Newport Medical Instruments, Inc.

NEWPORT HT50 VENTILATOR

Operating Manual

OPRHT50NA Rev. B

September 2008

Exclusively Distributed by:

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HT50 Operating Manual OPRHT50NA

DATE	REVISION	PAGES EFFECTED
September 2007	A	New release, for dual internal battery updates from OPRHT50B rev. D - 2-2, 2-3, 2-4, 2-5, 2-6, 3-12, 3-13, 6-8, 7-2, 7-3, 7-7, A-7
September 2008	B	Updated to include additional dual internal battery data, update intended use statement, refine cleaning and sterilization section

TABLE OF CONTENTS

1. OPERATOR'S RESPONSIBILITY

OPERATOR'S RESPONSIBILITY FOR PATIENT SAFETY

The Operating manual (p/n OPRHT50-NA) contains information intended to ensure safe and effective ventilator use. The label on the inside of the front panel cover door is meant to complement not replace the Operating manual.

The design of the HT50 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 Newport HT50.

Caution Federal law restricts this device to sale by or on the order of a physician.

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

When the HT50 is used in home care and sub acute environments it is important that the primary caregiver has received training and has demonstrated competency in all equipment functions. A specific written care plan must be established by the attending physician.

Transport of patients with the HT50 requires that medical staff have a good working knowledge of the ventilator's use and problem resolution. Proper emergency back-up equipment must be immediately available during transport.

HT50 operators must recognize their responsibility for implementing safety monitoring mechanisms which supply appropriate information on equipment performance and patient condition. Patient safety may be achieved through a wide variety of means such as electronic surveillance of equipment performance and patient condition. However, equipment surveillance should not replace direct observation of clinical signs. The HT50 operator is solely responsible for selecting the appropriate level and method of patient monitoring.

Product modification or misuse can be dangerous. Newport Medical Instruments, Inc. (NEWPORT) 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.

LIMITATION OF LIABILITY

The liability of Newport Medical Instruments, Inc. (NEWPORT) is subject to and limited to the exclusive terms and conditions as set forth herein. Said liability is limited whether arising out of, or related to, the manufacture and sale of goods, their installation, demonstration, sales representation, use, performance, or otherwise. Any liability based upon product warranty, whether breach of warranty or otherwise, is limited regardless of any fault attributable to NEWPORT and the nature of the action (including breach of warranty, negligence, and strict liability).

The expressed warranties are in lieu of all other warranties, expressed or implied, including, without limitation, warranties of merchantability, fitness for any purpose, or noninfringement.

NEWPORT shall not be liable for any special incidental or consequential damages incurred by the buyer to a third party. The buyer shall not be entitled to make liability recoveries from NEWPORT due to such situations.

WARRANTY

The Newport HT50 Ventilator is guaranteed to be free of defects for a period of two (2) years from date of delivery. The following are exceptions to this warranty:

1. Defects caused by misuse, mishandling, tampering, or by modifications not authorized by Newport Medical Instruments, Inc. (NEWPORT) or its representatives.

2. Rubber and plastic components and materials are guaranteed to be free of defects at time of delivery.

3. The internal batteries are warranted for six months.

Any product which proves to be defective in workmanship or material will be replaced, credited, or repaired. Newport retains the discretion to select the most suitable of these options. Newport is not responsible for deterioration, wear, or abuse. In all cases, Newport will not be liable beyond the original selling price.

Application of this warranty is subject to the following conditions:

1. NEWPORT or its authorized representatives must be promptly notified upon detection of the defective material or equipment.

2. Defective material or equipment must be returned to NEWPORT or its authorized representative.

3. Examination by NEWPORT or its authorized representatives must

confirm that the defect is covered by the terms of this warranty.

To ensure complete protection under this warranty, the Warranty Registration Card must be returned to Newport within ten (10) days of equipment receipt.

The above is the sole warranty provided by NEWPORT. No other warranty, expressed or implied, is intended. Representatives of Newport are not authorized to modify the terms of this warranty.

DEFINITIONS

WARNING Possibility of personal injury, to patient or others, if disregarded.

Caution Possibility of equipment damage if disregarded.

NOTE: Additional information intended to avoid inconveniences during operation. Notes also indicate important procedures to be followed.

Inspection: Examination of actual condition.

Service: Measures required to maintain a specified condition.

Repair: Measures required to restore a specified condition.

Maintenance: Required inspection, service, and repair of the device.

Preventive Maintenance: Maintenance performed at regular intervals to keep the device in good working condition.

TYPING CONVENTIONS

Within the text of this manual, controls, alarms, and indicators are designated by the labeling name as they appear on the ventilator, e.g.: Psupport (pressure support), Ptrig (pressure trigger), and SPONT (spontaneous mode).

Please review all **WARNINGS** and **Cautions** outlined in this manual prior to using the HT50 for the first time.

WARNINGS AND CAUTIONS

At all times, strictly follow this Manual. The safe use of the HT50 Ventilator requires a full understanding of its operation and adherence to the manual's instructions. The equipment is only to be used for the purpose specified under "Intended Use" (see

Section 2). Observe all of the **WARNINGS** and **Cautions** posted in this manual and on labels found on the HT50 Ventilator and associated accessories.

General Warnings

External power connection: To maintain grounding integrity when using A.C. power, only connect to hospital grade receptacles. Always disconnect the external power supply prior to servicing.

Always use the A.C. power cord supplied with the HT50. Make certain the power cord ferrite is always attached to the A.C. power cord to ensure that the HT50 meets EMC requirements.

There is a risk of explosion if used in the presence of flammable anesthetics.

All settings and adjustments in the different ventilation modes must be made in accordance with a physician's prescribed therapy.

NEWPORT cannot warrant or endorse the safe performance of third party humidifiers for use with the HT50.

When the HT50 is operating on battery power, the optional built-in humidifier does not function. A heat moisture exchanger, or other humidification device, should be used until the unit is connected to A.C. power at which time the built-in humidifier can be used.

Do not use electrically conductive patient circuits.

Always use a clean patient circuit.

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

Always use appropriate monitors to ensure sufficient oxygenation and ventilation (such as pulse oximeter and/or capnograph) when the HT50 Ventilator is in use on a patient.
The ventilator is ready for operation only when:

a) It is completely assembled, and;
b) The Quick Check Procedure, including the Exhalation Valve Calibration (see Appendix A, Operating Manual) or OVP (Service Manual) has been successfully completed.

Constant attention by qualified medical personnel is recommended whenever a patient is ventilated with the HT50.

When the HT50 is used in homecare environments, proper education and training of the appointed caregiver must be provided prior to the patient leaving the health care facility.

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 NEWPORT Technical Service Department immediately.

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

Continuous oxygen monitoring is required for patient safety. The HT50 does not have a built-in alarm system to notify user of a failure or disconnection of the oxygen source.

Ensure that the oxygen source is not empty before and during the use of the optional Air/Oxygen Entrainment Mixer or Oxygen Blending Bag Kit.

The primary internal battery should be replaced every 12 months or sooner if the use time no longer meets the needs of the user. This will depend on a number of factors including settings and usage patterns. The secondary internal battery should be replaced every 24 months.

Please recognize that any life support equipment should have appropriate alternate power sources and means of ventilation readily available in case of a mechanical or system problem. If you need alternative power sources, contact Newport Medical Instruments Inc.

When the HT50 is used for transport applications, ensure that the internal battery system is fully charged prior to use.

When the Battery Empty audible alarm sounds continuously, only a limited time of internal battery power remains and an alternate power source should be found immediately.

Frequent deep discharge of the internal battery system will decrease the amount of time the HT50 will operate on battery power from a full charge state.

If you use the internal battery system as your primary power source, replace the primary battery as needed to ensure that the battery operation time is sufficient.

Charge the internal battery system for a minimum of 8 hours before powering the ventilator from the internal batteries. This will provide approximately 80% of the battery charge. If the battery system is completely depleted, it will take approximately 10 hours to fully recharge.

Always ensure that the green *Ext. Power* LED lights after connecting the HT50 to an external AC or DC power source (it can take up to two minutes to light). If the LED does not light, check all power connections and resolve any problems.

Always plug the HT50 into an external power supply source when

not in use to insure best battery performance.

The flow resistance of the air inlet filter, located on the right side of ventilator, is likely to increase with repeated use. Ensure that the filter is changed regularly.

The HT50 Ventilator is guaranteed to perform to specification when the Newport HT50 breathing circuit with exhalation valve is used. See Appendix B for circuit configurations and parts list.

Only NEWPORT approved exhalation valves can be used with the HT50.

Perform an exhalation valve calibration each time a clean circuit/exhalation valve is installed.

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

This equipment has been tested and found to comply with the EMC limits for the Medical Device Directive 93/42/EEC (EN55011 Class A and EN 60601-1-2). These limits are designed to provide reasonable protection against harmful interference in a typical medical installation. 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.

Cautions

Only use medical grade oxygen with the Air/Oxygen Entrainment Mixer or Oxygen Blending Bag Kit.

Do not place liquid containers in the immediate vicinity or on top of the HT50. Liquids that get into the ventilator can cause equipment malfunction and damage.

After servicing an HT50, it must completely pass an Operational Verification Procedure (see Service Manual) before being returned to patient use.

An authorized Newport Medical Instruments factory-trained technician must do all service or repairs performed on the HT50.

Do not open the ventilator or perform service on an open unit while connected to external power.

Use standard anti-static techniques while working inside the ventilator or handling any electronic parts.

Clean all external parts of the ventilator prior to servicing.

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

Always replace a blown fuse with one of proper rating for corresponding voltage range.

NOTE: Review the HT50 Operating Manual and Theory of Operation (Section 4 of this manual) before using the ventilator.

NOTE: Use the tools and equipment specified in this manual to perform specific procedures.

Batteries contain materials that can harm the environment. Do not discard them in an incinerator or force them open. Batteries cannot be disposed of with normal waste.

Factory Maintenance or Repair

Scheduled maintenance or repair services are available from the Newport Technical Service Department. To send your ventilator in for service, see HT50 Service Manual for repackaging and shipping instructions.

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 using information below.

Contact Information

Address: Newport Medical Instruments, Inc.
1620 Sunflower Ave
Costa Mesa, California, USA 92626

Phone numbers:	Toll-free within the United States: 800.451.3111
	Worldwide: 1.714.427.5811
Fax numbers:	Main fax: 1.714.427.0489
	Technical Service fax: 1.714.427.0572
Website:	www.NewportNMI.com / www.ventilators.com
Email:	Info@NewportNMI.com
Department extensions:	Customer Service: 282
	Technical Service: 500 (24-hour pager activated after Technical Service department hours)
	Clinical Support: 123 (24-hour pager)
Corporate Office hours:	Monday through Friday, 8:00 am to 5:00 pm (USA Pacific Time)
Technical Service hours:	Monday through Friday, 7:00 am to 4:00 pm (USA Pacific Time)

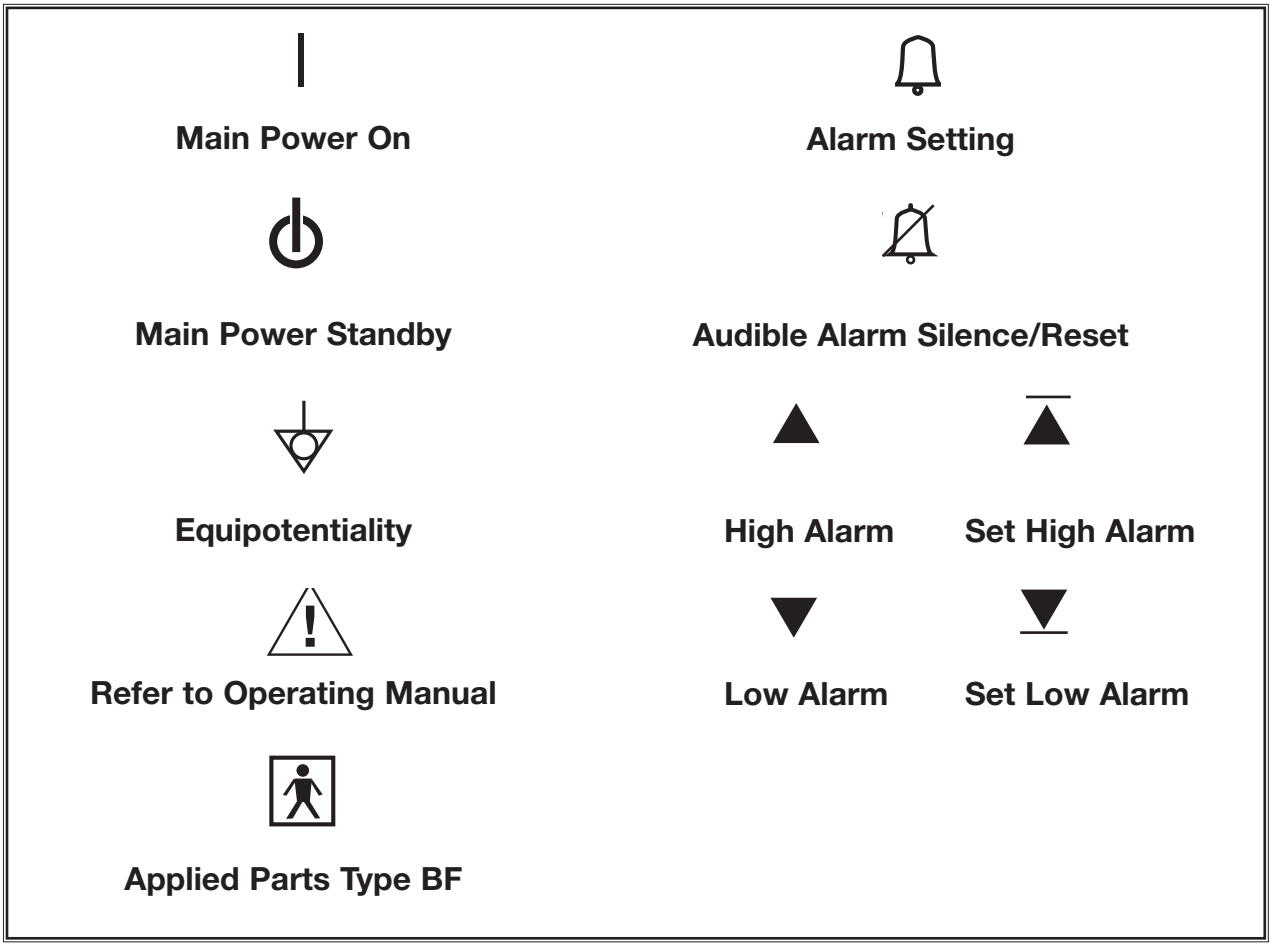
HT50s distributed internationally have CE authorization (HT50-H, HT50-H1) and are represented by: Obelis, s.a. , 34 Ave de Tervuren, bte 44, B-1040 Brussels, Belgium. Tel: +32.2.732.59.54 Fax:+32.2.732.60.03 email:mail@obelis.net

2. SPECIFICATIONS

INTENDED USE

This device is intended to provide continuous or intermittent mechanical ventilator support for the care of individuals who require mechanical ventilation. The ventilator is a restricted medical device intended for use by qualified, trained personnel under the direction of a physician. Specifically, the HT50 is applicable for adult and pediatric (i.e. infant, child and adolescent) patients, greater than or equal to 10 kg or 22 lbs., who require the following general types of ventilatory support, as prescribed by an attending physician: positive pressure ventilation with assist/control, SIMV and SPONT modes of ventilation. The HT50 is suitable for use in hospital, sub-acute, emergency room, home care environments as well as for transport and emergency response applications.

Front panel controls allow trained operators to select between a number of operational modes, pressure support and volume or pressure control. A comprehensive alarm system is built-in to alert the user to violations of set safety limits. When new and fully charged, the internal battery system provides up to 10 hours of power. With its patented, self-contained gas supply source, the HT50 requires no external air compressor.



SYMBOLS/LABELING TABLE

Controls/Alarms/Monitors	Range/Selection
1. MODE (Pressure or Volume Control)	A/CMV SIMV SPONT
2. Volume Control (Tidal Volume)	100 to 2,200 mL, ATPS, ± 10%
3. Pressure Control (Target Pressure)	PEEP +5 to 60 cmH_2O / mbar
4. $\dot{V}$ (Flow)	6 to 100 L/min
5. t_I (Inspiratory Time)	0.1 to 3.0 sec
6. f (Frequency)	1 to 99 b/min
7. Ptrig (Sensitivity)	–9.9 to 0 cmH_2O / mbar, pressure triggering (Patient Effort Indicator LED blinks once each time the airway pressure reaches the Ptrig setting.)
8. PEEP/CPAP	0 to 30 cmH_2O / mbar
9. Psupport (Pressure Support)	0 to 60 cmH_2O / mbar above baseline pressure, limited to PEEP + Psupport ≤ 60 cmH_2O / mbar
10. I:E Ratio	1:99 to 3:1
11. Maximum Limited Airway Pressure (Safety Valve)	100 cmH_2O (98 mbar)
12. Manual Inflation	3 sec maximum (While button is pushed, the ventilator closes the exhalation valve and delivers a operator controlled breath to the patient.)
13. Humidifier (Optional)	19ºC to 39ºC
14. Airway Pressure Meter	–10 to 100 cmH_2O / –10 to 98 mbar
15. Alarm Silence/Reset Button & Indicator	Pressing button silences an audible alarm violation for 60 seconds and resets a latched alarm indicator. LED lights to indicate that Silence is active.
16. ALARMS Indicators	Indicators for violated alarms blink red. When the alarm is no longer violated, the indicator latches (stays lit). Cancel a latched indicator by pressing the Silence/Reset button.
17. Int. Battery Button & Indicator	Pressing button displays the internal battery charge level in the airway pressure meter (Paw) window. Use only when operating on the internal battery system for accurate reading. LED lights to indicate internal battery system operation and alarms.

Controls/Alarms/Monitors	Range/Selection
18. F_IO_2 (with optional accessories)	0.21 to 1.00
19. On / Standby Button	Press once to put in Setting condition. (On-Setting/LED off) Press again to begin ventilating (On-Ventilating/LED on). When the HT50 is ventilating, press two times to put ventilator into Standby/Off condition (LED off).
20. Push To Unlock Buttons & Indicator	Pressing button unlocks front panel buttons if locked by automatic panel lockfeature. Auto lock is enabled/disabled in User Set Up. LED lights to indicate panel is locked.

21. Alarms

▲Paw (High Pressure)	4 to 99 cmH_2O / 4 to 99 mbar, must be 1< Low Paw
▼Paw (Low Pressure)	3 to 98 cmH_2O / 3 to 98 mbar, limited by ≥ PEEP + 3 and High Paw -1
Low Baseline Pressure	Paw ≤ PEEP - 3 cmH_2O/mbar for 3 sec during exhalation
High Baseline Pressure	Paw ≥ PEEP + 8 cmH_2O/mbar at onset of a breath or 3 sec after the start of exhalation
Occlusion	Paw ≥ PEEP + 15 cmH_2O/mbar at onset of a breath or 3 sec after start of expiration
Apnea	30 sec ± 3 sec
PCV Not Reached	Paw P < 50% of PCV setting
▲$\dot{V}_I$ Insp. Min. Volume	1.1 to 50.0 L/min
▼$\dot{V}_I$ Insp. Min. Volume	0.1 to 49.0 L/min
Check Prox Line	Prox Paw does not match machine Paw during inspiration
Humidifier (5 messages)	Humidifier malfunction/disconnection
Power Switchover	External power to internal battery switchover alert
Battery Low	Minimum of 30 minutes battery time remains until shutdown
Battery Empty	Minimum of 15 minutes battery time remains until shutdown

NOTE: The time between the Battery Low Alarm violation and the Battery Empty Alarm violation will vary depending on the ventilator load. At high volumes and pressures, the Battery Empty Alarm will occur much sooner after the Battery Low Alarm, than it will at lower volumes and pressures. In all cases, the stated minimum times for each alarm will be met, even if the two alarms occur almost simultaneously.

Device Alert (5 messages)	Ventilator malfunction: FAULT BAT SYS, OCCLUSION, 10V SHUTDOWN, SYSTEM ERROR or MOTOR FAULT
Shut Down Alert	On to Standby/Off Shut Down Alert

22. Message Display Window

Up to 16 characters, LED alpha numeric display
Displayed monitored parameters:

V_T (Actual delivered tidal volume)
$\dot{V}_I$ (Inspiratory minute volume)
f (Total breath frequency)
Paw P (Peak airway pressure)
Paw M (Mean airway pressure)

Paw B (Baseline airway pressure)
H (Hours of operation)
S (Software version)
L (or Q) (Buzzer volume (Loud or Quiet) for audible alarm)

Other displayed parameters (In USER SET UP):

Power Save (On / Off)
Airway Pressure Units (cmH_2O / mbar)
Set Up (User / Default)
Auto Panel Lock (Enabled / Disabled)
Tech. Setup (Technical set up, refer to Service Manual)

23. Front Panel Indicators

Modes

A/CMV	Green LED indicates that A/CMV mode is active.
SIMV	Green LED indicates that SIMV mode is active.
SPONT	Green LED indicates that SPONT mode is active.

Controls

Volume Control	Green LED indicates Volume Control ventilation.
Pressure Control	Green LED indicates Pressure Control ventilation.

Alarms

▲Paw (High Pressure)	Red LED indicates high peak airway pressure, high baseline pressure, or occlusion alarm violation.
▼Paw (Low Pressure) / Apnea	Red LED indicates low peak airway pressure, low baseline pressure, apnea, or PCV (50% of PCV setting not achieved) alarm violation.
Device Alert	Red LED indicates ventilator malfunction alert.
▲$\dot{V}_I$ (High Insp. Min. Volume)	Red LED indicates high inspiratory minute volume alarm limit is violated.
▼$\dot{V}_I$ (Low Insp. Min. Volume) (Back-Up Vent)	Red LED indicates low inspiratory minute volume alarm limit is violated.

Misc. Indicators

Silence / Reset	Yellow LED indicates that the audible alarm is silenced for 60 seconds.
Auto Lock On	Green LED indicates that the panel is currently locked.
On / Standby	Green LED indicates that the HT50 is ventilating.
Ptrig	Green LED blinks on to indicate patient breathing effort.
$\dot{V}$ (Flow)	Green LED indicates that Flow is displayed in the $\dot{V}$ / I:E Ratio numeric window display.
I:E	Green LED indicates that the I:E Ratio is displayed in the $\dot{V}$ / I:E Ratio numeric window display. Blinking LED indicates a breath with an inverse I:E Ratio.
Ext. Power / Charging Int. Battery	Green LED indicates external power is on and the internal battery is being charged. Red LED indicates power switchover to internal battery.
Int. Battery (Push to Test)	Yellow LED indicates internal battery is in use. LED blinks yellow to indicate Battery Low alarm condition or blinks red to indicate Battery Empty alarm condition.
Humidifier On	Green LED indicates humidifier is active. LED blinks yellow to indicate humidifier alarm condition.

