Newport Medical Instruments, Inc.

Newport HT70 Ventilator

Operating Manual for Plus Model

OPRHT70-2 Rev. F

06/13

Newport

M E D I C A L

CE 0344

HT70 Operating Manual OPRHT70-2

Revisions	Date	Description
Rev A	October 2011	New release
Rev B	November 2011	Miscellaneous type corrections, text change on page 3-3, 7-1, 7-3 regarding Power Pac.
Rev C	May 2012	Add Operating Manual Reivison. Notice regarding the following change: Pulse Oximeter accessory and related functions no longer available.
Rev D	July 2012	Software update ver. P05.12.10 and above, Remove references to optional Pulse Oximeter (not available), Change Slope/Rise setting was: 1 is fastest, is: 1 is slowest.
Rev E	November 2012	Update to correct image reversal in F-1 and F-2, callout labels on various drawings converted to numbers and referenced in text or added to table. Remove reference to Aequitron nurse call systems. Replace warranty details with who to contact information.
Rev F	June 2013	Add information about the Aequitron Remote Alarm System.

Contact Information

Thank you for using the Newport HT70 family of ventilators. With the HT70 you not only get a great ventilator, you get the support of Newport Medical. Since 1981 we have maintained a focused commitment to the design, production and sale of ventilators. We have dedicated our efforts to providing ventilators that are easy to use, clinically versatile, and cost effective.

We know that ventilatory support is critical in emergency and critical care situations. But for many of our customers, it is also a part of their daily lifestyle. The HT70 Ventilators offer home care users the expanded mobility that allows them to experience more freedom in their lives than many have ever known before.

We have designed this manual to be comprehensive and still very user friendly. For the best performance from your HT70 Ventilator, please take the time to review this manual completely.

See our contact information on the following page for complete details.

Contact Information

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FOLDOUT DRAWINGS
Use the following drawings as reference while reviewing
the manual sections

Unfold to view drawing on reverse side

Figure F-1   English Version- Front Panel Overview

1. **Breath Delivery Indicator LED.** Flashes green with every breath delivered by the ventilator.

2. **External Power LED.** Lights green whenever external power is connected. This also indicates that the Internal Dual Battery System is being charged.

3. **Manual Inflation button.** Press and hold this button to deliver flow to the patient. The ventilator will deliver flow at the current settings while the button is pressed. Flow delivery is limited to a maximum of 3 seconds or until the High Pressure alarm setting is reached.

4. **Brightness button.** Press this button repeatedly to scroll to one of four screen brightness levels.

5. **Device Alert LED.** Lights red when there is a device alarm. Take the ventilator out of service and use an alternate means of ventilation until resolved.

6. **Patient Gas Output.** Attach patient breathing circuit tubing here.

7. **Proximal Pressure Line connector.** Attach proximal pressure tubing here.

8. **Exhalation Valve Drive Tubing connector.** Attach exhalation valve drive tubing here.

9. **Alarm Violation LEDs.** LEDs in the handle light to indicate alarm conditions.

10. **Alarm Silence/Reset button.** Press this button to silence the audible alarm for 1 minute. Once an alarm condition has been corrected, press this button to clear/reset the alarm message and latched indicators.

11. **Alarm Silence LED.** Remains lit during the one minute alarm silence period.

12. **Cancel button.** Press this button if you want to cancel changes that have not already been accepted.

13. **Accept button.** Press this button to accept/confirm all changes made to control settings.

14. **▲ Up / ▼ Down Arrow buttons.** Press to change a highlighted parameter up/down by one unit. Hold down continuously and the parameter will change at an increasingly quicker pace.

15. **Touch Screen User Interface.** Touch screen to access alarms and parameter settings.

16. **Flow Sensor connector.** Attach on-airway flow sensor here.

Unfold to view drawing on reverse side

## Figure F-2   Symbols Version- Front Panel Overview

1. **Breath Delivery Indicator LED.** Flashes green with every breath delivered by the ventilator.

2. **External Power LED.** Lights green whenever external power is connected. This also indicates that the Internal Dual Battery System is being charged.

3. **Manual Inflation button.** Press and hold this button to deliver flow to the patient. The ventilator will deliver flow at the current settings while the button is pressed. Flow delivery is limited to a maximum of 3 seconds or until the High Pressure alarm setting is reached.

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15. **Touch Screen User Interface.** Touch screen to access alarms and parameter settings.

16. **Flow Sensor connector.** Attach on-airway flow sensor here.

Unfold to view drawing on reverse side

Figure F-3   HT70 Plus Model Touch Screen (Hospital Domain)
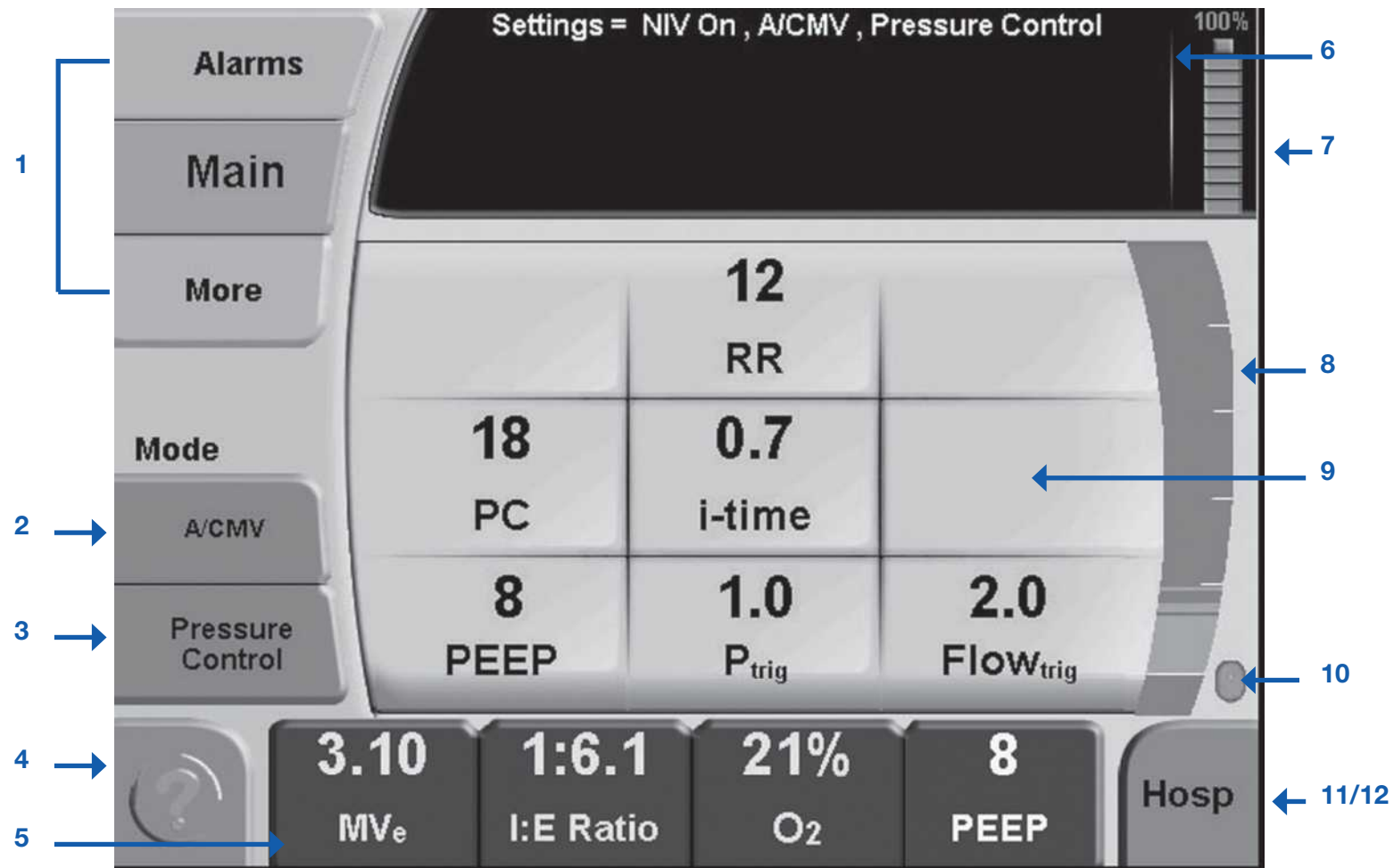
1. **Screen Selections buttons.** Touching any one of these buttons will take you to the new screen. The More screen includes links to Event, Trends, Wave and Utility screens.

2. **Mode selector.** Touching this button scrolls through the mode choices. The mode will not change until you press the Accept button.

3. **Breath Type selector.** Touching this button toggles the breath type choice. The breath type will not change until you press the Accept button.

4. **Help button.** Touching this button enables a tutorial for each feature on the screen. Touch the help button then touch any button for an explanation of that feature.

5. **Monitored Data buttons.** Touching any one of these four buttons opens a screen with a view of monitored parameter choices to display in that button.

6. **Message display.** This area shows all informational and alarm messages and current NIV selection, mode, and breath type selection. During an alarm violation this area will light red for High Priority, amber for Medium Priority and yellow for Low Priority alarms and display the alarm message.

7. **Battery Charge Level indicator.** Shows the charge level of the "Power Pac" battery pack (blue icon) during external power or Power Pac use or the charge level of the Backup Battery (red icon) during Backup Battery use.

8. **Pressure Bar.** Indicates dynamic pressure in the patient circuit in green, the High and Low Pressure Alarm settings in red and the peak pressure of the last breath in green.

9. **Parameter Setting buttons.** Touching any one of these buttons will activate the parameter to allow adjustments.

10. **Patient Effort indicator.** Flashes green to show a spontaneous patient effort.

11. **Domain button.** The HT70 can be set up in one of three Domains: Basic, Transport and Hospital. Touch to scroll through the Domain choices. Press Accept to confirm choice.

12. **AutoLock/Unlock button.** This button is only visible if Auto Lock is enabled and the panel is locked. Touch and hold for 3 seconds to unlock touch screen buttons.

NOTE: While operating on battery power with Power Save enabled and all alarms cleared, the touch screen will go to sleep after 2 minutes. Just touch the screen to bring it back into view.

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Introduction

Section 1:
Introduction

Brief Device Description

The Newport HT70 family of ventilators are state of the art ventilators that combine ruggedness, ease of use and clinical proficiency with exceptional mobility to provide ventilatory support for infant, pediatric and adult patients in emergency care, transport, critical care, subacute care and home care applications. They are also ideal for emergency preparedness applications.

The compact, lightweight HT70 ventilator is built for hard work with a durable polymer exterior and robust overall design that stands up to harsh environments.

The HT70 Ventilator defines ease of use with all essential controls at your fingertips using a simple membrane button and touch screen combination. There are no complicated menus or difficult sequences to follow in order to make necessary adjustments for common operations.

A three-tiered management domain system makes it very easy for critical caregivers to manage all controls while providing quick access to the more essential elements in transport situations and significantly enhanced safety and simplicity in the homecare environment.

Sophisticated Clinical Capabilities

In addition to its durability and ease of use, the HT70 ventilator offers the complete array of clinical capabilities needed for managing critical patients.

The twin micro-piston pump's ability to deliver a variable flow enables the HT70 to provide a full range of operating modes and breath types with servo-controlled, leak-compensated PEEP. Leak compensation helps to improve triggering and avoid auto-triggering when a leak is present. The HT70 may be used with an endotracheal tube, tracheal tube, face mask, nasal mask or prongs, or mouthpiece.

There are 3 models for the HT70 series of ventilators:

HT70S   HT70 Basic for use when Pressure Support is not needed.

HT70   HT70 Classic, adds Pressure Support and related parameters and Trends screen

HT70PM   HT70 Plus, adds on-airway flow sensor option with graphics, flow trigger and exhaled volumes

The HT70 Basic and Classic models provide monitoring of inspiratory tidal volume (every breath), inspiratory minute volume, total respiratory rate, peak pressure, mean pressure and baseline (PEEP) pressure. Real-time patient circuit pressure is displayed at all times

on the airway pressure gauge on the face panel. A comprehensive alarm system is built-in to alert the user to violations of user-set or ventilator safety limits. An optional built-in oxygen sensor allows monitoring of O_2 with high and low O_2 alarms.

The HT70 Plus model adds an on-airway flow sensor with onscreen graphics, exhaled tidal and minute volume monitoring/alarms, and flow trigger. This manual describes the HT70 Plus model and will denote features that are not available on the HT70 and HT70S models.

Gas delivery to the patient may be enriched with oxygen (0.21-1.00) using either the optional Air Oxygen Entrainment (50 psi) Mixer or optional Low Flow Oxygen Reservoir.

Exceptional Mobility

The ventilator's unique design provides maximum mobility and safety for short or long distance transport of critically ill patients and also for patients who are going about their normal activities of daily life. This exceptional mobility is derived from two sources: Newport's patented, power conserving dual-micro-piston technology which eliminates the need for an external compressed gas source, and the Internal Dual Battery System which allows virtually continuous use from battery power through hot-swappable technology.

The HT70's micro-pistons use a fraction of the power that is consumed by turbines and blowers. This enables longer battery use time.   Our patented system also uses considerably less supplemental oxygen than turbine or blower systems, again improving mobility for transport or homecare use. The superior technology of our micro-piston system over the turbine and blower systems allow the HT70 to ventilate safely over a wide range of environmental conditions and altitudes.

The HT70's twin micro-piston internal pump is made of mechanically moving components. As with any other gas delivery system made of moving components, it may emit a minor level of noise during operation. This is not a malfunction and does not affect the performance of the ventilator.

The Internal Dual Battery System consists of two independent but coordinated lithium ion batteries, the Power Pac battery, located on the back of the ventilator and the Backup Battery inside the ventilator. The Internal Dual Battery System can provide up to 10 hours of operation at standard settings when new and fully charged. This system assures continued support during transport, daily activities or power outages.

The detachable Power Pac is 'hot-swappable'. That is, if more battery time is needed, a depleted Power Pac can easily be removed from the back of the HT70 and replaced with a recharged Power Pac without interrupting ventilation. No tools are needed. The secondary Backup Battery maintains operation without interruption when the Power Pac is swapped out and also provides a minimum of 30 minutes of full operation when all other power sources are depleted. The Power Pac weighs two pounds and is charged anytime the ventilator is connected to an external power source (AC or DC). It can also be charged separately.

The HT70 may be operated from a variety of AC (100-240 VAC @ 50 / 60 Hz) or DC (12-24 VDC) external power sources or from the Internal Dual Battery System. The optional DC Auto Lighter Power Adapter accessory enables connection to an automobile-type DC outlet. Any time the ventilator is connected to external power, both batteries in the Internal Dual Battery System are charging, whether or not the ventilator is in use.

Travel Certified

The HT70 has been tested for and meets requirements for use in helicopter and fixed wing transport and for use on commercial airlines. Before traveling, be sure to speak with your airline representative about their particular concerns and clear all of your equipment with them well before your departure. The labeling that the FAA requires to be on the ventilator is located on the bottom of the HT70.

Intended Use

Newport HT70 family of ventilators is intended to provide continuous or intermittent positive pressure mechanical ventilatory support for the care of individuals who require mechanical ventilation through invasive or noninvasive interfaces.

Specifically, the Newport HT70 family of ventilators is applicable for infant, pediatric and adult patients greater than or equal to 5 kg (11 lbs) in hospital, sub-acute, emergency department, and home care environments as well as for transport and emergency response applications.

NOTE: Federal law (US) restricts sale by or on the order of a physician.

Ventilator Configurations

Newport Medical offers five configurations for the 3 models in the HT70 family of ventilators. See Table 1. In addition, the front control panel labeling is available in various languages and regional power cords, i.e. North American, European, etc., can be specified. See your Newport Medical Representative for details.

Table 1

Part Number	Description	Distinguishing Features
HT70PM	HT70 Plus	Full featured with Flow sensor, graphics and built-in oxygen monitor with alarms.
HT70	HT70, w/o Oxygen Sensor	Classic features No built-in oxygen monitor
HT70M	HT70, with Oxygen Sensor	Classic features Includes built-in oxygen monitor with alarms
HT70S	HT70, Basic w/o Oxygen Sensor	Classic features except: • No Pressure Support or Pressure Support parameters • No Trends • No built-in oxygen monitor
HT70SM	HT70, Basic with Oxygen Sensor	Classic features except: • No Pressure Support or Pressure Support parameters • No Trends Includes built-in oxygen monitor with alarms

Warnings, Cautions, and Notes

Please review all WARNINGS and Cautions outlined in this manual before operating the ventilator.

Use of the product requires full understanding and strict observation of all sections of these instructions. The equipment is only to be used for the purposes specified under Intended Use and in conjunction with appropriate patient observation and monitoring. Observe all WARNINGS and Cautions that appear in this manual and on equipment labels.

WARNING A warning describes a condition that can cause injury.

Caution: A caution describes a condition that can cause damage to equipment.

NOTE: A note emphasizes information that is important or convenient.

General Notes

The Newport HT70 has been designed to accommodate connectivity with nurse call/monitoring systems. Because it is not possible to anticipate every configuration of hardware and software associated with nurse call/monitoring system, it is the user's responsibility to confirm proper functionality of the system when used in conjunction with the HT70. Verification of alarms, alerts and patient data transmissions is required. If the system performance is not as expected, contact Newport Medical Technical Support for assistance troubleshooting the set-up. Do not use the HT70 ventilator with a nurse call/monitoring system until the functionality of the ventilator/system combination has been confirmed.

General Cautions

Do not place liquids on or near the ventilator.

Damage can occur if the HT70 is exposed to extreme temperatures. Do not store the HT70 in areas where it may be exposed to temperatures below -40° C (-40° F) or above 65° C (149° F).

To avoid the risk of electric shock, the ventilator should not be opened by anyone other than an approved service provider.

General Warnings

The design of the HT70 ventilator, the Operating and Service manuals, and the labeling on the ventilator take into consideration that the purchase and use of the equipment is restricted to trained professionals, and that certain inherent characteristics of the ventilator are known to the operator. Instructions, warnings and caution statements are therefore limited to the specifics of the HT70.

This manual excludes references to various hazards which are obvious to medical professionals and operators of this equipment including consequences of product misuse, and potential adverse effects in patients with abnormal conditions.

Transport of patients with the HT70 requires that medical staff have a good working knowledge of the ventilator's use and problem resolution. Proper emergency backup equipment must be immediately available during transport.

Product modification or misuse can be dangerous. Newport Medical Instruments, Inc. disclaims all liability for the consequences of product alterations or modifications, as well as for the consequences which might result from the combination of this ventilator with other products, whether supplied by Newport or by other manufacturers, unless such a combination has been specifically endorsed by Newport Medical. There is a risk of explosion if used in the presence of flammable anesthetics.

A patient connected to a ventilator requires the constant attention of trained caregivers to the patient's condition.

Ventilator alarms are a critical element in the safety net of patient care. It is extremely important for patient safety that caregivers immediately identify and correct alarm violations.

Always have an alternate power source and means of ventilation available when the ventilator is in use so that they are easy to access in case of a mechanical or system problem.

If a fault is detected in the ventilator and its life support functions are in doubt, immediately discontinue use; use an alternative method of ventilation until the fault has been corrected. Contact your service provider immediately.

Do not block the Emergency Gas Intake (on the bottom panel) or the Fresh Gas Intake Port (on the right side panel).

Always use appropriate monitors to ensure sufficient oxygenation and ventilation (such as a pulse oximeter and/or a capnograph) when the HT70 Ventilator is in use on a patient.

The optional Air/Oxygen Entrainment Mixer and Low Flow Oxygen Reservoir are designed to operate with medical grade oxygen.

Ensure that the oxygen source is not empty before and during the use of the optional Air/Oxygen Entrainment Mixer or Low Flow Oxygen Reservoir.

To avoid putting stress on the internal pump and compromising gas delivery to the patient, ensure that the Air/Oxygen Entrainment Mixer is not connected to the gas intake port on the ventilator when performing a Circuit Check. Ensure that the oxygen supply is enabled any time the optional Air/Oxygen Entrainment Mixer is secured in place while ventilating.

Calibrated oxygen monitoring at clinically appropriate levels is required for patient safety when supplemental oxygen is in use. The optional built-in oxygen sensor on the HT70 allows High and Low O2 alarms to be enabled which can be used to assure proper oxygen delivery.

Always plug the HT70 into an external power supply source whenever it is available, even when HT70 is not in use, to keep the Internal Dual Battery System fully charged and to ensure best battery performance. Check battery capacity on the front panel before detaching from external power.

When installing a replacement Power Pac during battery operation, always ensure that the charge level LED on the replacement pack is green, indicating 90% or higher charge level.

Always ensure that the green External Power LED lights when the ventilator is connected to an external AC or DC power source.

To maintain grounding integrity when using AC power, only connect to properly grounded receptacles.

Use only the Newport supplied AC Power Supply (p/n PWR3204P) with the HT70 ventilator and HT70 Power Pac (p/n BAT3271A).

Always disconnect the external power supply prior to servicing.

After servicing the HT70, it must pass the Operational Verification Procedure (OVP) before it is returned to patient use. See the HT70 Service Manual.

Do not use electrically conductive breathing circuits. Always use clean and dry breathing circuits.

Always use a clean, dry filter in the following locations: a standard bacteria filter on the gas output, a prox line (bacteria) filter on the proximal pressure tubing port and an intake (bacteria) filter behind the filter cover.

Adding attachments or other components or sub-assemblies to the ventilator breathing circuit system can increase the patient's work of breathing and/or add resistance to patient exhalation.

Always ensure that the audible alarm loudness level is set at a volume that can be heard by the caregiver. Do not use the ventilator in an environment where audible alarms cannot be heard by the caregivers.

The functioning of this machine may be adversely affected by the operation of other medical equipment, such as high frequency surgical(diathermy) equipment, defibrillators or short-wave therapy equipment in the vicinity.

This device has undergone EMC testing and found to be in conformance with IEC 60601-1-2:2001 and meets the requirement of CISPR11:2004 (Class B), IEC 61000-3-2:2006, and IEC 61000-3-3:1955 + A1:2001 + A2:2005. These requirements are designed to provide reasonable protection against harmful interference in a typical medical installation, as well as in homecare environments. The equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with these instructions, may cause harmful interference to other devices in the vicinity. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference with other devices, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures;

•   Reorient or relocate the receiving device.
•   Increase the separation between the equipment.
•   Connect the equipment into an outlet on a circuit different from that to which the devices(s) is connected.
•   Consult the manufacturer or field service technician for help.

Copyright Information

Section 2:
Overview

Section 2: Overview of Controls, Screens and Connectors

Front Panel Overview

Please refer to Foldout drawing F-1 at the front of the manual. The HT70 front panel consists of easy access membrane buttons, LED indicators and the patient connection manifold. The center touch screen panel provides access to alarm and parameter settings. The HT70 Plus model has the added port for connecting the on-airway flow sensor. This manual describes the HT70 Plus full features.

Touch Screen Overview (Hospital Domain)

Please refer to Foldout drawing F-3 at the front of the manual. The HT70 touch screen includes direct access to essential screens for setting patient parameters and alarms. Simple menu navigation allows access to advanced features and utility screens.

NOTE: While operating on internal battery power, when the Power Save feature is ON and there are no active alarms, the touch screen will go to sleep after two minutes. Just touch the screen or any membrane button to bring it back into view.

Internal Dual Battery System Overview

The Internal Dual Battery System can provide up to 10 hours of operation when new and fully charged (under standard conditions shown in Section 7) and consists of two independent but coordinated lithium ion batteries; the hot swappable Power Pac battery and the secondary Backup Battery. When external power is lost, the ventilator will run on the Power Pac until the "Switching to Backup Battery" alarm activates. The Backup Battery will then provide a minimum of 30 minutes of emergency back up power. The Backup Battery portion of the system also maintains operation without interruption whenever the Power Pac is swapped out. The Power Pac can be recharged independently from the ventilator. The Power Pac has an LED on the bottom edge to show charge condition. Push the button to see charge condition. Green = approximately 90% or higher charge level, Amber = charge not completed, Red = battery depleted. Always insert the Power Pac onto the HT70 and power it ON to verify

1. **Backup Battery (inside the case)**
2. **Power Pac Battery (exchangeable)**
3. **Release Latch**
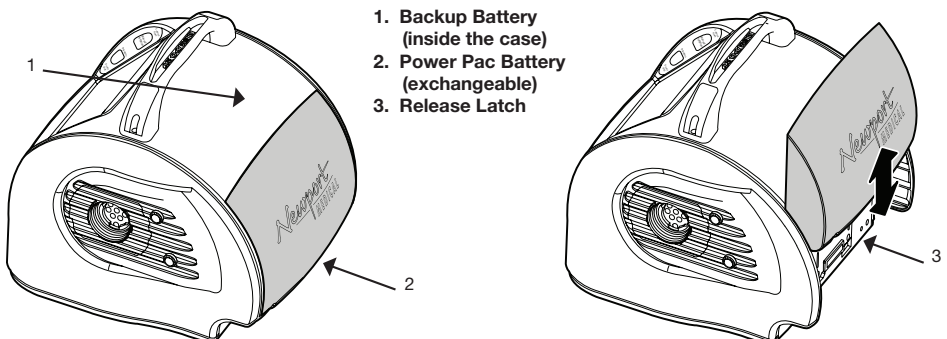
the actual charge level percentage (shown in the message display). Proper care and maintenance of the Internal Dual Battery System will ensure the longest life and best usage performance. See Section 7 for complete details on the Internal Dual Battery System.

