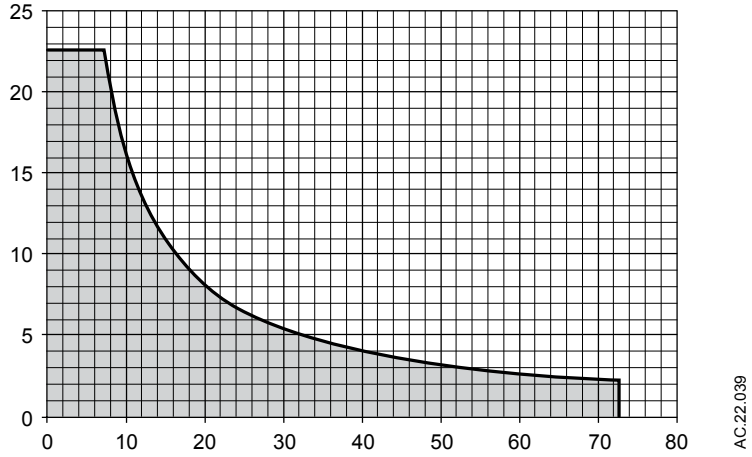


Figure 11-5 • The lower dovetail load in kg (vertical) versus load distance from the lower dovetail in cm (horizontal).

Top shelf rail loading

Maximum allowable top shelf rail loading is 4.5 kg and 3.7 Nm.

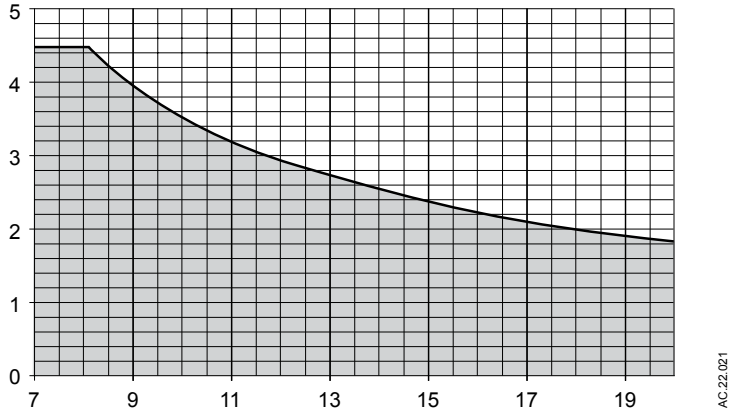


Figure 11-6 • Top shelf rail load in kg (vertical) versus load distance from the top shelf rail in cm (horizontal).

Environmental requirements

	Operation	Storage and Transport
Temperature	10 to 40°C Oxygen cell 10 to 40°C	-25 to 60°C Oxygen cell storage is -15 to 50°C, 10 to 95% RH LCD display storage is -20 to 60°C
Humidity	15 to 95% RH, non-condensing	15 to 95% RH, non-condensing
Altitude (with airway module)	500 to 800 mmHg (3565 to -440 meters)	425 to 800 mmHg (4880 to -440 meters)
Altitude (without airway module)	475 to 800 mmHg (4000 to -440 meters)	425 to 800 mmHg (4880 to -440 meters)

Note Do not operate the machine, or apply mains power, when the system is outside the specified operational temperature range and specified operational humidity. If the device is colder or warmer than the specified operating temperature, or if condensed water is visible or suspected, let the temperature stabilize before use.

Airway module specifications

Use only airway modules that have anesthetic agent monitoring and O2 monitoring on this system. The following modules can be used on this system:

- Airway Gas Option: N-CAiO
- CARESCAPE™ series: E-sCAiO and E-sCAiOV

Gas specifications for airway modules

Airway humidity (patient spirometry)	10% RH to 100% RH
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 CO2, O2, and N2O 5 minutes for operation of anesthetic agents 20 minutes for full specifications
Respiration rate	4 to 100 breaths/min
Diversion flow	120 +/- 20 ml/min
Airway pressure	-20 cmH2O to 100 cmH2O

Accuracy during stable conditions	
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	
CO2	+/- (0.2 vol% + 2% of reading)
O2	+/- (1 vol% + 2% of reading)
N2O	+/- (2 vol% + 2% of reading) between 0 and 85 vol% +/- (2 vol% + 8% of reading for N2O between 85 and 100 vol%

Accuracy during stable conditions	
Hal, Enf, Iso, Sev, Des	+/- (0.15 vol% + 5% of reading)

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

Note The effects caused by N2O to the measurement of CO2, O2, and anesthetic agents are automatically compensated for when using the airway module. The effects caused by anesthetic agents to the measurement of CO2 and N2O are automatically compensated for when using the airway module.