Hardware	Requirements
24. Electrical	Applied parts type BF
25. External A.C. /D.C. (Battery Input)	100-240 VAC, max. 2 A 50 / 60 / 400 Hz 12-30 VDC, max. 12 A
26. Dual Internal Battery	Primary battery: lead acid, 12 VDC, 5 AH Secondary back up battery: nickel metal hydride,12 VDC, 2.1 AH When new and fully charged, the Dual Pacinternal battery supplies power for up to 10 hours of operation at these settings: A/CMV mode, f=15, Volume Control=500 mL, t_I=1.0 sec, PEEP=Ø, max. airway pressure 30 cmH_2O/mbar, Power Save mode ON. **NOTE:** The dual internal battery charges whenever the HT50 is connected to an external power source. Battery charge level is best maintained by keeping the HT50 continuously connected to external power. **NOTE:** The primary internal battery capacity diminishes with age. As the battery ages the Battery Low alarm will occur sooner. If this begins to infringe on the needed battery time, prior to scheduled replacement, the primary internal battery should be replaced.
27. RS-232C Interface /Remote Alarm Output	8 pin SEMCONN connector. Operates at 19,200 baud. Allows put for interfacing with central alarms systems.
28. Pneumatics	Gas delivery system requires no external air compressor.
Miscellaneous	**Description**
29. Operating Temperature	–18ºC to 50ºC **NOTE:** For proper operation at low range temperatures (-18°C), the HT50 must be started in a normal room temperature environment and allowed to run for 30 minutes prior to transfer to colder environment. **NOTE:** At temperatures over 40ºC the charging circuit is disabled and the internal battery does not charge.
30. Operating Humidity	15 to 95% non-condensing
31. Operating Altitude	Sea level to 15,000 ft (0 to 4,572 m) There is no altitude limitation when HT50 is operated in a pressurized environment.
32. Operating Pressure	600 to 1,100 mbar
33. Regulatory and Agency Standards/Requirements	Complies with the following international standards & requirements: **IEC 60601-1:1988** (+A1:1991 +A2:1995; EN 60601-1:1990 +A1:1993 +A2:1995 +A3:1996) Medical Electrical Equipment – Part 1: General Requirements for Safety **CEI/IEC 60529:2001** Degrees of Protection Provided by

Enclosures (IP Code)
MIL-STD-810E Environmental Test Methods and Engineering Guidelines
IEC 601-2-12:1988 Particular Requirements for the Safety of Lung Ventilators for Medical Use
IEC 60601-1-2:2001 (+A1:2006) Medical Electrical Equipment, Collateral Standard: Electromagnetic Compatibility – Requirements and Tests
IEC 68-2-6 Test Fc Environmental Tests: Vibration (sinusoidal)
IEC 68-2-29 Test Eb Environmental Tests: Bump
IEC 68-2-32 Test Ed Environmental Tests: Free Fall
IEC 68-2-36 Test Fdb Environmental Tests: Random Vibration
ISO 8185:1997 Humidifiers for Medical Use: General Requirements for Humidification Systems
ASTM F 1100-90:1990 Standard Specifications for Ventilators Intended for Critical Care Use
ASTM F 1246-91:1991 Standard Specifications for Electrically Powered Home Care Ventilators – Part 1: Positive-Pressure Ventilators and Ventilator Circuits
DO-160D Environmental Conditions and Test Procedures for Airborne Equipment

34. Storage Temperature –40ºC to 65ºC

35. Storage Humidity 0 to 95% non-condensing

36. Height (includes handle) 10 inches (26 cm)

37. Width 11 inches (27 cm)

38. Depth 8 inches (20 cm)

39. Weight 16.7 lbs. (7.6 kg) without humidifier
18.0 lbs. (8.2 kg) with humidifier

40. Patient Range Adult - Pediatric (i.e. infant, child & adolescent) with body weight $\geq$10 kg

41. Factory Default Parameters

Patient Settings:

MODE	A/CMV	PEEP/CPAP	0 cmH_2O
Volume Control	500 mL	Psupport	0 cmH_2O
t_I	1.0 sec	Humidifier	Off
f	15 b/min	Buzzer Volume	Loud
Ptrig	–1.0 cmH_2O		
Paw Alarms	5 cmH_2O ▼Paw		
	40 cmH_2O ▲ Paw		
$\dot{V}_I$ Alarms	3 L/min ▼$\dot{V}_I$		
	20 L/min ▲ $\dot{V}_I$		

User Set Up:

Power Save	On
Pressure Units	cmH_2O
Auto Panel Lock	Disabled
Set Up	User

42. Patient Circuit — Reusable 22 mm I.D. adult/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 line, and exhalation valve.

43. Exhalation Valve — NEWPORT'S HT50 exhalation valve (P/N HT600039) is manufactured and designed specifically for the NEWPORT HT50 Ventilator. Newport Medical does not approve of the use of any type or brand of exhalation valve that has not been tested and approved by Newport Medical for use with the HT50.

HT50-H, HT50-HB Humidifier Specifications

(operates on A.C. power only)

Set Target Temperature Range:	19ºC to 39ºC
Operating Water Volume:	300 mL
Usable Volume of Water Bottle:	265 mL
Compliance at Minimum Water Level (Refill Line):	0.5 mL/cmH_2O / mbar @ 23ºC
Compliance at Maximum Water Level (Full Line):	0.33 mL/cmH_2O / mbar @ 23ºC
Intended Use:	Adult and pediatric patients whose supraglottic airway is or is not bypassed.
Warm-Up Time:	30 minutes
Gas Leakage:	2 mL/min at airway pressure of 80 cmH_2O / mbar
Humidifier Output:	33.8 mg/L at a continuous flow of 10 L/min @ 39ºC
Maximum Operating Airway Pressure:	100 cmH_2O / 98 mbar
Maximum Temperature at the Patient Wye That Triggers an Alarm:	41ºC

(optional) Air / Oxygen Entrainment Mixer Specifications

Pneumatic Requirements:

Oxygen	35 to 90 psig (2.4 to 6.2 Bar) full operating range 40 to 70 psig (2.7 to 4.8 Bar) accuracy ± .08
Air	Atmospheric pressure
F_IO_2 Control:	adjusted continuously from 0.21 to 1.00

WARNING Continuous oxygen monitoring is required for patient safety. The HT50 does not have a built-in alarm system to notify user of a failure or disconnect of the oxygen source.

(optional) Oxygen Blending Bag Kit Specifications

Pneumatic Requirements:

Oxygen	0-10 L/min (calibrated)
Air	Atmospheric pressure
F_IO_2 Control:	F_IO_2, indirectly adjusted from 0.21 up to 1.00 via oxygen flow (L/min)

WARNING Continuous oxygen monitoring is required for patient safety. The HT50 does not have a built-in alarm system to notify user of a failure or disconnect of the oxygen source.

3. DESCRIPTION OF CONTROLS, INDICATORS, ALARMS & CONNECTORS

FRONT PANEL OVERVIEW

The following is an overview of the HT50 front panel button functions. For an indepth description, please review FRONT PANEL CONTROLS AND INDICATORS.

Turning the HT50 On and Off

The On/Standby button toggles between the following conditions:

Standby → Setting → On → → Standby

Press On/Standby button once to go from Standby to Setting. Press again to turn On. Press twice to go from On to Standby.

Standby: HT50 dormant.
Setting: Enables setting of control parameters and exhalation valve calibration.
On: Enables ventilation

NOTE: There is approximately a two second delay in going from Standby to Setting condition. During this time, the HT50 performs a self test and will light all displays on the front panel.

Changing the MODE Control

The MODE control buttons (A/CMV / SIMV / SPONT) function differently in Setting and On conditions.

Setting Condition Press the A/CMV, SIMV or SPONT button. The LED on the selected Mode will light green to confirm the selection.

On Condition Press the A/CMV, SIMV or SPONT button. The LED on the selected Mode will blink green and the Message Display Window will read “PRESS AGAIN.” Press the button again within 5 seconds to confirm the mode change, or the previously selected mode will continue.

Changing between Pressure Control and Volume Control

The Pressure Control and Volume Control buttons function differently when in A/CMV or SIMV in On condition compared to when in SPONT mode in On condition or Settings condition.

On Condition: A/CMV or SIMV **Select—Adjust (▲Up / ▼Down)—Accept**

Select the Pressure Control or Volume Control button. Both the LED indicator and the target value will blink.

Adjust the blinking target value for the selected control with the ▲Up / ▼Down buttons.

To **Accept** the new control and target value you must press the desired control button (Volume or Pressure) a second time.

On Condition: SPONT
or
Setting Condition: A/CMV, SIMV, or SPONT

Select—Adjust (▲Up / ▼Down)—Accept

Select the Pressure Control or Volume Control button. Both the LED indicator and target value will blink.

Adjust the blinking target value for the selected control with the ▲Up / ▼Down buttons.

Accept the new control and target value by either pressing the selected button again; or by pressing another button to select a new parameter for adjustment, or by waiting 5 seconds without making a change.

Note: The transition to a new pressure or volume target may require several breaths.

Changing a Parameter (or Multiple Parameters)

Select—Adjust (▲Up / ▼Down)—Accept

Select the parameter by pressing the labeled button (i.e. *f*, P trig, etc). The parameter's numeric display will blink.

Adjust the numeric value with the ▲Up / ▼Down buttons.

Accept the value by either pressing the selected button again; or by pressing another button to select a new parameter for adjustment, or by waiting 5 seconds without making a change.

Enabling/Disabling Auto Panel Lock

Auto Panel Lock can be enabled or disabled via User Set Up (see pg 3-27). When the Auto Panel Lock is enabled, the Panel will lock 30 seconds after the last button is pushed and the LED lights green. All touch buttons (except Silence/Reset and Internal Battery Test) are locked, preventing accidental parameter changes.

NOTE: Auto Panel Lock is factory preset to "Disabled" (off).

To temporarily unlock parameters when Auto Panel Lock is active, push the Push To unlock button for at least one second. The Panel will relock 30 seconds after the last button is pushed.

Figure 3-1
HT50 Ventilator Front Panel
(model HT50-H1, HT50-H1B)

Figure 3-2
Newport HT50-H, HT50-HB (with built-in humidifier)

FRONT PANEL CONTROLS & INDICATORS

Front panel controls that have corresponding LED indicators are included with the description of the control.

The HT50 front panel is shown in Figure 3-1 on pg 3-3.

On / Standby

This button toggles between the following conditions:

Standby (if attached to external power, the battery is being charged) → **Setting** (allows setting of control parameters) → **On** (enables ventilation) → → **Standby**

Standby: The HT50 is dormant and ventilation is not enabled. If attached to external power, the Ext. Power/ Charging Int. Battery LED is lit green, indicating that the internal battery is being charged. The On/Standby indicator is not lit.

Setting: Pressing the On/Standby button once changes the ventilator from Standby to Setting condition.

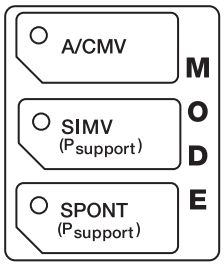
NOTE: There is approximately a two second delay in going from Standby to Setting condition. During this time, the HT50 performs a self test and will light all displays on the front panel.

During Setting condition, all adjustable LEDs are lit. This allows the operator to preset and adjust controls prior to ventilation. The On/Standby indicator is not lit. The Message Display Window shows “Press ON to Vent,” suggesting that the On/Standby button needs to be pressed if you want the HT50 to start ventilation.

On: Pressing the On/Standby button once more changes the ventilator from Setting to On. In the On condition, the HT50 is ventilating and the On/Standby indicator is lit green.

Pressing the On/Standby button twice while in On condition turns the ventilator from On to Standby.

MODE Control



The MODE control buttons enable the user to switch between the following operational modes:

- A/CMV
- SIMV
- SPONT

In A/CMV and SIMV, mandatory breaths can be pressure controlled or volume controlled. A green LED indicates which operational mode is active.

If the HT50 is in Setting condition, changes are made by pressing the requested MODE button once. If in ON condition, changes are made by pressing the requested MODE button twice. After the first press, the Message Display Window reads “PRESS AGAIN” and the requested MODE’s indicator starts to blink. If the requested MODE button is not pressed within 5 seconds, the change is cancelled.

A/CMV
(Assist / Control Mandatory Ventilation)

In A/CMV, the user may choose to pressure or volume control mandatory breaths. In either case, all breaths delivered to the patient, whether time (ventilator initiated) or patient-triggered, are the same.

The ƒ (frequency) setting determines the minimum number of time-triggered mandatory breaths delivered each minute. The Ptrig setting determines the airway pressure threshold that patient effort must reach to trigger additional mandatory breaths. If patient effort doesn’t cause airway pressure to drop enough to meet the Ptrig threshold, or if the patient doesn’t breathe, the HT50 will deliver the set ƒ (frequency) of mandatory breaths.

NOTE: If the Ptrig setting is not adjusted to a level that allows the patient’s inspiratory effort to be detected, A/CMV mode performs as CMV (control) mode.

SIMV
(Synchronized Intermittent Mandatory Ventilation)

In SIMV, the user may choose to pressure or volume control mandatory breaths. In either case, all mandatory breaths delivered to the patient, whether time (ventilator initiated) or patient-triggered, are the same. In addition, the user may choose to pressure support the spontaneous breaths in between mandatory breaths.

Unlike A/CMV, the ƒ (frequency) setting in this mode determines the total rather than the minimum number of time (ventilator) or patient triggered mandatory breaths delivered each minute.

The ƒ (frequency) setting also establishes a timing window which determines whether a patient trigger results in a mandatory breath or a spontaneous breath.

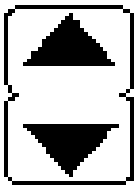
The Ptrig setting determines the airway pressure threshold that patient effort must reach to trigger mandatory breaths and also to trigger spontaneous breaths in between mandatory breaths.

If patient effort doesn’t cause airway pressure to drop enough to meet the Ptrig threshold or if the patient doesn’t breathe, the HT50 will deliver the set ƒ (frequency) of mandatory breaths each minute.

SPONT (Spontaneous Ventilation)

In this mode, all breaths are patient triggered by spontaneous efforts. Psupport (Pressure Support Ventilation) may be used to support spontaneous efforts. When PEEP/CPAP is set above 0, the ventilator mode is CPAP (without Psupport) or Bilevel Positive Airway Pressure (with Psupport).

▲ Up and ▼ Down Control



The ▲Up/▼Down control buttons have multiple uses on the HT50.

1. Parameter Adjustment: Use the ▲Up/▼Down buttons to adjust ventilation control parameter values (including Pressure Control and Volume Control values), alarms, and humidifier setting (if available). Select the desired parameter by pressing its touch button once. The corresponding value (numerical display) will blink. Press the ▲Up control to increase or the ▼Down to decrease the affected parameter value. The value continuously changes when the ▲Up/▼Down controls are pressed and held. The value adjustment is accepted if (1) the user presses the selected parameter button again, or (2) the user selects a different parameter, or (3) five seconds elapses. Pressing a parameter button without pressing either the ▲Up or ▼Down control button within 5 seconds causes the parameter to retain its current value.

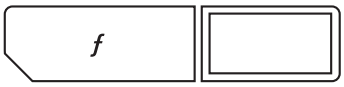
NOTE: If in the On condition and switching between Volume Control and Pressure Control, the value adjustment for the new breath type selected (Volume or Pressure) will be accepted as noted above, but the breath type (VC or PC) will only change if the user presses the new breath type control button again.

2. Monitored Information: The ▲Up/▼Down controls are used to access and display monitoring messages in the Message Display Window. Monitored information includes volume, frequency, pressure values and operation information. See pg 3-23 for more information on the Message Display Window.

When the HT50 is ventilating, and there are no alarm messages displayed on the Message Display Window, press the ▲Up control button to access the monitoring information. Pressing the ▲Up button again allows you to scroll through the messages.

3. Changing Default Settings: The ▲Up/▼Down controls are also used in User Set Up to change a set up value. See User Set Up on pg 3-27 for more details.

f (frequency)



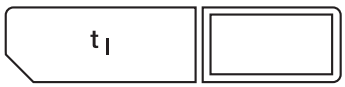
Range: 1 to 99 b/min

The *f* (frequency) setting determines the minimum number of time triggered mandatory breaths in the A/CMV mode and the total number of mandatory breaths in the SIMV mode. The frequency or rate value is displayed in the window adjacent to the selector button.

The user is alerted to frequency settings which result in an inverse I:E Ratio by an audible beep and an “Inverse I:E” message in the Message Display Window. Attempts to continue increasing the value after this alert are permitted up to an I:E Ratio of 3:1.

NOTE: In SPONT mode, the *f* setting is not utilized but the value can be preset.

t_I (inspiratory time)



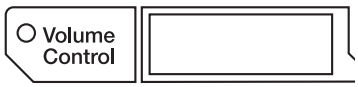
Range: 0.1 to 3.0 sec

The t_I setting determines the inspiratory time for mandatory breaths (volume or pressure control). The selected time value is displayed in the window adjacent to the selector button. The user is alerted to t_I settings which result in an inverse I:E Ratio by an audible beep and an “Inverse I:E” message in the Message Display Window. Attempts to continue increasing the value after this alert are permitted up to an I:E Ratio of 3:1. If the inspiratory time setting causes the flow rate to reach the maximum or minimum level of the flow specification, adjustment of t_I ceases, a beep sounds, and a setting limitation message appears in the Message Display Window.

NOTE: In SPONT mode, the t_I setting is not utilized but the value can be preset.

NOTE: See pg. 3-24 for a list of setting limitation messages.

Volume Control (tidal volume)



Range: 100 to 2,200 mL, ATPS

NOTE: When Volume Control is first initiated, or when a large change is made to the volume setting, it may take 5 or 6 breaths to reach the volume setting.

Pressing this control button, followed by pressing the ▲Up/▼Down controls, allows the adjustment of the tidal volume setting. When the green Volume Control LED illuminates, the adjacent window displays the set tidal volume. See Theory of Operation, pg 4-5 for more details.

If the Volume Control setting causes the flow rate to reach the maximum or minimum level of the flow specification, adjustment of Volume Control ceases, a beep sounds, and a setting limitation message appears in the Message Display Window.

NOTE: See pg. 3-24 for a list of setting limitation messages.

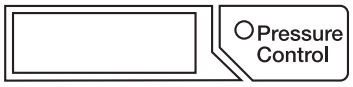
NOTE: In SPONT mode, the Volume Control is not utilized but the value can be preset.

Switching from Pressure Control to Volume Control:

Press the Volume Control button. The set tidal volume is displayed in the adjacent window if the HT50 is ventilating. A “PRESS AGAIN” message appears in the Message Display Window.

Adjust the tidal volume level by pressing the ▲Up/▼Down controls while the LED and numerical display are blinking. If the HT50 is ventilating you will need to press the Volume Control button again within 5 seconds following adjustment.

Pressure Control (target pressure)



Range: 5 to 60 cmH_2O / mbar

NOTE: When Pressure Control is first initiated or the setting is changed, the first few breaths may cycle off early until slope/rise is optimized. If early cycling off continues, re evaluate the breathing circuit configuration and lengthen the tubing as necessary.

Pressing this control button, followed by pressing the ▲Up/▼Down controls, allows the adjustment of the target airway pressure setting. Target pressure is referenced to ambient (atmospheric pressure). When the green Pressure Control LED illuminates, the adjacent window displays the set airway pressure. See Theory of Operation pg 4-4 for more details.

NOTE: In SPONT mode, the Pressure Control is not utilized but the value can be preset.

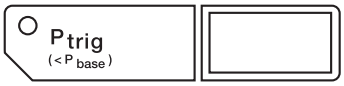
Switching from Volume Control to Pressure Control:

Press the Pressure Control button. The set target airway pressure value is displayed in the adjacent window if the HT50 is ventilating. A “PRESS AGAIN” message appears in the Message Display Window.

Adjust the set target airway pressure by pressing the ▲Up/▼Down controls while the LED and numerical display are blinking. If the HT50 is ventilating you will need to press the Pressure Control button again within 5 seconds following adjustment.

NOTE: The minimum target airway pressure is 5 cmH_2O / mbar above set baseline pressure.

Ptrig (sensitivity)



Range: 0.0 to –9.9 cmH_2O/mbar

The Ptrig setting determines trigger sensitivity in terms of how far airway pressure must drop below the set baseline pressure for a patient's spontaneous efforts to be detected. The Ptrig LED indicator illuminates each time the airway pressure reaches the set Ptrig level, and turns off once the airway pressure has returned to baseline pressure. The blinking Ptrig LED is referred to as the Patient Effort Indicator. The Ptrig value is displayed in the adjacent window. Set Ptrig as close to 0.0 cmH_2O as possible without autotriggering to maximize triggering synchrony.

PEEP/CPAP

Range: 0 to 30 cmH_2O/mbar

The PEEP/CPAP setting establishes airway pressure in the patient circuit during the exhalation phase. It is also referred to as base or baseline pressure. The set PEEP/CPAP value is displayed in the adjacent window.

NOTE: In Pressure Control ventilation, PEEP/CPAP cannot be set higher than 5 cmH_2O/mbar below the set Pressure Control setting.

NOTE: The value of PEEP/CPAP plus Psupport cannot exceed 60 cmH_2O/mbar.

Psupport (pressure support)

Range: 0 to 60 cmH_2O/mbar

The Psupport (pressure support) setting determines the target rise/change in pressure during inspiration for patient triggered spontaneous breaths in SIMV and SPONT modes. The target pressure is the set Psupport plus the PEEP level.

Any time the active Psupport control is pressed, Psupport flow delivery slows to a lower level then it gradually increases to the appropriate level as pressure rise is re-assessed.

NOTE: The value of PEEP/CPAP plus Psupport cannot exceed 60 cmH_2O/mbar.

Manual Inflation

Range: 0 to 3.0 sec

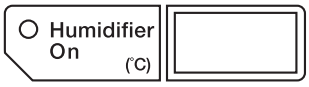
Pressing this button delivers an operator initiated Manual Inflation. Pressing the Manual Inflation button will not initiate an inflation if the patient is currently in the inspiratory phase of a breath or if airway pressure is > 5 cmH_2O (mbar) above the set PEEP/CPAP level. Manual Inflation delivers the set flow rate (in Volume Control) or the set target pressure (in Pressure Control), but inspiratory time is controlled by the user.