Rear Panel Overview
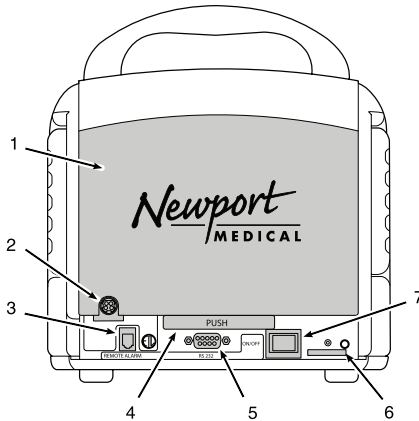
1. **"Power Pac" battery pack**

2. **External power supply input**

3. **Remote alarm output** Connects to Nurse Call systems.

4. **Release latch** Push to remove battery pack.

5. **RS-232 output** External communication port to communicate with central monitoring systems.

6. **Serial number label**

7. **On/Off power switch** Momentary switch to power the ventilator On/Off.

Right Side Overview
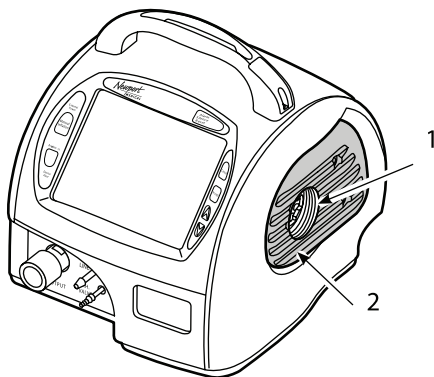
1. **Fresh Gas Intake port / Oxygen Accessories' connection/ Optional Oxygen Accessories / Bio-filter connection** Allows attachment of the optional Air Oxygen Entrainment Mixer, Low Flow Oxygen Reservoir or Bio-filter.

2. **Air Intake Filter cover** Allows visual inspection of the air intake filter through the transparent cover.

Left Side Overview
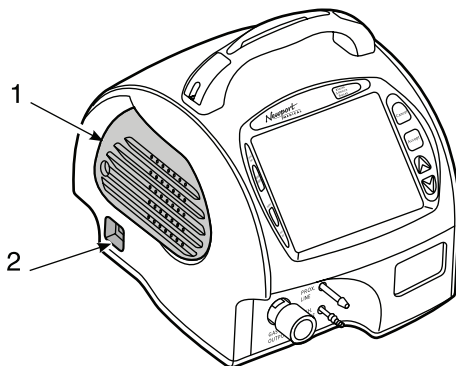
1. **Cooling fan cover** Protects the internal fan.

2. **USB ports (2)** Allows the attachment of optional accessories such as:
    *   a flash drive for downloading the Trends* and Event History files or uploading new software.

*not available on HT70S model

Bottom Panel Labeling

The Bottom Panel of the HT70 includes a label that contains information regarding agency approvals and power ratings. Here you will find the model number and manufacturing information.

NOTE: The serial number for the unit is located on the lower rear panel near the power switch.

Section 3:
Set-up

Section 3:
Set up and Pre-use Preparations

Unpack the HT70 Ventilator

Remove all of the items from the shipping box and inspect each part and component for completeness. Verify that there is no shipping damage. To obtain information about a warranty, if any, contact Technical Services or your local representative.

The Newport HT70 Ventilator, Plus Model assembly includes the following parts:

1 ea.	HT70PM-XX-XX	Ventilator
1 ea.	OPRHT70-2	Operating Manual
1 ea.	PWR3204P	AC Power Supply with Pinch Release
1 ea.	PWRXXXX	Country specific Power Cord
1 ea.	HT460300	Air Intake Filter, Disposable (pkg. of 5 filters)
1 ea.	HT6004701	Prox. Inline Filter, Disposable (pkg. of 5 filters)
1 ea.	FLT3302P	Bacteria Filter
2 ea.	-------------	Adult/Ped Flow Sensor Kit (pkg. of 1)

Optional accessories:

o	KIT3420A	Adult/Ped Flow Sensor Kit (pkg. of 4)
o	RSV3215A	Low Flow Oxygen Reservoir
o	MXL70A-XX-XX	Air/Oxygen Entrainment Mixer (country specific)
o	FLT3209P	Mixer Filter (for Air/Oxygen Entrainment Mixer)
o	ADP3203P	DC Auto Lighter Power Adapter
o	BAT3271A	Power Pac Battery Pack with LED
o	PWR3204P	AC Power Supply with Pinch Release (use to recharge extra batteries) (requires country-specific power cord)
o	PWR3207P	NA-North American Style Power Cord (use with Power Supply)
o	PWR3210P	UK-British Style Power Cord (use with Power Supply)
o	PWR3211P	EU-Euro Style Power Cord (use with Power Supply)
o	CBL3223	Remote Alarm Cable (1/4" phone jack connector)
o	CRT3215A	HT70 Cruiser Cart
o	MNT3208A	Single e-Cylinder Mount
o	MNT3209A	Dual e-Cylinder Mount
o	10104494	Aequitron Remote Alarm Cable

Contact Newport Medical Customer Service for more details on available accessories.

Assemble the Ventilator

1. After unpacking the ventilator, check to see that you have all the accessories needed and check for any damage that may have occurred during shipping.
2. Assemble the cart using the instructions provided with the cart.
3. Securely position the ventilator on the pedestal mount of the cart.

Caution: Take care to assemble the cart correctly to assure that the ventilator and accessories remain secure and are not damaged.

Connect to A.C. Power

The HT70 comes with an AC Power Supply that includes AC power adapter with pinch-release power plug. The detachable AC power cord can be ordered in country specific configurations. Only use the approved HT70 AC Power Supply to connect the HT70 Ventilator to AC power.
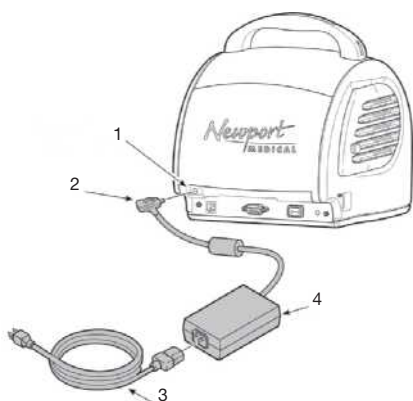
1. External power supply input
2. Pinch Release power cable
3. AC power cord
4. AC power adapter

Plug the pinch-release power plug from the AC Power adapter into the external power supply input located on the lower left corner of the Power Pac battery pack. Ensure that the cord is to the right of the plug and that it locks in place securely. Plug one end of the power cord into the adapter and the other end into a properly grounded outlet.

To remove the AC Power Supply from the external power supply input, gently pinch the connector to release the locking pin and then pull the plug out.
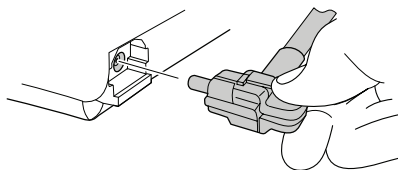
Pinch release power plug

Caution: Do not twist the power plug or it may be damaged.

When the HT70 Ventilator is connected to external power, both batteries in the Internal Dual Battery System are charged simultaneously.

NOTE: Check the Battery Charge gauge on the touch screen to ensure that both the Power Pac battery and the secondary Backup Battery are fully charged before disconnecting from external power.

The Power Pac can also be connected to external power independently of the ventilator. Before installation on an HT70 Ventilator, check the Battery Charge LED on the bottom edge of the battery to ensure that the green LED is lit, indicating that the charge level is approximately 90% or above. Insert the Power Pac onto the HT70 and power it ON to verify the actual charge level percentage (shown in the message display area).
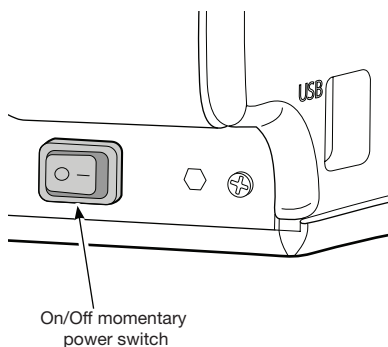
On/Off momentary
power switch

Using the Power Switch

The momentary-type power switch is located on the left side rear of the ventilator along the bottom edge.

To power the ventilator On: Press the power switch once and wait for the startup screen to appear.

The ventilator will be in Standby Condition. You can make settings changes and perform the Circuit Check prior to ventilation.

To start ventilation, touch the '*Start Ventilation*' button at the top of the screen.

To power the ventilator Off: Press the power switch once. A message appears that prompts you to 'Press *Accept* to Shutdown or *Cancel* to Ignore'. Pressing the *Accept*

button will power off the ventilator. Pressing *Cancel* will return the ventilator to its previous state. Press Alarm Silence to silence the Shut Down alarm.

Make Parameter Changes

Most parameters are changed with a simple Touch / Adjust / Accept method:

1. Activate the control by touching it (button will appear highlighted).
2. Use the *Up/Down* ▲ ▼ buttons to adjust the setting.
3. Press the *Accept* button to accept the change.

You can make several adjustments before accepting the changes. When you are satisfied with all of the changes, you can accept them all by pressing the *Accept* button once. In the case of a mode and or breath type change, select the Main Screen for view, change the mode and/or breath type and then adjust all visible parameters prior to pressing the *Accept* button.

Before you accept any change, if you want to go back to the previous settings, simply press the *Cancel* button.

NOTE: If a parameter is touched and adjusted but *Accept* is not pressed within 20 seconds of the last button touched, the parameter will revert to the original setting.

Attach a Patient Circuit

Always use a clean and dry patient circuit.

Always use an inline filter (p/n HT6004701 or equivalent) at the Prox. Line Connector to protect the internal transducers from moisture or other contaminants.

Always use a bacteria filter (p/n FLT3302P or equivalent) on the Gas Output connector.

Always orient the exhalation valve for the correct flow orientation. Valves used in a single limb circuit have arrows that point towards the patient and valves that are used in J style or two limb circuits have arrows that point away from the patient.

When using the on-airway flow sensor, orient it so that the blue tubing is towards the patient.

The HT70 Ventilator will perform to specification when Newport recommended breathing circuits and exhalation valves are used. Newport cannot guarantee the safe use of breathing circuits or exhalation valves that are not recommended.

For use with a third party humidifier:

When using a humidifier with the ventilator, be sure to follow the manufacturer's instructions for use.

See Figure 1:

1. Attach a bacteria filter to the Gas Output connector on the HT70.

2. Locate the short piece of 22 mm ID circuit tubing. Connect the end that includes the prox line pressure port to the inlet port of the humidifier.

1. Prox Line Pressure Port
2. Inlet port
3. Humidifier
4. Short section breathing circuit
5. Bacteria filter
6. Gas output connector
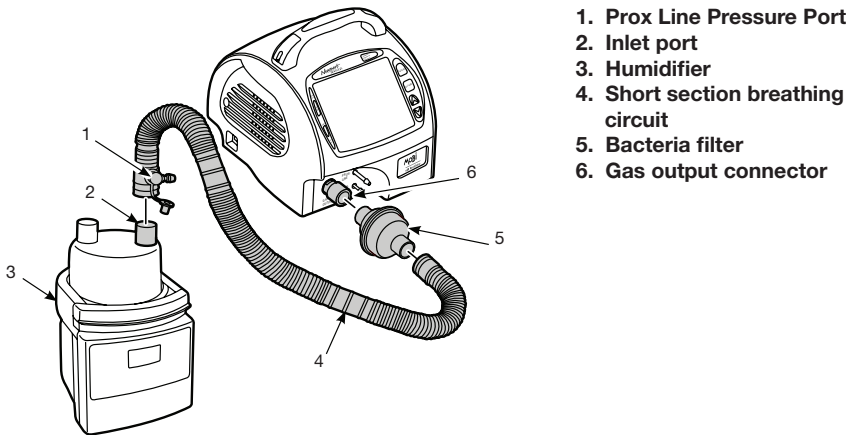
Figure 1

3. Attach the other end of the breathing circuit to the bacteria filter on the HT70 Gas Output connector.

1. **Breathing circuit**
2. **Outlet port**
3. **Humidifier**
4. **Pressure port**
5. **Prox line**
6. **Prox inline filter**
7. **Prox line connector**
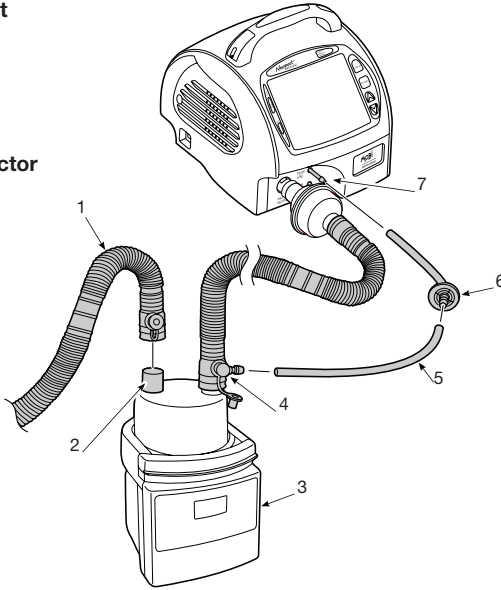
Figure 2

See Figure 2:

4. Locate the 22 mm ID end of the main breathing circuit. Attach this end to the outlet port of the humidifier chamber.

5. Attach the Prox Inline Filter with tubing to the Prox. Line connector.

6. Attach one end of the prox tubing to the Prox Inline Filter.

7. Attach the other end of the prox tubing to the prox line pressure port on the circuit tubing that is connected to the inlet port of the humidifier chamber.

1. Exhalation Valve connector
2. Exhalation Valve tubing
3. Patient wye connector
4. Breathing circuit
5. Exhalation valve

Figure 3

See Figure 3:

8. Attach one end of the exhalation valve tubing (smallest clear tubing) to the Exh. Valve connector.

9. Attach the other end of the exhalation valve tubing to the connector on the exhalation valve at the end of the circuit.

10. Attach Flex Tube (not shown), if used, on the patient wye connector.

11. If using the on-airway flow sensor, plug the connector into the front panel port. Attach the flow sensor with the blue tubing toward the patient onto the patient connection of the circuit. Use the 15/22mm adapter supplied with the flow sensor to attach to the patient interface as needed. Use the circuit clip supplied with the flow sensor to secure the flow sensor lines to the main breathing circuit tubing.

See Figure 4 for completed set up with humidifier.

12. If a temperature probe is used, insert probes into ports at either end of the tubing that connects the humidifier and the patient wye connector.
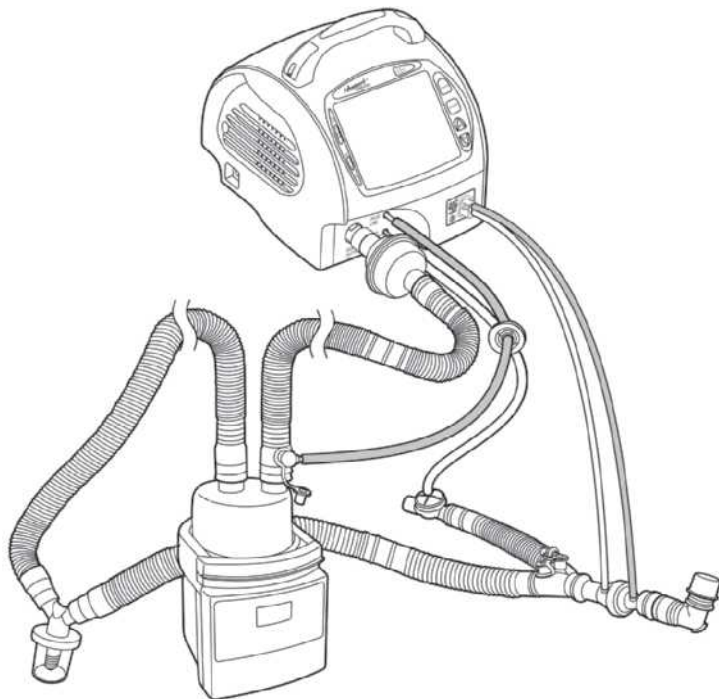
Figure 4

13. Perform the **Circuit Check**. If the circuit includes an end cap, use it during the first step of the Circuit Check. See Section 4 for instructions.

For use with an HME (artificial nose):

See Figure 5:

1. Attach a bacteria filter to the Gas Output connector on the HT70.

2. Locate the 22 mm ID end of the breathing circuit. Attach this end to the bacteria filter.

3. Attach the HME to the patient wye connector.

4. Attach a pressure tee if the on-airway flow sensor is not used.

5. Attach Flex Tube, if used, to the patient side of the pressure tee/ or on-airway flow sensor adapter.

6. Attach the Prox Inline Filter with tubing to the Prox. Line connector.

7. Attach one end of the prox tubing to the Prox Inline Filter.

8. Attach the other end of the prox tubing to the port located on the wye connector (on-airway flow sensor in use) or to the pressure tee adapter on patient side of the HME.
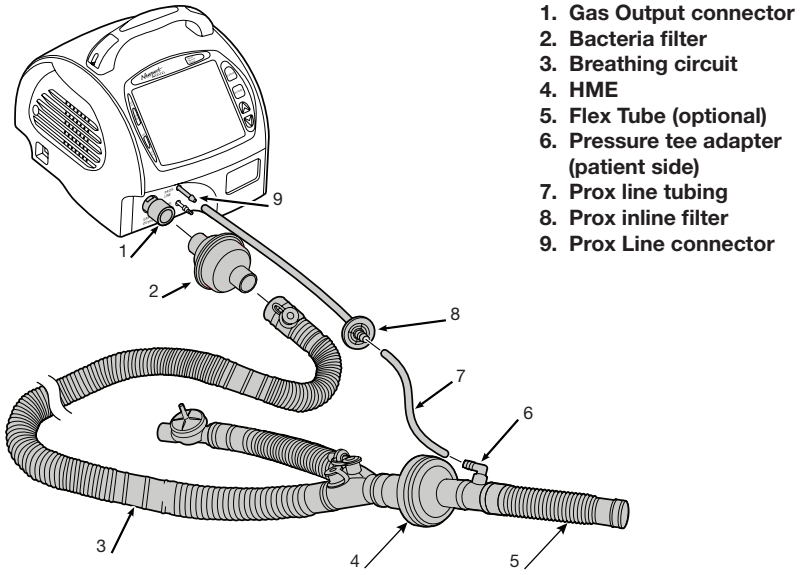
1. Gas Output connector
2. Bacteria filter
3. Breathing circuit
4. HME
5. Flex Tube (optional)
6. Pressure tee adapter (patient side)
7. Prox line tubing
8. Prox inline filter
9. Prox Line connector

Figure 5

See Figure 6:

9. Attach one end of the exhalation valve tubing (smallest clear tubing) to the Exh. Valve connector.

10. Attach the other end of the exhalation valve tubing to the connector on the exhalation valve.
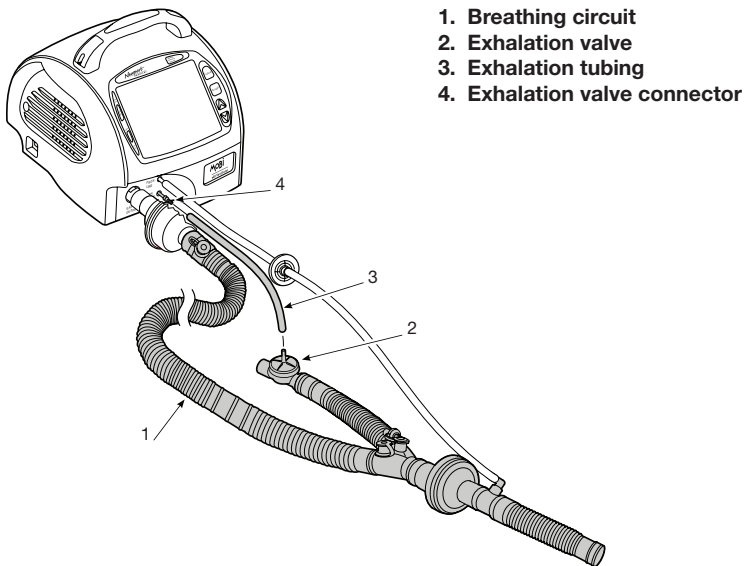
1. Breathing circuit
2. Exhalation valve
3. Exhalation tubing
4. Exhalation valve connector

Figure 6

11. If using the on-airway flow sensor, plug the connector into the front panel port. Attach the on-airway flow sensor with the blue tubing toward the patient to the wye connector of the circuit. Use the 15/22 mm adapter supplied with the on-airway flow sensor to attach to the patient interface as needed. Use the circuit clip supplied with the on-airway flow sensor to secure the on-airway flow sensor lines to the main breathing circuit tubing.
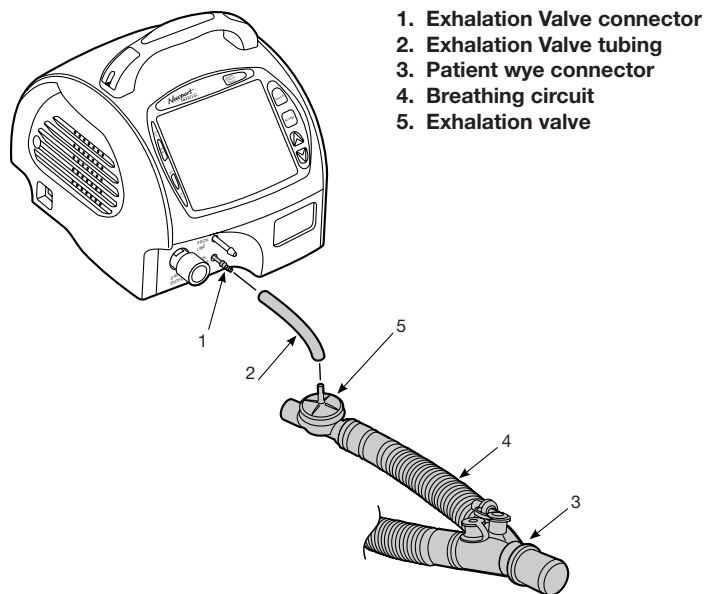
See Figure 7 for completed setup for HME with flow sensor.
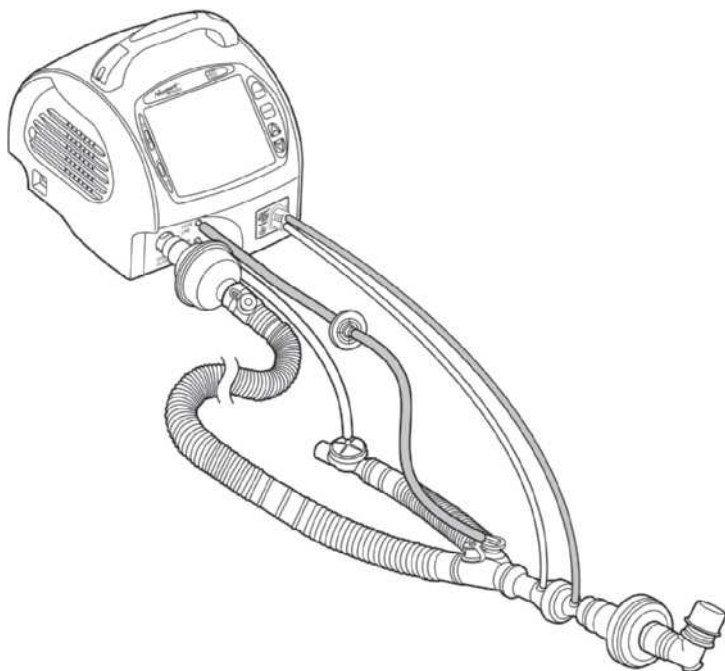
Figure 7

12. Perform the Circuit Check. If the circuit includes an end cap, retain it for use in the Circuit Check. See Section 4 for instructions.