Suction regulators (optional)

Venturi Suction Regulator	
Performance Category	Pharyngeal Suction
Supply	Air 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.	

Continuous Suction Regulator	
Performance Category	Pharyngeal Suction
Supply	External vacuum
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 engine is located in the middle pan of the system, under the user work surface. A precision flow servo system 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 breathing system. 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. Numerics come from the flow sensor data if Data source is set to Vent. If Data source is set to patient, numerics come from the airway module and the patient icon shows in the numerics field. 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 Do not use the system if the ‘No exp flow sensor’ alarm is active. If the expiratory flow sensor is not installed correctly, the patient disconnect alarm will not operate correctly.

O2 monitoring theory of operation

O2 monitoring measures O2 concentration in the patient circuit. The O2 concentration measured from the O2 cell is shown on the anesthesia system display.

The O2 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.

O2 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.

Note Systems with both an airway module and an O2 cell will display the patient inspired O2 value obtained from the airway module.

ecoFLOW theory of operation

The ecoFLOW option provides a split screen view that shows the approximate minimum O2 flow to maintain a preset FiO2 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 O2 flow on the bottom and the remaining gases (N2 and N2O) on top. These gases determine the total fresh gas flow setting. Below the fresh gas flow tube is the measured total O2 flow to the patient and the calculated FiO2 flow value. The FiO2 flow value is based on the ***FiO2 Setting*** specified in Super User mode. This is the minimum O2 flow needed to deliver a preset inspired O2 concentration. The FiO2 flow value is specific to each patient and case. It is calculated using the fresh gas settings, the patient O2 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)

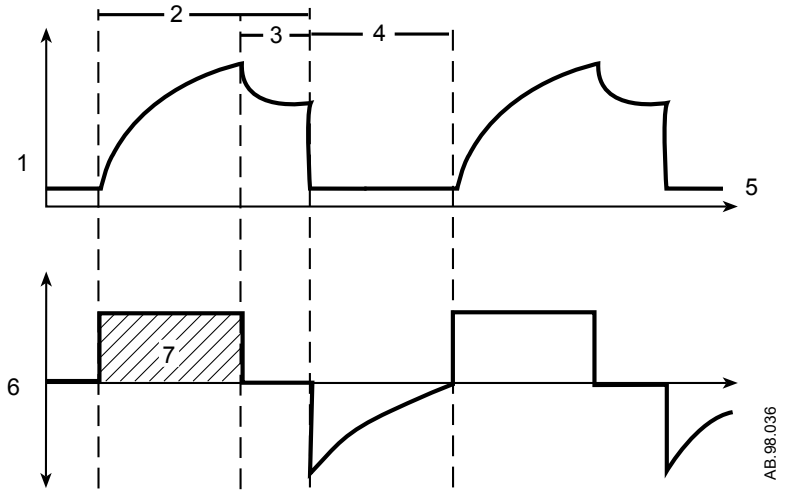
Volume control mode (VCV)

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. Texp
5. PEEP
6. Flow waveform
7. TV

Figure 11-7 • Volume control waveform

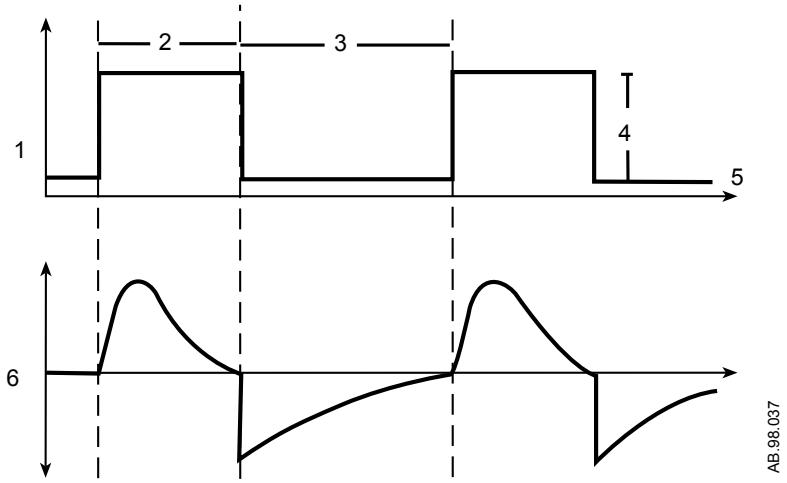
Pressure control mode (PCV)

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 (Pinsp).