During Manual Inflation, the breath is terminated if (1) the Manual Inflation button is released, or (2) the ▲Paw (High Pressure) alarm is violated or (3) three seconds have elapsed.

NOTE: Manual Inflation is only available in A/CMV and SIMV modes.

NOTE: Manual Inflation may be prematurely cycled off in the first several breaths in Pressure Control when the initial flow has not yet been optimized.

Humidifier On Button (HT50-H, HT50-HB only)



Range: 19°C to 39°C

This touch button activates the built-in humidifier. Pressing this button displays the set target temperature in the adjacent window. While the display is blinking, use the ▲Up/▼Down controls to adjust the target temperature. When temperature adjustment is complete and (1) five seconds have elapsed without touching the control, (2) the Humidifier On button is pressed again, or (3) another parameter is selected for adjustment, the display stops blinking and the measured temperature is displayed. While the humidifier is On, the target temperature can be readjusted at any time by pressing the Humidifier On button and using the ▲Up/▼Down controls.

NOTE: Preheating the humidifier for 30 minutes prior to beginning ventilation will improve the heating performance of the humidifier.

During ventilation (On condition) the displayed temperature is the measured temperature at the patient connector. In the Setting condition, the displayed temperature is the measured temperature at the humidifier bottle outlet.

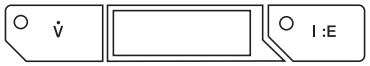
To turn the humidifier Off, press and hold the Humidifier On button for three seconds. See pg 5-10 for more details.

NOTE: The measured proximal temperature may be different from the set target temperature due to the environmental temperature, minute volume, patient temperature, etc.

NOTE: The humidifier is operational only when the HT50 is powered by external A.C. power.

NOTE: If the humidifier and/or the temperature probe is removed or malfunctions or if the humidifier bottle is removed prior to turning the humidifier off, the Humidifier On LED changes from green to blinking yellow, an audible alarm sounds and the heater shuts down automatically. To restart the humidifier, correct the alarm condition and press the Humidifier On button.

$\dot{V}$ (mandatory flow)

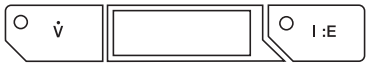


Range: 6 to 100 L/min
$\dot{V}$ shares a numeric display window with I:E Ratio.
$\dot{V}$ LED is illuminated green when flow is displayed.

Displays the calculated flow delivered from the ventilator during volume controlled mandatory breaths. $\dot{V}$ display is not available during Pressure Controlled breaths or SPONT mode.

NOTE: Flow can be adjusted indirectly by changing the tidal volume (Volume Control) or t_I settings.

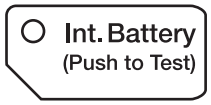
I:E Ratio (inspiratory time to expiratory time)



Range: 1:99 to 3:1
I:E Ratio shares a numeric display window with $\dot{V}$.
I:E LED is illuminated green when I:E Ratio is displayed.

I:E Ratio is determined by the f and t_I settings. If expiratory time is longer than inspiratory time, the display format is 1:X.X. If expiratory time is shorter than t_I, the display format is X.X:1. When the I:E Ratio is inverse, the I:E Ratio indicator illuminates once every breath. I:E Ratio does not function during SPONT mode.

Internal Battery Test Button and Indicator

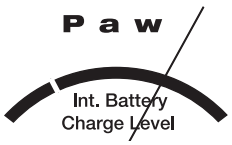


When the HT50 is powered by the dual internal battery, the LED on this button illuminates. A yellow LED indicates the internal battery system is in use. A blinking yellow LED indicates low power. When the battery system is completely discharged, the LED blinks red.

Pressing this button allows the Int. Battery Charge Level to be read in the lower half of the Paw meter window. The battery charge level should only be tested when the HT50 is operating on the dual internal battery. Testing while plugged into any external power source will give inaccurate readings.

Test the HT50 dual internal battery periodically to verify that the charge level is in the blue area. The numbers on the Paw meter do not reflect the percent of charge.

Internal Battery Charge Level Meter



The Int. Battery Charge Level meter is located beneath the Paw meter. If the needle is in the red when the test button is presed the battery charge is low. You should use an external power source. The blue area indicates medium to full battery charge. Each battery use time is different based on your conditions. The numbers on the Paw meter do not reflect the percent of charge.

NOTE: The battery charge level is best maintained by keeping the HT50 continuously plugged into an external power source.

Push to Unlock Button and Auto Lock Indicator

Auto Panel Lock can be enabled or disabled via User Set Up (see pg 3-29). When Auto Lock is set to “Enabled” in User Set Up and the ventilator is in On condition and 30 seconds have elapsed without pressing any buttons, the Auto Lock function is automatically activated and the (Auto Lock On) LED illuminates green. When Auto Lock is active, all touch buttons (except Silence/Reset and Int. Battery Test) are locked, preventing accidental changes.

Press and hold the Push to Unlock button for at least one second to unlock the panel and enable the activation of all touch buttons for adjustment. An audible beep sounds and the LED is extinguished. When 30 seconds have elapsed without pressing any buttons, the Auto Lock is automatically activated again.

NOTE: Auto Panel Lock is factory preset to “Disabled” (off).

Silence / Reset

The Silence/Reset button has three functions:

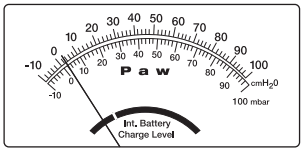
1. Silencing alarms: Press the Silence/Reset button to silence all alarms for 60 seconds. When the Silence/Reset indicator is illuminated, all alarms are silenced except Device Alert alarm. Press the Silence/ Reset button again to cancel the silence period.

2. Clearing alarm messages: Press the Silence/Reset button to clear all alarm messages in the Message Display Window and to release latched LED indicators when the cause for the alarm is no longer present.

3. Toggle Buzzer Volume (alarm loudness) between Loud and Quiet: Press and hold the Silence/Reset button when there are no alarm messages displayed to toggle the alarm audible volume between loud and quiet. The alarm will sound at the new setting.

NOTE: The Battery Empty Alarm and the Device Alert Alarm can not be silenced permanantly. These alarms indicate that an alternate source of ventilation must be utilized. See pgs 3-20 and 3-21 for more details.

Paw Meter (airway pressure meter)



Range: –10 to 100 cmH_2O / 98 mbar

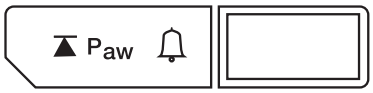
The Paw meter displays airway pressure. It also indicates the internal battery charge level when the Int. Battery button is pressed.

FRONT PANEL ALARMS

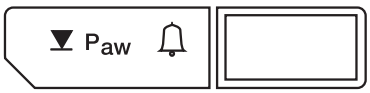
The front panel alarm LED indicators blink when an alarm limit setting is violated. Once the violation is no longer in effect, the indicators latch (remain steadily lit) until they are reset by pressing the Silence/Reset button.

High ▲ Paw and Low ▼ Paw Alarm Control and Display (airway pressure)

Range:	Paw	–10 to 100 cmH_2O / 98 mbar
	High ▲ Paw Alarm	4 to 99 cmH_2O / 97 mbar
	Low ▼Paw Alarm	3 to 98 cmH_2O / 96 mbar



The ▲ Paw button allows the selection of the high (peak) airway pressure alarm setting.



The ▼ Paw button allows the selection of the low peak airway pressure alarm setting.

To adjust either alarm, press the desired button once. The value in the adjacent display window will blink. Use the ▲Up/▼Down controls to adjust the displayed alarm setting value. The new setting can be retained by (1) pressing the selected button again to accept the alarm setting, (2) selecting another parameter for adjustment, or (3) allowing five seconds to elapse without adjustment.

NOTE: In SPONT mode the ▼ Paw alarm is inactive but the value can be preset.

NOTE: The ▼ Paw alarm setting cannot be a value below PEEP/CPAP + 3. The ▲ Paw alarm setting must be a value at least 1 above the ▼ Paw alarm setting.

▲ Paw (High Pressure) Alarm (user adjustable)

Audible Alarm: Intermittent beep
Visual Alarm: ▲Paw indicator blinks red
Message Window: HIGH PRESSURE

The High ▲Paw Alarm is activated when airway pressure (Paw) reaches the ▲ Paw alarm limit setting. Any breath in progress immediately cycles to exhalation. The alarm violation is cancelled when Paw falls below the Paw alarm limit setting and at least one second has elapsed since the alarm was activated.

▼ Paw (Low Pressure) Alarm (user adjustable)

Audible Alarm: Intermittent beep
Visual Alarm: ▼Paw indicator blinks red
Message Window: LOW PRESSURE

The Low ▼Paw Alarm is activated when airway pressure remains below the ▼Paw alarm limit setting for two consecutive mandatory breaths. The alarm violation is cancelled when one mandatory breath is delivered without a ▼Paw alarm violation.

NOTE: The Low ▼Paw Alarm does not function in SPONT mode. The ▼Paw alarm limit does not apply to spontaneous breaths in SIMV mode.

High ▲ $\dot{V}_I$ and Low ▼ $\dot{V}_I$ Alarm Control and Display (inspiratory minute volume)

Range:

	$\dot{V}_I$	0 to 99.0 L/min
	High ▲ $\dot{V}_I$ Alarm	1.1 to 50.0 L/min
	Low ▼ $\dot{V}_I$ Alarm	0.1 to 49.0 L/min

This window displays the inspiratory minute volume (in liters) and is automatically updated every 10 seconds. The $\dot{V}_I$ window always displays the delivered minute volume, except when the user is in the process of setting either the High or Low $\dot{V}_I$ alarm limit.

To adjust the High or Low $\dot{V}_I$ alarm limit, press the ▲ or ▼ $\dot{V}_I$ button. The value in the adjacent display window will blink. Use the ▲Up/▼Down controls to adjust the displayed alarm limit value. The new limit can be retained by (1) pressing the selected button again to accept the alarm setting, (2) selecting another parameter for adjustment, or (3) allowing five seconds to elapse without adjustment.

NOTE: The high inspiratory minute volume alarm limit is limited to 1 > the low alarm limit setting. The low alarm limit is limited to 1 < the high alarm limit setting.

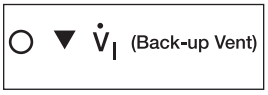
▲ $\dot{V}_I$ (High Insp. Minute Volume) Alarm (user adjustable)

Audible Alarm: Intermittent beep
Visual Alarm: ▲$\dot{V}_I$ indicator blinks red
Message Window: HIGH V̇i

The High Insp. Minute Volume Alarm is activated when the delivered inspiratory minute volume exceeds the High ▲ $\dot{V}_I$ alarm setting. The alarm is cancelled after delivered inspiratory minute volume falls below the ▲$\dot{V}_I$ alarm setting.

WARNING The Insp. Minute Volume Alarms are based on the delivered volume from the ventilator. The actual minute volume in the patient lungs may be significantly different in cases such as circuit leak, disconnection, and pneumothorax. To verify the exhaled minute volume, use a separate exhaled volume monitor.

▼ $\dot{V}_I$ (Low Insp. Minute Volume) Alarm Back-up Ventilation (user adjustable)



Audible Alarm: Intermittent beep
Visual Alarm: ▼$\dot{V}_I$ indicator blinks red
Message Window: LOW V̇i
LOW V̇i (BUV) (if back-up ventilation is active)

The Low Insp. Minute Volume Alarm is activated when delivered inspiratory minute volume falls below the Low ▼$\dot{V}_I$ alarm limit setting.

WARNING The Insp. Minute Volume Alarms are based on the delivered volume from the ventilator. The actual minute volume in the patient lungs may be significantly different in cases such as circuit leak, disconnection, and pneumothorax. To verify the exhaled minute volume, use a separate exhaled volume monitor.

Back-up Ventilation
Back-up Ventilation is an alarmed function that activates when the delivered inspiratory minute volume ($\dot{V}_I$) falls below the Low ▼$\dot{V}_I$ setting. During Back-up Ventilation, the Low ▼$\dot{V}_I$ (Back-up Vent) alarm indicator blinks, an audible alarm sounds, and "LOW V̇i (BUV)" is displayed in the Message Display Window. The ventilation settings employed by Back-up Ventilation are then displayed on the front panel. Back-up Ventilation ceases when $\dot{V}_I$ = ▼$\dot{V}_I$ + 10%, at which time ventilation and front panel displays return to user-set values.

Back-up Ventilation is functional in all modes. See page 4-5 for a complete description of Back-up Ventilation.

High Baseline Pressure Alarm (automatic)

Audible Alarm: Intermittent beep
Visual Alarm: ▲Paw indicator blinks red
Message Window: HIGH Pbase

The High Baseline Pressure (High Pbase) alarm is activated when airway pressure is above the Low ▼ Paw alarm limit setting at the beginning of a time activated mandatory breath. The alarm resets when Paw drops to within 5 cmH_2O / mbar of the set PEEP/CPAP level.

Occlusion Alarm, Circuit (automatic)

Audible Alarm: Intermittent beep
Visual Alarm: ▲Paw indicator blinks red at the high priority rate
Message Window: OCCLUSION

An Occlusion alarm is activated when airway pressure is above the set PEEP + 15 cmH_2O/mbar at 3 seconds after the beginning of expiration, or at the end of expiration, whichever comes first. When a breathing circuit occlusion occurs, the ventilator will be unable to release the pressure, therefore additional breaths will not be delivered until the condition is corrected. The alarm resets when airway pressure falls to within 15 cmH_2O/mbar of baseline, at which point breath delivery is resumed.

Occlusion Alarm, Device (automatic)

Audible Alarm: Intermittent beep
Visual Alarm: ▲Paw indicator blinks red at the high priority rate and Device Alert indicator blinks
Message Window: OCCLUSION

An Occlusion alarm is activated when airway pressure is above the set PEEP + 15 cmH_2O/mbar at 3 seconds after the beginning of expiration, or at the end of expiration, whichever comes first. When the Occlusion alarm is caused by a malfunction inside the ventilator, the HT50 will attempt to relieve circuit pressure through its redundant safety system. If successful, ventilation will continue, but in an alarmed state. It is possible that the condition causing the alarm will self-correct, in which case the alarm is reset. Otherwise, the ventilator will continue to alarm until the necessary service is performed. If the HT50 is unsuccessful in relieving circuit pressure, additional breaths will not be delivered unless airway pressure falls to within 15 cmH_2O/mbar of baseline.

WARNING Any time a Device Alert violation occurs along with the message "OCCLUSION," an alternate method of ventilation should be provided for the patient as soon as possible so that the cause of the violation can be adequately and safely investigated.

Low Baseline Pressure Alarm (automatic)

○ ▼ Paw/Apnea

Audible Alarm: Intermittent beep
Visual Alarm: ▼Paw/Apnea indicator blinks red
Message Window: LOW Pbase

The Low Baseline Pressure (Low Pbase) Alarm is activated by an unstable baseline (leak in the breathing circuit) or by a baseline decrease since the last PEEP/CPAP control change. A Low Pbase violation occurs in all modes when airway pressure remains ≥ 3 cmH_2O/mbar below baseline for 3 seconds. The same LED that blinks during Low ▼Paw violations blinks when this alarm is activated. The alarm resets when airway pressure is < 3 cmH_2O/mbar below baseline.

Check Prox Line Alarm (automatic)

○ ▼ Paw/Apnea

Audible Alarm: Intermittent beep
Visual Alarm: ▼Paw/Apnea indicator blinks red
Message Window: CHECK PROX LINE

The Check Prox Line Alarm is activated when, during inspiration, the pressure measurement of the proximal pressure sensing line is significantly different from the internal back up pressure sensing line located inside the ventilator. This may be caused by a disconnected, kinked, water-filled proximal sensing line, or a blocked proximal line filter. Ventilation is continued during the alarm condition, using the pressure measurement of the internal sensing line.

Apnea Alarm (automatic)

○ ▼ Paw/Apnea

Audible Alarm: Intermittent beep
Visual Alarm: ▼Paw/Apnea indicator blinks red
Message Window: APNEA

The Apnea Alarm is activated when no mandatory breaths or detected spontaneous efforts occur for 30 seconds. The alarm is reset by a time or patient trigger.

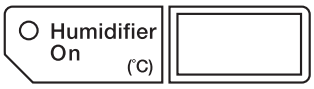
NOTE: The Apnea Alarm does not activate Back-up Ventilation.

PCV Not Reached Alarm (automatic)

Audible Alarm: Intermittent beep
Visual Alarm: ▼Paw/Apnea indicator blinks red
Message Window: PCV NOT REACHED

The PCV Not Reached Alarm is activated in pressure control ventilation when the maximum inspiratory pressure (Paw P) is less than 50% of the target pressure for 2 consecutive mandatory breaths. The alarm is reset when maximum inspiratory pressure (Paw P) is ≥ 50% of the target pressure.

Humidifier Alarm (automatic) HT50-H only



Audible Alarm: Intermittent 3-pulse caution beep
Visual Alarm: Humidifier indicator blinks yellow

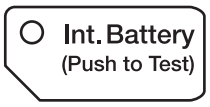
The Humidifier Alarm is activated when any of the following conditions occur in the HT50 built-in humidifier. When an alarm condition is detected the humidifier heater shuts down.

There are five humidifier alarms:

Message Display Window	Cause of Alarm
Check Humidifier	Bottle removed or not clamped properly when trying to activate the humidifier. Temp Probe not connected or missing when trying to activate the humidifier.
Humidifier Fail	Bottle removed while humidifier is On. Failure of the primary humidifier control.
Check Temp Probe	Temp Probe damaged or missing while humidifier is On.
High Prox Temp	Proximal temperature exceeds set target temperature by 4°C when set at ≥ 34ºC or 6ºC when set at < 34ºC.
High Temp Core	Excessive temperature in the humidifier heating element.

NOTE: The Humidifier Alarm is automatically set when using the HT50 humidifier. Humidifier Alarms (and the built-in humidifier) do not function when the HT50 is powered on internal battery.

Battery Low Alarm (automatic)

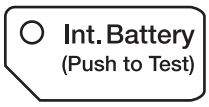


Audible Alarm: Intermittent 3-pulse caution beeps
Visual Alarm: Int. Battery indicator blinks yellow
Message Window: Battery Low

Indicates that a minimum of 30 minutes of operating power remains in the dual internal battery. Pressing the Silence/Reset button will cancel the audible three-pluse caution beeps but the visual alarm will continue to blink and the alarm will beep once every three minutes as long as the alarm condition continues. The alarm is reset when A.C. or external D.C. power is connected to the HT50.

NOTE: The battery condition and ventilator settings used will affect remianing time, but it will be at least 30 minutes.

Battery Empty Alarm (automatic)



Audible Alarm: Intermittent beep
Visual Alarm: Int. Battery indicator blinks red
Message Window: BATTERY EMPTY

Indicates that a minimum of 15 minutes of operating power remains in the dual internal battery. An alternate power source must be located immediately. This alarm can only be temporarily silenced as long as the alarm condition continues. The alarm is reset when A.C. or external D.C. power is connected to the HT50.

NOTE: The actual time remaining depends on the battery condition and the ventilator settings used.

NOTE: Frequent deep discharge of the dual internal battery will decrease the amount of time the HT50 will operate on battery power from a full charge state. Replace the battery when battery operation time is insufficient for application.

WARNING Immediately secure an external power source when the Battery Empty alarm is violated. Charge the battery for a minimum of 5 hours (~80% recharged) before powering the ventilator again from the internal battery. If the battery is completely depleted, it takes approximately 7 to 8 hours to fully recharge.

NOTE: If the HT50 is to be powered from the dual internal battery for an extended period, ensure that the dual internal battery is fully charged prior to use.

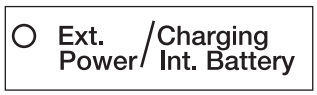
Fault, Battery System Alarm, Device Alert (automatic)

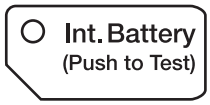
Audible Alarm: Intermittent beep
Visual Alarm: Device Alert indicator blinks red
Message Window: FAULT BAT SYS

The status of the internal battery system and the charging system is continuously monitored and any deficiency will result in a Battery Fault Alarm. The HT50 will continue to operate properly from an external power source but it can not be powered by the internal battery system.

NOTE: If the "Fault Bat Sys" device alert alarm occurs, keep the HT50 plugged into an external popwer source. Contact Newport Medical Technical Service Dept.

Power Switchover Alarm (automatic)





Audible Alarm: Intermittent 3-pulse caution beeps
Visual Alarm: Ext. Power indicator illuminates red
Int. Battery indicator blinks yellow
Message Window: No ext power

The Power Switchover Alarm is activated by switching from external power to the dual internal battery due to disconnection from the power cord or a power interruption. Pressing the Silence/Reset button will (1) cancel the audible alarm, (2) cancel the "No ext power" message, (3) cancel the Ext. Power LED and (4) cause the Int. Battery LED to change to non-blinking yellow indicator.

If external power is connected within 60 seconds following internal battery operation, the HT50 will immediately switch back to external power. If internal battery operation has lasted longer than 60 seconds, there will be a delay of up to an additional 60 seconds before the HT50 will switch back to external power. If "No ext power" message is still displayed following the re-connection to external power, press Silence/Reset button to cancel the message.

Device Alert Alarm (automatic)

Audible Alarm: Intermittent beep
Visual Alarm: Device Alert indicator blinks red
Message Window: OCCLUSION or 10V SHUTDOWN or FAULT BAT SYS or SYSTEM ERROR or MOTOR FAULT

The Device Alert Alarm is activated when the microprocessor detects a functional problem with the ventilator. With the

exception of OCCLUSION & FAULT BAT SYS, all other Device Alert alarms are non-recoverable and will result in the HT50 discontinuing ventilation. When this occurs, the ventilator must be powered down by pressing the On/Standby button. DO NOT use the ventilator until the cause of the alert has been determined and corrected.

NOTE: See Pg. 3-17, Occlusion Alarm, Device, and Pg. 3-21, Fault Battery System Alarm, for a detailed description of these recoverable Device Alert Alarms.