Using the On-airway Flow Sensor

The Newport Flow Sensor is a disposable, single patient use on-airway flow sensor that can be used for pediatric to adult patients. Use the 15/22 mm adapter supplied with the on-airway flow sensor to attach to the patient interface as needed. Use the circuit clip supplied with the on-airway flow sensor to secure the on-airway flow sensor lines to the main breathing circuit tubing.

Set up your patient breathing circuit as described above for the appropriate usage (with or without humidifier or HME). Plug the on-airway flow sensor connector into the port on the front panel of the HT70 Plus. Attach the on-airway flow sensor to the patient end of the breathing circuit with the blue tubing toward the patient.

When it is connected the ventilator will recognize the on-airway flow sensor and enable these added features:

- Flow trigger
- Exhaled volume monitoring
- High Tidal Volume alarm
- High and low expiratory minute volume alarms

Caution: When giving nebulizer treatments through the ventilator circuit, be sure to remove the flow sensor from the circuit. This will protect the flow sensor from medication build up.

Connect Optional Accessories

Connect optional accessories such as the Air/Oxygen Mixer, Low Flow Oxygen Reservoir or Biofilter, to the right side of the HT70 at the Fresh Gas Intake Port.

For External DC Power use, connect the DC Auto Lighter Cable into the external power supply input on the rear of the Power Pac battery pack.

WARNING Do not block the Fresh Gas Intake Port on the right side of HT70. Use only approved accessories.

Air/Oxygen Entrainment Mixer (optional)

The Air/Oxygen Entrainment Mixer (p/n MXL70A-XX-XX) which is used to blend atmospheric air with 50 psi medical grade oxygen, attaches to the Fresh Gas Intake Port on the Filter Cover (right side of the ventilator). Attach the mixer's high pressure hose to an active source of medical grade, 100% oxygen, before attaching the mixer to the ventilator. The mixer should not be attached to the ventilator before the Circuit Check is completed. Make sure that the oxygen source gas is always on while using the mixer during ventilation.

Use the mixer's control knob to adjust oxygen enrichment of the gas delivered to the patient circuit from 21 to 100 percent. The mixer does not need re-adjustment when the PEEP and Bias Flow settings or patient's minute volume change.

Use a calibrated oxygen monitor with alarms (such as the one that is built-in to the ventilator) to assure that the O_2 that is delivered by the ventilator into the patient circuit matches the prescribed value.

Check the mixer filter (p/n FLT3209P) at the time of setup and weekly during use. Replace when dirty. See section 8 for instructions.

Pneumatic Requirements:
Oxygen 35-65 psig
(2.4 to 4.5 Bar)
Maximum accuracy 40-50 psiq (2.7-3.4 Bar)

Note: Oxygen source gas must be medical grade, 100% oxygen.

Oxygen Mixer
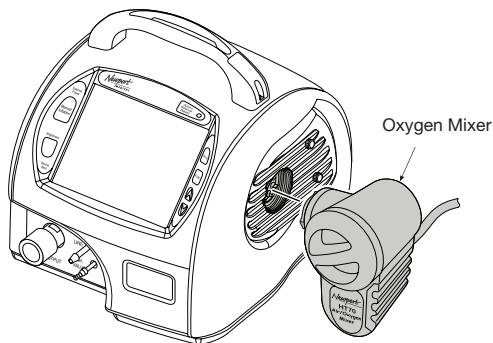
Low Flow Oxygen Reservoir (optional)

The Low Flow Oxygen Reservoir (p/n RSV3215A) which is used to blend atmospheric air with 1-10 L/min of medical grade oxygen, attaches to the Fresh Gas Intake Port on the Filter Cover (right side of the ventilator). Attach oxygen supply tubing between the oxygen flowmeter and the small bore connector on the reservoir. Attach the reservoir to the ventilator.

Low Flow Oxygen Reservoir
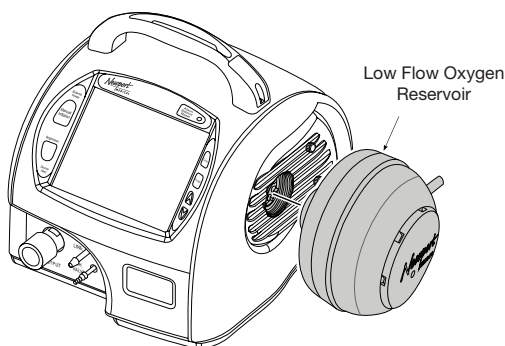
Use the oxygen flowmeter to adjust oxygen enrichment of the gas delivered to the patient circuit. When the Low Flow Reservoir is in use, the percent of oxygen that is delivered from the ventilator into the breathing circuit will vary, depending on the use of Bias Flow and PEEP, the delivered minute volume and the percent O_2 of the source gas.

**Oxygen Supply Flow vs Desired % of Oxygen
For Use With PEEP**

1	Min Vol i 25 Liters	5	Min Vol i 5 Liters
2	Min Vol i 20 Liters	6	Oxygen Supply Flow, L/min
3	Min Vol i 15 Liters	7	Desired % of Oxygen Enrichment
4	Min Vol i 10 Liters		
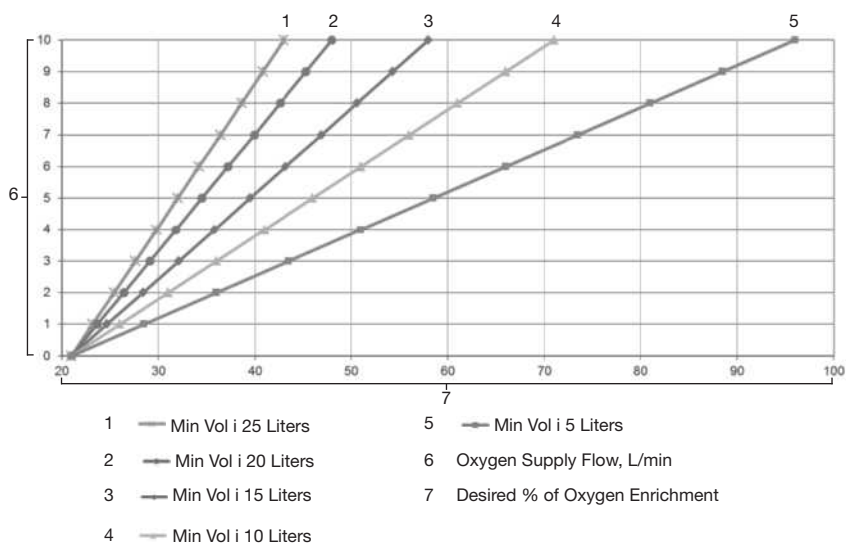
**Oxygen Supply Flow vs Desired % of Oxygen
For Use Without PEEP**

1	Min Vol i 25 Liters	5	Min Vol i 5 Liters
2	Min Vol i 20 Liters	6	Oxygen Supply Flow, L/min
3	Min Vol i 15 Liters	7	Desired % of Oxygen Enrichment
4	Min Vol i 10 Liters		
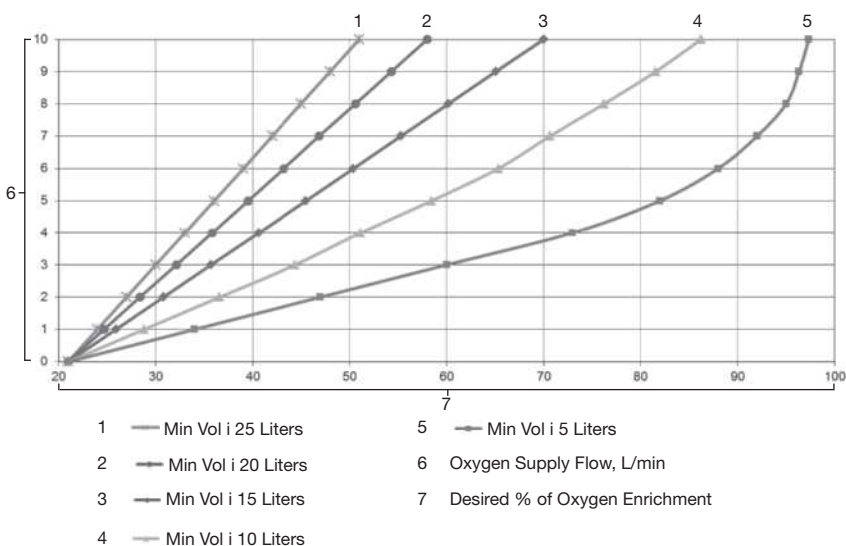
Use these graphs for estimating the liter flow of supplemental oxygen needed to attain a particular O_2 percentage. Note that the first graph applies when PEEP is on (and NIV off) and the second graph applies when PEEP is off. The graphs are also printed on the Instructions for Use that are packaged with the reservoir.

To keep a constant percentage of O_2, the flowmeter will need re-adjustment when PEEP is turned on or off or the Bias Flow setting is changed (PEEP and NIV on) or the patient's minute volume changes.

Use a calibrated oxygen monitor with alarms (such as the one that is built-in to the ventilator) to assure that the percentage of O_2 that

is delivered by the ventilator into the patient circuit matches the prescribed value.

Pneumatic Requirements: Oxygen 0-10 L/min

WARNING Using an oxygen concentrator in place of medical grade oxygen will result in lower oxygen percentage levels than what is printed on the graphs. Use a calibrated oxygen monitor to verify the level of oxygen enrichment.

Caution: Water in the oxygen supply can cause equipment malfunction and damage.

DC Auto Lighter Power Adapter (optional)

The DC Auto Lighter Power Adapter (p/n ADP3203P) is used to plug the HT70 into any vehicle's DC power outlet (12 VDC to 16 VDC). The external DC source of power will not only power the ventilator but also charge both batteries in the Internal Dual Battery System.

This cable can also be used to connect the HT70 Ventilator to other external batteries (12 VDC to 16 VDC) when combined with an alligator clip adapter that is available from common electronics outlets such as Radio Shack.

To use the DC Auto Lighter Power Adapter, plug the adapter's pinch-release power plug into the external power supply input located on the lower left corner of the Power Pac battery pack. Ensure that the cord is to the right of the plug and that it locks in place securely. Plug the other end of the adapter into a vehicles autolighter power outlet (12 VDC to 16 VDC).

To remove the DC Auto Lighter Power Adapter from the external power supply input, gently pinch the connector to release the locking pin and then pull the plug out.

Aequitron Remote Alarm Cable

The Aequitron Remote Alarm Cable allows the user to connect the HT70 Ventilator to the Aequitron 6217 remote alarm assembly.

This cable must be connected to both the nurse call and USB output ports on the ventilator. The other end of this cable must be connected to the original extension cable (not to the Aequitron unit itself).

The ventilator must be configured to "Norm Close" (see Figure 4 on page 4-18). In addition, see the General Notes regarding nurse call connectivity on page 1-5.

Complete a self-test after the cable has been installed and at regular intervals to ensure the Aequitron system is operating as intended. A self-test consists of inducing an alarm and confirming the Aequitron unit emits an audio alarm, and also confirming the audio alarm ceases once the alarm in the ventilator has been reset.

Section 4:
Navigating

N Section 4: Navigating the Screens

Touchscreen (Graphical User Interface) Layout

The touchcreen display is color coded so that it is very easy to differentiate between basic ventilation settings which are green, alarm settings which are red and monitored values which are yellow (on blue background). The "More" and "Utility" settings are in blue.

If the power save feature is enabled, the HT70's touch screen will go dark if not touched for 2 minutes (while running on internal battery). To bring it back into full view just touch the screen or a membrane button.

Primary Screen Navigation
The buttons for accessing Alarms, Main, and More screens as well as the buttons for selecting mode and breath type are consolidated along the left margin. Monitored values are displayed across the bottom margin and the pressure bar graph rises and falls along the right. This leaves plenty of room for the display in the middle of the screen.

The name of the active screen is written in larger letters than the other two. To change to a different screen view, just touch one of the other screen buttons. There is no need to press *Accept*.

Primary Screen Buttons and Displays
Refer to Figure 1
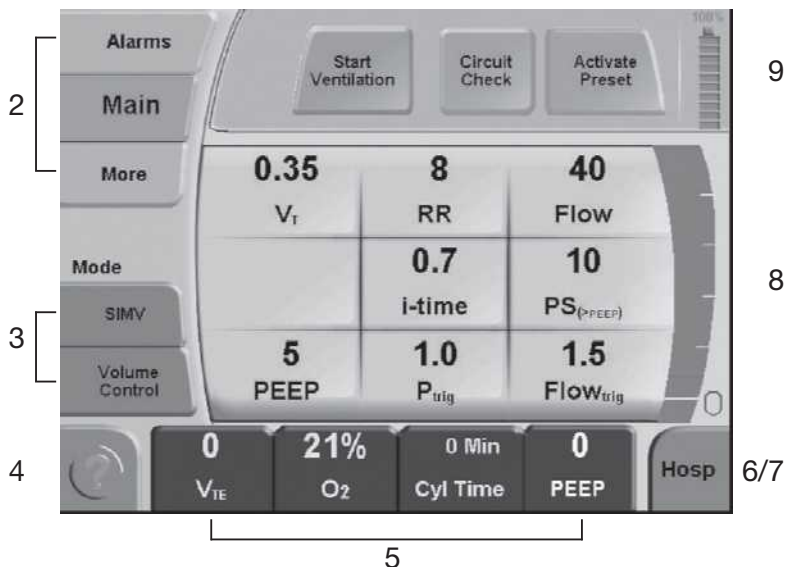
Figure 1

1. **Start up Screen selection buttons:** While in Standby Condition there are three additional buttons in the Message and Alerts display window. They disappear when the *Start Ventilation* button is touched. See Startup Screen Navigation on page 4-4 for a full description.

2. **Screen selection buttons**: Touch the *Alarms*, *Main* or *More* buttons to open these screens in the center display area. Simply touch the desired button and the screen changes. You do not need to press *Accept*. See following pages for details on these screens.

   NOTE: From the "More" screen you can choose to view these additional screens: Trends*, Events, Waves+ and Utility. You can return to the Main screen from any of these screens by touching the screen selection button labeled "*Main*".

3. **Breath Type/Mode Selection buttons:** Touch the breath type button to toggle between Volume Control and Pressure Control. Then press *Accept*. Touch the mode button to scroll through the selections A/CMV, SIMV or SPONT. Press *Accept* to confirm.

4. **Help button:** Touch the *help* button, then touch any feature or button on the touch screen and the center panel displays an explanation of the features or controls. Touch any button except the *help* button again to close the tutorial.

5. **Monitor Data display buttons:** Monitor Data buttons are located at the bottom of the screen. To choose and change the parameters displayed, touch any one of the buttons to select it. The full monitoring screen appears and shows all twelve monitored parameters. Touch the parameter that you would like to display. That parameter will automatically appear in the *Monitor Data display* button that was selected. You can arrange these parameters in the order you want. The Monitor screen will remain, showing the monitored parameters, until you make an alternate selection, press a different screen button (*Alarms*, *Main* or *More*) or for 2 minutes to allow you to view and check all monitored values. The values on the monitor screen do not update while the screen is displayed.

NOTE: For monitor display selections, you do not have to push *Accept* to complete your change.

6. **Domain button:** The level of accessibility for HT70 controls is determined by the Domain selection. The HT70 user interface can be setup in one of three Domains: Basic, Transport and Hospital. The Basic Domain is a simplified screen for use in the longterm care or homecare setting. The Transport Domain is an specifically designed to assist

*not available in the HT70S models
+only available in the HT70 Plus models

during transport applications. The Hospital and Transport Domains provide full access to all ventilation and alarm settings as well as to the special screens and menus. Full access is recommended for use in acute care settings and for the initial setup of patients in long term care before switching to Basic Domain. See Domain Navigation on pg 4-23 for more details.

7. **Auto Lock button:** The Auto Lock function is enabled from the *Utility* screen. When *Auto Lock* is enabled, the touchscreen will automatically lock 20 seconds after the last button was touched. When this occurs, a lock icon will appear in the lower right corner in place of the *Domain* button. To unlock the screen, simply touch and hold the lock icon for 3 seconds. The screen will automatically relock when no buttons have been touched for 20 seconds.

8. **Pressure Bar:** The pressure bar appears on every screen. It indicates dynamic pressure in the patient circuit with a green bar that rises and falls. The High and Low Pressure Alarm settings are indicated with red lines and the peak pressure of the last breath is indicated with a green line.

9. **Battery Charge Level display:** A battery icon is displayed in the upper right corner of the screen. This icon indicates the percent of charge level of the battery that is currently operating the ventilator - either the Power Pac battery pack (blue icon) or the Backup Battery (red icon).

10. **Messages and Alerts display:** In Standby Condition there are three startup buttons that appear in this area. They disappear when the ventilator is in ventilating condition. While in Standby or while ventilating, messages, including alarm alerts, are displayed in the message display area of the screen in order of priority. Active alarms are displayed first followed by latched alarms that have not been cleared by the user.

NOTE: To clear alarm messages, press the *Alarm Silence Reset* button (located on the top of the panel). As you clear each alarm message, the alarm message with the next priority will appear in the message display area. Continue pressing to clear all alarm messages. Press and hold for 3 seconds to clear all at once.

Ventilator Settings Adjustment

Most ventilator settings are changed by touching a parameter to highlight it, using the up and down arrows to change the set value, and then pressing *Accept* to confirm the change. Pressing and holding the *arrow* button makes the change happen more rapidly. Other parameters are changed by toggling, meaning that the same button is touched repeatedly to change the value, then confirmed by pressing *Accept*. In either case, you can press the *Accept* button after each setting change or make multiple changes and then press *Accept*.

If you decide not to make the changes you started, press the *Cancel* button instead of pressing *Accept* or just wait and the values will revert back to the original settings.

The mode and mandatory breath type selections determine which Main Screen breath delivery parameters are active and available for adjustment. Follow these steps when setting up ventilation:

1. While the Main screen is in view, start by selecting the mode and mandatory breath type along the left margin of the screen.
2. Adjust all Main screen parameters that are visible.
3. Press the *Accept* button to implement the mode/breath type and relevant parameters change.
4. Visit the More screen to turn NIV ON or OFF.
5. When NIV is turned ON while PEEP is in use, the Bias Flow adjustment window appears so that you can also adjust Bias Flow.
6. Adjust the other relevant ventilation parameters on the More screen.
7. Visit the Alarm screen to adjust/check alarm parameters.

Startup Screen Navigation (Standby Condition only)

When the HT70 is turned On, it goes through a short self-test before entering the Standby Condition. Make sure that you hear the alarm sound and see the LEDs light during the short self-test. While in Standby, the Startup Screen is available. In addition, ventilator settings can be adjusted. The Startup screen includes three buttons in the top message area: Start Ventilation, Circuit Check and Activate Presets.
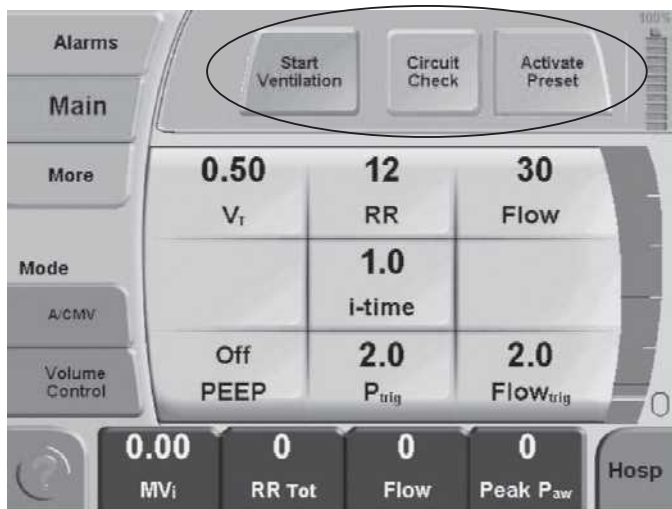
Startup Screen

Circuit Check Button

Perform a *Circuit* Check each time the breathing circuit or exhalation valve is replaced. While the ventilator is in Standby Condition, touch the *Circuit Check* button and follow the instructions on the screen. It is a simple two-step automated process. The Circuit Check is not available during ventilation.
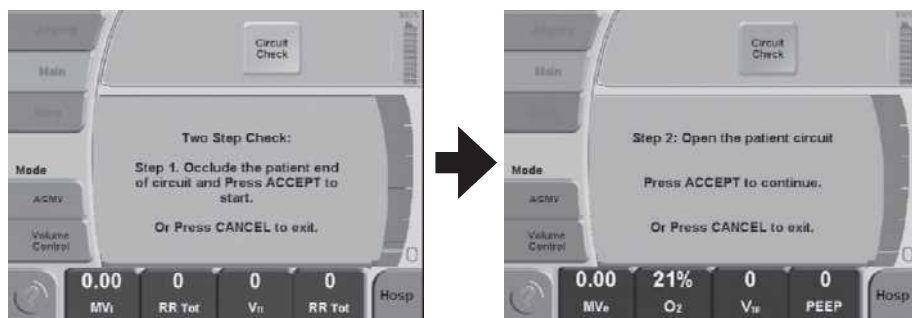
How to perform a Circuit Check

1. Touch the *Circuit Check* button at the top of the touchscreen and follow the on-screen instructions.

2. For Step 1, occlude the patient connection end of the circuit. (Do not use a test lung.)

3. Press the *Accept* button to confirm and start the Circuit Check.

4. For Step 2, open the patient connection end of the patient circuit.

5. Press the *Accept* button to continue the *Circuit* Check.

6. If the test passes, the message "Circuit Check PASSED Press Accept to Confirm" will be displayed.

7. When the Circuit Check is completed, adjust patient settings as needed and touch the *Start Ventilation* button when you are ready to begin ventilation.

8. To cancel the Circuit Check and return to the Startup Screen, press the *Cance*l button.

If the Circuit Check fails:

o   The message "Circuit Check FAILED Press *Accept* to Continue" will be displayed.

o   Press the *Accept* button to return to Startup Screen.

o   Check that all breathing circuit connections are properly connected and leak free.

o   Verify that the Air Oxygen Entrainment Mixer is not attached to the Fresh Gas Intake port.

o   Then touch the *Circuit Check* button to redo the test.

If the Circuit Check fails repeatedly, try a different circuit.

WARNING Do not use the HT70 if the Circuit Check fails, inadequate ventilation may result. Use an alternate method of ventilation. Contact Newport Medical Technical Support.

NOTE: The Circuit Check results are logged into the Event History and retained after power down.

Activate Preset Button
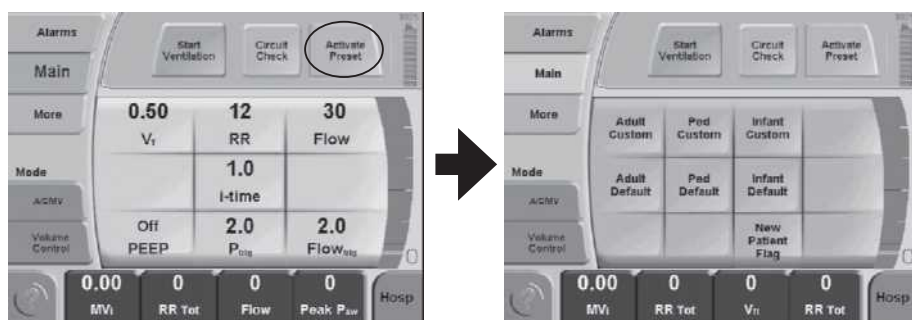
While in Standby, ventilation and alarm settings can be adjusted manually or they may be adjusted using custom or default pre-programmed parameter sets (presets) for Adult, Pediatric and Infant patients. From the Activate Preset screen you can also touch the *New Patient Flag* button to enter a "New Patient" flag in the Events History log. You must be in Standby Condition to activate a preset or enter a new patient flag.

How to Use a "Preset"

1. Touch the *Activate Preset* button.
2. Touch one of the six preset buttons that appear on the screen. Default Preset settings are based on factory set defaults. Custom Preset settings must be established by the user.
3. Press the *Accept* button to implement the settings.

NOTE: If you do not want to use a Preset, press the *Main, More* and *Alarms* buttons and adjust ventilation and alarm parameters.

To establish custom parameters for a preset you must first set all parameters and alarms as you want them for your patient. Then go to the *More/Utility/Custom Settings/*Set Custom Preset to select a custom preset button. For instructions on how to customize the Custom Patient Presets see page 4-20.

Start Ventilation button

Touch the *Start Ventilation* button to exit the Standby Condition and begin ventilation.

NOTE: Be sure to review all sections of this manual before you use the HT70 for the first time.

WARNING Ensure that all settings are appropriate for the patient prior to starting ventilation. Note that during Standby Condition the

monitored O_2 is not representative of the set O_2 or the O_2 that will be delivered during ventilating condition. After starting ventilation, use a calibrated oxygen monitor (such as the one that is built-in to the ventilator) to verify that the Air Oxygen Entrainment Mixer setting or liter flow attached to the Low Flow Oxygen Reservoir is delivering the prescribed O_2.