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

PCV mode settings:

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



1. Paw waveform
2. Tinsp
3. Texp
4. Pinsp
5. PEEP
6. Flow waveform

Figure 11-8 • Pressure control waveform

PCV-VG mode

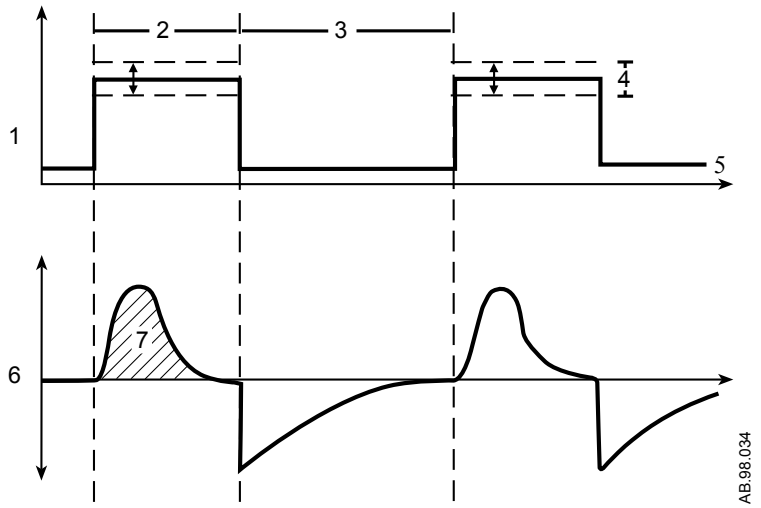
In PCV-VG, a tidal volume is set and the ventilator delivers that volume using a decelerating flow and a constant pressure. The ventilator will adjust the inspiratory pressure needed to deliver the set tidal volume breath-by-breath so that the lowest pressure is used. The pressure range that the ventilator will use is between the PEEP + 2 cmH2O level on the low end and 5 cmH2O below Pmax on the high end. The inspiratory pressure change between breaths is a maximum of +/- 3 cmH2O. If a high airway pressure alarm is active due to the current breath, the next breath's target will be 0.5 cmH2O 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
3. Texp
4. Variable pressure to deliver desired TV
5. PEEP
6. Flow waveform
7. TV

Figure 11-9 • 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.

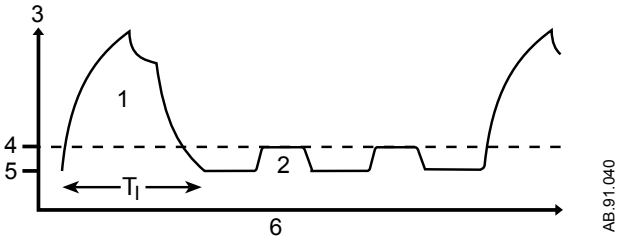
At the specified time interval, the ventilator will not wait for the next inspiratory effort from the patient. The sensitivity of this effort is adjusted using the flow trigger level. When the ventilator senses the beginning of inspiration within the Trigger window it synchronously delivers a volume 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 11-10 • SIMV VCV waveform