There are three possible messages that will be displayed when a non-recoverable Device Alert Alarm occurs; (1) MOTOR FAULT (2) 10V SHUTDOWN and (3) SYSTEM ERROR. For MOTOR FAULT and10V SHUTDOWN the full text message will be displayed for 5 seconds, followed by an abbreviated form of the message, eg. MTR Fail, or 10V Fail. A timing message will also appear, documenting how long the condition has been present. The format for the time is “H:MM:SS.” The SYSTEM ERROR message will always be displayed with full text.

NOTE: If the cause of the SYSTEM ERROR does not allow the HT50 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. Upon the next power up of the unit, the SYSTEM ERROR message will be displayed. If the cause of the alarm has been corrected, the message can be cancelled by pressing the Silence/Reset button.

WARNING If a non-recoverable Device Alert alarm occurs, immediately disconnect the patient from the ventilator and provide an alternate method of ventilation.

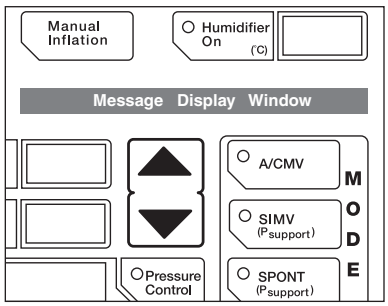
NOTE: A non-recoverable Device Alert Alarm cannot be silenced without first turning the ventilator Off (Standby).

Shut Down Alert Alarm (automatic)

Audible Alarm: Intermittent beeps
Visual Alarm: –
Message Window: –

The Shut Down Alert Alarm occurs when the ventilator is powered Off. An intermittent audible alert indicates the ventilator is no longer operating. The intermittent beeps will continue for at least 10 minutes or until it is silenced by pressing the Silence/Reset button.

FRONT PANEL MESSAGE DISPLAY WINDOW



All messages and alarms are displayed in a 16 character, alpha numeric window located above the MODE controls.

Monitoring Messages:

When the Message Display Window is blank (no message displayed) press the ▲Up control button to scroll through the monitoring messages available. Monitored information includes volume, frequency, pressure values and operation information. Tidal volume, peak pressure, and baseline pressure are updated breath by breath. Frequency and mean pressure are also updated breath by breath, using a 6 sec. rolling average for frequency and a 60 sec. rolling average for mean pressure. Minute volume is updated every 10 seconds using a 60 sec. rolling average.

NOTE: Monitoring Messages cannot be accessed during alarm violations.

There are 3 selections available:

- VT / V̇i / f
- Paw / P / M / B
- H/S/L (or Q)

Press the ▲ Up button to scroll through the lines. Three seconds after selecting a line, the relevant operating parameters are displayed.

Following are the parameters for each line:

Line 1: "VT xxx V̇i xx f xx"

- VT – Tidal volume (in mL)
- V̇i – Insp. Minute Volume (in L/min) rounded to nearest whole number
- *f* – Total number of patient or time activated breaths detected for the last 60 seconds (in b/min)

Line 2: "Paw Pxx Mxx Bxx"

- P – Peak airway pressure of last breath
- M – Mean airway pressure
- B – Baseline airway pressure at the end of expiration

Line 3: "H xxxxx Sxxxxx L (or Q)"

- H – Hour meter reading
- S – Software Version
- L/Q– Audible Level of Alarm (Loud or Quiet)

After 4 seconds this line will go blank. Access this information any time by pressing the ▲ Up button.

Alarm and Caution Messages:

All alarms have corresponding messages in the Message Display Window. See pg 2-3 for list of alarms. If more than one alarm is violated, they are displayed in order of medical priority. Alarm messages override the display of monitored parameters.

Setting Limitation Messages:

The following "Setting Limitation" messages are displayed to notify the user that adjustments have caused parameters to reach software defined limitations.

Reached Max $\dot{V}$:	maximum $\dot{V}$ (flow) setting has been reached
Reached Min $\dot{V}$:	minimum $\dot{V}$ (flow) setting has been reached
Inverse I:E:	inverse I:E ratio has been reached
Reached Max I:E:	inverse I:E ratio has reached 3:1
$\dot{V}$ Unavailable:	$\dot{V}$ display is not available in Pressure Control
Peep + PS Too High:	set PEEP + P support is higher than 60
PC – Peep Too Low:	Pressure Control value minus PEEP is less than 5 cmH_2O/mbar
↑ – PEEP Too Low:	High Pressure alarm limit minus PEEP is less than 5 cmH_2O/mbar

The following messages are provided as "prompts" or reminders.

Panel Locked:	notifies user that the front panel buttons are now locked
PRESS AGAIN:	notifies user that a second press on the same button is required in order to confirm change requested

LEFT SIDE CONNECTORS

WARNING The round heater for the optional humidifier is located near the left side connectors. This heater becomes extremely hot when the humidifier is on. DO NOT TOUCH!

Airway Pressure Connector

AIRWAY PRESSURE ▶

Measures airway pressure. Connect the proximal pressure sensing line of the patient breathing circuit to this fitting.

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

Gas Output Connector

GAS OUTPUT ▶

Supplies gas flow to the patient. Connect the patient breathing circuit to this outlet.

Exhalation Valve Connector

▲ EXH. VALVE

Controls the exhalation valve. Connect the exhalation valve control drive line to this outlet.

Temperature Probe Connector

(HT50-H model)

TEMP . PROBE

Electrical connector for dual-channel temperature probes which are used to measure the temperature in the humidifier water bottle and the patient breathing circuit.

RS-232C Connector

COMM. PORT

An 8 pin SEMCONN connector operating at 19,200 baud which allows the ventilator system to interface with central alarm systems and remote alarms.

NOTE: Contact your NEWPORT representative for more information regarding compatibility with specific remote monitoring systems.

Emergency Air Intake

◀ W A R N I N G !
EMERGENCY AIR INTAKE
DO NOT OBSTRUCT!

Allows the patient to pull ambient air into the breathing circuit in the event of a complete system failure. Air intake opening pressure is approximately –3 cmH_2O (–3 mbar).

WARNING Do not obstruct the Emergency Air Intake! Any impediment could result in patient suffocation.

WARNING HOME CAREGIVERS: Should a complete failure of the ventilator occur, the Emergency Air Intake allows the patient to breath from room air through the intake valve. Blockage of the valve could result in suffocation. Check periodically to ensure that the valve functions correctly.

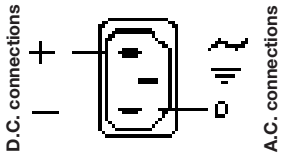
RIGHT SIDE CONNECTORS

Fresh Gas Intake And Filter Cover

Environmental air enters through this 30 mm ID Fresh Gas Intake. The air inlet particle filter is placed behind the Filter Cover to protect the patient as well as the ventilator's piston system from dirt and particles. The Fresh Gas Intake is the attachment socket for the optional HT50 Air/Oxygen Entrainment Mixer or an Oxygen Blending Bag.

WARNING Do not block the Fresh Gas Intake.

External Power Connector



100-240 VAC, max. 2A 12-30 VDC, max. 12A
50/60/400 Hz

The HT50 uses a single inlet for both A.C. and D.C. power sources. The inlet power connector automatically recognizes A.C. voltage ranges from 100 to 240 and D.C. ranges from 12 to 30. A Newport approved external battery can be attached to this connector.

WARNING To ensure proper grounding and prevent possible shock hazards, this device should only be connected to "Hospital Grade" power receptacles.

WARNING HOME CAREGIVERS: External power in the home environment must support min. 100 to max. 240 VAC and must have a grounded receptacle.

Equipotential Connector

Used for electric potential equalization.

Power Cord Ferrite

Use of the Power Cord Ferrite ensures that the HT50 meets EMC requirements. Anytime the HT50 is operating on A.C. power, the ferrite should be attached to the power cord. Operating from D.C. power does not require the use of the ferrite.

NOTE: Always use the A.C. power cord supplied with the HT50.

OPTIONAL ACCESSORIES

Air/Oxygen Entrainment Mixer

The Air/Oxygen Entrainment Mixer (p/n HT460700) is used to blend atmospheric air with medical grade oxygen at a precise ratio. A control knob allows for incremental adjustment from 0.21 to 1.00 F_IO_2. The high pressure oxygen hose has a standard female DISS 1240 connection. The Mixer attaches into the Fresh Gas Intake of the HT50 on the Filter Cover, located on the right side of the ventilator.

Pneumatic Requirements
Oxygen 35-90 psig (2.4 to 6.2 Bar)

NOTE: See page 5-13 for a more detailed description.

Oxygen Blending Bag Kit

The Oxygen Blending Bag Kit (p/n HT600044) is used to blend atmospheric air with a low flow (0 to 10 L/min) medical grade oxygen source. The Oxygen Blending Bag Kit attaches into the Fresh Gas Intake on the Filter Cover, located on the right side of the ventilator. This system allows the user to ventilate patients with oxygen enriched gas from 0.21 up to 1.00 F_IO_2.

Pneumatic Requirements
Oxygen 0-10 L/min

Auto Lighter Cable

The Auto Lighter Cable (p/n HT460085) allows the HT50 to be powered through the D.C. lighter plug in an automobile. The internal battery charges whenever the HT50 is connected to an external power source, equal to or greater than 12 VDC, including the D.C. lighter plug.

USER SET UP

The User Set Up allows the operator to select a variety of functional parameters. User Set Up parameters must be established before the HT50 is used for ventilation.

NOTE: HOME CAREGIVERS: The User Set Up parameters should be defined in conjunction with your physician or Homecare Dealer. Once established, these parameters are kept in memory and will be in affect each time the ventilator is powered on until the operator enters User Set Up and makes changes.

NOTE: To enter User Set Up the HT50 must be in the Standby condition.

To access User Set Up, when connected to A.C. power, press and hold the Silence/Reset button down. When operating on internal battery, you must press the On/Standby button while pressing and holding the Silence/Reset button. When the Message Display Window briefly displays the message “USER SETUP”, release the button. The Message Display Window will next display the first parameter. See Table 3-1.

The user may scroll through the rest of the set up parameters by pressing the Int. Battery button. Use the ▲Up/▼Down control buttons to change the parameter setting. To exit User Set Up, press the Silence/Reset button once. The HT50 is now ready for use.

Parameter	Display	▲ Up/ ▼ Down (allows selection)
Headline	USER SETUP	None
Power Save	Power Save ON*	Toggles On/Off
Pressure Units	Pressure cmH_2O*	Toggles cmH_2O/mbar
Set up	Set up USER*	Toggles User/Default
Auto Panel Lock	Lock DISABLED*	Toggles Enabled/Disabled
Technical Set Up	Tech. Setup	Refer to Service Manual Section 5

* Factory default setting. May be different if another setting was selected during the previous User Set Up.

Table 3-1: User Set Up Parameters

NOTE: Only the ▲Up/▼Down, Silence/Reset, and Int. Battery buttons are active during User Set Up.

User Set Up Parameter

Power Save

Use the ▲Up/▼Down controls to toggle the Power Save function On or Off. To conserve battery power consumption during internal battery operation, the Power Save function automatically blanks the HT50's numeric displays if the ventilator has operated for 2 minutes with no buttons pressed or alarms violated. MODE, On/Standby, Int. Battery indicators and message display window remain active at all times.

If an alarm condition occurs, or any button is pressed, the Power Save function is suspended for 2 minutes. The Power Save feature can extend battery operating time by as much as 30%.

Pressure Units

Selects between cmH_2O and mbar as the unit used on the pressure meter and the various front panel controls. The HT50 is factory set to cmH_2O. Use the ▲Up/▼Down controls to toggle to the mbar setting.

NOTE: For consistency, particularly in medical record keeping, it is recommended that each institution standardize to either "cmH_2O" or "mbar" operation.

NOTE: HOME CAREGIVERS: The unit of measure, along with other parameter settings, should be established by the patient's physician or Homecare Dealer.

Set Up

The Set Up parameter allows the operator to set the ventilator's start up settings. There are two selections, DEFAULT or USER. Use the ▲Up/▼Down button to toggle between selections.

When USER is selected, all of the ventilation parameters in effect at shutdown will be saved. The saved parameters will appear next time the ventilator is powered on.

When DEFAULT is selected, factory set default parameters will appear next time the ventilator is powered on. Default parameters are listed on pg 2-6.

NOTE: HOME CAREGIVERS: This parameter should always be set to USER for home use to ensure that when the HT50 is powered off and on the physician directed ventilation settings remain in place.

Auto Panel Lock

This setting allows the user to enable (turn on) or disable (turn off) the Auto Panel Lock feature. For a complete description of Auto Panel Lock see pg 3-13. The Auto Panel Lock feature is factory set at Disabled or off. Use the ▲Up/▼Down buttons to toggle between Enabled and Disabled.

NOTE: HOME CAREGIVERS: NEWPORT recommends that the Auto Panel Lock feature be enabled in homecare environments as an added safety feature to prevent accidental changes to panel controls.

Exiting User Set Up

Exit by pressing the Silence/Reset button at any time.

4. THEORY OF OPERATION

GENERAL SYSTEM OVERVIEW

The Newport HT50 Ventilator is a compact, lightweight, power-conservative, ventilator that is designed to provide ventilation for adult and pediatric (infants, children & adolescents) patients with body weight ≥10 kg.

The HT50 Ventilator's unique, patented dual-micro-piston gas compressing technology allows the HT50 to operate without an external compressed gas source, making it convenient to use in a variety of environments such as hospitals, emergency response, subacute facilities, homes and transport operations. The dual micro pistons' ability to deliver a variable flow enables the HT50 to provide a full range of operating modes and breath types, including Assist Control, SIMV and SPONT modes with Volume Control and Pressure Control mandatory breaths, Pressure Support of spontaneous breathing and servo-controlled leak-compensated PEEP. Leak compensation helps to improve triggering and avoid auto-triggering when a leak is present. The HT50 may be used with an endotracheal tube, tracheal tube, mask or mouthpiece.

The HT50 provides 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.

The user sets variable alarm settings for High Pressure, Low Pressure, High Inspiratory Minute Volume and Low Inspiratory Minute Volume, with Back Up Ventilation provided in all modes in response to a Low Minute Volume Alarm. There are also built in alarms for High Baseline, Low Baseline, (Circuit) Occlusion, Apnea, PCV Not Reached, Check Prox Line, Power Switchover (from external to internal), Low Battery and Empty Battery and Device Alerts. The HT50-H model also provides humidifier related alarms.

Gas delivery to the patient may be enriched with oxygen (0.21-1.00) using either the Air Oxygen Entrainment (50 psi) Mixer (HT460700) or the Low Flow Oxygen Blending Bag Kit (HT600044).

There is an Auto-Lock feature that may be enabled or disabled. The alarm loudness may be set to two different levels.

The HT50 may be operated from a variety of AC (100-240 VAC @ 50 / 60 / 400 Hz) or DC (12-30 VDC) external power sources or from the Dual Pac Internal Battery System. The Autolighter Cable (HT460085) accessory enables connection to an automobile-type DC outlet.

Any time external power is connected to the ventilator, the Dual Pac Internal Battery system is charging. And when external power is lost, the (new and fully charged) Dual Pac Internal Battery system takes over and powers the HT50 for up to 10 hours, at standard ventilator settings. A Battery Low Alarm alerts the user when a minimum of 30 minutes operating time remains.

The HT50 is available with a built-in humidifier or without.

The HT50 is very easy to set up and use with clear indications of all ventilation and alarm settings and alarm violations.

NOTE: When the HT50 is used in a home care environment it is important that the primary caregiver has received training and has demonstrated competency in all equipment functions. A specific written care plan must be established by the attending physician.

NOTE: Transport of patients with the HT50 requires that medical staff have a good working knowledge of the ventilator's use and problem resolution. Proper emergency back-up equipment must be immediately available during transport.

A/CMV MODE (Assist/Control Mandatory Ventilation)

In A/CMV mode, time activated (mandatory) breaths are delivered in accordance with the *ƒ* setting. Patients can trigger mandatory breaths in addition to, or in place of, time activated (mandatory) breaths if the effort they generate causes airway pressure to meet the P trig setting. Every such patient effort results in a mandatory breath. The breath can be volume or pressure controlled. PEEP/CPAP may be added. Tidal volume is determined by the target pressure, t_I, and patient respiratory mechanics in Pressure Control and by the tidal volume setting in Volume Control.

As with all HT50 operating modes, Back-up Ventilation is activated if the Low ▼$\dot{V}_I$ alarm limit is violated.

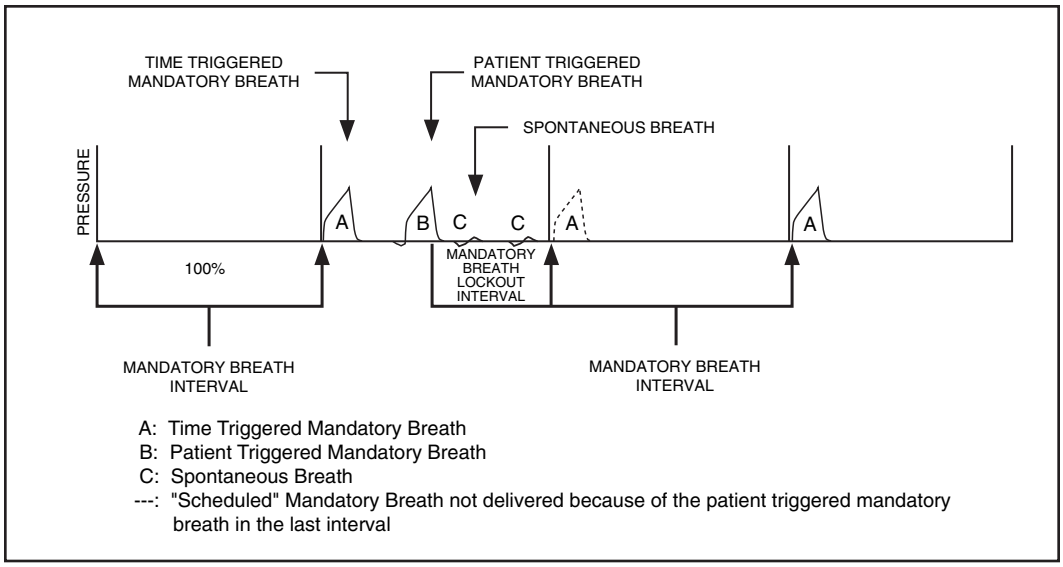


Figure 4-1
Synchronized Intermittent Mandatory Ventilation (SIMV)

SIMV MODE (Synchronized Intermittent Mandatory Ventilation)

In SIMV mode, patients receive a fixed number of volume or pressure controlled mandatory breaths (time or patient activated) and may breathe spontaneously between mandatory breaths, with or without pressure support (Psupport). See Figure 4-1 for schematic illustration. PEEP/CPAP may be added.

The first patient triggered breath in any mandatory breath interval will be a patient triggered mandatory breath. The patient has the rest of the interval to breathe spontaneously. If the patient does not trigger the ventilator, and one complete mandatory breath interval has elapsed, a time triggered mandatory breath is delivered.

A mandatory breath lockout interval is activated whenever the patient triggers a mandatory breath. This limits the number of mandatory breaths (time triggered or patient triggered) the patient receives in 60 seconds to the f (b/min) setting.

As with all HT50 operating modes, Back-up Ventilation is activated if the Low $\blacktriangledown\dot{V}_I$ alarm limit is violated.

SPONT MODE (Spontaneous Ventilation)

In SPONT mode, mandatory breaths are not delivered but the user can adjust both PEEP/CPAP and pressure support (Psupport) levels. The patient has control over each breath.

When PEEP/CPAP is set above 0, the ventilator mode is CPAP (without Psupport) or Bi-level Positive Airway Pressure (with Psupport). Ensure that Ptrig is set so the HT50 detects all spontaneous patient efforts.

Entries for tidal volume, pressure control, f, t_I and Low Paw alarm limit are all inactive in SPONT mode. However, users can preset these parameters for future A/CMV or SIMV operation.

As with all HT50 operating modes, Back-up Ventilation is activated if the Low $\blacktriangledown\dot{V}_I$ alarm limit is violated.

PSUPPORT (Pressure Support)

Psupport only functions during patient triggered spontaneous breaths in SIMV and SPONT modes. During each spontaneous breath, the ventilator supports the patient by elevating the airway pressure to the Psupport + PEEP level. Breaths are terminated when (1) flow to the patient drops to 25% of that breath's peak flow rate, or (2) the target airway pressure is exceeded by 3 cmH_2O (mbar), or (3) after 3 seconds of inspiration.

PRESSURE CONTROL (Pressure Control Ventilation)

The HT50 targets and maintains patient airway pressure at the set pressure control level throughout inspiration. Breath termination occurs when (1) the set t_I elapses, or (2) Paw exceeds the Pressure Control setting by 8 cmH_2O (mbar).

NOTE: The target airway pressure for pressure controlled mandatory breaths in A/CMV and SIMV is the display setting above ambient pressure, not above PEEP.

Both time and patient triggered mandatory breaths can be delivered in A/CMV and SIMV Pressure Control operation. During SIMV Pressure Control operation, patients can breathe spontaneously between mandatory breaths with or without pressure support.

NOTE: When disconnecting the patient circuit during PCV/PSV 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 readjust to meet the patient's demand.

VOLUME CONTROL
(Volume Control Ventilation)

During Volume Control ventilation, tidal volume can be set for mandatory breaths. If a 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 $\dot{V}$ (mandatory flow) changes.

If an attempted tidal volume setting results in a flow rate in excess of 100 L/min or less than 6 L/min, adjustment ceases and the user is alerted by an audible beep and the message "Reached Max $\dot{V}$" or "Reached Min $\dot{V}$" will appear in the Message Display Window.

NOTE: Make sure that the mandatory flow ($\dot{V}$) setting is adequate to meet patient flow demands. The flow setting is displayed by pressing the front panel button labeled $\dot{V}$. Mandatory flow is changed by adjusting t_I.

BACK-UP VENTILATION

Back-up Ventilation is an alarmed function that activates when the delivered inspiratory minute volume ($\dot{V}_I$) falls below the Low $\underline{\blacktriangledown}\dot{V}_I$ alarm limit setting. During Back-up Ventilation, the Low $\blacktriangledown\dot{V}_I$ (Back-up Vent) alarm indicator blinks, an audible alarm sounds, and "Low $\dot{V}$ i (BUV)" is displayed in the Message Display Window. The ventilation settings employed by Back-up Ventilation are displayed on the front panel.

Back-up Ventilation is functional in all modes.

NOTE: Back-up Ventilation is not active for 60 seconds after the user adjusts any ventilator controls, changes modes or turns the ventilator On from the Setting condition.