Alarms Screen Navigation

(May be accessed in all Domains, Standby or Ventilating Condition except where noted) Refer to Figure 2.

See Section 9, Specifications, for ranges and more details for each alarm and setting.

To enter Alarms Screen: Touch the *Alarms* button.

To set Alarm limits (not available in Basic Domain): Touch an Alarm limit button to activate (highlight) it, use the up and down arrow panel buttons to adjust the limit, then press *Accept* to confirm changes or press *Cancel* to return to original settings. You can set multiple limits before pressing *Accept*.
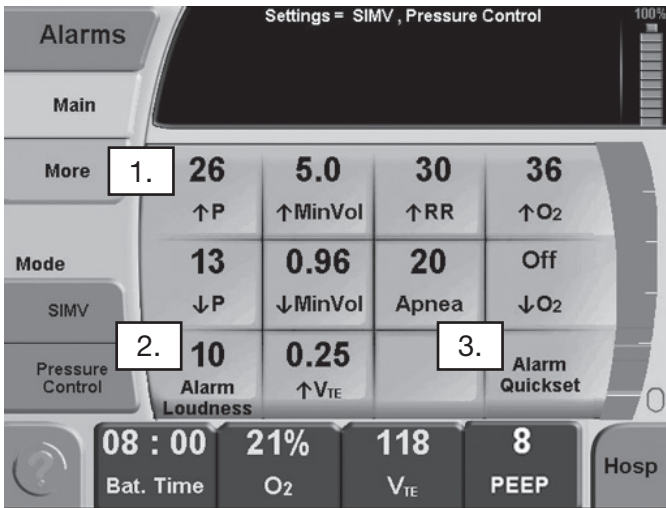
Figure 2

1. **Settable Alarms**

↑P (High Pressure)	↑Min Vol (High Minute Volume)
↓P (Low Pressure)	↓Min Vol (Low Minute Volume)
↑RR (High Respiratory Rate)	Apnea (time adjustment)
↑O_2 (High O_2)	↑VTE (High Exp. Tidal Volume)+
↓O_2 (Low O_2)	

+ only available on the HT70 Plus model when the on-airway flow sensor is in use

2. Alarm Loudness Level 1-10 (10 is loudest) – Touch this button, use the up and down arrow panel buttons to adjust the loudness level, then press *Accept*. Always set the alarm loudness level high enough to ensure that caregivers will hear any alarm. If necessary attach a remote alarm system (see Utility Screen for remote alarm selections) to ensure that the caregiver can always hear an alarm when it sounds.

3. Alarm Quickset – During Ventilating (not Standby) condition, when there are no active alarms violations, Alarm Quickset will automatically set the alarm limits. Touch this button to enter the Alarm Quickset screen, then press *Accept* to activate or *Cancel* to return to the *Alarms* screen.

When activated, Alarm Quickset monitors settings for 30 seconds and then sets the alarms. If an alarm occurs during the monitoring period, Quickset is canceled. During the 30 second period the touch screen will not respond unless an alarm occurs or the *Cancel* button is pressed.

Alarm Quickset will only activate when in ventilating condition.

Main Screen Navigation
(May be accessed in all Domains, Standby or Ventilating Condition)

See Section 9, Specifications, for ranges and details for all parameters.

The ventilation parameters that are displayed on the Main Screen are determined by the mode and breath type that are selected with the Mode/Breath Type buttons along the left margin of the touchscreen. Select the Mode and Breath Type first to see the Main Screen parameters that need adjustment.

Main Screen

To set ventilation parameters (not available in Basic Domain):

Touch a ventilation parameter button to activate (highlight) it, use the up and down arrow panel buttons to adjust the setting, then press *Accept* to confirm changes or press *Cancel* to return to original settings. You can set multiple parameters before pressing *Accept*.

List of all possible ventilation parameter settings on the Main Screen

VT (Tidal Volume)	RR (Respiratory Rate)
PEEP	PS (Pressure Support)*
Ptrig	PC (Pressure Control)
Flow (in volume control)	Flow Trig+
i time	

NOTE: When an on-airway flow sensor is detected, both the Flow Trig and Ptrig settings are active and the first available detection of patient effort (either flow or pressure) will trigger a breath.

NOTE: For Volume Control mandatory breaths, VT, Flow and i time are available to be set. The VT (tidal volume) is the controlling setting. Flow and i time setting are inversely related to each other. Changing either Flow or i time causes the inversely related setting to be recalculated to match the new Flow or i time setting and the VT remains steady.

For example, if you change the Flow rate to a higher setting, the i time will decrease to meet the new Flow setting. If you change the

*not available on HT70S models
+ only available on HT70 Plus models

i time to a longer time period, the Flow rate will decrease to meet the new i time setting.

Also while in Volume Control, changing the Flow waveform setting on the More Screen will cause the Flow to change on the Main screen. A square wave will use a lower flow and a descending ramp waveform will use a higher flow. Always recheck the settings and monitored values after changing the Flow waveform.

More Screen Navigation
(Hospital and Transport Domain, Standby and Ventilating Condition) Refer to Figure 3.

See Section 9, Specifications, for ranges and more details for each parameter.
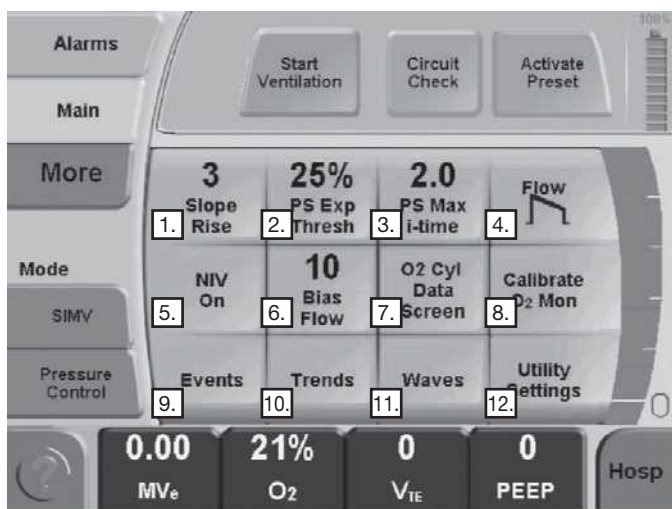
Figure 3

Press the *Accept* button to confirm changes made to any of the following parameters.

1. Slope Rise   touch button, use up/down ▲ ▼
                               to adjust from 1 - 10 (1 is slowest)
                               (Pressure Control and Pressure
                               Support breaths)

2. PS Exp Threshold *   touch button, use up/down ▲ ▼
                               to adjust from 5 - 85% (5% is
                               longest) (Pressure Support breaths)

*not available on the HT70S models

3.   PS Max i Time*   touch button, use up/down ▲ ▼ to adjust from 0.1 - 3.0 s (Pressure Support breaths)

4.   Flow [Square or Descending]   touch button to select square or descending ramp flow (Volume Control breaths)

5.   NIV   touch button to select NIV (Non Invasive) function ON or OFF for all breaths

6.   Bias Flow   touch button, use up/down ▲ ▼ to adjust from 3 to 30 L/min. Bias Flow is delivered during exhalation phase when PEEP is ON.

NOTE: For the above settings, if you have not pressed the *Accept* button, you can press *Cancel* at anytime to revert to previous setting.

7. O_2 Cylinder Data Screen   touch button to access screen to set up oxygen cylinder content tracking. (see page 4-16 for details)

8.   Calibrate O_2 Monitor   touch button to access calibration screen for the internal oxygen sensor (see page 4-17 for details)

9.   Events   touch button to access Events screen (see page 4-13 for details)

10. Trends*   touch button to access Trends screen (see page 4-14 for details)

11. Waves+   touch button to access Waves screen (see page 4-15 for details)

12. Utility Settings   touch button to access Utility screen, see description on the following pages

*not available on the HT70S models
+only available on the HT70 Plus models

More Screen Details

Events Screen
(Hospital and Transport Domain, Standby and Ventilating Condition)
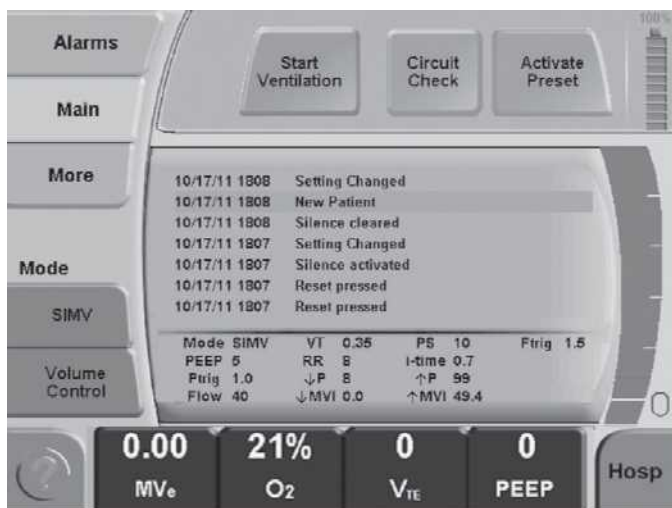
The Events Screen displays the last 1,000 recordable events. When a new event occurs, the oldest event is cleared. Use the up and down arrow panel buttons ▲ ▼ to scroll through the list of Events. Recordable events include Circuit Check, parameter changes, alarm activate/deactivate, date/time changes, alarm silenced, alarm cleared, calibrations, screen brightness changes, new patient, and power On/Off.

To record when a new patient is started, touch the 'Activate Presets' button while in the Startup Screen (Standby Condition) and then press the "New Patient Flag" button. The Event History log will record a "New Patient" entry.

As you scroll through Events, the time and parameters in use during that Event are displayed.

NOTE: Date and time format selection is located on the Utility Screen.

Trends Screen Navigation*

(Hospital and Transport Domain, Standby and Ventilating Condition)
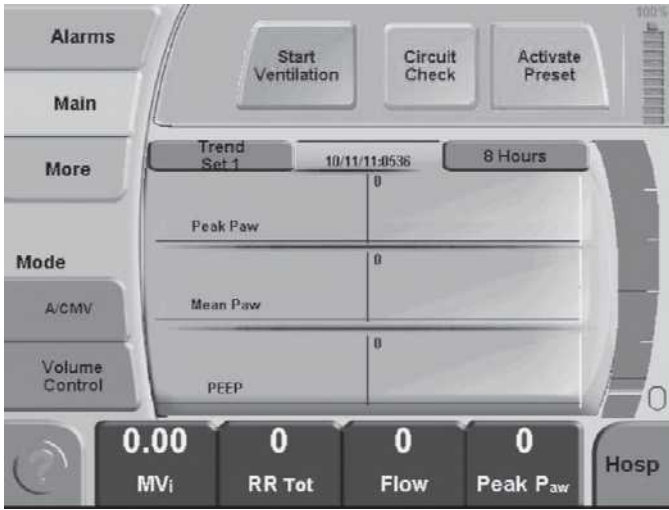
The Trends Screen displays trended data for monitored parameters. Push the up and down arrow panel buttons to move the cursor to the right or to the left.

As the cursor line moves across the graph, the time display will indicate the time at that point on the graph and the numbers on the line will show the value for each monitored parameter. The yellow vertical bars represent time that the ventilator was off and not collecting data.

There are four sets of parameters to display.

To Select a Trend Set:

To change the displayed parameters, touch the *Trends Set* button on top of the Trends graph to scroll through these choices:

1) Peak pressure, Mean pressure and PEEP

2) Tidal Volume, Resp. Rate Total, Minute Volume

3) Peak Flow, Power Pac, Back up Batt

4) Power Pac Temp, Back up Batt Temp, Internal Temp

*not available on the HT70S models

To Adjust the Time Scale

You can display the trends in time frames of 1, 2, 4, 8, 24 or 72 hours. To scroll through the time scale selections simply touch the hours button on the top of the Trends graph.

Waves Screen⁺

(Hospital and Transport Domain, Standby and Ventilating Condition)
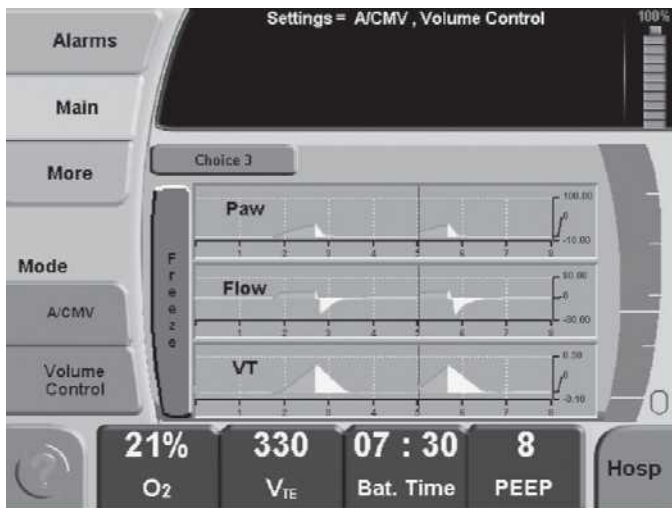
The Waves Screen displays real time graphics for Pressure, Volume and Flow. If the on-airway flow sensor is not installed, only the pressure graph will be displayed.

Touch the '*Choice*' button at the top of the central panel to select 1, 2 or 3 graphs for display. When only one or two graphs are chosen, you can select which waveform you want displayed by toggling the '*Wave*' button(s) at the top of the central panel.

Freeze. Touch the '*Freeze*' button to the left of the graphs to freeze the current waveform. The up/down arrows will move the cursor across the waveforms and display the value for the displayed graph at that point in time. To unfreeze, touch the same button again.

Time Scale (x-axis). To change the time scale simply touch the screen anywhere in the central panel. The time axis will turn yellow and you can use the up/down arrows to increase/decrease the time scale. Press *Accept* to save the new time scale.

Amplitude Scale (y-axis). To change the height of any waveform simply touch the central panel anywhere in the desired graph twice.

+only available on the HT70 Plus models

The first touch will highlight the time scale in yellow and the second touch will highlight the y-axis. The up/down arrows can now be used to increase/decrease the height of the y-axis. Press *Accept* to save the change.

Oxygen Cylinder Data Screen
(Hospital and Transport Domain, Standby and Ventilating Condition)
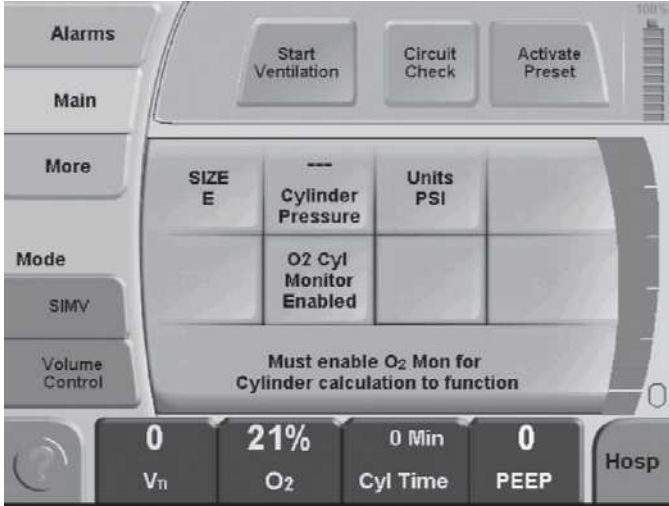
Estimated cylinder use time can be displayed on the monitor screen if the relevant cylinder data is entered, the O_2 Cylinder Monitor is Enabled, and the O_2 Monitor on the Utility Screen is Enabled.

Touch More, touch O_2 *Cylinder Data Screen*, then enter the size, pressure units and pressure for the cylinder you are using. Finally, touch O_2 *Cylinder Monitor* to Enable the function, and press *Accept*. The HT70 will then calculate the estimated duration of your oxygen supply and warn you before your cylinder may run out. Allow the calculated display to stabilize for several minutes before starting a transport and ensure that the estimated time is sufficient for the planned trip or outing.

NOTE: The oxygen cylinder use time displayed in the monitor is an estimate only. It can be affected by many factors such as leaks in the O_2 path. Do not rely solely on this measurement. Check the oxygen cylinder remaining pressure level frequently to confirm actual oxygen consumption rate.

Size: Toggle to the size of oxygen cylinder in use: D, E, H, M, K, 100 L, & 150 L.

Units: Toggle this button to use the desired pressure units for the oxygen cylinder (psi or ATM).

Cylinder Pressure: Touch this button and use the up/down arrows to enter the current pressure in the oxygen cylinder (300-2450 psi or 25-175 ATM).

O_2 Cylinder Monitor: Toggle this button to 'Enabled' and press *accept* when all data has been entered.

NOTE: You must enable the O_2 Monitor (Utility Screen) for this function to operate.

Calibrate O_2 Mon Screen
(Hospital and Transport Domain, Ventilating Condition)
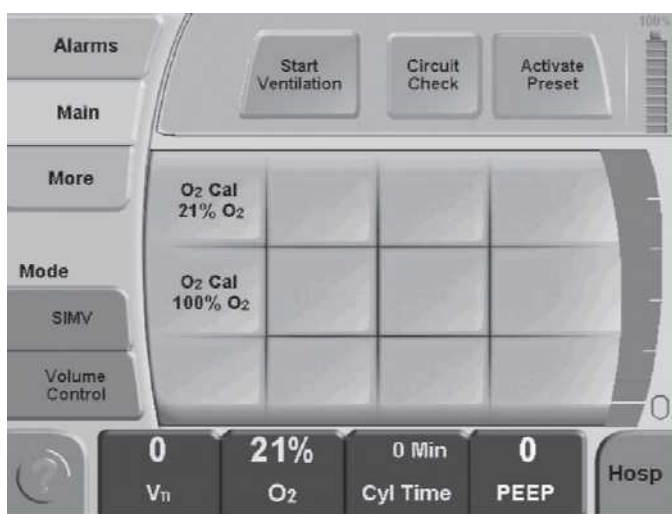
This screen allows the user to calibrate the internal oxygen sensor. Either a single point or a two point calibration can be done. This can be done while on a patient if they can tolerate the desired calibration point (room air or 100% oxygen). Touch this button to go to the Calibrate O_2 Mon screen.

O_2 Cal, 21% O_2. Touch this button and follow the onscreen directions to calibrate at room air. Ensure that no oxygen device is connected to the air intake port on the right side of the ventilator.

O_2 Cal, 100% O_2. Touch this button and follow the onscreen directions to calibrate at 100% oxygen. Ensure that 100% oxygen is being delivered to the air intake port on the right side of the ventilator. Newport suggests using the Low Flow Oxygen Reservoir with 10 L/min. of medical grade 100% oxygen connected to it.

Utility Screen

(Hospital and Transport Domain, Standby and Ventilating Condition except where noted)
Refer to Figure 4

Access the Utility Screen through the More Screen as shown above. See Section 9, Specifications, for ranges and more details for each parameter.
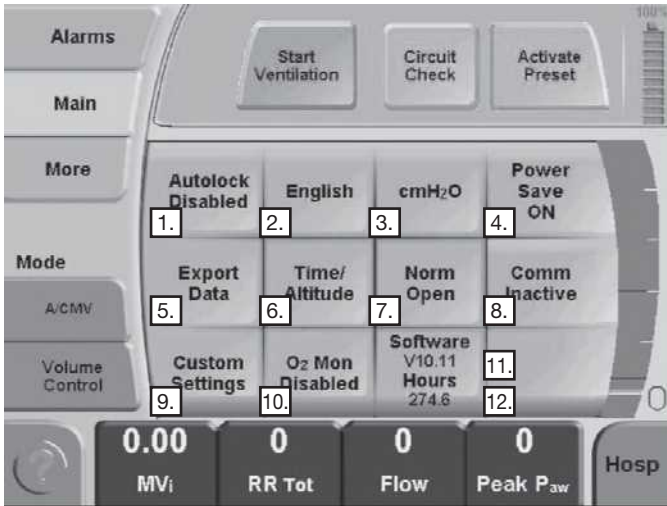
Figure 4

Press *Accept* button to confirm changes made to any of the following parameters.

1. Auto Lock   touch button to select Autolock function Enabled or Disabled

2. Language   touch button to scroll through language selections

3. cmH$_2$O or mbar   touch button to select cmH$_2$O or mbar pressure units

4. Power Save   touch button to select Power Save function ON or OFF

5. Export Data   only available in Standby Condition. Touch to download data to Flash USB Drive or computer. This is not available while ventilating. Follow the instructions on the screen.

6. Time/Altitude   touch button to access Time and Altitude screen (see page 4-19 for details)

7.	Remote Nurse Call	touch button to select from Norm Open (normally open), Norm Close (normally closed), and Respironics nurse call systems
		For use of the Aequitron Remote Alarm System, use *Norm Close*.
8.	Comm	touch button to select from Bernoulli enabled, Vuelink enabled or Comm inactive for central monitoring systems
9.	Custom Settings	touch button to access Backup Ventilation (BUV) and Custom Presets screens (see page 4-20 for details).
10.	O₂ Monitor	touch button to select to O₂ Monitor Enabled or Disabled
11.	Software	the software version installed is displayed here
12.	Hours	the number of hours of ventilator operation is displayed here

Utility Screen Details

Time/Altitude Screen
(Hospital and Transport Domain, Standby and Ventilating Condition)
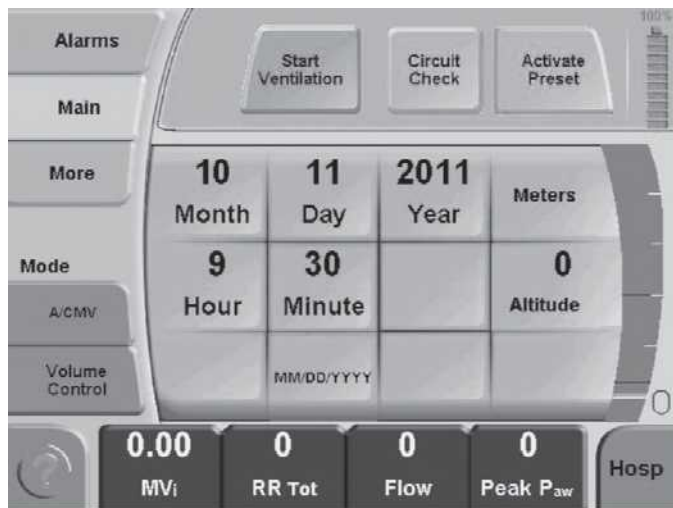
Access the Time/Altitude Screen through the More/Utility Screens as shown above.

Touch a button to activate (highlight) it, use the up and down arrow panel buttons to adjust the setting, then press *Accept* to confirm changes or press *Cancel* to return to original settings. You can set multiple parameters before pressing *Accept*. The Hours are displayed in military style; 1 - 12 for AM and 12 - 24 for PM.

Altitude can be displayed in meters or feet. The Altitude adjustment is only for the accuracy of the on-airway flow sensor. If the flow sensor is used, ensure that the altitude is set.

NOTE: The HT70 ventilator automatically maintains accurate volume delivery in altitudes up to 15,000 feet. The patented twin micro-piston system is a volume displacement technology that will deliver the set volume regardless of the altitude.

Custom Settings Screen
(Hospital and Transport Domain, Standby and Ventilating Condition)
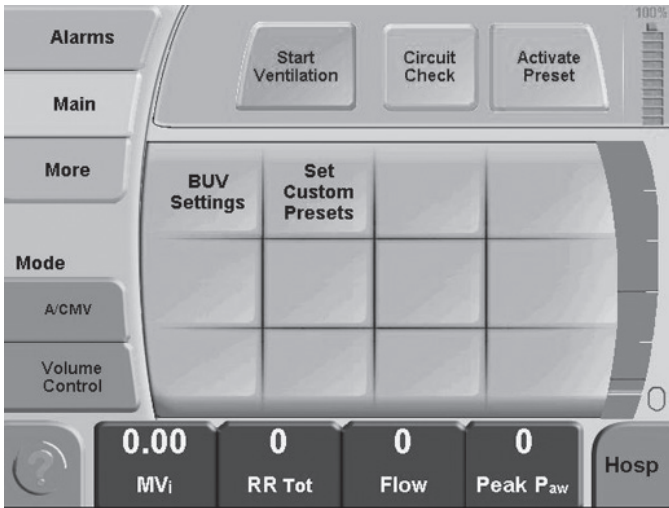
Access the Custom Settings Screen through the More/Utility Screens as shown above.