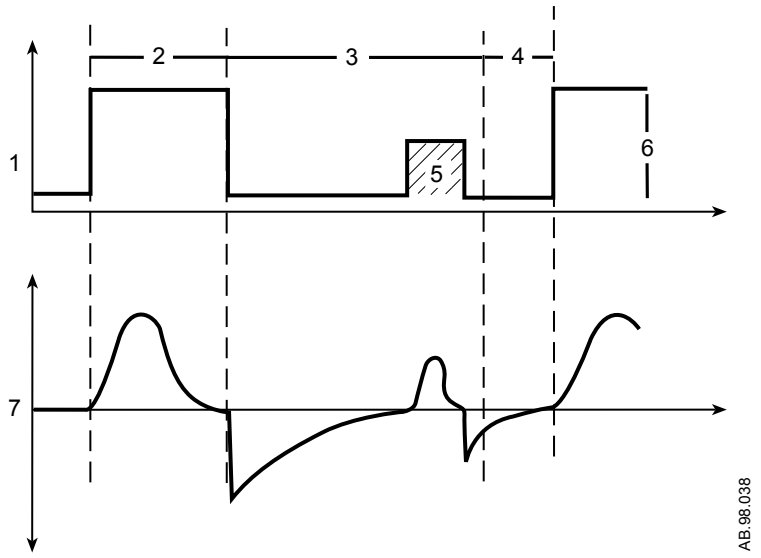
SIMV PCV mode

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 11-11 • 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 cmH2O

level on the low end and 5 cmH2O below Pmax on the high end. The inspiratory pressure change between breaths is a maximum of +/- 3 cmH2O. If a high airway pressure alarm is active due to the current breath, the next breath's target will be 0.5 cmH2O less than the current breath's pressure target.

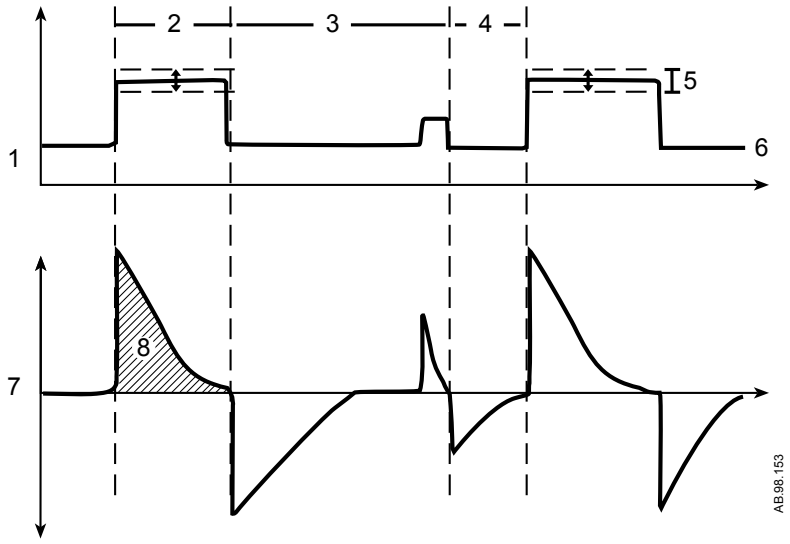
SIMV PCV-VG begins by delivering a volume controlled breath. The patient's compliance is determined from the volume controlled ventilation breath and the inspiratory pressure level is then established for the next PCV-VG breath. The remaining mandatory breaths will be pressure controlled with a guaranteed 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 cmH2O). 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 11-12 • 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.

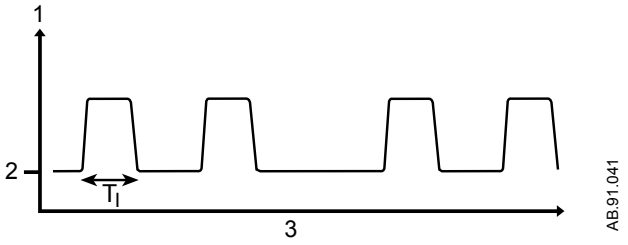
PSVPro uses an inspiration termination level that establishes when the ventilator will stop the pressure-supported breath and cycle to the expiratory phase. The inspiration termination level is user adjustable from 5 to 75%. This parameter sets the percent of peak inspiratory flow that the ventilator 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 longer the inspiratory time and conversely, the higher 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 11-13 • 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 s/minimum rate + ([60 s/minimum rate] - previous measured breath period).

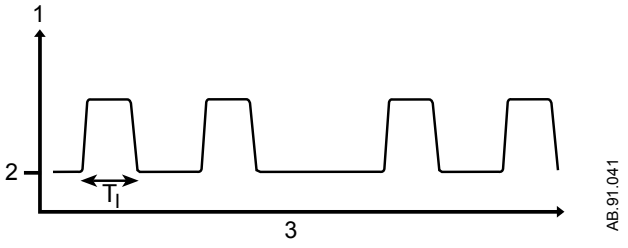
The inspiratory support pressure and the inspiratory pressure settings are linked at the start of each case. When the inspiratory support pressure setting is changed, the inspiratory pressure setting is automatically adjusted to match the inspiratory pressure setting. The link can be broken by changing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