NOTE: During Back-up Ventilation, the Silence/Reset button can be pressed to silence the audible alarm. This will not cancel Back-up Ventilation.

NOTE: Back-up Ventilation in the HT50 is based on the delivered inspiratory 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 patient airway leak.

Back-up Ventilation in A/CMV and SIMV Modes:
(Back-up Ventilation parameters are indicated on the front panel displays.)

In A/CMV or SIMV modes, mandatory breath frequency increases by 1.5 times the frequency (f) setting, up to a maximum of 99 b/min. The minimum breath frequency delivered is 15 b/min.

The frequency (f) will only increase up to a rate that produces a 1:1 I:E ratio even if the calculated Back-up Ventilation rate is higher.

Back-up Ventilation in SPONT Mode:
(Back-up Ventilation parameters are indicated on the front panel displays.)

In SPONT mode, the MODE changes from SPONT to SIMV, Pressure Controlled ventilation, mandatory breath frequency (f) = 15 b/min., peak inspiratory pressure = 15 cmH_2O/mbar above set PEEP and inspiratory time (t_I) = 1.0 sec.

Cancellation of Back-up Ventilation

User Cancelled

If during Back-up Ventilation, the user adjusts any ventilation parameter, Back-up Ventilation is suspended for one minute and all user selected ventilation parameters are employed. Another 60 seconds must pass after parameter adjustments before a $\underline{\blacktriangledown}\dot{V}_I$ alarm violation will result in Back-up Ventilation.

Patient Cancelled

If delivered inspiratory minute volume exceeds the Low $\underline{\blacktriangledown}\dot{V}_I$ alarm setting by 10%, Back-up Ventilation is cancelled, the audible alarm stops, the Low $\blacktriangledown\dot{V}_I$ (Back-up Vent) alarm indicator latches and the HT50 resumes ventilation at the user-selected parameters.

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

5. VENTILATOR SET UP & USE

INTRODUCTION

Familiarize yourself with the instructions in this section prior to ventilating patients with the HT50. Following all of the listed steps is essential to ensuring the safest possible operation of the ventilator. Use the information in this section in conjunction with established hospital protocols and homecare dealer instructions.

WARNING Non-medical home caregivers must have complete training and demonstrate competency in proper set up, use, troubleshooting and maintenance of the HT50 prior to use. They must have a planned response to emergencies and must comply with appropriate infection control procedures.

NOTE: This section provides instructions for both Pressure Control and Volume Control ventilation. Follow the sections specific to the type of ventilation required for your patient(s).

ASSEMBLING THE VENTILATOR

Before assembling the ventilator, review the assembly set up shown in Figure 5-1 and familiarize yourself with the various components. Remove all of the items from the shipping box and inspect each part and component for completeness and to verify that there is no shipping damage. Complete the Order Review Form and Warranty Card, and process as per the instructions.

The complete assembly consists of the following parts:

HT50 Ventilator — Select one:

HT50-H, HT50-HB (home care/hospital use) with built-in humidifier

HT50-H1,HT50-H1B (home care/hospital/transport use) without built-in humidifier

Includes:

1 ea.	OPRHT50NA	Operating Manual
1 ea.	V24-00900-60	A.C. Power Cord with Ferrite
1 ea.	HT600039	Exhalation Valve
1 ea.	HT460300	Air Intake Filter Disposable (pk. of 5 filters)
1 ea.	HT6004701	Prox. Inline Filter, Disposable (pk. of 5 filters)

With built-in humidifier includes (all items listed above plus):

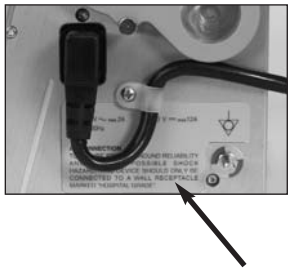
1 ea.	HT460910	Humidifier Bottle – Upper
1 ea.	HT460920	Humidifier Bottle – Lower
1 ea.	HT460930	Heat Sink
1 ea.	HT460940	Dual Airway Temperature Probe
1 ea.	HT460950	Flex Hose – Humidifier Connection
1 ea.	HT460960	Absorbent Paper (pk. of 10 papers)

NOTE: The built-in humidifier on the HT50 only functions when used on A.C. power. It provides temperature monitoring and

alarm functions. When using the HT50 on battery, for transport or in home care environments for example, alternate humidification devices may be necessary.

NOTE: For a complete list of HT50 accessories, see Appendix B.

VENTILATOR SET UP PROCEDURE



Power Cord Restraint

Power Cord Ferrite

1. Mount the ventilator on a stable surface (e.g., bedside table or the Compact Stand Assembly).

2. For Compact Stand Assembly, follow the instructions provided with stand to position the ventilator on pedestal mount and secure using the screws provided.

3. Remove the white plastic cord restraint next to the power entry module. Slip the power cord into the restraint. Plug the power cord into the power entry module and re-attach the restraint with cord onto the side of the HT50. Be careful to position the cord so that it won't interfere with the Air/Oxygen Entrainment Mixer attachment.

4. Verify that the A.C. power cord supplied with the HT50 has the Power Cord Ferrite attached between the adapter box and the ventilator. If utilizing external power, plug the ventilator's electric cord into a properly grounded outlet. If using internal battery, ensure that battery is fully charged.

WARNING Always use the A.C. power cord supplied with the HT50 that has the Power Cord Ferrite attached between the adapter box and the ventilator to ensure that the HT50 meets EMC requirements.

5. Attach a patient circuit as follows:

   a. For use without a humidifier, attach one end of the 22 mm ID breathing circuit to the Gas Output on the HT50.

   b. When using a humidifier, connect one end of the short humidifier tubing to the Gas Output on the HT50 and the other end to the inlet port of the humidifier. Then attach one end of the 22 mm ID breathing circuit limb to the outlet port of the humidifier. See Figure 5-4.

   c. Attach the Proximal Inline Filter with tubing to the Airway Pressure connection located below the Gas Output port.

   d. Attach one end of the Proximal Pressure sensing line to the Proximal Inline Filter as shown in Figure 5-1, Detail B.

e. For use without a humidifier or HME, attach the other end of the Proximal Pressure line to the pressure port on the exhalation valve. See Detail A, Figure 5–1.

- For use with an HME, attach the Proximal Pressure line to a pressure tee adapter (p/n NP130-22) on the patient side of the HME. Use the cap that comes with the tee adapter to seal the pressure port on the exhalation valve. See Figure 5–5.

- For use with a humidifier, attach the Proximal Pressure line to a pressure tee adapter (p/n NP130-22) before the inlet port on the humidifier. Use the cap that comes with the tee adapter to seal the pressure port on the exhalation valve. See Figure 5–4.

f. Attach the reusable exhalation valve to the patient end of the breathing circuit.

g. Attach one end of the exhalation valve drive line to the exhalation valve and the other end to the Exh. Valve connection located below the Gas Output on the HT50. See Figure 5–1.

h. When using the HT50 built-in humidifier (model HT50-H, HT50-HB), plug the temperature probe electrical connector into the Temp Probe connection on the left side of the HT50. Attach the short wire plug into the elbow outlet on top of the humidifier. Attach the long wire plug into the exhalation valve port. See Figure 5–2.

Exhalation Valve Calibration

6. Calibrate the exhalation valve prior to use as follows:

WARNING Each time an exhalation valve is replaced or maintained it must be calibrated.

a. Connect the HT50 patient breathing circuit to the ventilator as instructed above. Connect an adult (500 mL) test lung with restrictor (LNG500A) or occlude the patient connection of the breathing circuit.

b. Press the On/Standby button once to enter Settings condition.

c. Press the Manual Inflation button once, then again within three seconds.

d. The HT50 will start the EZ Cal and the ventilator will automatically test the exhalation valve. If it passes the test, the messages "Cal Completed", then "Press ON to Vent" will be displayed.

e. If the test fails, the message "Cal Failed" will be displayed.

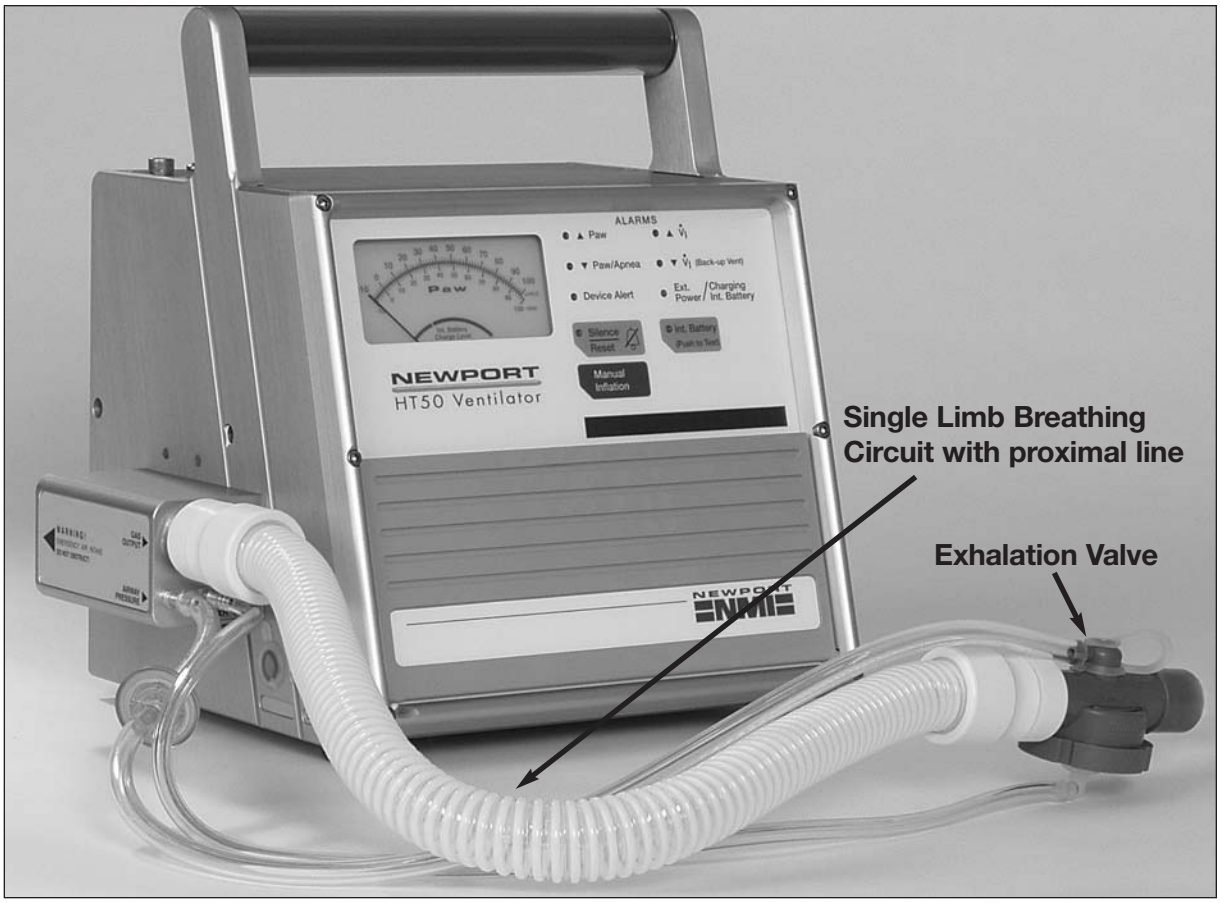
- Press the Silence/Reset button.
- If using a test lung during the EZ Cal, remove the test lung and occlude the patient connection instead.
- Check the integrity of the circuit and connections, then press the Manual Inflation button twice to initiate calibration again.

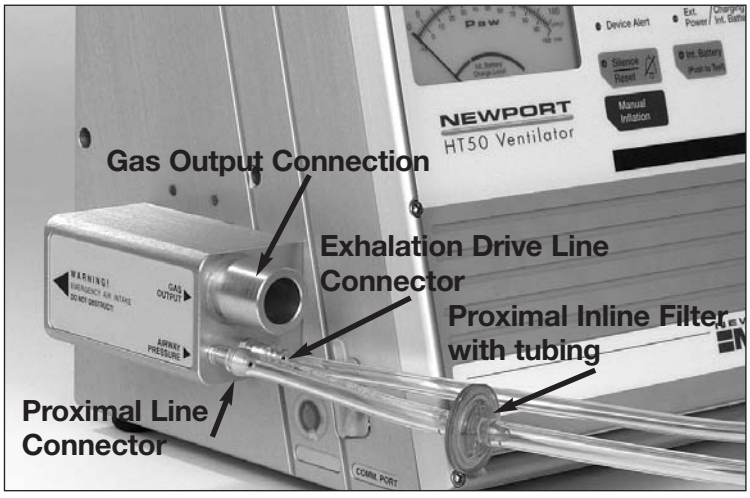
f. When calibration is finished, adjust patient settings appropriately, then press On/Standby to begin ventilation.

WARNING Inadequate ventilation may result if the exhalation valve is not calibrated properly. If the circuit/exhalation valve fails the calibration procedure, try another circuit/exhalation valve or use an alternate method of ventilation.

WARNING Some disposable breathing circuit/exhalation valve assemblies are not compatible with the HT50 Ventilator due to the requirements of the ventilator's sophisticated servo-controlled, pressure management system. If your disposable circuit fails consistently, switch to a Newport approved, reusable HT50 breathing circuit/exhalation valve assembly to ensure that the HT50 Ventilator performs to specification.

NOTE: HOME CAREGIVERS: It is common practice to have two patient breathing circuits available in homecare environments to ensure that a clean circuit is always available for regularly scheduled circuit changes. The exhalation valve in each circuit must be calibrated before being put into use.





DETAIL B
Left Side Panel Connections

DETAIL A
Exhalation Valve

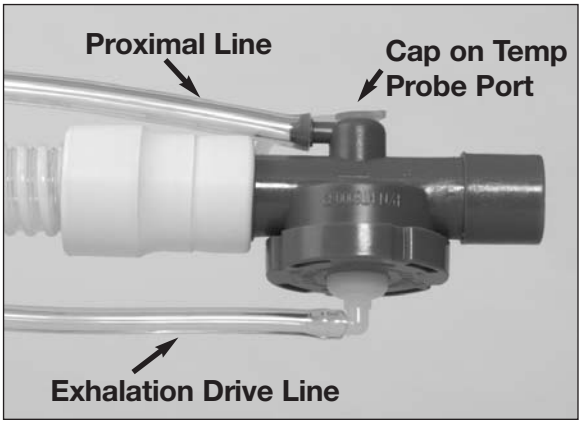


Figure -1
HT50-H1, HT50-H1B –Set Up Assembly

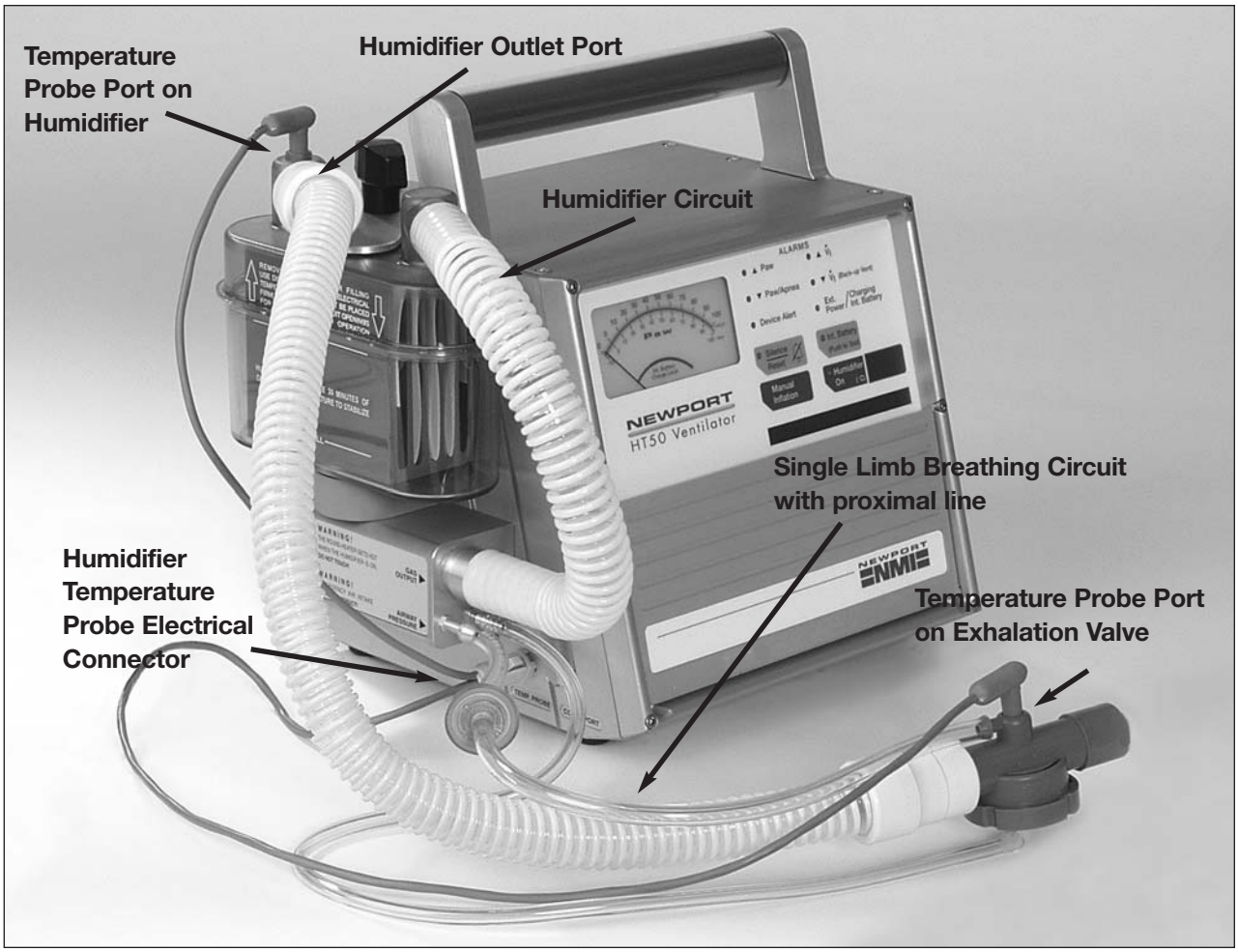


Figure 5-2
HT50-H, HT50-HB (with built-in humidifier) – Set Up Assembly

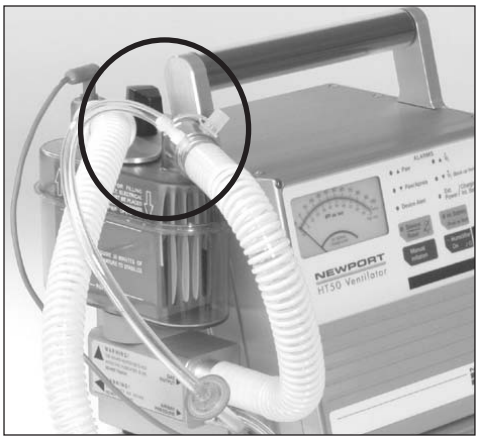


Figure 5-3
HT50-H, HT50-HB with Prox Line Tee'd into Dry Side of Humidifier

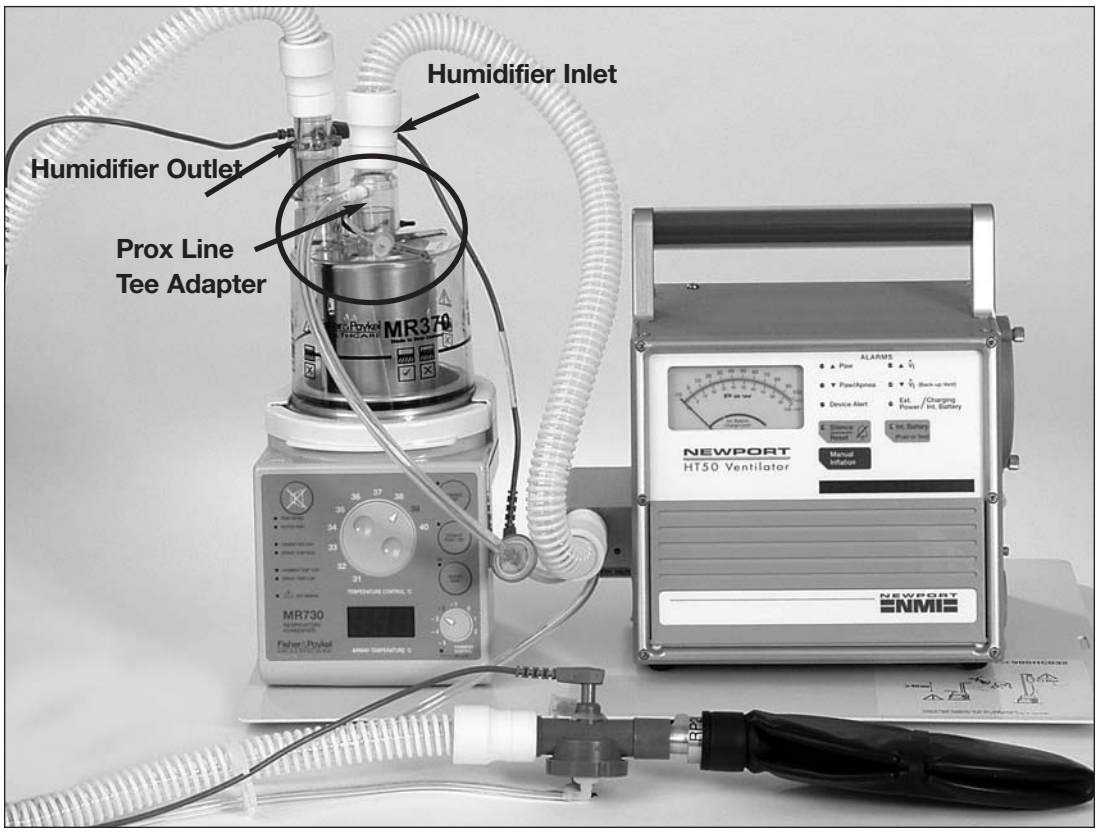


Figure 5-4
HT50-H1, HT50-H1B with Third-Party Humidifier Set Up and Prox Line Tee'd into Dry Side

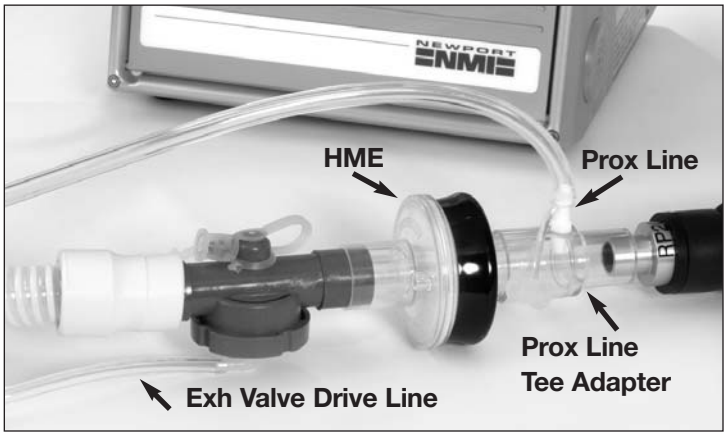


Figure 5-5

HT50-H1, HT50-H1B with HME and Prox Line Tee'd into Patient Side

PATIENT SET UP PROCEDURE

NOTE: A “Quick Reference Guide” is located on the front panel cover door to assist the user in setting controls and alarms.