This screen allows access to available customization options for BUV (Backup Ventilation) function and the Preset functions. The following options are available on the Custom Settings Screen:

1. Set Custom Presets   touch to access menu to define the available Custom Presets

2. BUV Settings   touch to access the BUV Settings Screen

Set Custom Presets (from the Custom Settings Screen)
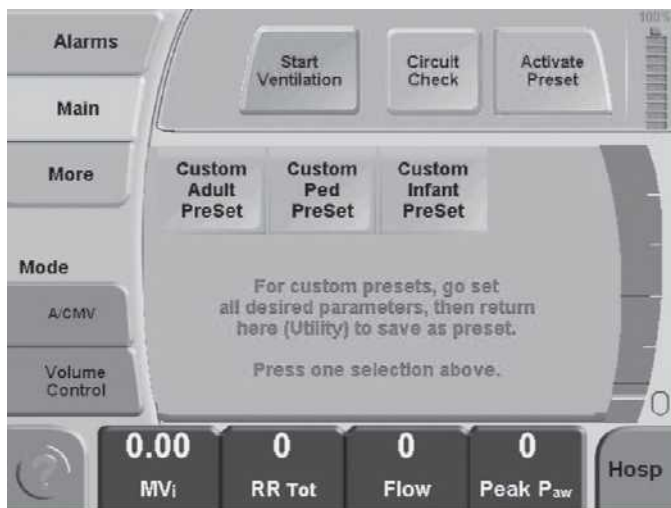
To store customized presets for different customized patient protocols:

1. Turn the ventilator on.

2. Make all the changes on the ventilator that you require for your protocol. Be sure to check the settings in the More screen and the Alarms screen.

3. Once you are satisfied with the settings for your patient protocol, return to the More Screen/Utility Screen/Custom Settings screen and touch the Set Custom Presets button.

4. Touch the desired Custom Preset (infant, pediatric or adult).

5. Touch the *Accept* button to confirm and save your choice.

You can choose "*Activate Presets*" button to enable your preset parameters from the *Startup Screen* (see page 4-17) in the Standby condition.

NOTE: Custom Presets are retained after power down.

BUV Settings Screen (from the Custom Settings Screen)
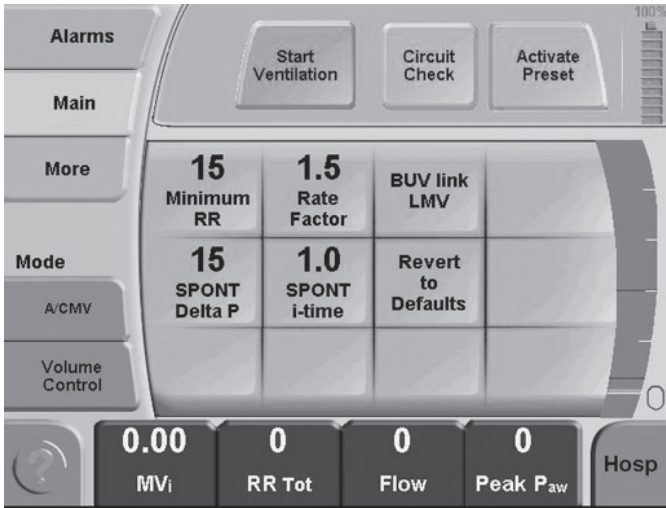
This screen allows you to customize Backup Ventilation (BUV) to your institution's policies or to revert to factory default for the Backup Ventilation parameters. You can also choose to link Backup Ventilation to the Low Minute Volume alarm (LMV), the Apnea alarm, or to both alarms. See Section 9, Specifications, for ranges and more details for each parameter.

Press *Accept* button to confirm changes made to any of the parameters.

The BUV Settings Screen includes the following adjustable parameters:

1. Minimum RR (respiratory rate)
2. Rate Factor (set rate will be multiplied times this number to determine the BUV breath rate)
3. SPONT (mode) delta P (pressure target above set PEEP for breath delivery)
4. SPONT (mode) i-time (i time for BUV breaths delivered while in SPONT mode)
5. BUV Link (with LMV [low minute volume] alarm, Apnea alarm, or both)
6. Revert to Defaults

Domain Navigation

The Newport HT70 is designed with the flexibility of useful application in the acute care as well as longterm care environments. To make the product easy and safe to use in the full spectrum of applications, we have divided care into three domains: hospital – which means acute care, Transport – anytime the user is on the move with battery and supplemental oxygen supplies, and Basic – for the long term/ home care environments.

Touch the *Domain* button in the lower right corner of the touch screen to scroll through the domain choices, Hosp (Hospital), Trans (Transport) and Basic (Basic). Press *Accept* to change to the new domain. If the panel is locked this button is not visible until the panel is unlocked.

Hospital Domain
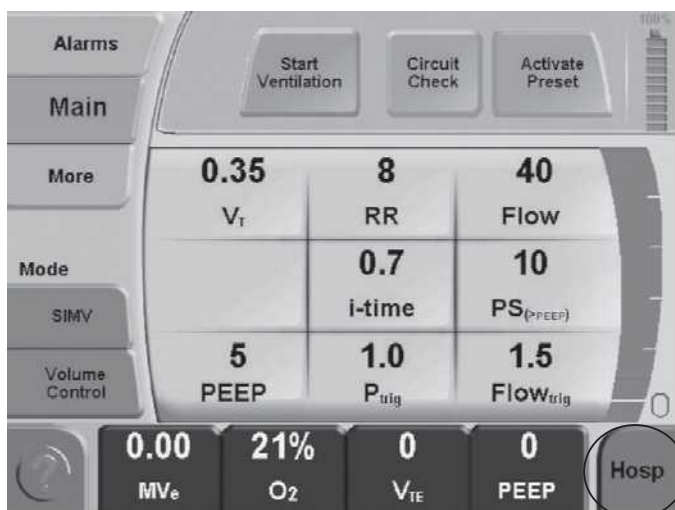
The Hospital Domain has full access to all features and screen selections available on the HT70. This manual describes all of the features and screen selections found in the Hospital Domain. The Transport and Basic Domain features and screen selections work identically to the Hospital Domain with the limitations as noted below.

Transport Domain

This Domain gives preference to transport related monitoring features like O$_2$ Cylinder use duration and estimated battery use time.

Basic Domain
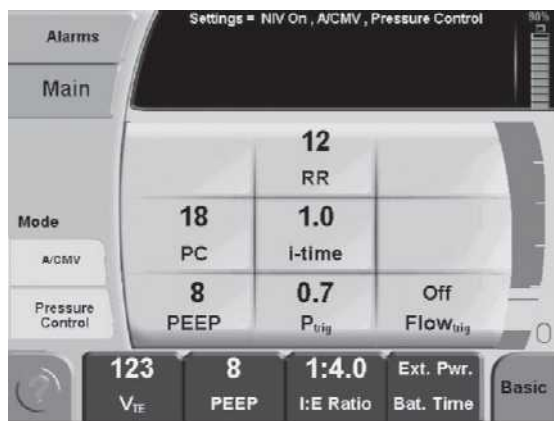
This is a simplified screen for use in a homecare or sub-acute facility type environment.The central parameter platform is replaced with a digital clock unless the *Main* or *Alarm* buttons are touched. The Breath Type and Mode settings are displayed and the user has access to the Main and Alarm screens and can view all monitored data by touching one of the monitor buttons at the lower margin of the screen. The More screen is not available. No settings can be changed within this Domain. This helps simplify operation and protect against accidental settings changes. If a setting change is needed or access to the More screen is required, simply use the *Domain* button in the lower right corner of the screen to toggle to the Hospital Domain. Press *Accept* to confirm your selection.

Section 5:
Operating

Section 5:
Operating the Ventilator

Quick Check Procedure

Introduction
This procedure is intended to assist qualified operators to establish a routine program for verifying proper HT70 operation. Perform this Quick Check procedure each time the ventilator is prepared for new patient use. The Quick Check procedure should be performed every 6 months as part of the routine maintenance procedure to confirm proper ventilator operation. Use a copy of the Quick Check Procedure Check-off Sheet found at the end of this section to record the results of each check.

HOMECARE PROVIDERS: This procedure should be performed prior to delivery of the HT70 to a patient's home.

NOTE: If Power Save is On, the screen will go to sleep (go blank) when not used for two minutes. Just touch the screen anywhere to bring it back into view.

WARNING Do not use the HT70 if it fails the Quick Check Procedure.

Equipment needed:
- o   1 liter test lung with resistor (LNG800P)
- o   Patient breathing circuit with exhalation valve

Pre-test Inspection
1. Inspect the Air Intake Filter through the filter cover on the right side of HT70. Replace the filter if it is dirty. See Section 8 for replacement.
2. Examine the test lung and patient circuit to ensure that there are no holes that will cause leaks.
3. Verify that the AC power supply is in good condition.

Set Up
1. Connect the AC power supply to an AC power source.
2. Verify that the External Power LED is lit.
3. Turn the ventilator on and verify that the audible alarm sounds and the LEDs light during the self test.
4. Connect a breathing circuit with exhalation valve and on-airway flow sensor if used.
5. Set the ventilator to the following Standard Test Settings and press Start Ventilation.

Standard Test Settings
Mode	A/CMV
Breath Type	Volume Control
NIV	Off
Tidal Volume	500 mL
i time	1.0 sec
RR	15 b/min
Ptrig	1 cmH$_2$O / mbar

Flow Trig	Off
↓Low P Alarm	5 cmH$_2$O / mbar
↑High P Alarm	99 cmH$_2$O / 97 mbar
↓Low Min Vol alarm	0.01 L (minimum setting)
↑High Min Vol alarm	50 L (maximum setting with NIV Off)
↑VTE Alarm	1.00 L
PEEP/CPAP	0 cmH$_2$O / mbar

Quick Check Procedure

1. Perform a Circuit Check
o   Touch the *Circuit Check* button at the top of the touchscreen and follow the on-screen instructions.
o   For Step 1, occlude the patient connection end of the circuit. (Do not use a test lung.)
o   Press the *Accept* button to confirm and start the Circuit Check.
o   For Step 2, open the patient connection end of the patient circuit.
o   Press the *Accept* button to continue the Circuit Check.
o   If the test passes, the message "Circuit Check PASSED Press *Accept* to Confirm" will be displayed.

If the test fails, the message "Circuit Check FAILED Press *Accept* to Continue" will be displayed.

o   Press the *Accept* button to return to Startup Screen.
o   Check that all breathing circuit components/connections are properly connected and leak free.
o   Verify that the Air Oxygen Entrainment Mixer is not attached to the Fresh Gas Intake port.
o   Then touch the *Circuit Check* button to redo the test.

If the Circuit Check fails repeatedly, try a different circuit.

WARNING Do not use the HT70 if the Circuit Check fails, inadequate ventilation may result. Use an alternate method of ventilation. Contact Newport Medical Technical Support.

o   Connect the test lung to the patient connection of the circuit. Touch Start Ventilation.

2. No External Power Alarm Check
o   Disconnect the AC power supply. Verify that there is an audible alarm and the alarm LEDs in the HT70 handle flash. Verify that the External Power LED turns off, and the Message Area turns yellow and displays the No External Power alarm message. Confirm that HT70 continues to ventilate.
o   Press the Alarm Silence/Reset button and confirm that its LED lights yellow, the audible alarm is muted and the message area returns to black.
o   Press the Alarm Silence/Reset button again and confirm that the alarm message clears.
o   Reconnect the AC power supply. Verify that the External Power LED lights green.

3. Alarms and Indicators Check

High ↑P Alarm
o   Set the High Pressure alarm limit to 20 cmH2O/mbar. Verify that an audible alarm sounds and the High Pressure message displays and that inspiration ends when pressure reaches the high limit. Set the High Pressure alarm limit back to 99 cmH2O /mbar and verify that the audible alarm stops and the alarm message remains. Press the Alarm Silence/Reset button to clear the alarm message.

Low ↓P Alarm
o   Disconnect the test lung from the breathing circuit and verify that after two breaths an audible alarm sounds and the Low Pressure Alarm message displays.
o   Attach the test lung to the breathing circuit and verify that the audible alarm ceases and the alarm message remains. Press Alarm Silence/Reset button to clear the message.

4. Pressure Gauge / PEEP Check
o   Verify that the pressure gauge moves up and down with each breath.
o   Select PEEP and Peak Paw to display in each of two Monitor Data buttons.
o   Adjust PEEP to 5 cmH2O. Verify that the Monitor Data button displays a PEEP value of 4 to 6 cmH2O. Reduce PEEP to zero.
o   Select Pressure Control and set PC at 20 cmH2O. Verify that the Monitor Data button displays a Peak Paw of 17 to 23 cmH2O.

5. Volume/Minute Volume/Respiratory Rate Monitor Check
o   Change Breath Type back to Volume Control and confirm Tidal Volume is set to 500.
o   Select VT, Min Vol and RR Tot to display in each of three Monitor Data buttons. Verify that VT= 450-550, Min Vol = 6-9 and RR Tot = 13-17.

6. Power Pac Battery Pack and Backup Battery Check
o   Unplug the AC power supply, clear the alarm with the Alarm Silence/Reset button. Verify that HT70 continues to ventilate and the Power Pac battery gauge (blue icon) reads at least 80%. If battery charge level is not sufficient, plug into external power to fully charge the Internal Dual Battery System.
o   Remove the Power Pac battery pack. Verify that HT70 continues to ventilate, the alarm sounds, the alarm LEDs light and the message in the message area indicates that the Backup Battery is in use.
o   Verify that the battery gauge is now red (for secondary backup battery) and reads at least 80%. If the secondary backup battery charge level is not sufficient, re-insert the Power Pac battery and plug into external power to fully charge the system.
o   Replace the Power Pac battery pack and verify that the audible alarm clears but the message remains.
o   Reconnect the AC power supply into the Power Pac battery pack and confirm that the External Power LED turns green.

o   Press the Alarm Silence/Reset button repeatedly until all alarm messages are cleared.

7. Brightness Check
o   Press the Brightness button and verify that it scrolls through 4 levels of brightness. Set the brightness at desired level.

THIS CONCLUDES THE QUICK CHECK PROCEDURE

HT70 Ventilator Quick Check Procedure

Pass / Fail Check-Off Sheet

Preparation for Use Tests   Indicate result for each test

1. Circuit Check Procedure   Pass _____ Fail _____

2. No External Power Alarm Check Pass _____ Fail _____

3. Alarms & Indicators Check
    High ↑P Alarm   Pass_____ Fail _____
    Low ↓P Alarm   Pass _____ Fail _____

4. Pressure Gauge / PEEP Check   Pass _____ Fail _____

5. Volume/Minute Volume/   Pass _____ Fail _____
    Respiratory Rate Monitor Check

6. Power Pac Battery Pack and   Pass _____ Fail _____
    Backup Battery Check

7. Brightness Check   Pass _____ Fail _____

The ventilator is ready for operation when all tests have been successfully completed.

Note any comments on inspection of unit, corrective action taken, or recommendations for further action.

Completed by: _____   Date: _____

Facility: _____

Serial #: _____

Unit hours: _____

Patient Set Up Procedure

WARNING Review all of the General Warnings and Cautions in Section 1 prior to using the ventilator.

All ventilator controls and alarm limits must be appropriate for the patient's condition, according to the therapy prescribed by a physician.

1. Press the momentary power switch located on the back of the ventilator to turn the ventilator On. The ventilator performs a brief self-test to ensure proper microprocessor function. During the self-test, verify that the Startup Screen appears, the LEDs light and the audible alarm sounds briefly.

2. Ensure the ventilator, patient circuit and accessories are assembled correctly. (See Section 3)

3. Make sure HT70 has passed the Quick Check Procedure.

4. Perform the Circuit Check. Resolve any issues. (See Section 4)

5. Set all parameters per physician's prescription using manual adjustment or a Custom or Default Preset. See Section 9 for specifications on all settings.
    a. Select mode and breath type. Then set all parameters on the Main Screen and relevant parameters on the More Screen.
    b. Select safe/appropriate alarm limits on the Alarms Screen.
    c. Ensure that the Alarm Loudness is set loudly enough for the alarm to be heard under all circumstances.

6. Place a test lung on the patient end of the breathing circuit and press the Start Ventilation button on the touchscreen.

7. Ensure that the ventilator starts operation appropriately.

NOTE: While ventilating a test lung, peak pressure for volume breaths and volume delivery for pressure breaths will be different than they will be on the patient. Pressure Support breaths will not perform the same way they do on patients. And PEEP may cause auto-triggering. These differences may cause nuisance alarms during this step.

8. When you are ready, remove the test lung and attach the patient connection of the breathing circuit to the patient interface.

9. Monitor the patient settings and check for appropriate alarm settings.

10. Verify that the patient trigger icon lights each time the patient initiates a spontaneous breath. Re-adjust sensitivity (Ptrig or Flow trig if using on-airway flow sensor on HT70 Plus model) as necessary to ensure comfortable triggering without auto-triggering. When using PEEP while ventilating a patient with an airway leak, set NIV to ON and adjust Bias Flow to stabilize the PEEP and eliminate auto-triggering at reasonable trigger settings.

11. Closely monitor the patient and ventilator to ensure appropriate oxygen delivery, and adequate oxygenation and ventilation.

WARNING Always ensure adequate monitoring is in place when ventilating patients.

WARNING If, at any time, the patient is not responding to ventilation appropriately, the patient should be taken off the ventilator immediately and connected to an alternate method of ventilation. Contact your health care provider or physician immediately.

NOTE: To ensure best battery performance, always plug the HT70 into an external power source when it is available, even when the ventilator is not in use.

Troubleshooting Guide for Newport HT70

Ventilation and alarm settings are determined by the physician's prescription. Consult with your physician on ventilation and alarm settings.

- Alarm messages can be cleared with the Silence/Reset button.
- Review the entire Operating Manual for full user instructions.
- Note that the minute volume alarms are expiratory minute volume alarms when the on-airway flow sensor is in use and they are inspiratory minute volume alarms when the on-airway flow sensor is not in use.
- Back up Ventilation increases the respiratory rate in A/CMV and SIMV and provides pressure controlled breaths in SPONT mode. It may be caused by the violation of a Low Minute Volume Alarm or Apnea Alarm. Resolve the alarm to resolve the back up ventilation.

Problem/ Area of Concern	Probable Cause	Resolution
Touchscreen doesn't respond to touch	Screen is locked by Auto-lock function (set on Utilities screen)	Touch the lock icon in the lower right corner of the screen for 3 seconds to unlock the screen
	Using Basic Domain and the parameters are changed to displays rather than buttons	Touch the Basic Domain button in the lower right corner of the screen to toggle the domain to Hospital (Hosp), then press *Accept*.
Touchscreen is dark/blank	Power Save is ON (Utility Screen) and the screen has "gone to sleep" to save power	Touch the screen or push any button to "wake up" the screen
Need to view all monitored values		Touch any monitored value at lower edge of the screen
Alarm indicator(s) lit but not blinking/Alarm message in the message window	Alarm condition is resolved. (Alarm is "latched".)	Push Silence/Reset button to clear the indicator and messages one at a time. Hold 3 seconds to clear all messages at once.
Water accumulating in the breathing circuit	Gas is cooling as it travels through the circuit tubing	Keep tubing as short and warm as possible between the humidifier and the airway so that water remains in the vapor state Keep tubing away from cold surfaces Do not aim a cooling fan at the tubing If appropriate, use a heated wire circuit
	Water trap needs to be emptied	Empty the water trap frequently

Problem/ Area of Concern	Probable Cause	Resolution
Audible alarm is too quiet	Alarm Loudness is set too low	Touch Alarms, touch Alarm Loudness. Adjust setting to a higher number and press *Accept*.
Power Pac battery doesn't last long enough	Not fully recharged	Connect the Power Pac to external AC or DC power for at least 3 hours between uses
	Ventilator settings/ patient condition (a large leak during pressure ventilation, a high level of bias flow setting, or an aggressively breathing patient) demand more gas delivery than the standard settings.	The Power Pac battery is functioning normally. Carry at least one extra fully charged Power Pac battery (Part Number: BAT3271A) for ventilator dependent patients and for patients whose ventilation pattern requires higher battery power consumption.
	Power Pac needs to be replaced	Contact a Newport Authorized Service Provider or Newport Medical Technical Service Department for assistance. Email: techservice@ ventilators.com Tel: 1.714.4275811 Ext. 500
Check Circuit or Prox Line Alarm	Circuit disconnect	Reconnect the circuit
	Humidity in Proximal Line	Change where Proximal Line is connected to the circuit. Move it from the connection at the patient wye (wet environment) to an adapter placed directly on the inlet of the humidifier chamber(dry environment).
	No proximal filter in place	Insert approved proximal filter (part number: HT6004701)
	Inspiratory Flow is too low, circuit pressure does not rise fast enough when the breath starts	As appropriate, increase Flow or change flow pattern in Volume Control or speed up Slope Rise in Pressure Control/Pressure Support.

Problem/ Area of Concern	Probable Cause	Resolution
Circuit Check fails	Leak in breathing circuit	Tighten all circuit & water trap connections
		Trim ends of the proximal and exhalation valve tubings to enable a tighter fit
		Check the integrity of/replace the exhalation valve diaphragm
	Connecting test lung instead of occluding patient connection of the circuit in step 1.	Remove test lung and occlude the patient connection of the circuit during step 1.
	Incorrect assembly of circuit/ exhalation valve	See Operating Manual for proper assembly
	Incompatible circuit/exhalation valve	Contact Newport Medical to verify if circuit is compatible. Email: clinical@ ventilators.com
	Oxygen connected directly to the circuit	Use the Low Flow Oxygen Reservoir or 50 psi Air Oxygen Mixer. Connect oxygen devices to the Fresh Gas Intake port after, not before, the Circuit Check is complete
	Ventilator needs service	Contact a Newport Authorized Service Provider or Newport Medical Technical Service Department for assistance. Email: techservice@ ventilators.com Tel: 1.714.4275811 Ext. 500
Green "Ext Power" indicator on panel does not light when HT70 is plugged into external AC (wall) or DC (external battery or auto lighter outlet) power	No external power is reaching HT70. HT70 is running from the Internal Battery System.	Check power cord connections (L-shaped pinch fit connector on rear of HT70 should angle toward the midline of the ventilator, not away. See diagram on sticker.)
		Check that power outlet is active
		External battery is depleted, plug into another external battery, auto lighter or AC power
		Check / replace the fuse in the External Battery System or Auto DC Cable
		Contact a Newport Authorized Service Provider or Newport Medical Technical Service Department for assistance. Email: techservice@ ventilators.com Tel: 1.714.4275811 Ext. 500

Problem/ Area of Concern	Probable Cause	Resolution
Auto-triggering (at a typical trigger setting) (green trigger light illuminates when there is no patient effort)	Circuit and/or airway leak	Check for and resolve leaks if unintentional. If airway leak is intentional, turn on NIV and adjust Bias Flow/Trigger settings so that the patient can trigger effectively without auto-triggering. Consider using the Flow Sensor and Flow Trigger.
In SIMV or SPONT modes, some or all breaths seem to last extra long	Leak is causing flow to remain high during pressure support breath delivery, so the PS Exp. Threshold (flow cycling off threshold) is never met	Eliminate circuit leaks Set the PS Max i-Time control to limit the breath delivery to a reasonable inspiratory time
Occlusion Alarm/ Sustained Occlusion Alarm The patient will not be ventilated. Manually ventilate the patient until this is resolved.	The patient's expiratory gas pathway is occluded or partially occluded	Evaluate everything in the patient's pathway of exhalation to determine what is causing resistance and resolve the issue Change HME and/or expiratory filter if used Change the exhalation valve Unkink expiratory drive line Replace flow sensor
High (Peak) Pressure Alarm This alarm violation stops breath delivery until pressure drops	Coughing / need for airway care or bronchodilator treatment Secretions too dry due to inadequate humidity Pneumatic nebulizer inline cont.	Perform suctioning/airway care, or if due and prescribed, give prescribed bronchodilator treatment Use heated humidifier with appropriate temperature setting and keep tubing warm Contact Newport Medical for assistance Email: clinical@ventilators.com Tel: 1.714.4275811 Ext. 123 cont.