1. Paw
2. PEEP
3. Time

Figure 11-14 • 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

Setting	Range	Mode							
		VCV	PCV	PCV-VG	SIMV VCV	SIMV PCV	SIMV PCV-VG	PSVPro	CPAP +PSV
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	*	*	*	80	80	80	80	*
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 though 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 O2
Peak gas flow	120 l/min at 240 kPa (35 psi), 0.75 seconds
Flow valve range	1 to 120 l/min at 240 kPa (35 psi)

Fresh gas compensation

Flow compensation range	0.1 to 15 l/min
Gas composition	O2, N2O, Air, anesthetic agents

Pressure

Patient airway pressure measurement range	-20 to 120 cmH2O, +/- 1 cmH2O resolution
High pressure alarm set range	12 to 100 cmH2O, 1 cm increment
Sustained pressure alarm range	6 to 40 cmH2O, 1 cm increment
Display range	-20 to 120 cmH2O

Volume

Tidal volume display range	less than 1 to 9999 ml, 1 ml resolution
Tidal volume setting range	20 to 1500 ml
Minute volume display range	less than 0.1 to 99.9 l/min, 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% O2
Display resolution	1% increments
Sensor type	Galvanic fuel cell
Measurement range	0 to 100% O2
Measurement accuracy	+/- 2.5% full scale plus 2.5% of reading
Cell response time	Less than 35 seconds Note: Response time of cell and adapters is measured using the text method described in ISO 7767 (1997).
Low O2 alarm range	18% to 99%
High O2 alarm setting	19 % to 100% or Off Note: Low O2 limit may not be set above high O2 limit. High O2 limit may not be set below the low O2 limit.
Expected cell life	Two years of shelf life (23°C room air) and additional two years of normal operation.
Output drift in 21% O2	Less than 1% over one month
Influence of humidity	- 0.03% of reading per %RH
Gas cross effect	Less than 0.3% vol% anesthetic agents and N2O

Ventilator accuracy data

The following accuracy data is based on patient conditions and settings described in ISO 80601-2-13. For the following to be true, the ventilator is operating with 100 percent oxygen in the breathing system and is connected to an integrated airway module.

The minimum detectable breath size is 5.0 ml.

Delivery accuracy	
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 cmH2O
PEEP delivery accuracy	+/- 1.5 cmH2O
Paw monitory accuracy	Greater of +/- 5% or +/- 2.4 cmH2O
Breath rate accuracy	+/- 1 bpm
I:E accuracy	+/- 0.5 I:E
Note: If the ventilator is operating at a temperature, pressure, and/or gas composition that differs from when it was calibrated, accuracy will decrease.	

If the system is used without an integrated airway module, the ventilator accuracy test requires the use of a properly calibrated O2 cell, 100 percent oxygen mixed gas, and one anesthetic agent in the listed concentration: 3.4% Des, 3.1% Enf, 2.9% Hal, 3.1% Iso, or 2.8% Sev.

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, such as inaccurate measure of patient parameters including agent, oxygen or pressure monitoring. Such items should be used no closer than 30 cm (12 in) to any part of the anesthesia system. Degradation of the performance of the system could result. 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.

Essential performance

The essential performance of the system consists of:

- Providing oxygen flow under all conditions except failure of the oxygen supply (pipeline or cylinder) to the system or the generation of an alarm.
- Delivery of a non-hypoxic gas mixture to the patient or the generation of an alarm.
- Non-delivery of excessive concentrations of anesthetic agent or the generation of an alarm.
- Airway pressure monitoring and associated alarms.

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 1009-5935-000.
Monitor On/STBY	Standard 9-pin D-subminiature male connector with shielded cable - 1.8 m maximum length. Part number M1187043.

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.

Phenomenon	Professional healthcare facility environment
Conducted and radiated RF emissions	CISPR 11
Harmonic emissions IEC 61000-3-2	Not applicable
Voltage fluctuations/flicker emissions IEC 61000-3-3	Not applicable

Note The emissions characteristics of this equipment make it suitable for use in industrial areas and hospitals (CISPR 11 class A). If it is used in a residential environment (for which CISPR 11 class B is normally required) this equipment might not offer adequate protection to radio-frequency communication services. The user might need to take mitigation measures, such as relocating or re-orienting the equipment.