NOTE: HOME CAREGIVERS: The front panel cover door should be left up as an added safety feature to prevent accidental parameter changes. There is also an optional Auto Panel Lock feature that locks in parameter settings once they have been made. See pg 3-13 for more details.

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

1. Ensure the ventilator is assembled correctly and the exhalation valve calibration is performed as described in the previous sections.

2. Verify proper ventilator operation by performing the Quick Check Procedure (see Appendix A) upon initial set up for use. The Quick Check should be repeated or an Abbreviated Check Procedure (see Appendix A) performed each time the ventilator is placed on a new patient and when the breathing circuit/exhalation valve is changed.

NOTE: HOME CAREGIVERS: Initial set up and verification of the ventilator operation should be done by the caregiver in conjunction with the Homecare Dealer or hospital-provided clinician.

3. Press the On/Standby button located on the lower right side of the ventilator’s front panel. The ventilator performs a brief self-test to ensure proper microprocessor function. During the self test, verify that all indicators illuminate; the numeric LEDs, Message Display Window and airway pressure meter activate and alarm buzzer makes a single beep.

4. Following the self-test, the HT50 enters Settings condition in which the ventilation parameters may be adjusted but the HT50 does not ventilate. The On indicator does not illuminate when the HT50 is in the Settings condition.

5. Push the appropriate MODE of operation button (A/CMV, SIMV or SPONT) to select.

6. Set the patient parameters for f (frequency), t_I (inspiratory time) and Volume Control (mandatory tidal volume) or Pressure Control (target pressure). Use the dual display $\dot{V}$ / I:E: to verify the mandatory flow or the I:E ratio.

NOTE: The $\dot{V}$ (flow) display is unavailable during SPONT and Pressure Control operation. The I:E Ratio display is also unavailable during SPONT mode.

WARNING Always ensure adequate monitoring is in place when ventilating patients. HOME CAREGIVERS: Follow physician prescribed monitoring checks. These may include regularly scheduled pulse, frequency of breathing and airway pressure checks.

7. Set Ptrig.
8. Set PEEP/CPAP, as needed.
9. Set the Psupport level, as needed.
10. Set the ▲ High and ▼ Low Paw alarm settings.
11. Set the ▲ High and ▼ Low $\dot{V}_I$ alarm limit settings.
12. Check all alarm limit and control settings to ensure they are appropriate for the patient to be ventilated.
13. If the HT50-H, HT50-HB humidifier is being used, set the target temperature level.
14. Press the On/Standby button again to initiate ventilation. The On indicator illuminates.
15. Connect the ventilator breathing circuit to the patient interface.
16. Reassess ▲ High and ▼ Low Paw alarm settings and adjust to appropriate levels.
17. Verify that the Ptrig indicator blinks each time the patient initiates a spontaneous inspiratory effort. Readjust Ptrig as necessary.
18. Reassess ▲ High and ▼ Low $\dot{V}_I$ alarm settings and adjust to appropriate levels.

NOTE: Newport strongly recommends that you set the High $\dot{V}_I$ alarm no more than 1 L above and the Low $\dot{V}_I$ alarm no more than 1 L below the patient's average $\dot{V}_I$ in order to ensure the quickest response to changes in patient and/or breathing circuit conditions.

19. Closely monitor the patient and ventilator for at least 10 minutes to ensure adequate ventilation.

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 physician or health care provider immediately.

20. To power down the HT50 after it is removed from the patient, press the On/Standby button twice. An audible beep sounds and the HT50 automatically shuts down. Press the Silence/Reset button to mute the audible alarm.

BUILT-IN HUMIDIFIER (HT50-H, HT50-HB only)

NOTE: You will need to use an alternate source of humidification with HT50 model HT50-H1, HT50-H1B.

NOTE: HOME CAREGIVERS: The patient's physician or your Homecare Dealer will determine the appropriate type of humidification device to be used. Proper training is required prior to setting up and using the HT50-H, HT50-HB built-in humidifier.

WARNING The HT50-H, HT50-HB humidifier operates only on A.C. power. It turns off automatically when A.C. power is disconnected, when the humidifier bottle is opened to refill the water and after sixty (60) minutes in the Setting condition.

NOTE: The HT50 built-in humidifier can only be powered on by the user. It never powers on automatically.

NOTE: When the HT50 is powered by internal battery, appropriate actions, such as using an HME, should be taken to prevent significant humidity deficit in the patient.

WARNING When a humidifier malfunction is detected, or a humidifier alarm exists, the humidifier turns OFF. The user is alerted by both an audible alarm and a change in the LED from green to blinking yellow. The nature of the alarm is displayed in the message window. Pressing the Silence/Reset button silences the audible alarm and cancels the latched alarm indicator. Press the Humidifier On button to restart the humidifier after the alarm condition is corrected.

WARNING The humidifier's round heating mechanism gets hot when the humidifier is on. **Do not touch!**

General Description

The HT50 humidifier is a precision, temperature-regulation device that employs microprocessor control to target the user-defined temperature at the patient breathing circuit connection by regulating the temperature of the sterile, distilled water in the humidification bottle.

The Humidifier On button toggles the humidifier On (indicator lit) and Off (indicator unlit). Turning the humidifier on causes the display to flash, indicating that target humidification temperature is now adjustable. Use the ▲Up/▼Down controls to adjust the set target temperature.

The set target temperature (blinking) is displayed only during the adjustment period. The monitored temperature is displayed whenever the value is not blinking. During ventilation, temperature at the patient connector is monitored. During Setting condition, humidifier bottle temperature is monitored. Pressing the button while the humidifier is operating shows the set target temperature (blinking) and allows for re-adjustment.

To turn the humidifier Off, press and hold the Humidifier On button for one second, after which an audible beep is heard and both the indicator and the display go dark.

The HT50-H, HT50-HB humidifier is powered on independently from the ventilator. But when the ventilator is switched from On to Standby, the humidifier is also turned off.

NOTE: Refer to pg 3-19 for a summary of humidifier alarms.

Preparation For Use

WARNING The humidifier's round heating mechanism gets hot when the humidifier is on. **Do not touch!**

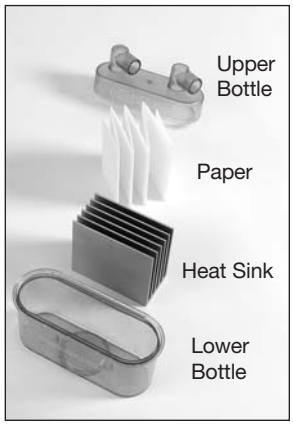
WARNING Use sterile, distilled water only.

WARNING Electric temperature probes must be placed firmly in the patient circuit opening for proper humidifier operation.

WARNING It is unsafe to configure the HT50 humidifier with accessories that are not specified for use with the humidifier.

NOTE: Remove the plastic packaging from the humidifier bottle and heat sink before use.

1. Ensure that the patient circuit and humidifier are assembled correctly. Refer to Figure 5-2.



2. Open the humidifier clamp knob located on the upper case of the ventilator, then remove the humidifier bottle from the ventilator. Open the humidifier bottle, remove the heat sink and place absorbent paper between the heat sink ribs. Position the heat sink inside the lower half of the bottle.

3. Fill the lower half with sterile, distilled water, up to the FULL line. Attach the upper half of the bottle to the lower half.

4. Re-attach the humidifier bottle to the ventilator. Secure the clamp knob.

5. Connect the short side of the Humidifier Temperature Probe cable to the port on the top of the humidifier bottle. Plug the electical connector into the side of the HT50 and then connect the other end of the cable to the temperature probe port on the exhalation valve. See Figure 5-2.

Set Up And Operation

1. From the Off/Standby condition, switch the ventilator to the Setting condition by pressing On/Standby one time.

2. Turn the humidifier on by pressing the Humidifier On button.

3. Adjust humidification temperature.

4. After a minimum of 30 minutes (for temperature to stabilize), maximum of 55 minutes, start ventilation by pressing On/Standby again.

WARNING Failure to change from the Setting condition to the On condition within 60 minutes will cause the humidifier to turn off. After restarting, ensure that temperature is appropriate before starting ventilation.

5. When the humidifier water level reaches the “REFILL” line, refill with sterile distilled water. The humidifier must be restarted afterward by pressing the Humidifier On button.

6. The absorbent paper in the humidifier should be replaced with each cleaning, weekly during use, or sooner if it becomes torn.

NOTE: Humidifier specifications may be found on pg 2-7.

NOTE: For cleaning, disinfection and sterilization of the humidifier, please see Section 6.

OXYGEN ACCESSORIES

WARNING Continuous oxygen monitoring is required for patient safety. The HT50 does not have a built-in alarm system to notify user of a failure or disconnection of the oxygen source.

WARNING Ensure that the oxygen source is not empty before and during the use of Air/Oxygen Entrainment Mixer or Oxygen Blending Bag Kit.

AIR / OXYGEN ENTRAINMENT MIXER (Optional Accessory)

An optional Air/Oxygen Entrainment Mixer (p/n HT460700) is designed for exclusive use with the Newport HT50 ventilator. It is used to blend atmospheric air with pressurized medical grade oxygen at a precise ratio. The standard oxygen inlet connection is DISS 1240.

Flow Range:	Up to 100 L/min
F_IO_2:	0.21 to 1.00
Accuracy:	±8% (at flows: 10-100 L/min)
Input Pressure – Oxygen:	35-90 psig / 240-620 kPa

WARNING The oxygen concentration to the patient should be monitored with a device that will sound an alert if the concentration deviates from the set value.

WARNING The Air/Oxygen Entrainment Mixer is designed to operate with hospital grade O_2 supply.

NOTE: No oxygen is delivered through the Air/Oxygen Entrainment Mixer while the HT50 is in User Setup or Settings Condition.

Installation Instructions

WARNING Make sure to monitor and when necessary replace the air inlet filter to ensure that it is clean when using the Mixer.

The Air/Oxygen Entrainment Mixer attaches into the inlet port on the Filter Cover, located on the right side of the ventilator.

NOTE: Before attaching the Air/Oxygen Entrainment Mixer, make sure that the three hold-down screws on the Filter Cover are tight. If the screws are not tight, ambient air may enter the HT50 from around the inlet cover. This may change the oxygen enrichment level delivered to the patient when the Mixer is in use.

Inspect Filter

1. Unscrew the three thumb screws on the Filter Cover from the ventilator housing.
2. Remove the Cover and inspect the filter. Replace it if it is dirty.
3. Reattach the Filter Cover, ensuring that the three thumb screws are tight.
4. With the oxygen hose facing toward the front of the ventilator, press the 30 mm O.D. outlet of the Mixer into the Attachment

Socket (Fresh Gas Intake port) of the HT50 Filter Cover. Rotate the mixer 1/4 turn clockwise to secure it into place.

5. Connect the oxygen hose DISS fitting to the oxygen supply and secure the fitting.

6. Open the supply pressure valve slowly and listen to verify that there is no hiss, indicative of a leak. Do not use the oxygen mixer with a leak in the system.

7. Set the entrainment mixer dial to the desired concentration.

WARNING Ensure that the oxygen supply is enabled prior to powering the HT50 On when the Air/Oxygen Entrainment Mixer is secured in place. Otherwise, stress to the internal pump will occur and gas delivery to the patient will be compromised.

OXYGEN BLENDING BAG KIT (Optional Accessory)

This Oxygen Blending Bag Kit is designed for exclusive use with the Newport HT50 ventilator. The Oxygen Blending Bag Kit (p/n HT600044) allows the user to ventilate patients with oxygen enriched gas of up to 100% oxygen.

WARNING The Oxygen Blending Bag Kit is designed to operate with hospital grade O_2 supply. The supply should not exceed 10 L/min flow to the oxygen blending bag.

NOTE: Before attaching the Oxygen Blending Bag, make sure that the three hold-down screws on the Filter Cover are tight. If the screws are not tight, ambient air may enter the HT50 from around the inlet cover. This may change the oxygen enrichment level delivered to the patient when the Oxygen Blending Bag is in use.

WARNING Keep the oxygen supply tubing (and cylinder) away from traffic areas.

WARNING Using an oxygen concentrator as the oxygen supply source may effect the level of oxygen enrichment because in most cases oxygen concentrators do not supply 100% oxygen. Use an oxygen monitor to verify F_IO_2 delivery.

WARNING Any change in settings or any change in patient assisted breathing patterns that alters delivered minute volume will alter the level of oxygen enrichment.

Materials Required for Installation:

- Hospital grade oxygen source
- Oxygen 50 psig regulator/flowmeter (0-10 L/min) assembly with small-bore connector
- A suitable length of oxygen supply tubing

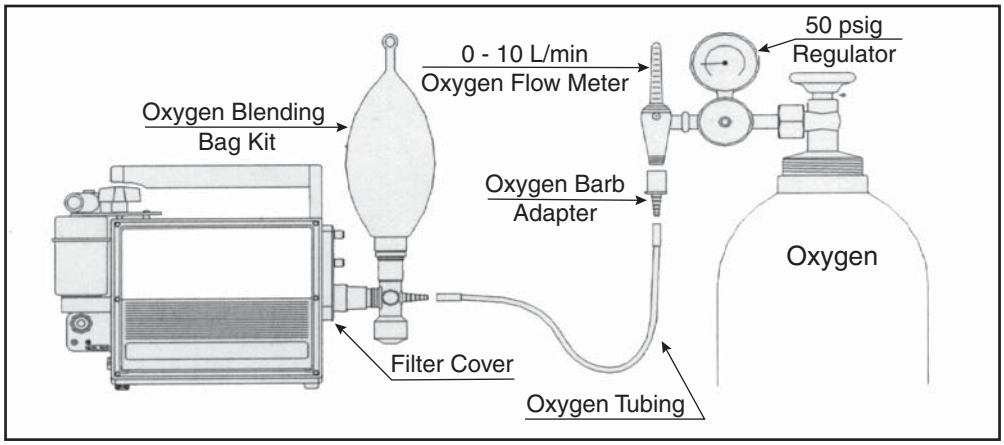


Figure 5-6
Oxygen Blending Bag Kit Assembly Diagram

The Oxygen Blending Bag is not a calibrated mixing device. The level of oxygen enrichment achieved is affected by these variables: minute volume, oxygen supply flow and the presence or absence of PEEP.

After identifying the level of oxygen enrichment that the patient needs, use the graphs in Table 5-1 and Table 5-2 to estimate how many liters per minute of oxygen are needed for the minute volume delivered to the patient. Verify F_iO_2 delivery with an oxygen monitor.

Installation Instructions

The Oxygen Blending Bag Kit attaches into the Fresh Gas Intake port on the Filter Cover, located on the right side of the HT50.

1. Remove the three thumb screws from the Filter Cover.
2. Open the Cover and inspect the filter. Replace it if it is dirty.
3. Close the Filter Cover, ensuring that the three thumb screws are tight.
4. Press the 30 mm O.D. outlet of the Oxygen Blending Bag Kit into the Fresh Gas Intake port of the HT50 Filter Cover.
5. Attach the oxygen supply tubing to the oxygen flowmeter and to the small-bore connector of the Oxygen Blending Bag Kit.
6. Tug lightly on both ends of the tubing to verify that it is secure.

7. Adjust the oxygen flowmeter to the appropriate liter flow to obtain the desired level of oxygen enrichment.

8. Monitor the patient's inspiratory minute volume and delivered F_IO_2 regularly and adjust oxygen liter flow as necessary to maintain the prescribed level of oxygen enrichment.

Disassembly and Cleaning

For information on disassembly and cleaning see instructions included with Blending Bag Kit or see pg. 6-2.

Oxygen Supply Flow Graphs

WARNING The oxygen blending bag is not a calibrated oxygen mixing device. It requires the use of an oxygen monitor, positioned in the inspiratory limb of the patient circuit near the airway, to verify the level of oxygen enrichment. The information in these graphs should be used as a reference only.

To use the graphs:

1. Select the appropriate graph determined by whether you are ventilating with or without PEEP.

2. Select the Desired % of Oxygen Enrichment listed at the bottom of the graph.

3. Follow your selection up vertically until it meets with the line that is equal to the minute volume of the patient (i.e. $\dot{V}_I$ L/min).

NOTE: The patient's delivered minute volume can be read from the $\overline{\blacktriangle}\ \dot{V}_I$ and $\underline{\blacktriangledown}\dot{V}_I$ alarm setting display window on the HT50 when it is not blinking.

4. Move horizontally to the left and identify the estimated oxygen supply flow (L/min) needed.

5. Set the flowmeter at the oxygen supply flow indicated.

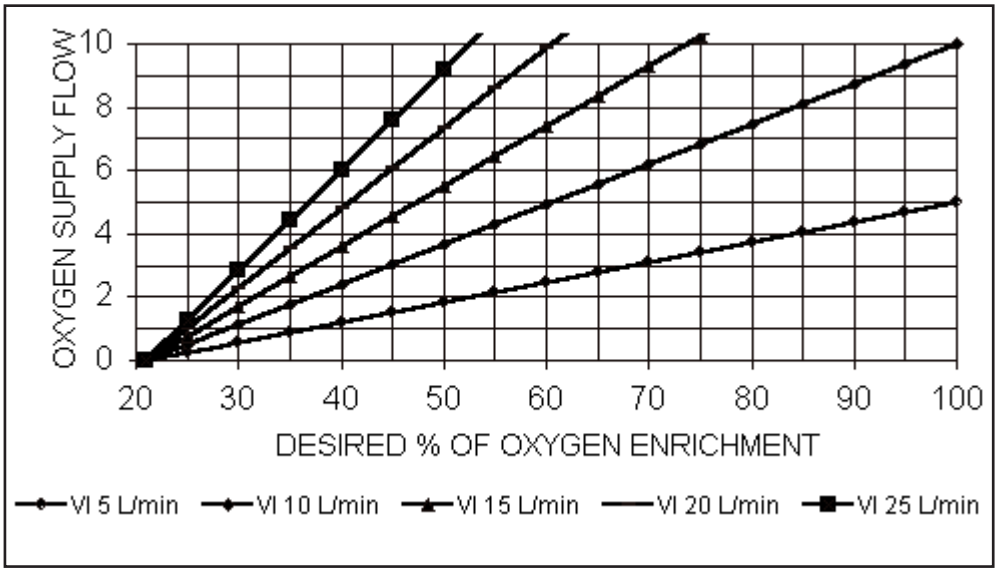


Table 5-1
Oxygen Supply Flow for Desired % of Oxygen Enrichment – Without PEEP

NOTE: When PEEP is added it changes the mixing of oxygen with air. Use Table 5-1 when the patient is ventilated without PEEP and Table 5-2 in the presence of PEEP. Data in Table 5-2 are taken at an I:E ratio of 1:2. Different I:E ratios may slightly affect the Desired % of Oxygen Enrichment when PEEP is in use.

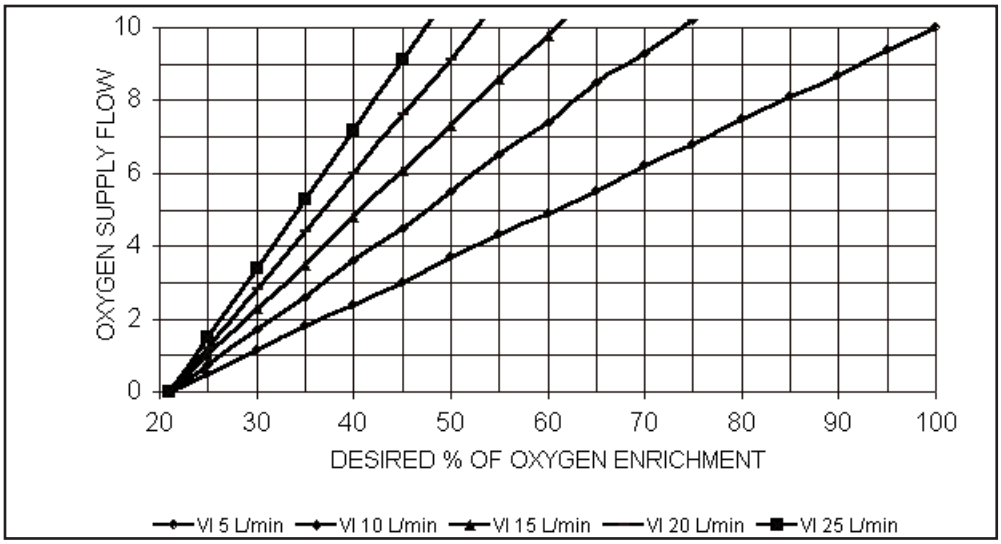


Table 5-2
Oxygen Supply Flow for Desired % of Oxygen Enrichment – With PEEP

6. CLEANING & MAINTENANCE

STERILIZATION & CLEANING

The NEWPORT HT50 Ventilator and associated patient circuits are shipped in a clean but not sterile condition. Reusable breathing circuits should be sterilized before patient use.

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

Definition of CLEAN: Indicates that a medical detergent or alcohol based cleaning solution should be used.

Definition of DISINFECT: Indicates that a liquid chemical disinfectant should be used.

Definition of STERILIZE: Indicates that liquid chemicals, pasteurization, steam autoclave or Ethylene Oxide (EtO) should be used.

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 may cause superficial crazing of plastic components and will accelerate the aging of rubber components.

HT50 Ventilator

Wipe clean between patients and once per week while in use.

The exterior of the ventilator and all parts not in direct contact with patients should be wiped clean with a cloth dampened with a medical detergent 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 HT50 ventilator. These processes will damage the HT50, rendering it unusable.