Problem/ Area of Concern	Probable Cause	Resolution
High (Peak) Pressure Alarm cont.	Supplemental oxygen flowing directly into breathing circuit	Use the Low Flow Oxygen Reservoir or 50 psi Air Oxygen Mixer
	Kinked tubing	Un-kink it
	Sticky exhalation valve and or on-airway flow sensor from medication treatments or secretions	Install a clean exhalation valve and/or on-airway flow sensor
	Ventilation settings mismatch the patient condition, such as an actively spontaneously breathing patient under controlled ventilation mode, ventilator's inspiratory time (i-time) setting too long, Flow setting too high, VT setting too high	Evaluate patient and change settings (Ventilation Mode, Flow, VT, i-time, Flow Waveform) as appropriate
	Alarm setting too low	Resolve appropriately
Low (Peak) Pressure Alarm Note: Situations that violate the Low Pressure Alarm in Volume Control may violate the High Inspiratory Minute Volume alarm or Low Expiratory Minute Volume alarm in Pressure Control. You should seek similar remedies.	Circuit leak (especially while using Volume Control)	Check for and resolve leaks in circuit or exhalation valve (similar to resolving failed Exhalation Valve Calibration)
	Flow setting is too low (i-time setting is too high) in Volume Control	Evaluate patient and change settings (Flow, VT, Flow Waveform) as appropriate
	Big airway leak while using Volume Control	Evaluate cuff inflation/ trach tube size
		Reposition mask. Make sure mask is not vented.
		Use Pressure Control instead of Volume Control if clinically appropriate
	Trigger setting too insensitive	Use Ptrig setting that is closer to zero

Problem/ Area of Concern	Probable Cause	Resolution
High (Expiratory) Minute Volume Alarm This alarm is only active when the on-airway flow sensor is in place	Patient is breathing faster than usual	Check patient for anxiety, pain, discomfort, change in illness
	A change in ventilator settings or patient condition has caused delivery of a higher patient tidal volume	Check the patient. If appropriate, lower the Pressure Control/Pressure Support setting until the exhaled volume is suitable for the patient
	High Min Vol alarm has not been set properly for use with on-airway flow sensor	Set alarm appropriately
	Pneumatic nebulizer inline	Contact Newport Medical for assistance Email: clinical@ventilators.com Tel: 1.714.4275811 Ext. 123
	Supplemental oxygen flowing directly into breathing circuit	Use the Low Flow Oxygen Reservoir or 50 psi Air Oxygen Mixer
	On-airway flow sensor is not clean	Replace sensor
Low (Expiratory) Minute Volume Alarm The on-airway flow sensor is in place	Circuit or airway leak – not intentional	Check for and resolve circuit leaks (similar to resolving failed Exhalation Valve Calibration)
		Evaluate cuff inflation/ trach tube size, increase as needed
		Only at night? Make sure alarm settings are appropriate for day and night conditions
		Reposition mask. Make sure mask is not vented
	Intentional leak for speech	If a speaking valve is in use, this alarm will need to be disabled. Make sure appropriate monitoring is in place to maintain patient safety.
	Patient is breathing slower than usual cont.	Check patient and resolve problems cont.

Problem/ Area of Concern	Probable Cause	Resolution
Low (Expiratory) Minute Volume Alarm cont.	Low Min Vol alarm has not been set properly for use with on-airway flow sensor	Set alarm appropriately
	Connected to a test lung with a resistor	The resistor may be causing flow eddies which make the flow sensor measurement inaccurate. Try a test lung with less resistance.
High (Inspiratory) Minute Volume Alarm On-airway flow sensor is not in place. Note: Situations that violate the Low Pressure Alarm in Volume Control may violate the High Inspiratory Minute Volume alarm or Low Expiratory Minute Volume alarm in Pressure Control. You should seek similar remedies.	Large airway or circuit leak (Pressure Control or Pressure Support)	Check for and resolve leaks (similar to resolving failed Exhalation Valve Calibration) Reposition mask. Make sure mask is not vented. Evaluate cuff inflation/ trach tube size Only at night? Make sure alarm settings are compatible with day and night conditions.
	Patient is breathing faster than usual	Check patient for anxiety, pain, discomfort, change in illness
	Circuit just reconnected after disconnect	Press Alarm Silence, the alarm will resolve by itself
	Auto-triggering due to airway leak	Turn on NIV and increase Bias Flow setting. Balance Trigger and Bias Flow settings to provide the most effective triggering and comfort
	High Min Vol alarm has not been set properly for use without on-airway flow sensor	Set alarm appropriately or reconnect on-airway flow sensor

Problem/ Area of Concern	Probable Cause	Resolution
Low (Inspiratory) Minute Volume On-airway flow sensor is not in place. This will trigger back up ventilation if the back up ventilation link is set to "LMV" or "Both"	Need suctioning/ airway care when using Pressure Control or Pressure Support	Suction/perform airway care
	Upper airway occlusion during mask ventilation	Reposition head/neck
	Supplemental oxygen flowing directly into breathing circuit	Use the Low Flow Reservoir or 50 psi Air Oxygen Mixer instead of adding oxygen directly into the circuit
	Ventilator is not triggering with each breathing effort	Use Ptrig setting that is closer to zero or add flow sensor and use Flow Trigger
	Patient is breathing slower than usual	Replace HME if it is used Assess the patient and ventilator settings
	Low Min Vol alarm has not been set properly for use without on-airway flow sensor	Set alarm appropriately or reconnect on-airway flow sensor
High VTE Alarm High Expiratory Tidal Volume Alarm This alarm is only active when the on-airway flow sensor is in place	A change in ventilator settings or patient condition has caused delivery of a higher patient tidal volume	Check the patient. If appropriate, lower the Pressure Control/Pressure Support setting until the exhaled volume is suitable for the patient
	High VTE alarm has not been set properly for use with the on-airway flow sensor	Set alarm appropriately
	On-airway flow sensor is not clean	Replace sensor

Problem/ Area of Concern	Probable Cause	Resolution
BUV (Back Up Ventilation) Back Up Ventilation is delivered in response to Low Min Vol alarm or Apnea Alarm (set in More – Utilitiy – Custom Settings – BUV screen)	Same causes as Low Min Vol or Apnea Alarm Resolved when inspiratory minute volume rises to 10% above the Low Min Vol alarm setting or Apnea Alarm is resolved	Resolve Low Min Vol alarm or Apnea Alarm Note: Back-up Ventilation is suspended for one minute at power ON and after you adjust any ventilation setting or change screens
High Baseline Pressure Alarm	Circuit Check was not done when circuit was installed	Do a Circuit Check every time a fresh circuit/exhalation valve is installed
	Increased resistance to exhalation	Evaluate everything in the patient's pathway of exhalation to determine what is causing resistance and resolve the issue Change HME and/or expiratory filter if used Change the exhalation valve Unkink expiratory drive line Replace flow sensor with a clean one
	Exhalation drive tubing is kinked	Un-kink it
	Auto-triggering due to leaks (if PEEP is set > 0)	Check for and resolve leaks and/or activate NIV and adjust Bias Flow on the More Screen.
	Auto-triggering due to flow and or pressure trigger settings being too low	Re-adjust trigger settings to eliminate auto-triggering (higher number is less sensitive)
	Pressure Support breaths are not ending when patient exhales	Increase Expiratory Threshold and/ or decrease PS Max i-Time (More Screen)
	Too little time allowed for exhalation	As appropriate, shorten i-time, change flow waveform, decrease respiratory rate

Problem/ Area of Concern	Probable Cause	Resolution
Apnea Alarm	No mandatory breaths or spontaneous efforts detected within the set time period, 5 - 70 seconds.	Is the patient is breathing? Is Ptrig / Flow trig setting sensitive (low) enough? Use A/CMV or SIMV (not SPONT) and make sure respiratory rate setting is adequate
Pressure Control Setting Not Reached Alarm	Big leak/disconnect	Check for and resolve leaks or disconnect
No external power Power Switchover Alarm HT70 will use its internal battery system Unless external power was disconnected on purpose, ALL resolutions MUST include making sure that the green "External Power" LED lights up	HT70 does not detect external power Power source is switched OFF Power cord is not fully inserted/ inserted backwards Power source is depleted	Intentionally unplugged? Press Silence/Reset to clear the message. Not intentional? Plug the HT70 into external power Switch power source ON Fully insert power cord in the proper orientation (angled to the right). Refer to illustrated label on Power Pac. Connect to another power source If power was not purposely disconnected and none of these actions resolves the issue, call for service immediately.
Running on Backup Battery Alarm Power Pac is nearing depletion and HT70 has switched to the Emergency Backup Battery.	Minimum of 30 minutes Internal Battery System use time left	Connect to external AC or DC power, and make sure that the green "External Power" LED lights up. Don't leave the ventilator until you see the green light. You need to connect to external power!

Problem/ Area of Concern	Probable Cause	Resolution
Backup Battery Shutdown Imminent Alarm Internal Battery System is depleted. Connect to external power immediately.	Minimum of 15 minutes Internal Battery System use time left	Connect to external AC or DC power, and make sure that the green "External Power" LED lights up. Don't leave the ventilator until you see the green light! If no external power is available, prepare an alternate method of mechanical ventilation immediately.
High Respiratory Rate Alarm The delivered breath rate is higher than the alarm setting	Patient is breathing fast. Auto-triggering of ventilator caused by leak Flow and/or Pressure Trigger sensitivity setting is too sensitive Double triggering caused by too short of an inspiratory time setting	Check the patient and resolve. Resolve leak in circuit by tightening all connections If airway leak, turn on NIV and increase Bias Flow setting Optimize trigger setting(s) As appropriate, increase i-time, and/or PS Max i-Time and/or decrease Expiratory Threshold
High O2 Alarm Delivered oxygen concentration is higher than set high limit	Oxygen was increased prior to an intervention (e.g. suctioning) and was not reduced back to prescribed value Low flow reservoir is in use and: patient's minute volume has decreased airway or circuit leak has decreased cont.	Adjust oxygen setting back to prescribed value Evaluate patient and re-adjust settings or alarm as appropriate cont.

Problem/ Area of Concern	Probable Cause	Resolution
High O$_2$ Alarm cont.	during pressure control and so delivered minute volume is lower NIV is on and Bias Flow was decreased oxygen concentrator is putting out a higher FIO2 than expected High O$_2$ alarm is set inappropriately Oxygen sensor calibration was not done appropriately	 Set the High O$_2$ alarm appropriately Calibrate Oxygen Sensor appropriately
Low O$_2$ Alarm Delivered oxygen concentration is lower than set low limit	Oxygen supply loss or disconnect or cylinder empty Low flow reservoir is in use and: patient's minute volume has increased airway or circuit leak has increased during pressure control and so delivered minute volume is higher NIV is on and Bias Flow was increased oxygen concentrator is putting out a lower FIO2 than expected cont.	Restore oxygen supply Resolve leak, evaluate patient and re-adjust settings or alarm as appropriate cont.

Problem/ Area of Concern	Probable Cause	Resolution
Low O$_2$ Alarm cont.	Low O$_2$ alarm is set inappropriately	Set the Low O$_2$ alarm appropriately
	Oxygen sensor calibration was not done appropriately	Calibrate Oxygen Sensor appropriately
	Patient inhales room air through emergency intake valve	Make sure the ventilator settings (such as flow, tidal volume, i-time, and trigger) match the patient needs.
O$_2$ Sensor Failure Alarm	O$_2$ Sensor needs calibration, is depleted or is past recommended replacement time	Perform .21 and 1.00 FIO2 calibrations. If either calibration fails when performed properly, replace the sensor
The system date time has reset to 2006/01/01 or the following message is displayed "Date has reset. Please replace coin battery".	The internal coin battery needs to be replaced.	Revise the date and contact a Newport Authorized Service Provider or Newport Medical Technical Service Department for assistance. Email: techservice@ventilators.com Tel: 1.714.4275811 Ext. 500

For further assistance, contact Newport
Technical Support or Clinical Support.

Technical – techservice@ventilators.com
Phone: +1.714-427-5811 ext. 500

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Section 6:
Alarms

Ventilator Alarms

See Section 9, Specifications, for alarm priority level, ranges and descriptions.

Setting Alarms

The Alarm controls are changed just like the parameter controls - with a simple *Touch / Adjust / Accept* method:

1. Touch the *Alarms* button to enter the Alarms screen.
2. Touch the desired Alarm control (it will appear highlighted)
3. Use the ▲ or ▼ buttons to make the desired adjustment.
4. Press the *Accept* button to confirm the change.

You can make several adjustments before accepting the changes. When you are satisfied with all the changes, you can accept them all by pressing the *Accept* button once.

Before you accept any change, if you want to go back to the previous settings, simply press the *Cancel* button.

The minute volume alarms are expiratory minute volume alarms when the on-airway flow sensor is in use and they are inspiratory minute volume alarms when the on-airway flow sensor is not in use.

Alarm Quickset
When no alarms are being violated, you can choose to have the HT70 automatically set the alarm limits. From the *Alarms* screen, touch *Alarm Quickset* and confirm by pressing the *Accept* button. The HT70 will monitor ventilation for 30 seconds and then set the alarm limits. During the 30 second period the touch screen will not respond unless an alarm occurs or the *Cancel* button is pressed.

If an alarm occurs during the monitoring period, Quickset is canceled. If this occurs, check the ventilator settings and confirm that they meet the physician's prescription and are meeting the patient's needs. Adjust alarms manually if needed to clear any alarm condition. Then you can activate Quickset again.

Alarm Quickset will not activate when in Standby Condition, you must be in Ventilation Condition.
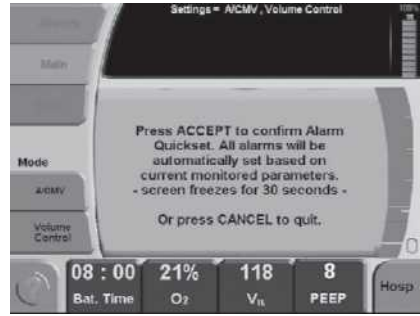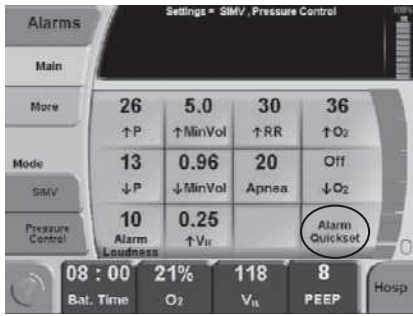
Alarm Indicators

When an alarm limit is violated:
1. The message area changes color according to alarm priority and an alarm message is displayed.
2. The alarm LEDs in the handle of the HT70 flash.
3. The alarm parameter button on the Alarms Screen (if it is an adjustable alarm) is highlighted.
4. An audible alarm sounds.

When the violation is no longer in effect, the alarm message latches (remains steadily visible) until it is reset by pressing the *Alarm Silence/Reset* button.

Alarm Silence/Reset button
Press this button to silence the audible alarm for one minute (60 sec). Once an alarm condition is corrected, press this button to clear (reset) the alarm message. Press repeatedly to clear multiple messages. Press and hold for 3 seconds to clear all alarm messages at once.

WARNING Failure to identify and correct alarm violations may result in patient injury.

Alarm Silence LED
Located next to *Alarm Silence/Reset* button, the LED remains lit during the one minute alarm silence period.

User Adjustable Alarms

↑P (High Pressure)
↓P (Low Pressure)
↑RR (High Respiratory Rate)
Apnea (time adjustment)
↑VTE (High Tidal Volume)[+]

↑ Min Vol (High Inspiratory or Expiratory[+] Minute Volume)
↓ Min Vol (Low Inspiratory or Expiratory[+] Minute Volume)
↑O2 (High Oxygen Concentration)
↓O2 (Low Oxygen Concentration)

+ only available on the HT70 Plus model when the on-airway flow sensor is in use

The HT70S and HT70 model Ventilators monitor the volume of gas output from the ventilator, therefore the high and low inspiratory minute volume alarms respond to changes in delivered, not exhaled, volumes. For these models use the High Inspiratory Minute Volume Alarm (↑Min Vol) to detect leaks or disconnects while using pressure controlled ventilation and use the Low Pressure Alarm (↓P) to detect circuit leaks or disconnect while using volume controlled ventilation.

For the HT70 Plus model, if the on-airway flow sensor is in use, the sensor measures exhaled volumes. So in this case the ventilator will automatically display exhaled Tidal Volume and exhaled Minute Volume and the alarms will respond accordingly. That is, when the on-airway flow sensor is in use, the Low Minute Volume alarm will respond to leaks and disconnects when minute volume leaving the patient drops to the alarm setting. If exhaled volumes are important to the care of your patient, then we recommend using the HT70 Plus model with the on-airway flow sensor. To verify exhaled volumes when not using the flow sensor, use a separate exhaled volume monitor.

Low Pressure Alarm ↓P

The Low Pressure Alarm determines the minimum pressure that must be attained in the breathing circuit during mandatory breaths. It should be set as close to the patient's normal peak pressure as possible.

The Low Pressure Alarm limit does not apply to any breaths in the SPONT mode or to spontaneous breaths in SIMV mode.

NOTE: The Low Pressure Alarm setting is limited to no less than three (3) above the PEEP/CPAP setting. If NIV is enabled, it is limited to no less than one (1) above the PEEP/CPAP setting.

High Pressure Alarm ↑P

The High Pressure Alarm setting determines the maximum pressure allowed in the breathing circuit. In general, it should be set 10 to 15 cmH_2O above the patient's normal peak pressure, but always at or below a safe ventilating pressure.

Low Inspiratory Minute Volume Alarm ↓Low Min Vol

The Low Inspiratory Minute Volume Alarm alerts the caregiver when delivered minute volume decreases to the set alarm level. Delivered minute volume may decrease due to slowed or absent patient breathing effort in any mode/breath type. It may also decrease due to worsening lung conditions or secretion build up in pressure control or pressure support.

This alarm may be linked with Backup Ventilation.

When the NIV feature is turned ON, the Low Inspiratory Minute Volume can be set to OFF.

Low Expiratory Minute Volume Alarm ↓Low Min Vol
(with on-airway flow sensor in use)

The Low Expiratory Minute Volume Alarm alerts the caregiver when exhaled minute volume decreases to the set alarm level. Exhaled minute volume may decrease due to slowed or absent patient breathing effort in any mode/breath type. It may also decrease due to worsening lung conditions or secretion build up in pressure control or pressure support. It may also decrease due to leaks at the airway (such as deflated cuff) or in the breathing circuit.

This alarm is not compatible with use of a speaking valve. The speaking valve diverts the patient's exhaled gas around the trach tube so that it can pass through the vocal cords, and therefore the gas does not exit the patient through the flow sensor. When using a speaking valve, turn NIV ON and then disable the Low Expiratory Minute Volume Alarm. Make sure to provide appropriate monitoring and alarms from other sources to ensure patient safety.

This alarm may be linked with Backup Ventilation.

When the NIV feature is turned ON, the Low Expiratory Minute Volume can be set to OFF.

High Inspiratory Minute Volume Alarm ↑High Min Vol

The High Inspiratory Minute Volume Alarm alerts the caregiver when delivered minute volume increases to the set alarm level. This alarm helps to alert the caregiver to increases in breath rate, auto-triggering and during pressure control or pressure support, to large leaks or tubing disconnects.

High Expiratory Minute Volume Alarm ↑High Min Vol
(with on-airway flow sensor in use)

The High Expiratory Minute Volume Alarm alerts the caregiver when exhaled minute volume increases to the set alarm level. This alarm will help alert the caregiver to increases in breath rate, auto-triggering or improvements in lung compliance.

High Respiratory Rate Alarm ↑RR

This alarm alerts the caregiver if the total respiratory rate rises above the alarm setting.

High ↑O$_2$ Alarm (O$_2$ Sensor must be installed and Enabled)

This alarm alerts the caregiver if the delivered oxygen concentration increases to the ↑O$_2$ alarm setting.

Low ↓O$_2$ Alarm (O$_2$ Sensor must be installed and Enabled)

This alarm alerts caregiver if the delivered oxygen concentration decreases to the ↓O$_2$ alarm setting.

High Tidal Volume Alarm ↑VTE
(with on-airway flow sensor in use)

This alarm alerts caregiver if the measured exhaled tidal volume increases to the High ↑VTE alarm setting. This alarm will help alert the caregiver to changes in patient condition during pressure support/pressure control ventilation.

Apnea Alarm

The Apnea alarm is violated when no mandatory breaths or detected spontaneous efforts occur within the set time period.

This alarm may be linked with Backup Ventilation.

Backup Ventilation

Backup Ventilation can be set to be activated by either the Low Inspiratory/Expiratory+ Minute Volume alarm or the Apnea alarm or both. See the More/*Utility*/Custom *Settings* Screen parameters for selecting BUV criteria.

When Backup Ventilation is activated:
1. The alarm indicator blinks,
2. An audible alarm sounds,
3. A Backup Ventilation alert is displayed in the Message Window.
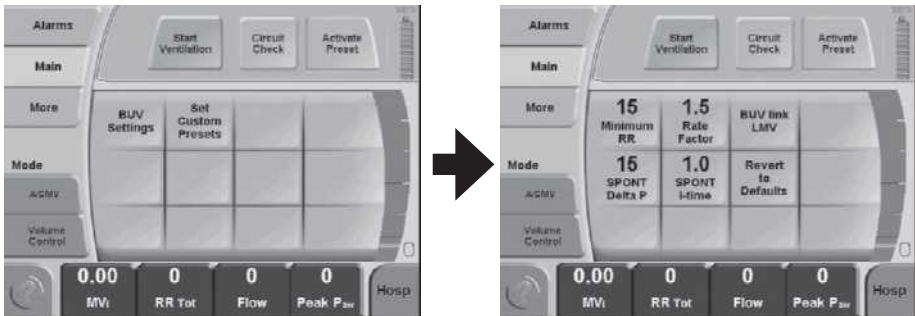
NOTE: Backup Ventilation is functional in all modes/breath types

Automatic Alarms

The following alarms are automatically set by the ventilator based on patient settings or device condition. Violated alarms are indicated by an audible alarm, an alarm message displayed on the touchscreen and the LEDs in the handle flashing.

High Baseline Pressure	Pressure Control Setting Not
Low Baseline Pressure	Reached
Occlusion	Backup Battery Low Charge
Sustained Occlusion	No External Power
Check Circuit or Prox Line	Shut Down Alert
Device Alert	Backup Battery Low
Power Pac Battery Pack Low	Backup Battery Shutdown
Integrated Power Pac Failure Alarm	Imminent
Switching to Backup Battery	Internal Temperature
Running on Backup Battery	Backup Battery Temperature
Motor Fault	Power Pac Temperature Alarm
Flow sensor disconnect / failure+	Backup Battery Failure
O2 Cylinder Low / Empty	

+ only available on the HT70 Plus model when the on-airway flow sensor is in use

High Baseline Pressure Alarm

The High Baseline Pressure alarm is activated by obstruction or high resistance to exhalation. Check for obstructions to patient exhalation or for improper exhalation valve function. This could be caused by aerosol medication build up on the exhalation valve; an occluded filter, or incomplete exhalation due to auto-triggering.

Low Baseline Pressure Alarm

The Low Baseline Pressure Alarm is activated by an unstable baseline (for example, leak in the breathing circuit or at the patient interface). Check for leaks and for improper exhalation valve operation. If the leak is purposeful (i.e. deflated tube cuff), turn NIV ON and adjust Bias Flow to stabilize PEEP (baseline).

Occlusion Alarm

An Occlusion alarm is activated by an obstruction in the breathing circuit. The HT70 will attempt to relieve the pressure that has built up in the circuit and will not deliver additional breaths until the situation is resolved. The alarm resets when the occlusion is resolved and breath delivery will resume at that point.

Sustained Occlusion Alarm

A Sustained Occlusion alarm is activated if the Occlusion alarm is not cleared within 10 seconds or 2 breath periods, whichever is shorter. The HT70 will attempt to relieve the pressure and will not deliver additional breaths until the situation is resolved. The alarm resets when the occlusion is resolved and breath delivery will resume at that point.

Check Circuit or Prox Line Alarm

This alarm indicates that the circuit has become disconnected or the proximal pressure tubing is disconnected, kinked or has water in it. Check the circuit for disconnects or problems with the prox line pressure tubing/prox line filter.

NOTE: Be sure to keep the Prox Inline Filter clean and dry at all times.

Flow Sensor Disconnect / Failure Alarms[+]

These alarms indicate that the on-airway flow sensor has become disconnected, or the tubing has been partially blocked with water or the flow sensor is no longer working.

Pressure Control Setting Not Reached Alarm

The Pressure Control Setting Not Reached alarm is activated by inadequate pressure rise during pressure controlled breaths. Check that Slope/Rise is set to a fast enough level setting and check for leaks.

No External Power Alarm

The No External Power Alarm is activated by disconnection from the power cord or a power interruption. The ventilator will automatically switch to the Power Pac battery pack or back up battery. Pressing the *Alarm Silence/Reset* button will clear the alarm.

Device Alert Alarm – System Error

The Device Alert Alarm is activated when the microprocessor detects a functional problem with the ventilator. When this occurs, an alternate means of ventilation should be used. The ventilator must be powered down by pressing the *On/Off* button on the back of the unit.

If the cause of the device alert does not allow the HT70 to display the alarm message and the Device Alert indicator to light, the ventilator will shut down and the Shut Down Alert Alarm will activate.