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.

Phenomenon	Basic EMC standard or test method	Professional healthcare facility environment
Electrostatic discharge	IEC 61000-4-2	+/- 8 kV contact +/- 2 kV, +/- 4 kV, +/- 8 kV, +/- 15 kV air
Radiated RF EM fields	IEC 61000-4-3	3 V/m 80 MHz - 2.7 GHz 80 % AM at 2 Hz (test performed at 2 Hz is worst case as identified for risk management) (system compliant to 10 V/m immunity test level)
Proximity fields from RF wireless communications equipment	IEC 61000-4-3	See the RF wireless communication equipment table in "*Recommended separation distances*".
Rated power frequency magnetic fields	IEC 61000-4-8	30 A/m 50 Hz or 60 Hz

Phenomenon	Basic EMC standard or test method	Professional healthcare facility environment
Electrostatic fast transients / bursts	IEC 61000-4-4	+/- 2 kV 100 KHz repetition frequency
Surges Line-to-line	IEC 61000-4-5	+/- 0.5 kV, +/- 1 kV
Surges Line-to-ground	IEC 61000-4-5	+/- 0.5 kV, +/- 1 kV, +/- 2 kV
Conducted disturbances induced by RF fields	IEC 61000-4-6	3 V 0.15 MHz - 80 MHz 6 V in ISM bands between 0.15 MHz and 80 MHz 80 % AM at 2 Hz (test performed at 2 Hz is worst case as identified for risk management) (system compliant to 10 V immunity test level)
Voltage dips	IEC 61000-4-11	0 % UT: 0.5 cycle at 0°, 45°, 90°, 135°, 180°, 225°, 270°, and 315° 0 % UT: 1 cycle and 70 % Ut: 25/30 cycles sine phase at 0°
Voltage interruptions	IEC 61000-4-11	0 % UT: 250/300 cycle

Phenomenon	Basic EMC standard or test method	Professional healthcare facility environment
Note: UT is the AC mains voltage prior to application of the test level		

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.

RF wireless communication equipment						
Test frequency (MHz)	**Band (MHz)**	**Service**	**Modulation**	**Maximum power (W)**	**Distance (m)**	**Immunity test level (V/m)**
385	380-390	TETRA 400	Pulse modulation 18 Hz	1.8	0.3	27
450	430-470	GMRS 460, FRS 460	FM +/- 5 kHz deviation 1 kHz sine	2	0.3	28
710 745 780	704-787	LTE Band 13, 17	Pulse modulation 217 Hz	0.2	0.3	9
810 870 930	800-960	GSM 800/900, TETRA 800, iDEN 820, CDMA 850, LTE Band 5	Pulse modulation 18 Hz	2	0.3	28
1720 1845 1970	1700-1990	GSM 1800: CDMA 1900; GSM 1900; DECT; LTE Band 1, 3, 4, 25: UMTS	Pulse modulation 217 Hz	2	0.3	28
2450	2400-2570	Bluetooth, WLAN, 802.11 b/g/n, RFID 2450 LTE Band 7	Pulse modulation 217 Hz	2	0.3	28
5240 5500 5785	5100-5800	WLAN 802.11 a/n	Pulse modulation 217 Hz	0.2	0.3	9

12 Super user mode

In this section

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.
- Super user and Service password use is limited to authorized personnel who are trained and qualified. Do not share the passwords with unauthorized personnel.
- To safeguard patient information, do not leave the system unattended while in Super User or Service mode. Exit Super User or Service mode when finished making changes.

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.

Note The manufacturer strongly recommends this equipment only be used by authorized users in an access-controlled environment.

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***, ***P-ACGO***, 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***, ***Vent and Airway Gas Module TV Basis***, ***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

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.