HT50 Accessories

All accessories should be thoroughly cleaned, rinsed and air dried prior to disinfecting/sterilizing.

Caution Always inspect the accessories after cleaning and/or sterilizing for damage. Also monitor performance when putting back in service. If any damage is found or accessory does not perform to specification replace the accessory.

Oxygen Blending Bag Kit

Clean and disinfect between patients and as needed while in use.

Disassemble: Remove the Oxygen Blending Bag Kit from the HT50 air inlet. Disconnect the oxygen tubing and slide the rubber bag off its fitting.

Clean: Wash the outside of the rubber bag (do not immerse the bag or get the inside of the bag wet) and the plastic parts (without taking them apart) using a soft brush with water and a mild 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.)

NOTE: The rubber bag is a single patient use item. Discard the rubber bag between patients and replace with a new bag.

Caution Avoid touching the rubber valves, which are inserted in the plastic body. Do not attempt to clean the inside of the rubber bag – keep it dry.

Disinfect: Use the following disinfecting methods:

Soak plastic and metal parts in a solution of one part white vinegar to two parts of water thirty (30) minutes; rinse thoroughly with sterile, distilled water; air dry.

Or soak in an approved chemical disinfectant following the manufacturer's instructions. Rinse thoroughly with sterile, distilled water; air dry.

Sterilize: The following sterilizing method is suitable for the plastic and metal parts of the Oxygen Blending Bag Kit:

Soak plastic and metal parts in a Gultaraldehyde solution (Cidex [2.4%]) for twelve (12) hours, rinse thoroughly with sterile, distilled water, air dry.

NOTE: Do not immerse or soak the rubber bag.Use a soft cloth dampened with a medical detergent or alcohol based cleaning solution to wipe the external surface. Replace the rubber bag between patients.

NOTE: All parts must be completely dry before reassembling and attaching to the ventilator.

Caution Always inspect the Oxygen Blending Bag Kit after cleaning and/or sterilizing for damage. Also monitor its performance when putting back in service. If any damage is found or it does not perform to specification replace it.

Humidifier Assembly
(HT50-H, HT50-HB only)

Clean and disinfect once per week while in use.
Clean and sterilize between patients.

NOTE: The following instructions are for the HT50-H, HT50-HB integrated humidifier. If a third party humidifier is used see humidifier manufacturer's instructions for cleaning. See Figure 6-1 for humidifier assembly.

Upper Bottle

Absorbent Paper

Heat Sink

Lower Bottle

Figure 6-1 Humidifier Assembly

Disassemble: Remove the humidifier bottle from the HT50. Open the humidifier bottle and remove the heat sink. Remove the absorbent paper from the heat sink and discard. Wash off any residual paper that remains on the heat sink with running water.

Clean: Wash both halves of the bottle and the heat sink in a warm detergent solution using a soft brush. Rinse thoroughly with sterile water.

Caution Do not use harsh abrasives on humidifier bottle or heat sink.

Shake off excess water and place all parts on a clean towel to air dry. (Do not heat or blow dry.)

Disinfect: Use the following disinfecting methods:

Soak in one part white vinegar to three parts of water and rinse thoroughly with sterile, distilled water; air dry.

Or soak in an approved chemical disinfectant such as a glutaraldehyde solution (2%) following the manufacturer's instructions. Rinse thoroughly with sterile, distilled water; air dry.

Sterilize: The following sterilizing methods are suitable for the bottle and heat sink.

Soak in an approved chemical sterilant following the manufacturer's instructions. Rinse thoroughly with sterile, distilled water; air dry.

Autoclave 121ºC / 250ºF for 20 min.

NOTE: NEWPORT recommends that only sterile, distilled water be used in the humidifier to prevent build-up of mineral deposits.

NOTE: Always use new absorbent paper when reassembling the humidifier.

Caution Visually inspect all parts for cracks or damage. Do not use cracked or damaged parts. Contact NEWPORT for replacements.

Humidifier Temperature Probe

Clean and disinfect twice per week while in use.
Clean and sterilize between patients.

Disassemble: Remove the temperature probes from the patient breathing circuit (humidifier outlet and exhalation valve), then unplug the electrical connector from the side of the ventilator by pressing the release tab and pulling gently.

Caution The electrical connector that plugs into the ventilator must stay dry at all times.

Clean: Probe cable: Wipe down with a soft cloth dampened in a mild detergent.
Probe tips: Wash the probe tips in a mild detergent with a brush. 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.)

Disinfect: Use one of the following disinfecting methods for disinfecting the probe tips:

Soak the probe tips in one part white vinegar to one part of water for 2 hours and rinse thoroughly with sterile, distilled water; air dry.

Or place the probe tips in a glutaraldehyde solution such as Cidex (2%) for 2 hours. Rinse thoroughly with sterile, distilled water; air dry.

Sterilize: The following method is suitable for sterilizing the entire probe assembly:

Ethylene Oxide	55ºC / 131ºF

Caution Visually inspect all parts for cracks or damage. Do not use cracked or damaged parts. Contact NEWPORT for replacements.

Reusable Breathing Circuits

Clean once per week while in use. Always use a clean exhalation valve (and humidifier/probe assembly if appropriate) when the breathing circuit is reassembled for patient use.

Clean and sterilize between patients.

The breathing circuit includes the tubing, water trap (if used), proximal pressure line and exhalation valve drive line.

WARNING NEWPORT breathing circuits are supplied non-sterile.

NOTE: HOME CAREGIVERS: In the home environment it is important to always use a clean, disinfected breathing circuit.

If you are using a NEWPORT reusable breathing circuit refer to cleaning directions below. If you are using another manufacturer's permanent breathing circuit please refer to manufacturer's instructions for cleaning.

Disassemble: Remove the entire circuit from the ventilator. Remove the exhalation valve, proximal inline filter (if attached) and temperature probe (if used) from the circuit. Disassemble the circuit to expose all surfaces for cleaning.

Caution The NEWPORT breathing circuit is manufactured from a Polyester Elastomer, high-temperature material and incorporates a silicone rubber cuff. To avoid damage to the circuit, attach and detach circuit by handling only the silicone cuffs. Do not pull or twist the circuit.

Clean: 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 with a soft brush. 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.)

Sterilize: Any of the following sterilizing methods (using standard institutional procedures) are suitable for the NEWPORT breathing circuit components:

Autoclave	132ºC / 270ºF for 3-5 min.
	126ºC / 259ºF for 10 min.
	121ºC / 250ºF for 15 min.

Ethylene Oxide	55ºC / 131ºF
Pasteurization	75ºC / 170ºF

Caution Breathing circuit components should NOT come in contact with the following solutions because they may cause disintegration of the tubing:

Hypochlorite	Phenol (>5%)	Inorganic Acids
Formaldehyde	Ketone	
Chlorinated Hydrocarbons	Aromatic Hydrocarbons	

Caution Breathing circuits should be inspected after cleaning and/or sterilizing to check for deterioration. If the circuit is damaged or shows excessive wear, replace with a new circuit. Also perform the exhalation valve calibration when putting in service to assure that the circuit will perform correctly.

Reusable Exhalation Valve
(p/n HT600039)

Clean and sterilize between patients and twice per week while in use.

NOTE: The older revision (prior to February 2003) of the Newport Exhalation Valve does not disassemble. The new revision of the valve can be cleaned as assembled or it can be disassembled for thorough cleaning.

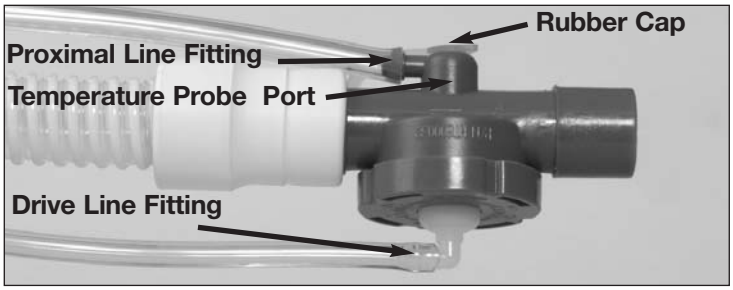


Figure 6-2 Exhalation Valve Assembly

Caution The Exhalation Valve should be inspected after cleaning and/or sterilizing to check for deterioration. If the valve is damaged or shows excessive wear, replace with a new valve. Also perform the exhalation valve calibration whenever the circuit is changed to assure that the circuit will perform correctly.

Preparation for cleaning

Assembled Valve: Remove the exhalation valve from the patient breathing circuit. Remove the rubber cap from the Temperature Probe Port of the exhalation valve and place it on the Drive Line Fitting Port of the exhalation valve. See Figure 6-2. You will need to replace the cap to its original location after cleaning and disinfecting is complete.

Disassembled Valve: To disassemble the current revision exhalation valve, rotate the top cap counter-clockwise and lift it off. Lift out the valve drive line fitting and separate it from the diaphragm. See Figure 6-3.

Clean: Use a low flow of running water to clear passages of organic matter. Wash the exhalation valve with a soft brush. Rinse thoroughly with sterile, distilled water. Shake off excess water and place it on a clean towel to air dry. (Do not heat or blow dry.)

Disinfect: Any of the following disinfecting methods are suitable for the NEWPORT exhalation valve (p/n HT600039):

Soak in one part white vinegar to one part of water for 2 hours and rinse thoroughly with sterile, distilled water; air dry.

Place the exhalation valve in warm distilled water, boil the water and allow to cool, Drain and air dry.

Sterilize: Use the following sterilizing method for the Newport exhalation valve.

Note: The exhalation valve must be disassembled prior to sterilization.

Soak in a Gultaraldehyde solution (Cidex [2.4%]) for twelve (12) hours; rinse thoroughly with sterile, distilled water; air dry.

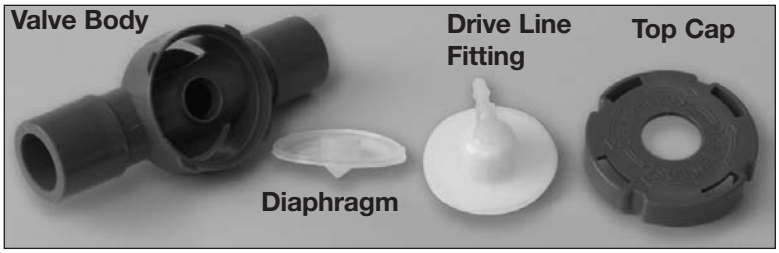


Figure 6-3 Exhalation Valve Disassembled Parts

Reassemble Valve: Reassembly must be done correctly to ensure proper operation of the ventilator.

1. Attach the diaphragm to the white plastic drive line fitting. The diaphragm must be carefully seated so that it lays flat on the white plastic drive line fitting and snaps on around the edge completely.

2. Place the fitting/diaphragm assembly in the valve body with the drive line fitting lined up in the same direction as the proximal pressure fitting on the other side of the valve.

3. Carefully place the cap over the fitting/diaphragm assembly and turn the cap clockwise until it comes up against the stop.

4. Perform an exhalation valve calibration to ensure proper operation of the ventilaor.

NOTE: Do not try to turn the drive line fitting after securing the cap. This may cause the diaphragm to become wrinkled or unseated and affect ventilator performance. Perform a successful exhalation valve calibration to verify proper valve assembly.

HT50 Air Inlet Particle Filter

WARNING NEVER operate the HT50 without a clean inlet particle filter in place.

WARNING NEVER reverse inlet particle filter when dirty.

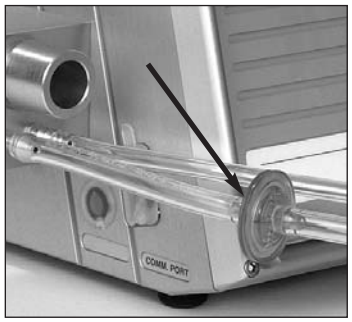
The air inlet particle filter, located on the right side of the ventilator behind the Filter Cover, keeps dirt and particles out of the ventilator's piston system. As the filter becomes dirty it can reduce the volume of air drawn into the ventilator.

Check the inlet filter weekly. Replace with a new filter when the majority of the filter surface area has changed from a clean white to a dirty brown color. Inlet filters are not reusable.

NOTE: After replacing the filter, make sure that the three hold-down screws on the Filter Cover are tight. If the screws are not tight, ambient air may enter the HT50 from around the inlet cover.

NOTE: HOME CAREGIVERS: When the HT50 is used in homecare environments, the filter may become dirty more frequently and must be inspected and/or changed more often.

Proximal Inline Filter



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

WARNING Never reverse the Proximal Inline Filter.

The Proximal Inline Filter has a very important function in the HT50. Located at the Airway Pressure Connector, it protects the internal pressure transducers from moisture or other contaminants that may be present in the proximal airway tubing. Since there is no purge flow coming from the HT50, it is important to always use a Proximal Inline Filter (p/n HT6004701 or equivalent).

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

In the event that the filter does become occluded, the primary indication for this would be a Low Pressure Alarm indication with the message “CHECK PROX LINE.” Should this happen, replace the filter.

NOTE: NEWPORT strongly recommends that extra Prox Inline Filters be available at all times when using the HT50 ventilator

Caution Do not wash or sterilize the Prox Inline Filter.

MAINTENANCE

Preventive Maintenance

The Air Inlet Filter (located behind the Filter Cover) must be checked weekly. Replace when the majority of the filter surface area has changed from a clean white to a dirty brown color. Air Inlet Filters are not reusable.

NOTE: HOME CAREGIVERS: When the HT50 is used in homecare environments, the filter may become dirty more frequently and must be inspected and/or changed more often.

WARNING NEVER reverse inlet particle 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.

Inspect the HT50 on a regular basis for signs of broken or frayed power cord. The exhalation valve should be inspected 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. If service is required contact your home equipment provider.

Dual Internal Battery Maintenance

The primary internal battery should be replaced every 12 months or sooner if the use time no longer meets the needs of the user. This will depend on a number of factors including settings and usage patterns. The secondary internal battery should be replaced every 24 months.

To preserve the Dual Pac internal battery life:

1. Always plug the HT50 into external power sources when available to keep the Dual Pac Internal Battery charged up, whether or not the HT50 is in use. Be sure to check that the green “Ext. Power” LED is lit.
2. Always keep Power Save function ON.
3. Always have available a back up power source, AC Power Cord and optional Autolighter Power Cord Accessory (p/n HT460085).
4. It is recommended that you keep a Battery Use Time Log so that you know when it is time to have your primary internal battery (LA) replaced. “Use Time” is the time from when you unplug your ventilator from A.C. and power it on internal battery until it indicates a “Battery Low” alarm.

10,000 Hour Maintenance

A comprehensive maintenance should be performed after 10,000 hours of operation. The 10,000 hour maintenance includes replacement of the intake filter and pump assembly and performance of the Operational Verification Procedure.

Refer to the HT50 Service Manual, p/n SERHT50-NA, or contact the Newport Medical Technical Service Department for detailed information on the 10,000 hour maintenance.

NOTE: HOME CAREGIVERS: Do not attempt to open or perform any service procedures on the HT50. Only Newport Medical trained technicians are authorized to service the ventilator. Contact your Homecare Dealer or Newport Medical. See page 1-6 and 1-7 for contact information.

Caution If the message “Service Needed” appears in the Message Display Window upon power-up, contact Newport Medical or your local dealer for maintenance service.

GENERAL WARNINGS

Preventive maintenance work, repairs, and service may only be performed by NEWPORT 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, physician prescription or Homecare Dealer 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, humidifier bottle, and other parts that come in direct contact with the patient should be sterilized between use.

7. TROUBLESHOOTING

INTRODUCTION

The NEWPORT HT50 Ventilator is used in life-support situations. As such, it is essential that all individuals using the NEWPORT HT50, including clinicians and support staff, have a thorough understanding of its operation. This should include a working knowledge of the ventilator's pneumatic and electronic systems.

The following practical troubleshooting guide is provided as a training resource for individuals learning how to use the NEWPORT HT50, and as a reference tool for those already familiar with its use and operation. It should be noted that this outline is not all-inclusive, and is intended only as a guide.

NOTE: HOME CAREGIVERS: Contact your Homecare Dealer, physician or Newport if you have questions or concerns about the performance of the HT50 ventilator.

WARNING Non-medical home caregivers must have complete training and demonstrate competency in proper set up, use, troubleshooting and maintenance of the HT50 prior to use. They must have a planned response to emergencies and must comply with appropriate infection control procedures. Training may be provided by your Homecare Dealer or NEWPORT representative.

Further questions or problems should be addressed to the Technical Service Department at Newport Medical Instruments.

800.451.3111 (USA only) or 1.714.427.5811 ext. 500
FAX 1.714.427.0489
email: TechSupport@NewportNMI.com

Or write to:

Technical Service Department
NEWPORT MEDICAL INSTRUMENTS, INC.
1620 Sunflower Ave
Costa Mesa, CA 92626 USA

TABLE 7-1: ALARMS

PROBLEM	POTENTIAL CAUSE	SUGGESTED CORRECTIVE ACTION
Apnea Alarm ▼ Paw/Apnea LED blinks red, audible alarm sounds	Patient did not trigger a breath for 30 seconds.	Re-evaluate patient and ventilator settings and provide increased ventilatory support as needed.
	Patient efforts not detected. Trigger level set improperly.	Use Ptrig to adjust trigger level closer to baseline pressure (0 cmH_2O/mbar) so that patient efforts are detected (indicated by the Ptrig LED illuminating green).
Battery Empty Alarm Int. Battery LED blinks red continuous audible alarm sounds, unsilencable	Internal battery system charge is depleted and ventilator shutdown will occur in approximately 15 minutes.	Immediately connect HT50 to external A.C. or D.C. power.
Battery Low Alarm Int. Battery LED blinks yellow intermittent audible alarm	A minimum of 30 minutes of battery operation remains.	Plug power cord into an external power source to charge.
Check Prox Line Alarm ▼ Paw/Apnea LED blinks red, audible alarm sounds	Humidity in proximal line.	Change proximal line filter and re route proximal line to a connector on the inlet (dry) side of the humidifier.
	No proximal filter in place.	Insert approved proximal filter.
	Proximal line disconnected or kinked.	Reconnect proximal line or un-kink line.
	Circuit is disconnected from patient.	Reconnect circuit to patient.
	Pressure transducer is improperly calibrated or defective.	Call NEWPORT Technical Service Dept.
Fault, Battery System Device Alert LED red, intermittent audible alarm	Battery system is not functioning properly	Keep HT50 plugged into external power source for proper operation. Call NEWPORT Technical Service Dept. immediately. See page 1-6 and 1-7 for contact information.
High Paw Alarm ▲ Paw LED blinks red, audible alarm sounds	Increased patient resistance or decreased patient compliance.	Evaluate patient. Patient may need suctioning, aerosol therapy, etc.
	Increased breathing circuit resistance.	Check for obstructions (kinked tubes, water in tubing, occluded filters, etc.)
	Control/alarm parameters changed.	Re-evaluate settings.
	High Paw alarm set incorrectly.	Re-adjust High Paw alarm if appropriate. Notify physician as necessary.

TABLE 7-1: ALARMS continued

PROBLEM	POTENTIAL CAUSE	SUGGESTED CORRECTIVE ACTION
High Pbase Alarm ▲ Paw LED blinks red, audible alarm sounds	Airway pressure remains above the Low Paw alarm setting at beginning of inspiration. Indicates an occlusion in the circuit/exhalation valve or that the proximal pressure line or exhalation drive line is pinched.	Unblock occluded area. Re-calibrate exhalation valve.
	High breath rate (insufficient time to exhale).	Evaluate patient and make necessary adjustments to ventilation parameters.
	Ventilator autotriggering from leak or improper Ptrig setting.	Fix leak and re-adjust Ptrig as needed.
High $\dot{V}_I$ Alarm ▲ $\dot{V}_I$ LED blinks red, audible alarm sounds	Increased spontaneous patient breathing.	Evaluate patient. Adjust the High $\dot{V}_I$ alarm setting if needed.
	Increase in trach/airway leak.	Evaluate leak, look for normal wake-sleep trends and set alarms appropriately.
	Increased minute volume due to ventilator auto triggering from: a. Leak.	a. Check circuit for leak and correct. Perform leak check (exhalation valve calibration) on breathing circuit.
	b. Ptrig setting too low (most common with single patient use exhalation valve).	b. Re-evaluate / re-adjust Ptrig setting (especially after circuit change)
	c. Loose expiratory drive line or proximal tubing connections loose.	c. Clip off ends of expiratory drive line and proximal line to tighten connection.
	d. Circuit disconnected for airway care or by accident.	d. Reconnect circuit securely. Push Alarm Silence when reconnecting after airway care (to allow one minute for stabilization).
Low Paw Alarm A/CMV or SIMV modes, ▼ Paw LED blinks red, audible alarm sounds	Decreased patient resistance or increased patient compliance.	Evaluate patient. Adjust the ventilation settings and/or Low Paw alarm as needed.
	Leak or disconnect in the breathing circuit and/or humidifier assembly.	Verify that connections are tight and leak free.
	Low Paw alarm set incorrectly.	Readjust Low Paw alarm if appropriate. Notify physician as necessary.

TABLE 7-1: ALARMS continued

PROBLEM	POTENTIAL CAUSE	SUGGESTED CORRECTIVE ACTION
Low Paw Alarm-cont'd. A/CMV or SIMV modes, ▼ Paw LED blinks red, audible alarm sounds	Ptrig setting too low (most common with single patient use exhalation valve).	Re-evaluate / re-adjust Ptrig setting (especially after circuit change)
	Loose expiratory drive line or proximal tubing connections loose.	Clip off ends of expiratory drive line and proximal line to tighten connection.
	Circuit disconnected for airway care or by accident.	Reconnect circuit securely. Push Alarm Silence when reconnecting after airway care (to allow one minute for stabilization).
Low Pbase Alarm ▼ Paw/Apnea LED blinks red, audible alarm sounds	Baseline pressure is below set Pbase due to airway or circuit leak or fluid pooled in tubing.	Verify all circuit connections are secure and leak free and that all fluid is cleared from tubing.
Low $\dot{V}_I$ Alarm / BUV ▼ $\dot{V}_I$ LED blinks red, audible alarm sounds	Patient efforts not detected. Trigger level (Ptrig) set improperly.	Perform leak check on breathing circuit (exhalation valve calibration) , secure circuit connections, evaluate Ptrig setting. Detected patient efforts are indicated by the Ptrig LED illuminating green.
	The set Low $\dot{V}_I$ alarm is set above delivered mandatory minute volume.	Readjust Low $\dot{V}_I$ alarm setting level.
	Patient needs suctioning/airway occlusion (pressure control/pressure support).	Suction and evaluate patient.
	Patient slow breathing/not breathing.	Evaluate patient.
	Breathing circuit too narrow/too short on small patient (V_T = 20 mL repeatedly in monitor window).	Use an ≥ 8 foot, 22 mm ID circuit. a. Make sure the circuit is 22 mm ID b. Increase circuit length to ≥ 8 ft.
	Nebulizer treatment inline during pressure control/pressure support.	Adjust alarm during nebulizer treatment.
Occlusion Alarm ▲ Paw LED blinks red at the high priority rate, audible alarm sounds	Exhalation valve blocked or line kinked.	Check exhalation valve line. Replace exhalation valve assembly.
		Re-calibrate exhalation valve.
	High breath rate.	Change to lower rate, evaluate patient.
Occlusion Alarm ▲ Paw & Device Alert LED blink red at the high priority rate, audible alarm sounds	Internal defect. Primary exhalation valve solenoid is malfunctioning.	Use an alternate means of ventilation and call NEWPORT Technical Service Dept. for repair procedures. See page 1-6 and 1-7 for contact information.