WARNING If a Device Alert alarm occurs, immediately disconnect the patient from the ventilator and provide an alternate method of ventilation until the cause of the alert has been determined and corrected.

Motor Fault Alarm

The Motor Fault Alarm is activated when the microprocessor detects a functional problem with the motor or motor control systems. When this occurs, the ventilator should be replaced and sent in for service.

+ only available on the HT70 Plus model when the on-airway flow sensor is in use

Shut Down Alert Alarm

The Shut Down Alert Alarm occurs when the ventilator is turned Off. A continuous audible alert indicates the ventilator is no longer operating. The alert beeps will continue for at least 15 minutes or until it is silenced by pressing the *Alarm Silence/Reset* button.

Internal Temperature Alarm

This alarm indicates that the internal temperature has exceeded specifications. Environmental temperature during operation should not exceed 40°C (104°F). Connect the HT70 to an external power source as soon as possible and take steps to make the environment cooler. Also check that the Fan Filter is clean.

O_2 Cylinder Low / Empty Alarms

This alarm indicates that the Oxygen Cylinder that was setup in the O_2 Calculator data screen has reached a low or empty level. The O_2 Cylinder Low Alarm will sound when the time reaches 10 minutes. The O_2 Cylinder Empty Alarm will sound when the estimated time reaches 5 minutes.

Battery Alarms

Power Pac Battery Pack Low Alarm

This alarm indicates that the Power Pac battery pack should be replaced with a fully charged battery pack or the ventilator should be plugged into an external power supply. Pressing the *Alarm Silence/Reset* button will clear this alarm.

Integrated Power Pac Failure Alarm

This alarm message indicates there was a loss of communication with the Power Pac battery. The charge level indicator will not be correctly updated. Replace Power Pac battery.

Switching to Backup Battery Alarm

This alarm occurs when the Power Pac battery pack can no longer power the HT70 and the unit switches to the Backup Battery. Connect the ventilator to an alternate power source immediately or install a fully charged battery pack. Pressing the *Alarm Silence/Reset* button will clear this alarm.

Running on Backup Battery Alarm

An audible alarm sounds if the HT70 has been running on the Backup Battery for more than 15 minutes. This alarm can be silenced, but a reminder alarm will occur every 5 minutes until a fully charged Power Pac battery pack is inserted and/or an external power source is connected.

Backup Battery Low Alarm

This alarm indicates that there is a minimum of 15 minutes left on the Backup battery. Connect the ventilator to an alternate power source immediately. This alarm can be silenced, but a reminder alarm will sound every minute until a fully charged Power Pac battery pack is inserted and/or an external power source is connected.

Backup Battery Shutdown Imminent Alarm

This alarm indicates that the Backup Battery is empty and about to shut down. It can not be silenced until the ventilator is powered Off or a fully charged Power Pac battery pack is inserted and/or an external power source is connected.

WARNING Immediately secure an external power source or insert a fully charged Power Pac battery pack when the Backup Battery Shutdown Imminent alarm occurs.

NOTE: It is highly recommended to carry at least one extra, fully charged Power Pac during transport or outdoor applications.

Backup Battery Failure Alarm

This alarm indicates that the Backup Battery is faulty and will not safely operate the HT70. Do not use the HT70 on battery power until it has been serviced.

Backup Battery Low Charge Alarm

This alarm indicates that the Backup Battery has insufficient charge to maintain ventilation if the Power Pac battery runs low or is removed. Attach to external power to charge both batteries. If the Backup Battery does not charge within 3 hours, do not use HT70 on battery power until it has been serviced.

Power Pac Battery Pack Temperature Alarm

This indicates that the Power Pac battery pack temperature has exceeded specifications for the battery. Replace the Power Pac battery pack with a fully charged one. Contact Newport Service department for repair or replacement of the battery.

Backup Battery Temperature Alarm

This alarm message indicates that the Backup Battery temperature has exceeded specifications for the battery. Attach to external power, do not use on battery power until ventilator has been serviced. Use an alternate means of ventilation and have the ventilator serviced.

Battery Operation

Battery

Section 7:

Operation

Internal Dual Battery System

The Internal Dual Battery System consists of two internal independent but coordinated lithium ion batteries, the Power Pac, located on the back of the ventilator and the secondary Backup Battery inside the ventilator. The Internal Dual Battery System can provide up to 10 hours of operation at standard settings* when new and fully charged. This system assures continued support during transport, daily activities or power outages.

The Power Pac is "hot-swappable". The Backup Battery will provide a minimum of 30 minutes of back up power during Power Pac swaps or power outages. Proper care and maintenance of the Internal Dual Battery System will ensure the longest life.

NOTE: Always plug the HT70 into an external power source when available. Plug the HT70 into external power source even when not in use to insure best battery performance. Check battery capacity on the front panel before removing from external power.

NOTE: For longterm storage the batteries should be recharged every 6 months. If the storage temperature is above 80 °F (27°C), then the batteries should be charged up every 3 months.

Power Pac Battery Pack

The integrated Power Pac battery pack is a detachable "hot-swappable" battery. You can easily slide it out and replace it with a fully charged battery pack – without interrupting ventilation.

Charge the Power Pac for a minimum of 3 hours for 100% recharge. If the battery charge is not fully depleted, the charge time may be less.

NOTE: It's a good idea keep an extra Power Pac with the HT70 ventilator.

When the HT70 is used for transport applications, ensure that the Power Pac battery pack is fully charged prior to use. It is highly recommended to carry an extra fully charged Power Pac during transport or outdoor applications.
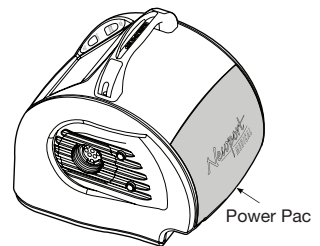
Power Pac

The Power Pac can be charged up independently from the ventilator. The Power Pac (BAT3271A) has an LED on the bottom edge to show charge condition. Push the button to see charge condition. Green = approximately 90% or higher charge level, Amber = charge not completed, Red = battery depleted. Always insert the Power

Pac onto the HT70 and power it ON to verify the actual charge level percentage (shown in the message display).

*Standard Settings: Fully charged, new battery in good condition. Power Save set On. Peak pressures below 30 cmH$_2$O with these settings:

a. Mode = A/CMV   d. Inspiratory Time = 1.0 seconds
b. Respiratory Rate = 15   e. PEEP = 0
c. Tidal Volume = 500 mL

Backup Battery

The secondary Backup Battery will provide a minimum of 30 minutes operation. HT70 will automatically switch to the backup battery whenever the Power Pac battery pack is removed or when the Power Pac power is low and the "Switching to Backup Battery" alarm occurs.

Conditions that Affect Battery Use Time

- Power Save
- Pressure
- Respiratory Rate
- PEEP on or off
- Time/Usage

Each of the items listed above will affect the amount of time that the Internal Dual Battery System will last. The most significant setting that affects battery use time is the Power Save setting. If this is left OFF, it will decrease your battery use time by about 30%. When Power Save is On, the screen will go to sleep (go blank) to save energy. An active alarm will temporarily end Power Save and the screen will become active. Power Save will resume two minutes after the alarm condition is resolved.

Peak pressures and respiratory rate also affect battery use time. If the peak pressure rises above 30 cmH$_2$O consistently and the respiratory rate is above 20, you can expect to lose another 15% to 25% of the battery use time.

Using PEEP means that the Bias Flow will be in use. Since this means that the twin pistons will run during both inspiration and exhalation, battery time will be shorter with PEEP on.

As the batteries age with use, the time that the HT70 will operate on battery power from a fully charged state will decrease. Replace the Power Pac battery pack every 24 months or sooner if battery operation time is insufficient for your usage.

If the HT70 will be powered from the Power Pac battery pack for an extended period, ensure that the battery pack is fully charged prior to use.

NOTE: It is highly recommended to carry at least one extra, fully charged Power Pac during transport or outdoor applications.

Check Battery Charge Level and Battery Time Estimator

Before using the HT70 for transport or when planning to use the Internal Dual Battery System as the primary power source, always check the Power Pac and Backup Battery charge condition. The charge level indicator on the touchscreen shows the percent of charge available. A blue battery icon indicates the status for the Power Pac battery pack and a red battery icon indicates the status for the Backup Battery. A gray battery icon with a red question mark indicates there was a loss of communication between the ventilator and the Power Pac battery. To view the Backup Battery condition, temporarily remove the Power Pac.

Also check the "Battery time estimator" displayed on the monitoring screen. When the HT70 is disconnected from external power, this indicator shows you the estimated time remaining on the HT70 based on the current ventilation settings.

NOTE: The battery use time that is displayed in the monitor is an estimate only. It can be affected by many factors such as the environmental temperature, aging of battery, etc. Also, battery use time will change as ventilation conditions change. Do not rely solely on this estimate. Check the battery charge level indicator frequently to confirm actual battery consumption.

When installing a replacement Power Pac during battery operation, always ensure that the charge level LED (located on the bottom of the pac) is green, indicating that the charge level is approximately 90% or higher. Insert the Power Pac onto the HT70 and power it ON to verify the actual charge level percentage (shown in the message display area).

Best Use Tips

When the battery use time begins to encroach on the user's lifestyle or impede transport times, it is time to replace the Power Pac battery pack (BAT3271A). Use these "Best Use Tips" to help prolong the life of your batteries.

1. Always keep the Power Save function On.

2. Use an external power source when possible. For example, when traveling, use the optional DC Auto Lighter Power Adapter accessory to power the ventilator from an automobile lighter outlet.

3. Always have a backup power source nearby, for example an extra Power Pac battery pack. When the "Switching to Backup Battery" alarm is activated, install the fresh Power Pac or plug into external power. This alarm means you have a minimum of 30 minutes of the emergency back up battery time left.

4. Keep both the Power Pac and Backup Battery charged up. Partially discharged batteries will age faster.

NOTE: Remember, the Internal Dual Battery System is charging anytime the HT70 is connected to external AC or DC power.

Battery System Maintenance

See Section 8, Cleaning and Maintenance, for more information on Integrated Battery System Maintenance.

Proper care of your battery system will preserve your battery use time.
- Keep the HT70 plugged into an external power source whenever available.
- Keep an additional fully charged Power Pac battery pack as a backup.

Power Pac Battery Pack Removal

To remove the Power Pac battery pack, simply press in on the release latch labeled "PUSH" and at the same time lift up at the base of the Power Pac and slide upwards.

The HT70 ventilator should always have a Power Pac battery pack installed. The AC power connection for the ventilator is located on the back of the Power Pac battery pack.

Release latch
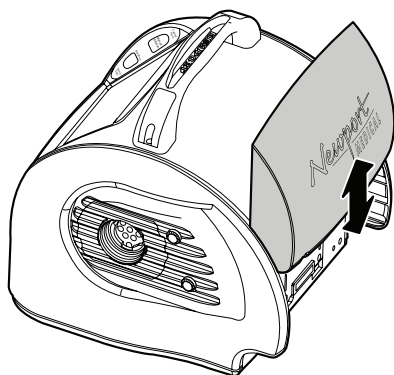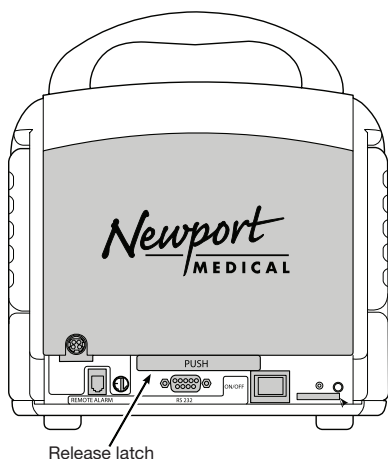
When inserting the power supply into the AC connection on the Power Pac, ensure that the cord is to the right of the plug and that it locks in place securely. Plug one end of the power cord into the adapter and the other end into a properly grounded outlet. Ensure that the Green Ext. Power LED lights whenever the HT70 is connected to external power.

To remove the AC Power Supply from the Power Pac, gently pinch the connector to release the locking pin and then pull the plug out.

WARNING Batteries contain environmentally unfriendly materials. Do not discard them in an incinerator or force them open. Batteries cannot be disposed of with normal waste. Dispose of in accordance with your institution's or local jurisdiction's policy.

Battery Alarms Overview

See Section 6, Ventilator Alarms, for descriptions of each alarm. See Section 9, Specifications, for alarm priority level and description.

The HT70 automatically monitors the Power Pac battery pack and the secondary Backup Battery to alert you of their condition. An icon in the upper right corner of the touch screen displays the charge level condition of the battery that is in use.

Battery condition alarm violations are indicated by an audible alarm, an alarm message displayed on the touch screen and the LEDs in the handle of the ventilator flashing. The battery alarms will occur in this sequence:

1. Power Pac Battery Pack Low
2. Switching to Backup Battery
3. Running on Backup Battery
4. Backup Battery Low
5. Backup Battery Shutdown Imminent

In addition, there are functional alarms for the battery system:
1. Power Pac Battery Temperature Alarm
2. Backup Battery Temperature Alarm
3. Backup Battery Failure Alarm
4. Backup Battery Low Charge Alarm

WARNING Immediately secure an external power source or insert a fully charged Power Pac battery pack when the Backup Battery Shutdown Imminent alarm is violated.

Charge the Power Pac battery pack for a minimum of 3 hours for 100 % recharge. If the battery charge is not fully depleted, the charge time may be less.

Power Accessories

Power Pac Battery Pack (BAT3271A)
It is recommended to have extra Power Pac battery packs on hand at all times. The Power Pac is "hot swappable" – you can remove one and insert another without interruption of ventilation.

AC Power Supply (PWR3204P)
It is recommended to have an extra AC Power Supply available to charge the extra Power Pac battery when not attached to the ventilator.

Country Specific Power Cord
For the AC Power Supply you can order a power cord that has the appropriate outlet plug for your area. You can choose from NA-North American style (PWR3207P) / UK-British style (PWR3210P) / EU-European style (PWR3211P).

External Battery System (BAT3300A)
The Newport Medical External Battery comes in a sturdy case for easy handling. Use the battery charger (CHG3313P) every night to recharge the external battery. Use the DC Auto Lighter Power Adapter (ADP3203P) to connect to the ventilator.

DC Auto Lighter Power Adapter (ADP3203P)
The Newport DC Auto Lighter Power Adapter, allows you to plug the ventilator into a vehicle's autolighter power outlet (12 VDC to 16 VDC) or external battery. To save internal battery power for when you need it, use this adapter to plug the HT70 into the autolighter port any time the ventilator is used while in a vehicle. While plugged in, the ventilator will be powered and both of the internal batteries will be recharged.

Section 8:
Cleaning and Maintenance

Section 8:
Cleaning and Maintenance

Cleaning and Disinfecting

Use the information in this section in conjunction with hospital policy, physician prescription, Homecare Dealer or accessory manufacturer instructions.

Definitions
Cleaning: A process that uses a medical detergent or alcohol based cleaning solution to remove blood, tissue and other residue. Rinse thoroughly with sterile, distilled water and allow to air dry.

Disinfection: A liquid chemical process that kills microbial organisms.

Sterilization: A process that uses steam autoclave or ethylene oxide (EtO) this is designed to render a product free of viable microorganisms.

Caution: When using liquid chemical agents, closely follow the manufacturer's recommendations. Prior to use, verify that the agent is compatible with plastics.

WARNING Ethylene Oxide (EtO) is toxic. All accessories MUST be completely dry prior to packaging for ethylene oxide sterilizing. After sterilizing, they must be properly aerated to dissipate residual gas absorbed by the material. Follow the EtO manufacturer's recommendations for the specific aeration periods required.

Caution: Ethylene Oxide (EtO) may cause superficial crazing of plastic components and will accelerate the aging of rubber components.

Caution: Always inspect breathing circuits and accessories after cleaning, disinfecting or sterilizing to check for deterioration. If the any part is damaged or shows excessive wear, replace with a new part. Do not use cracked or damaged parts.

Ventilator

Wipe clean between patients and as needed while in use. The exterior of the ventilator should be wiped clean with a cloth dampened with a medical detergent, disinfectant or alcohol based cleaning solution.

Caution: Do not use agents that contain acetone, toluene, halogenated hydrocarbons, or strong alkalines on the face panel or ventilator housing.

Caution: Never autoclave or EtO sterilize the HT70 ventilator. These processes will damage the HT70, rendering it unusable.

Accessories

Low Flow Oxygen Reservoir

Clean and disinfect between patients and as needed while in use, refer to the instructions provided with the oxygen reservoir.

Disassembly from the HT70 ventilator: Remove the Oxygen Reservoir from the HT70 Fresh Gas Intake port. Disconnect the oxygen tubing.

General Cleaning Instructions: Hold the Low Flow Oxygen Reservoir in both hands and twist the top counterclockwise to disassemble. Separate all the parts and clean with soap and water, rinse thoroughly and then air dry.

Caution: Never mount the Low Flow Oxygen Reservoir onto the ventilator when wet.

Air/Oxygen Entrainment Mixer

Between patients and as needed while in use, the exterior of the mixer and attached hose should be wiped clean with a cloth dampened with a medical detergent, disinfectant or alcohol based cleaning solution.

1. Oxygen mixer
2. Filter
3. Cover
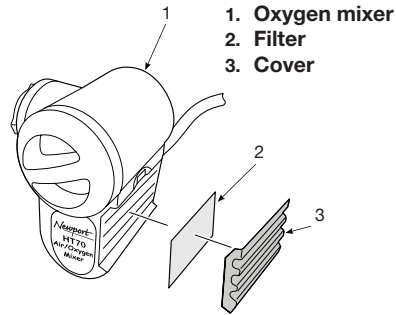
Check the mixer intake filter (p/n FLT3209P) at setup and at least weekly and replace when dirty.

WARNING Always use a Mixer Intake Filter in the mixer to protect the internal mechanisms from contaminants and preserve the lifespan of your mixer.

WARNING Never reverse the Mixer Filter.

Caution: Do not wash or sterilize the Mixer Filter.

Reusable Breathing Circuits and Exhalation Valves

The HT70 ventilator may be used with a standard single limb or "J" style breathing circuit with a quality exhalation valve. Reusable breathing circuits and exhalation valves are generally provided in clean, but not sterile, condition. Follow the manufacturer's instructions to clean and/or disinfect prior to use.

WARNING Do not use electrically conductive breathing circuits. Always use clean and dry breathing circuits.

Reusable circuits should be cleaned and disinfected between patients and as needed while in use. Always use a clean, disinfected exhalation valve (and humidifier/probe assembly if appropriate) when a breathing circuit is reassembled for patient use. Clean and disinfect in accordance with the instructions provided by the manufacturer.

Caution: To avoid damage to a reusable circuit, attach and detach the circuit by grasping the cuffs at the end of the circuit tubing. Do not pull or twist the circuit tubing.

General Cleaning Instructions: Use a low flow of running water or low flow of air to clear tubings and passages of organic matter. Wash all components of the breathing circuit and exhalation valve with a soft brush in a mild medical detergent. Rinse thoroughly with sterile, distilled water. Shake off excess water and place all parts on a clean towel to air dry. (Do not heat or blow dry.) Always follow the instructions provided by the manufacturer.

Disinfect: Refer to the instructions provided by the breathing circuit and exhalation valve manufacturer.

Sterilize: Refer to the instructions provided by the breathing circuit and exhalation valve manufacturer.

Air Intake Filter (p/n HT460300)

The Air Intake Filter, located on the right side of the ventilator behind the Filter Cover, keeps dirt and particles out of the ventilator's piston system and patient gas pathway. As the filter becomes dirty it can reduce the volume of air drawn into the ventilator and add stress to the pump. Check the Intake Filter weekly. Replace with a new filter when the majority of the filter surface area is no longer white. Intake Filters are not reusable.

WARNING NEVER operate the HT70 without a clean Air Intake Filter in place. NEVER reverse the Air Intake Filter when dirty.

Proximal Inline Filter (p/n HT6004701 or equivalent)

Check the Proximal (Prox) Inline Filter weekly and replace it at least every 3 months. Discard it and replace with a new filter if it appears to have gotten wet or come in contact with a contaminant. Proximal Inline filters are not reusable. If the filter becomes occluded, replace the filter. The primary indication for this would be a Check Circuit or Prox Line Alarm.

Newport Medical strongly recommends that extra Prox Inline Filters be available at all times when using the HT70 ventilator.

WARNING Always use a Proximal Inline Filter (p/n HT6004701 or equivalent) at the Prox. Line Connector to protect the internal pressure transducers from moisture or other contaminants.

WARNING Never reverse the Proximal Inline Filter.

Caution: Do not wash or sterilize the Prox Inline Filter.

Maintenance Guidelines

Routine Maintenance

✓ Perform the Circuit Check each time a fresh circuit/exhalation valve is installed.

✓ Check the Air Intake Filter (located behind the Filter Cover) at setup and at least weekly while in use. In some environments, it may need to be checked more often. Replace when the majority of the filter surface area is no longer white. Air Intake Filters are not reusable.

WARNING NEVER reverse the Air Intake Filter when dirty.

✓ Check the Prox Inline Filter weekly. Replace with a new filter if it appears to have gotten wet or come in contact with a contaminant. Inline filters are not reusable.

✓ Check the Mixer Intake Filter (located behind the Mixer Cover) at setup and at least weekly while in use. In some environments, it may need to be checked more often. Replace when the majority of the filter surface area is no longer white. Mixer Intake Filters are not reusable.

✓ Inspect the AC Power Adapter on a regular basis for signs of broken or frayed cord or connectors.

✓ Inspect the exhalation valve after each cleaning to verify that there are no cracks or damaged surfaces.

✓ Wipe down the surface of the ventilator housing regularly to remove any dust that might accumulate.

✓ Inspect and when necessary, replace accessories.

✓ If service is required, contact Newport Medical or your local equipment provider..

✓ To preserve the Internal Dual Battery System life:

1. Whenever possible, plug into external power source to charge the batteries.

2. Use the optional DC Auto Lighter Cable accessory to power the HT70 when traveling by automobile or to connect to an external battery.

See Section 7, Battery Operation for more information on the proper operation of the HT70 Internal Dual Battery System.

6 Month Maintenance

✓ Routine maintenance as described above

✓ Perform the Quick Check Procedure (described in Section 5)

12 Month Maintenance

✓ Routine maintenance as described above

✓ Perform the Quick Check Procedure (described in Section 5)

24 Month Maintenance

✓ Replace air intake and prox inline filter

✓ Replace the primary integrated battery (Power Pac)

✓ Replace the secondary internal back up battery

✓ Replace the oxygen sensor (if installed)

✓ Replace the cooling fan filter

✓ Calibration and OVP performed by Authorized Service Provider

15,000 Hour Maintenance (or every 4 years)

✓ A comprehensive maintenance should be performed after 15,000 hours of operation or every 4 years, whichever comes first. Refer to the HT70 Service Manual, or contact the Newport Medical Technical Service Department for detailed information on the 15,000 Hour Maintenance.

Do not attempt to open or perform any service procedures on the HT70. Only Newport Medical trained technicians are authorized to service the ventilator.

Newport Medical Technical Service Department:
Telephone: +1.714.427.5811 ext. 500
Fax: +1.714.427.0572 Email: Techservice@ventilators.com

General Warnings

Preventive maintenance work, repairs and service may only be performed by Newport Medical trained or factory-authorized personnel.

Always follow accepted hospital procedures or physician instructions for handling equipment contaminated with body fluids.

The ventilator and its accessories must be thoroughly cleaned and disinfected after each patient use. Perform all cleaning and sterilization of external parts and accessories in accordance with established hospital procedures and manufacturer's instructions.

Certain components of the ventilator, such as the exhalation valve and the front panel, consist of materials that are sensitive to some organic solvents used for cleaning and disinfection (e.g. phenols, halogen releasing compounds, oxygen releasing compounds, and strong organic acids). Exposure to such substances may cause damage that is not immediately recognizable.

The reusable exhalation valve, reusable breathing circuit and other parts that come in direct contact with the patient should be disinfected or sterilized between uses according to hospital policy.

Factory Maintenance or Repair

An authorized Newport Medical Instruments factory-trained technician must do all service or repairs performed on the HT70.

Caution: Always disconnect the external power supply prior to servicing.

Scheduled maintenance or repair services are available from the Newport Technical Service Department. To send your ventilator in for service, see Repackaging /Return Information that follows in this section.

Current pricing for scheduled maintenance and labor rates can be found in Newport Medical Instruments Annual Price List. To obtain a copy, please contact your local Newport Sales Representative or contact our Customer Service Department.

Repacking / Return Information

Use the original packing carton and material to ship the ventilator back to Newport Medical. Or you can contact Newport Medical Customer Service department to order replacement packing material.