Default settings for Page view setup				
	Page 1	**Page 2**	**Page 3**	**Page 4**
Top	Paw	Paw	Paw	Off
Middle	Flow	Flow	Off	Flow
Bottom	CO2	CO2	CO2	CO2
Left	Loops/Off	Off	Loops/Off	Off
Middle Left	Resp	Resp	Flow	Off
Middle Right	Agent	Agent	Agent	Off
Right	Gases	Gases	Gases	Gases
Split Screen	Paw	Spiro/None	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	
Data Source	Vent		Vent		Vent		Vent	
Auto MV Limits	Off		Off		Off		Off	
Alarm Volume	3		3		1		3	
MV/TV Alarms	On		On		On		On	
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	
Minimum RR	12		16		12		12	

Page 2 Default settings for default case types								
Settings	ADULT		PEDIATRIC		LOCAL		CUSTOM 1	
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	80		80		80		80	
Flow Trigger	2.0		2.0		2.0		2.0	
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	
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	

Page 5 Default settings for default case types								
Settings	ADULT		PEDIATRIC		LOCAL		CUSTOM 1	
Right Digit Field	Gases		Gases		Gases		Gases	

Page 6 Default settings for default case types								
Settings	ADULT		PEDIATRIC		LOCAL		CUSTOM 1	
MV Low	2.0		2.0		Off		2.0	
MV High	10.0		10.0		Off		10.0	
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	3.0		3.0		3.0		3.0	
EtCO2 High	8.0		8.0		8.0		8.0	
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								
Settings	ADULT		PEDIATRIC		LOCAL		CUSTOM 1	
EtIso Low	Off		Off		Off		Off	
EtIso High	Off		Off		Off		Off	
FiIso Low	Off		Off		Off		Off	
FiIso High	5.0		5.0		5.0		5.0	
EtSev Low	Off		Off		Off		Off	
EtSev High	Off		Off		Off		Off	
FiSev Low	Off		Off		Off		Off	
FiSev High	8.0		8.0		8.0		8.0	
EtDes Low	Off		Off		Off		Off	
EtDes High	Off		Off		Off		Off	
FiDes Low	Off		Off		Off		Off	
FiDes High	15.0		15.0		15.0		15.0	
EtEnf Low	Off		Off		Off		Off	
EtEnf High	Off		Off		Off		Off	
FiEnf Low	Off		Off		Off		Off	

Page 7 Default settings for default case types								
Settings	ADULT		PEDIATRIC		LOCAL		CUSTOM 1	
FiEnf High	5.0		5.0		5.0		5.0	

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	5.0		5.0		5.0		5.0	

Copy logs

Use the ***Copy Logs*** menu to save logs to a USB memory device. The system can copy error logs, event logs, alarm logs, and key press logs.

Using copy logs

1. From Super User mode, select ***Copy Logs***.
2. Follow the instructions on the screen.
3. Select ***Close*** to exit the menu.

Note Do not remove the USB memory device until the status shows ***OK*** on the screen.

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.

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Warranty

This Product is sold by the manufacturer under the warranties set forth in the following paragraphs. Such warranties are extended only with respect to the purchase of this Product directly from the manufacturer or the manufacturer's Authorized Dealers as new merchandise and are extended to the Buyer thereof, other than for the purpose of resale.

For a period of twelve (12) months from the date of the original delivery to the Buyer or Buyer's order, but in no event for a period of more than two years from the date of original delivery by the manufacturer to a manufacturer Authorized Dealer, this Product, other than its expendable parts, is warranted against functional defects in materials and workmanship and to conform to the description of the Product contained in this User's Reference manual and accompanying labels and/or inserts, provided that the same is properly operated under the conditions of normal use, that regular periodic maintenance and service is performed and that replacements and repairs are made in accordance with the instructions provided. This same warranty is made for a period of thirty (30) days with respect to expendable parts. The foregoing warranties shall not apply if the Product has been repaired other than by the manufacturer, or altered by anyone other than the manufacturer, or if the Product has been subject to abuse, misuse, negligence, or accident.

The manufacturer's sole and exclusive obligation and Buyer's sole and exclusive remedy under the above warranties is limited to repairing or replacing, free of charge, at the manufacturer's option, a Product, which is telephonically reported to the nearest manufacturer Customer Service Center and which, if so advised by the manufacturer, is thereafter returned with a statement of the observed deficiency, not later than seven (7) days after the expiration date of the applicable warranty, to the manufacturer Customer Service and Distribution Center during normal business hours, transportation charges prepaid, and which, upon the manufacturer's examination, is found not to conform with above warranties. The manufacturer shall not be otherwise liable for any damages including but not limited to incidental damages, consequential damages, or special damages.

There are no express or implied warranties which extend beyond the warranties hereinabove set forth. The manufacturer makes no warranty of merchantability or fitness for a particular purpose with respect to the product or parts thereof.

Carestation™ 620/650/650c (A1)
User's Reference Manual
English
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