Prior to returning your ventilator for service or repair you must obtain a returned goods authorization number (RGA) from our Technical Service Department. Refer to the HT70 Service Manual or contact Technical Service department for complete instructions.

See Contact Information page at the front of this manual for address, phone and website details.

Section 9:
Specifications

Section 9:
Specifications

Front Panel Buttons - Symbols Version	
	Accept
	Cancel
	Alarm Silence Reset / LED
	Breath Delivery Indicator
	Brightness
	Device Alert LED
	External Power LED
	Manual Inflation
	Up/Down Arrow

Miscellaneous Reference Symbols

▰	Manufacturer Name and Address
EC | REP	Authorized Representative in the European community
O	Main Power Off / On (momentary switch)
↓	Low (Paw or Min Vol) alarm
↑	High (Paw, Min Vol or RR) alarm
⚠	Attention, see instructions for use
⏚	Equipotentiality
(Type BF)	Applied Parts Type BF
☀	Brightness control
🔔	Alarm Silence
▲ / ▼	Up / Down arrow
℞	Federal law (US) restricts sale by or on the order of a physician
✈	Meets FAA requirements in RTCA standard, DO160, sec 21 category M for use in all stages of air travel, including takeoff and landing.
②	Single patient use
c (UL) US CLASSIFIED	Underwriters Laboratories mark
c (CSA) US	Canadian and U.S. Certification Mark Note: Products bearing this mark have been tested and certified in accordance with applicable U.S. and Canadian electrical safety and performance standards.
ETL Classified c (ETL) US Intertek	ETL (Electrical Testing Labs) mark. Classified Note: This certification mark indicates that the product has been tested to and has met the minimum requirements set forth by ETL.
CE 0344	CE mark Designates that the product labeled is authorized for sale in European countries.

Controls/Monitors

Controls / Monitors	Range / Selection	Resolution
MODE (Pressure or Volume Control)	A/CMV	
	SIMV	
	SPONT	
Breath type (mandatory)	Pressure Control or Volume Control	
NIV (Non Invasive ventilation)	On or Off, When On, allows ↓Min Vol Alarm to be set to Off, ↓P Alarm to be to be set 1 cmH2O/mbar above PEEP and allows adjustment of bias flow during PEEP	
VT (Tidal Volume)	50 to 2,200 mL, ATPS, ± 10%	1.0 mL
PC (Pressure Control)	5 to 60 cmH2O / mbar	1.0 cmH2O/mbar
Flow	6 to 100 L/min	1.0 L/min
i time (Inspiratory Time)	0.1 to 3.0 sec	0.1 sec
RR (Respiratory Rate)	1 to 99 b/min	1.0 b/min
P trig (Sensitivity)	−9.9 to 0 cmH2O / mbar, pressure triggering	0.1 cmH2O/mbar
Flow trig (Sensitivity)	0.1 to 10 L/min	0.1 L/min
PEEP/CPAP	0 to 30 cmH2O / mbar	1.0 cmH2O/mbar
PS (Pressure Support)*	0 to 60 cmH2O / mbar above baseline pressure, limited to PEEP + PS ≤ 60 cmH2O / mbar	1.0 cmH2O/mbar
I:E Ratio	1:99 to 3:1	0.1 for 9.9:1 to 1:99 and 1 for 99:1 to 1:99
Airway Pressure Gauge	−10 to 100 cmH2O / −10 to 98 mbar includes indicator bars to show low and high PAW alarm limits	
O2 Sensor	Enabled or Disabled When Enabled, high and low O2 alarms are active and O2 Cylinder Time Calculator is available	
PS Max i time*	0.1 - 3.0 sec	0.1 sec
PS % Exp Threshold*	5 - 85%	5
Slope Rise	1 -10 (1 is slowest)	1
Flow Wave Pattern	Square or Descending	
Bias Flow	0 L/min - PEEP Off 7 L/min - PEEP On 3-30 L/min - PEEP + NIV On	1
AutoLock function	Enabled/ Disabled	

*not available on the HT70S models

Controls / Monitors	Range / Selection	Resolution
AutoLock icon	Touch for 3 seconds to unlock buttons if AutoLock is Enabled in Utility screen. When Lock is on screen, all controls are locked except Alarm Silence Reset, manual inflation and Brightness control.	
O_2 Cylinder Data	Size: D, E, H, M, K, 100 L & 150 L Cylinder Pressure: 300 to 2450 psi or 25 to 175 ATM or 2,000 to 17,000 kPa Units: psi or ATM or kPa O2 Cylinder Monitor; Enabled/Disabled.	
Altitude	-1,000 to 10,000 feet, -1,000 to 10,000 meters (with Flow Sensor use)	
BUV Settings	Minimum RR: 8 to 30 b/min Rate Factor: 1.1 to 1.8 SPONT Delta P: 5 to 20 cmH2O/mbar SPONT i-time: 0.4 to 2.0 s	

Monitor Data Selections		
Minute Volume	0.01 L to 80.0 L	0.01 L
Insp./Exp. Tidal Volume	0.01 L to 3.0 L	0.01 L
RR total	0 to 200 b/min	1 b/min
P Peak	0 to 100 cmH2O /mbar	1 cmH2O/mbar
P Mean	0 to 100 cmH2O /mbar	1 cmH2O/mbar
P Base (PEEP)	0 to 100 cmH2O /mbar	1 cmH2O/mbar
(Peak) Flow	5 to 150 L/min	0.1 L/min
O_2 Cylinder time	hours / min	15 minutes
Battery time	hours / min	15 minutes
O_2% (optional)	21 to 100	1%
I:E Ratio	1:99.0 to 3.0:1	0.1 (9.9:1 to 1:9.9) 1.0 (99:1 to 1:99)

Front Panel Membrane Buttons and Indicators	
Cancel	Press front panel button to cancel any touchscreen settings changes that have not been accepted
Accept	Press to confirm or accept any touchscreen setting changes
Up / Down Arrows ▲ / ▼	Arrow buttons allow adjustment of settable parameters. Use up arrow to increase and down arrow to decrease.
Brightness control	Press to select brightness levels, maximum, medium high, medium and low.
Manual Inflation	3 second maximum. While button is pressed, the ventilator closes the exhalation valve and delivers an operator controlled breath to the patient.
Breath Indicator LED	Lights to indicate the ventilator is delivering a breath.

External Power LED	Lights to indicate the ventilator is powered by external power
Device Alert LED	Lights to indicate a ventilator malfunction. **WARNING Use alternate ventilation source until malfunction is identified and corrected.**

Alarms	
Handle LED	Alarm Indicators flash red or yellow for violated alarms.
Alarm Silence/ Reset button	Silences audible alarm for 60 sec; resets latched alarm messages. Press repeatedly (or push and hold for 3 seconds) to clear all latched messages.
Alarm Silence LED	LED remains lit during the alarm silence period
Message Display area	Alpha numeric display, turns color during an alarm violation and shows alarm message. Multiple alarm messages display in order of priority (red is high, amber is medium and yellow is low).
Alarm Loudness (in Alarm Screen)	1 - 10 (10 is loudest)

User Adjustable alarms	**Alarm Priority**	**Range / Description**
↑P (High Pressure)	High	4 to 99 cmH$_2$O / 4 to 99 mbar
↓P (Low Pressure)	High	NIV Off: 3 to 98 cmH$_2$O / 3 to 98 mbar (limited by PEEP + 3); 2 breath delay NIV On: 1 to 98 cmH$_2$O / 1 to 98 mbar (limited by PEEP + 1); 3 breath delay
↑Min Vol (High Insp./ Exp. Minute Volume)	High	NIV Off: 1.1 to 50 L/min NIV On: 1.1 to 80 L/min
↓Min Vol (Low Insp./ Exp. Minute Volume)	High	NIV Off: 0.01 to 49.0 L/min NIV On: Off, 0.01 to 49.0 L/min
↑RR (High Respiratory Rate)	Med	Off, 30-100 b/min
Apnea	High	5 - 70 seconds
↑O2	Med	Off, 24 - 100, only available when O$_2$ Sensor is enabled
↓O2	Med	Off, 22- 98, only available when O$_2$ Sensor is enabled
↑VTE	Med	OFF, 0.06 to 2.2 Liters
Backup Ventilation (BUV)	Med	Can be set to be activated by either the Low Minute Volume alarm or the Apnea alarm or both via the More/ Utilities/Custom Settings/BUV Settings. Functional in all modes

Automatic alarms	**Alarm Priority**	**Description**
Low Baseline Pressure	High	Paw < PEEP minus 2 cmH$_2$O/mbar for 3 sec

Automatic alarms	Alarm Priority	Description
High Baseline Pressure	High	Paw 5 above set PEEP at onset of a time-triggered breath
Pressure Control Setting Not Reached	High	P Peak < 50% of PCV setting for 2 consecutive breaths
Check Circuit	High	Circuit may be disconnected or proximal pressure line may be pinched or blocked
No External Power	Low	Loss of External power, automatic switchover to Internal Dual Battery System
Occlusion	High	An occlusion or restriction in the circuit that interferes with exhalation
Occlusion - Sustained	High	Occlusion continues for 10 sec or 2 breath periods, whichever is shorter
Device Alert	High	Ventilator malfunction, Device Alert LED lights red
Shut Down Alert	High	Silence by pressing Alarm Silence/Reset button
Motor Fault	High	Hardware detected fault in the motor drive circuit has occurred
Internal Temperature	Low	Internal temperature is > 60° C
Backup Battery Temperature	Low	Backup Battery temperature is > 60° C
Power Pac Battery Temperature	Low	Power Pac Battery temperature is > 60° C
Power Pac Battery Pack Low	Med	Less than 2 Ah of charge is left on Power Pac battery pack
Integrated Power Pac Failure	Med	Loss of communication with the Power Pac battery. Replace Power Pac battery.
Switching to Backup Battery	Med	Indicates that the Power Pac battery pack is not available or useable. Ventilator is switching battery operation to Backup Battery.
Running on Backup Battery	Med	The Ventilator is operating on Backup Battery for > 15 minutes. Audible alarm will sound every 5 minutes thereafter
Backup Battery Low	High	Backup Battery has insufficient charge, less than 1Ah
Backup Battery Shutdown Imminent	High	Backup Battery is extremely low and will lose power very soon. Connect to external power or insert new Power Pac battery pack
Backup Battery Failure	High	Indicates a failure in Backup Battery due to communication failure with host processor or capacity is below 1 Ah
Flow Sensor disconnect	Med	Flow sensor is no longer detected or is faulty

Hardware Requirements	
Description	
Patient outlet	22 mm OD
AC Power input	100 to 240 VAC
DC Power input	12 to 24 VDC
Power switch	momentary switch to power on and off
RS-232C Interface	9 pin standard RS232 connector
Nurse Call / Remote Alarm	RJ435 connector
USB Ports	Two USB ports for connecting to central monitoring systems, uploading software upgrades or download data files.
Electrical	Applied parts type BF Class I Protection Against Electric Shock 100-240 VAC, max. 2 A, 50 / 60 Hz 12-24 VDC, max. 5 A
Internal Dual Battery System	Power Pac Battery Pack: 14.4 VDC, 6.5 amp hours Recharge: minimum 3 hours for 100% charge When new and fully charged, the primary Lithium Ion battery pack supplies power for up to 10 hours of operation at these settings: A/CMV mode, RR=15, Tidal Volume=500 mL, i time=1.0 sec, PEEP=Ø, max. airway pressure 30 cmH$_2$O /mbar, Power Save On, Bias flow Off. **NOTE:** The Power Pac and Backup batteries are charged whenever the HT70 is connected to an external power source. Battery charge level is best maintained by keeping the HT70 continuously connected to external power. Backup Battery: 14.4 VDC, 2 amp hour The secondary Lithium Ion backup battery will supply power for a minimum of 30 minutes.
Pneumatics	Dual micro-piston system requires no external air compressor.

9   Specifications

Hardware Requirements	Description
Emergency Intake	Maximum inspiratory and expiratory pressure drop at single fault conditions: 10 cmH$_2$O/ L/sec (measured at patient connection port)
Maximum Limited Pressure (Pressure Relief)	100 cmH$_2$O/mbar
Environment	
Description	
Operating Temperature	-18°C to 40°C **NOTE:** For proper operation at low range temperatures (-18°C), the HT70 must be started in a normal room temperature environment and allowed to run for 30 minutes prior to transfer to colder environment.
Water Ingress Protection	IEC 60529 IPX4
Operating Humidity	15 to 95% non-condensing
Operating Altitude	Sea level to 15,000 ft (0 to 4,572 m) There is no altitude limitation when HT70 is operated in a pressurized environment.
Operating Pressure	600 to 1,100 mbar
Storage and Shipping Temperature	-40° C to 65° C
Storage and Shipping Humidity	0 to 95% non-condensing
Size and Weight	
Height (includes handle)	10.25 inches (26.04 cm)
Width	9.75 inches (24.77 cm)
Depth	11 inches (27.94 cm)
Weight	15.4 lbs. (6.9 kg)

Factory Default Parameters

Patient Settings:		
	MODE	A/CMV
	VT (Volume Control)	500 mL
	i time	1.0 sec
	RR	15 b/min
	Ptrig	−1.0 cmH$_2$O
	↓Paw Alarm	5 cmH$_2$O
	↑Paw Alarm	40 cmH$_2$O
	↑MV Alarm	3 L/min
	↓MV Alarm	20 L/min
	↑O$_2$	Off
	↓O$_2$	Off
	PEEP/CPAP	0 cmH$_2$O
	PS	0 cmH$_2$O
	Alarm Loudness	Level 7

Miscellaneous

Patient Circuit	Reusable or disposable 22 mm I.D. adult or 15 mm I.D. pediatric circuit with 3/16 inch (4.8 mm) I.D. proximal pressure sensing line, 1/8 inch (3.2 mm) I.D. exhalation valve control drive tubing, and exhalation valve. **NOTE:** Newport Medical cannot guarantee the safe use of breathing circuits that are not recommended by Newport.

(Optional) Air / Oxygen Entrainment Mixer (MXL70A) Specifications

Pneumatic Requirements:	
Oxygen	35 to 65 psig (2.4 to 4.5 Bar) full operating range, maximum accuracy 40 to 50 psig (2.7 to 3.4 Bar) accuracy ± .08
Air	Atmospheric pressure
FiO2 Control	adjusted continuously from 0.21 to 1.00

NOTE: Oxygen source gas must be medical grade, 100% oxygen.

(Optional) Low Flow Oxygen Reservoir (RSV3215A)

Pneumatic Requirements:	
Oxygen	0-10 L/min
Air	Atmospheric pressure
FiO2 Control	FiO2, indirectly adjusted from 0.21 up to 1.00 via oxygen flow (L/min)

WARNING Appropriate oxygen monitoring is required for patient safety.

9 Specifications

Regulatory and Agency Standards
Testing and evaluation of the HT70 Ventilator has been conducted in compliance with the following voluntary standards:
ASTM F 1100-90:1997 Standard Specifications for Ventilators Intended for Critical Care Use
ASTM F 1246-91:2005 Standard Specifications for Electrically Powered Home Care Ventilators – Part 1: Positive-Pressure Ventilators and Ventilator Circuits
IEC 60068-2-6:2008 Environmental Testing- Part 2: Tests- Test FE: Vibration (Sinusoidal)
IEC 60068-2-27:2008 Environmental Testing- Part 2: Tests- Test EA and Guidance: Shock
IEC 68-2-34:1973 Environmental Testing- Part 2: Tests- Test Fd: Random Vibration Wide Band – General Requirements
IEC 60601-2-12:2001 Particular Requirements for the Safety of Lung Ventilators for Medical Use
IEC 60601-1:1988 (+A1:1991 +A2:1995) Medical Electrical Equipment – Part 1: General Requirements for Safety
IEC 60601-1-1:2000 Medical Electrical Equipment, Collateral Standard: Safety Requirements for Medical Electrical Systems
IEC 60601-1-2:2001 Medical Electrical Equipment, Collateral Standard: Electromagnetic Compatibility- Requirements and Tests
IEC 60601-1-4:2000 Medical Electrical Equipment, Collateral Standard: Programmable Electrical Medical Systems
EC 60601-1-6:2004 Medical Electrical Equipment, Collateral Standard: Usability
IEC 60601-1-8:2006 Medical Electrical Equipment, Collateral Standard: General Requirements, Tests, and Guidance for Alarm Systems in Medical Electrical Equipment and Medical Electrical Systems
MIL-STD-810E Test Method Standard for Environmental Engineering Considerations and Laboratory Tests
CSA 22.2-601.1 Medical Electrical Equipment - Part 1-1: General Requirements for Safety

Explanation of Modes and Controls

Extraction

Section 10:

Explanation of Modes and Controls

* Not available on the HT70S models

A/CMV Mode
(Assist/Control Mandatory Ventilation)

In A/CMV mode, all breaths are mandatory volume control or pressure control breaths, determined by the selection on the touchscreen. The RR setting determines the minimum number of mandatory breaths that are delivered each minute. If the patient does not trigger the ventilator, the breaths are time triggered. If the patient makes a breathing effort that causes airway pressure or flow to meet the Ptrig or Flow trig setting, the patient can trigger mandatory breaths in addition to, or in place of, time triggered (mandatory) breaths. PEEP may be added. See Pressure Control and Volume Control below for descriptions of how each of these breath types work.

SIMV Mode
(Synchronized Intermittent Mandatory Ventilation)

In SIMV mode, the patient receives mandatory volume control or pressure control breaths (see A/CMV) that are either time triggered by the ventilator or flow/pressure triggered by the patient and they may also receive spontaneous breaths with or without pressure support (PS)* in between mandatory breaths. PEEP/CPAP may be added.

The RR setting determines the number of mandatory breaths that are delivered each minute (+/- 1 b/min). If the patient does not trigger the ventilator, these breaths are time triggered at intervals determined by the RR setting. Patients can trigger mandatory breaths in place of time triggered (mandatory) breaths if the effort they generate causes airway pressure or flow to meet the Ptrig or Flow trig setting.

The first patient trigger in each mandatory breath interval will result in a mandatory breath. A mandatory breath lockout interval is then activated for the rest of the interval, allowing the patient to breathe spontaneously with or without pressure support (PS)* until the beginning of the next interval. If the patient does not trigger the ventilator for one complete mandatory breath interval, a time triggered mandatory breath is delivered at the end of the interval.

See Pressure Control, Volume Control and Pressure Support below for descriptions of how each of these breath types work.

*Pressure Support is not available in HT70S models

SPONT Mode
(Spontaneous Ventilation)

In SPONT mode, all breaths are spontaneous breaths that are flow/pressure triggered by the patient. The user can adjust both PEEP/CPAP and pressure support (PS)* levels. See Pressure Support below for a description of how this breath type works.

When PEEP/CPAP is set above 0, the ventilator mode is CPAP (without PS) or Bi-level Positive Airway Pressure (with PS).* Ensure that Ptrig or Flow trig is set so the HT70 detects all spontaneous patient efforts.

The Low Pressure alarm limit is inactive in SPONT mode. However, users can preset this parameter for future A/CMV or SIMV operation.

As with all HT70 operating modes, Backup Ventilation is activated if the BUV linked alarm is violated.

NIV
(Non Invasive Ventilation)

The HT70 can be used for noninvasive ventilation in all modes. Go to the More Screen and touch the NIV button to toggle On noninvasive.

When NIV is On, the following features are activated to assist with noninvasive ventilation:

- o Bias flow is increased to 10 L/min and can be adjusted as needed from 3-30 L/min
- o The Low Minute Volume alarm can be turned off (Alarms screen)
- o The Low Pressure alarm can be set closer to the base pressure (1 cmH_2O /mbar above baseline) (Alarms screen)
- o The High Minute Volume Alarm range is expanded to 80 L/min.

PS
(Pressure Support)*
Pressure Support (PS) spontaneous breaths are available to support a patient's spontaneous breathing efforts in SIMV and SPONT modes. During each Pressure Support breath, the ventilator elevates and then maintains patient airway pressure at a pressure equal to

*Pressure Support is not available in HT70S models

Pressure Support + PEEP throughout inspiration. Breaths are cycled from inspiration to to exhalation when (1) flow to the patient drops to the Expiratory Threshold setting (a % of that breath's peak flow rate), or (2) the target airway pressure is exceeded by 3 cmH$_2$O (mbar), or (3) after the PS Max i time setting has been reached. Maximum airway pressure never exceeds the High P alarm limit setting.

During Pressure Support, tidal volume is determined by the pressure change during the breath (PS setting), Slope Rise, Expiratory Threshold, PS Max i time, patient effort and patient respiratory mechanics.

PC
(Pressure Control Ventilation)

Pressure Control mandatory breaths are available during A/CMV and SIMV modes. The HT70 targets and maintains patient airway pressure at the set pressure control level above ambient (not above PEEP) throughout inspiration. Breaths are cycled from inspiration to exhalation when (1) the set i time elapses, or (2) Paw exceeds the Pressure Control setting by 8 cmH$_2$O (mbar). Maximum airway pressure won't exceed the user set High P alarm setting.

During Pressure Control breaths, tidal volume is determined by the pressure change during the breath (PC-PEEP settings), Slope/Rise, i time, patient effort and patient respiratory mechanics.

When disconnecting the patient circuit during PC or PS ventilation, i.e. for suctioning, the flow may increase in order to compensate for the low pressure. After reconnecting the patient circuit, the flow will automatically re-adjust to meet the patient's demand.

VC
(Volume Control Ventilation)

Volume Control mandatory breaths are available during A/CMV and SIMV modes. During Volume Control breaths, the HT70 delivers the set tidal volume at the flow and i time shown on the Main screen and with the Flow Waveform set on the More screen. If the tidal volume setting is changed while the ventilator is operating, the change takes place in increments over a series of breaths.

When tidal volume is adjusted, inspiratory time remains constant and mandatory flow changes.

During Volume Control breaths, tidal volume is determined by the tidal volume (VT) setting.

If an attempted tidal volume setting results in a flow rate in excess of 100 L/min or less than 6 L/min, flow adjustment ceases, the user is alerted by an audible beep and a message appears in the Message Display Window. To allow further volume adjustment, change the i time to set the Flow to meet the patient's need.

Backup Ventilation

Backup Ventilation activates when the currently linked alarm occurs. This function can be linked with the Low Minute Volume (MVI/MVE) alarm, the Apnea alarm, or both alarms. During Backup Ventilation the linked alarm(s) will sound and the message window will indicate that Backup Ventilation is in use. There are default Backup Ventilation parameters, but the user may adjust these in the *More/ Utilities/Custom Setting/BUV* Screen.

Backup Ventilation is functional in all modes.

Backup Ventilation is not active for 60 seconds after the user adjusts ventilator controls, changes modes or starts ventilation from the Standby condition.

During Backup Ventilation, the Alarm Silence/Reset button can be pressed to silence the audible alarm. This will not cancel Backup Ventilation.

When linked with the Low Minute Volume alarm, Backup Ventilation is based on the monitored inspiratory (on-airway flow sensor not in use) or expiratory (on-airway flow sensor in use) minute volume. The inspiratory minute volume may be different from the expiratory minute volume in some conditions, such as in the case of a patient breathing circuit or airway leak or circuit disconnect and between different breath types. Be sure to check and if necessary, readjust these alarm settings when installing or disconnecting the on-airway flow sensor.

Backup Ventilation in A/CMV and SIMV Modes:

The factory default setting for Backup Ventilation in these two modes will increase the respiratory rate by 1.5 times the set rate, up to a maximum of 99 b/min. The minimum breath rate delivered is 15 b/min.

The respiratory rate (RR) will only increase up to a rate that produces a 1:1 I:E ratio even if the calculated Backup Ventilation rate is higher.

Backup Ventilation in Spont Mode:

The factory default setting for Backup Ventilation in the SPONT mode will implement these changes:
Mode = SIMV mode
Rate = 15 b/min
Pressure Control breath type = 15 cmH$_2$O above set PEEP
i time = 1.0 sec

Cancellation of Backup Ventilation

User Canceled

If during Backup Ventilation, the user adjusts a ventilation parameter, Backup Ventilation is suspended for one minute and all user selected ventilation parameters are employed.

60 seconds must pass after parameter adjustments before a linked alarm violation will result in Backup Ventilation.

Patient Canceled

If linked to low minute volume, when minute volume exceeds the Low Min Vol alarm setting by 10%, Backup Ventilation is canceled. If linked to Apnea Alarm, after 2 minutes of Backup Ventilation it is canceled. At that time the audible alarm stops, the alarm indicator latches and the HT70 resumes ventilation at the user-selected parameters.

Press the *Alarm Silence/Reset* button to cancel the latched alarm indicator and alarm message in the Message Display Window.