TABLE 7-1: ALARMS continued

PROBLEM	POTENTIAL CAUSE	SUGGESTED CORRECTIVE ACTION
PCV Not Reached Alarm Pressure Control modes ▼ Paw/Apnea LED blinks red, audible alarm sounds	Gross leak in the patient circuit and/or humidifier assembly.	Check all patient breathing circuit connections.
	Target pressure setting requires a flow rate that is beyond the HT50's maximal flow capability.	Re-evaluate the ventilator settings and strategy.
Power Down Alarm (Shutdown) audible alarm, no visual alarm indicator	Shutdown Alarm indicates that the ventilator has been powered off.	
	a. User powered ventilator down.	a. Push the Silence/Reset button.
	b. External power cord is disconnected; internal battery is discharged.	b. Reinsert power cord, and recharge internal battery.
	c. External power source and/or internal battery system failure.	c. Use an alternate external power sourrce. If none is available, ventilate the patient with a manual resuscitator or alternate ventilator system until problem is corrected. Replace internal battery when possible.
Power Switchover Alarm Ext. Power LED red Int. Battery LED blinks yellow intermittent audible alarm	External power cord is disconnected.	Reinsert power cord.
	External power source failure.	Use the dual internal battery. Recharge dual internal battery when A.C. is available.
System Error	Unrecoverable internal system failure e.g., memory error.	Ventilate the patient with an alternate means of ventilation. Make note of the message in the display window. Contact NEWPORT MEDICAL Technical Service Dept. immediately. See page 1-6 and 1-7 for contact information.
System Failure Alarm Device Alert LED red, continuous audible alarm	Unrecoverable internal system failure.	Ventilate the patient with an alternate means of ventilation. Make note of the message in the display window. Contact NEWPORT MEDICAL Technical Service Dept. immediately. See page 1-6 and 1-7 for contact information.

TABLE 7-2: BUILT-IN HUMIDIFIER (model HT50-H, HT50-HB only)

PROBLEM	POTENTIAL CAUSE	SUGGESTED CORRECTIVE ACTION
Check Humidifier Message	Humidifier bottle is loose or missing.	Tighten humidifier clamp. Install humidifier bottle. Press Humidifier On to restart.
	Temperature probe is disconnected.	Connect temperature probe. Press Humidifier On to restart.
	Humidifier water level is low.	Fill humidifier bottle to approriate level. Press Humidifier On to restart.
	Humidifier heater failure.	Contact NEWPORT Technical Service Dept. See page 1-6 and 1-7 for contact information.
Check Temp Probe Alarm Red LED, humidifier function terminated	Temperature probe is disconnected.	Insert temperature probe into port. Press Humidifier On to restart.
	Faulty temperature probe.	Replace temperature probe. Press Humidifier On to restart.
Humidifier Fail Alarm Red LED, humidifier function terminated	Humidifier bottle is loose or missing.	Tighten humidifier clamp. Install humidifier bottle. Press Humidifier On to restart.
	Failure of the humidifier control.	Contact NEWPORT Technical Service Dept. See page 1-6 and 1-7 for contact information.
High Temp Core Alarm Red LED, humidifier function terminated	Excessive temperature in the heating element.	If occurs repeatedly, contact NEWPORT Technical Service Dept. See page 1-6 and 1-7 for contact information.
High Prox Temp Alarm Red LED, humidifier function terminated	Set humidifier temperature is lower than ambient temperature.	Increase set humidifier temperature. Press Humidifier On to restart.
	Temperature of inhaled or exhaled gas coming in contact with the airway temperature probe is higher than the set temperature.	Increase humidifier temperature setting or move temperature probe farther away from airway. Restart humidification. Press Humidifier On to restart.
	Set temperature was recently lowered by a significant amount.	Wait for water to cool in humidifier bottle. Restart humidification. Press Humidifier On to restart.

TABLE 7-3: GENERAL / CLINICAL

PROBLEM	POTENTIAL CAUSE	SUGGESTED CORRECTIVE ACTION
Alarm volume too loud or too quiet	Unintended setting.	To toggle between loud and quiet, clear all alarms, then push and hold the Alarm Silence button for 3 seconds until you hear a beep.

TABLE 7-3: GENERAL / CLINICAL

PROBLEM	POTENTIAL CAUSE	SUGGESTED CORRECTIVE ACTION
Battery depleted too fast not lasting up to 10 hours **Note:** New battery use time is up to 10 hours at nominal ventilator settings with Power Save turned ON (see Specifications on pg. 2-4). The first Battery Low alarm will occur when a mimimum of 30 minutes of operating time remains. Battery Empty alarm will occur when a mimimum of 15 minutes of battery time is left.	Battery is not fully charged.	Charge battery to full charge level. Battery charges in 5-8 hrs from A.C. or external D.C. Check charge level by pressing Int. Battery (Push to Test) button and view level in Paw monitor window. Extend battery use time by plugging into A.C. or D.C. (car adapter) when available. Suggestion: Optional accessory, Automobile 12V power cord p/n HT460085, can be used to plug ventilator into automobile cigarette lighter. Ensure that the green *Ext. Power* LED is lit when connected to an AC or DC power source (it can take up to two minutes). If LED is not lit, check connections and resolve any problems.
	Power Save is OFF. This will decrease battery use time by 20% to 30%.	Enter User Setup and turn Power Save ON.
	Ventilator can not enter Power Save because latched alarms indicators have not been cleared.	Press Alarm Silence/Reset to clear latched alarm indicators.
	Ventilation settings used create higher peak and mean pressures than nominal settings as outlined in operating manual.	At your ventilator settings, note the battery use time until the first Battery Low alarm sounds. A minimum of 30 minutes of operating time remains until shutdown. This will be your expected battery use time at your settings.
	Battery is not in optimal condition / needs to be replaced.	The internal battery capacity begins to diminish at approximately 200 deep discharge cycles. This means that after 200 deep discharge cycles (battery is used to the “Battery Low” alarm and then recharged), the total battery use time will be significantly less than when new. As the battery ages the Battery Low alarm will occur sooner. If this begins to infringe on the needed battery use time prior to scheduled replacement, the primary internal battery should be replaced.
CO_2 rises Child’s CO_2 rises dramatically when put on ventilator	Too much deadspace (rebreathing) in the breathing circuit. (On a single-limb circuit, the tubing on the patient side of the exhalation valve is deadspace. On a "J" circuit the tubing between the wye connector and the patient is deadspace.)	On small patients, deadspace tubing should be as small (15 mm ID) and short as possible. Please Note: The rest of the breathing circuit tubing should always be 22 mm ID even on small children.

TABLE 7-3: GENERAL / CLINICAL continued

PROBLEM	POTENTIAL CAUSE	SUGGESTED CORRECTIVE ACTION
Circuit disconnect/ no alarm sounds Breathing circuit is disconnected from patient, but there is no alarm.	Proximal line is not appropriately placed in circuit.	Place proximal line at closest possible position to patient without creating problems with humidity in prox line or excessive deadspace for patient. If a heat moisture exhanger (HME) is in use in place of a heated humidifier, connect the proximal line to the breathing circuit on the patient side of the HME to improve alarm responsiveness.
	Low Paw alarm is not appropriately set.	Set Low Paw alarm to ensure that it sounds when patient circuit is disconnected. After setting up patient and stabilizing ventilation, remove circuit from patient at airway and observe peak airway pressure that develops with the next breath. Reconnect patient and set Low Paw alarm above this pressure.
	High / Low Minute Volume $\dot{V}_I$ alarm limits are not appropriately set.	Set High / Low $\dot{V}_I$ alarms to bracket patient minute volume.
Exhalation Valve Cal Fails (Cal Failed) Reusable or single patient use exhalation valve	A leak in the system.	a. Check all circuit connections. b. Check that the test lung is leak-free and that it is ≤ 1 L in size. c. Check that the exhalation valve drive line and prox line are not reversed. d. Use your thumb (covered with a clean gauze pad or equivalent) instead of a test lung to occlude circuit during calibration. e. If using a reusable exhalation valve, ensure that the diaphragm is seated properly. f. Try a different exhalation valve. NOTE: After corrective action, press Silence/Reset prior to repeating Exhalation Valve Calibration procedure.
	Oxygen is being titrated directly into the circuit rather than using the Oxygen Blending Bag Kit or Air/Oxygen Entainment Mixer.	Make sure that oxygen is not titrated directly into the breathing circuit. Use the Oxygen Blending Bag Kit or Air/Oxygen Entrainment Mixer to provide oxygen enrichment.
	Exhalation valve in use is not compatible with ventilator.	Use an exhalation valve that is approved for use with the HT50 ventilator.

TABLE 7-3: GENERAL / CLINICAL continued

PROBLEM	POTENTIAL CAUSE	SUGGESTED CORRECTIVE ACTION
Exhalation Valve Honks Exhalation valve makes honking noise	Low compliance/high resistance of circuit system.	Make sure the breathing circuit is 22 mm ID (regardless of patient size) and at least 8 ft long for small patients.
		If using approved single patient use exhalation valve with PEEP > 10 cmH_20/ mbar, remove flow deflector at bottom of valve (ensure that it cannot be blocked).
	The single patient use exhalation valve in use is not compatible with ventilator.	Use an exhalation valve that is approved for use with the HT50 Ventilator.
External Power Not Working After plugging into external A.C or D.C. outlet, Ext. Power indicator on panel does not light after two minutes	Power cord is not plugged far enough into the ventilator outlet.	Check that power cord is pushed in all the way on both ends.
	A.C. outlet has no power.	Check for power to A.C. outlet or use another A.C. outlet with power.
	D.C. Auto lighter outlet is not active with engine off.	Make sure auto lighter outlet is active with engine off or turn engine on.
	HT50 cannot detect external power.	Switch to alternate ventilator and contact Newport Medical Technical Service Dept.
Frequency is 1.5 Times Set Value Ventilator is alarming and respiratory frequency is 1.5 times the original set value	Ventilator is in Back up Ventilation in response to the Low Minute Volume Alarm being violated.	Back up Ventilation will stop and the respiratory frequency will return to normal when the monitored minute volume is 10% above the Low Minute Volume Alarm limit.
Manual Inflation Button Breath terminates and High Paw alarm is violated	High Paw alarm setting reached during Manual inflation.	If a higher inflation pressure is needed, increase the High Paw alarm limit setting to a safe but appropriate level. Otherwise, decrease flow rate or manual inflation time.
Manual Inflation Button Can't generate adequate rise in pressure	Mandatory flow is set too low.	Evaluate ventilation settings. If appropriate, decrease inspiratory time to increase flow.
	Gross leak in patient breathing circuit.	Check/secure all patient breathing circuit connections.
	Faulty exhalation valve.	Replace exhalation valve.
	Pressure Control mode.	Assess Pressure Control setting.
PEEP/CPAP Control Baseline pressure during exhalation continues to slowly decrease	Faulty exhalation valve.	Replace exhalation valve.
	Leak in patient breathing circuit.	Perform leak check (exhalation valve calibration) and eliminate any leaks found.
	Leak around ET tube / patient interface.	Check ET tube / patient interface.

TABLE 7-3: GENERAL / CLINICAL continued

PROBLEM	POTENTIAL CAUSE	SUGGESTED CORRECTIVE ACTION
PEEP/CPAP Control Monitored Pbase is less than set Pbase.	Leak in breathing circuit, humidifier, endotracheal tube cuff, patient interface. etc.	Find and correct leak.
	Uncalibrated exhalation valve.	Calibrate exhalation valve per instructions on pg. 5-3.
	Faulty exhalation valve.	Replace exhalation valve.
Pressure Meter Pressure does not return to zero when PEEP is set to zero	Breathing circuit resistance caused by an occluded filter/exhalation valve, pooled water or lodged secretions which prevent the free exit of patient exhalation.	Temporarily disconnect the patient circuit from the ventilator GAS OUTPUT outlet. If the pressure meter returns to zero, the cause of the elevated baseline pressure is circuit resistance. Check for (and empty) water in the patient circuit. Check for (and replace) clogged filter or heat moisture exchanger in the patient circuit. Check for (and clean) an exhalation valve that has become clogged with medications or patient secretions. Ensure that the expiratory drive line in not kinked.
	Meter needs calibration.	Disconnect circuit at the GAS OUTPUT outlet. If the pressure meter doesn't return to zero, it needs to be adjusted. Refer to Service Manual, Section 5.
Pressure Meter Baseline pressure (PEEP) fluctuating	Water in breathing circuit tubing.	Drain tubing.
	Leak in patient breathing circuit.	Perform exhalation valve calibration, leak check /eliminate any leaks found.
	Leak in the exhalation valve.	Replace the exhalation valve.
	Bounce/rebound from test lung	Use a test lung with more physiologic performance.
Pressure Not Rising Ventilator sounds like it is delivering breaths but pressure is not rising during the breath	Massive leak in the breathing circuit.	Locate leak and fix it.
	Exhalation valve diaphragm has come unseated.	Replace exhalation valve/breathing circuit.
Settings Change When Vent Turned Off and On Ventilator changes settings when turned off and on	*Set up: Default* selected in User Set Up parameters.	Patient must be off ventilator. Enter User Set Up and select *Set up: User*.

TABLE 7-3: GENERAL / CLINICAL continued

PROBLEM	POTENTIAL CAUSE	SUGGESTED CORRECTIVE ACTION
Trigger Problem Patient cannot trigger the ventilator	Inappropriate Ptrig setting.	Adjust the Ptrig towards "0" until the ventilator auto-triggers, then slowly increase the Ptrig setting until the auto-triggering stops.
	Baseline pressure increased inadvertently due to f, t_I, Volume control or Pressure control change.	Check ventilation settings; re-adjust if necessary.
	Baseline pressure increased inadvertently due to incomplete exhalation.	Check ventilation settings; re-adjust if necessary.
	Pressure Support is cycling off late.	Manage airway leak / fix circuit leak.
	Patient does not have any spontaneous effort or has very weak effort.	Evaluate patient.
Trigger Problem Ventilator auto-triggering	Ptrig is not set properly.	Re-adjust Ptrig level.
	Leak in patient circuit or exhalation valve or expiratory drive line.	Check/secure circuit connections. Change exhalation valve. Clip off 0.5 inches (1 cm) of each end of expiratory drive line and reconnect
Trigger Problem Patient double-triggers the ventilator (patient has trouble exhaling because second breath is being delivered)	In volume control, flow is set inappropriately low.	Check flow setting in $\dot{V}$ display window on face panel. If it is too low for patient need, decrease inspiratory time (t_I) setting until the flow is set appropriately.
	Pressure support is set too low for patient need.	Re-evaluate pressure support setting.
Ventilator Makes Noise When Air/Oxygen Mixer Is Connected HT50 makes a loud noise when using the Air Oxygen Entrainment Mixer connected to a gas cylinder	Cylinder is turned off or empty.	Check that cylinder is turned on and that it is not empty.
Ventilator Pistons Move Between Breaths Ventilator sounds like the dual micro pistons continue to move between breaths	The HT50 generates a 7.5 L/min of continuous flow in between breaths when PEEP is > 0 cmH_2O.	Ventilator is operating correctly.
Water in Breathing Circuit Tubing	Room temperature is cooler than the heated, humidified breathing gas in the circuit. When the gas in the circuit cools, water precipitates out.	a. Place water trap inline with the breathing circuit and empty it regularly. b. Wrap circuit tubing with pipe insulation or plastic sandwich wrap. c. Use a heated wire circuit.

TABLE 7-4: SETTING LIMITATION MESSAGES

MESSAGE	CAUSE	SUGGESTED CORRECTIVE ACTION
Reached Max $\dot{V}$	Maximum $\dot{V}$ (flow) setting has been reached.	Increase inspiratory time (t_I) or decrease tidal volume to resolve.
Reached Min $\dot{V}$	Minimum $\dot{V}$ (flow) setting has been reached.	Decrease inspiratory time (t_I) or increase tidal volume to resolve.
Inverse I:E	Inverse I:E Ratio has been reached.	Decrease inspiratory time (t_I) or decrease frequency (f) to resolve.
Reached Max I:E	Inverse I:E Ratio has reached 3:1	Decrease inspiratory time (t_I) or decrease frequency (f) to resolve.
$\dot{V}$ Unavailable	$\dot{V}$ (flow) display is not available in Pressure Control because $\dot{V}$ is variable and regulated breath by breath.	
PEEP + PS Too High	Set PEEP + Psupport is higher than 60.	Adjust PEEP or Psupport to resolve.
PC – PEEP Too Low	Pressure Control value minus PEEP is less than 5 cmH_2O/mbar.	Adjust PEEP or Pressure Control to resolve.
↑ – PEEP Too Low	High Pressure alarm limit minus PEEP is less than 5 cmH_2O/mbar.	Adjust PEEP or High Paw alarm setting to resolve.

TABLE 7-5: AIR OXYGEN ENTRAINMENT MIXER

PROBLEM	POTENTIAL CAUSE	SUGGESTED CORRECTIVE ACTION
Monitored F_IO_2 is lower than set F_IO_2 by > .08 when using Air Oxygen Entrainment Mixer	Filter cover is loose.	Tighten filter cover.
	Filter cover needs to be replaced.	Contact your provider or Newport to obtain replacement filter cover.
Mixer makes a pronounced clicking sound during normal operation	Oxygen source gas pressure is low.	Check that oxygen source gas is 50 psig.
	Oxygen source regulator is oscillating.	Check oxygen source regulator. If noise continues contact Newport Technical Service Dept.
Oxygen leaks out of Mixer when connected to 50 psig oxygen gas source.	Mixer diaphragm is leaking.	Contact Newport Technical Service Dept.

APPENDIX A:
QUICK CHECK PROCEDURE

INTRODUCTION

This procedure is intended to assist qualified operators to establish a routine program for verifying proper HT50 operation. Perform this Quick Check procedure each time the ventilator is prepared for clinical use.

NOTE: HOME CAREGIVERS: This procedure should be performed by your Homecare equipment provider, prior to delivery of the HT50, to verify proper operation. The Abbreviated Check Procedure may be performed in the homecare environment to ensure proper set up and function of the ventilator. See pg A-6.

NOTE: When ventilator changes are made allow time for the new settings to stabilize. In certain conditions (e.g., V_T adjustment), the HT50 may take five or six breaths to make the adjustment.

■ **WARNING** Do not use the HT50 if it fails this procedure.

Pre-test Inspection

1. Remove the three screws from the Filter Cover. Inspect the filter. Replace the filter if it is dirty. Re-install screws.

2. A 500 mL test lung with restrictor (LNG500A) is required to perform this procedure. Examine the test lung and patient circuit to ensure that there are no holes that will cause leaks.

3. Verify that the condition of the A.C. power cord is acceptable (e.g., no frays or breaks).

Set Up

1. Connect the A.C. power cord to an A.C. power source.

2. Connect an adult/pediatric breathing circuit (22 mm ID) with exhalation valve and 500 mL test lung with restrictor (LNG500A) to the HT50.

3. Calibrate the exhalation valve and then return the HT50 to Standby/Off condition. See pg A-6 for calibration procedure.

4. Press the On/Standby button once. The ventilator performs a self-test and then switches to “Setting” condition. During the self-test, verify that an audible alarm sounds and that all LED indicators, numeric and alphanumeric displays light. Verify that single color and dual color indicator LEDs are functional and have the same intensity. Press each button (except Manual Inflation, Push to Unlock and On/Standby) to verify that it is operational.

5. Set the ventilator to the following Standard Test Settings:

NOTE: If the HT50-H, HT50-HB with built-in humidifier is being used, it should be filled with sterile, distilled water and connected in the circuit at this time. Connect the dual temperature humidifier probe to the HT50, humidifier outlet, and the exhalation valve in the patient circuit.

Standard Test Settings

Control	Setting
MODE	A/CMV
Volume Control	500 mL
t_I	1.0 sec
f	15 b/min
Ptrig	(–)1 cmH_2O / mbar
▼Paw	3 cmH_2O / mbar
▲Paw	99 cmH_2O / 97 mbar
▼$\dot{V}_I$ alarm	0.1 L (minimum setting)
▲ $\dot{V}_I$ alarm	50 L (maximum setting)
PEEP/CPAP	0 cmH_2O / mbar
Psupport	0 cmH_2O / mbar
Humidifier	Off

QUICK CHECK PROCEDURE

1. Power Switchover Alarm Check

- Disconnect the A.C. power cord. Verify that there is an audible beep (Power Switchover alarm). The Ext. Power/Charging indicator turns red and the “Int. Battery” indicator blinks to indicate that the ventilator is on battery power. The Message Display Window displays “No ext power.”

- Reconnect the A.C. power cord. Verify that within two minutes the “Int. Battery” indicator turns off and the Ext. Power/Charging indicator turns green. Press the Silence/Reset button to clear the Message Display Window.

2. Alarms and Indicators Check

- If the HT50-H, HT50-HB is being used, press Humidifier On button and use ▲/▼ control button to set the desired temperature.

- Press the On/Standby button again to exit Settings condition and start ventilation.

High ▲Paw Alarm

- Set the High Paw alarm limit to 20 cmH_2O/mbar. Verify that an audible and visual High Paw alarm occurs and that inspiration ends when pressure reaches the high limit. Set the High Paw alarm limit back to 99 cmH_2O/97 mbar and note that the audible alarm stops and the ▲Paw LED latches. Press the Silence/Reset button to clear the alarm.

Low ▼ Paw Alarm

- Disconnect the test lung from the breathing circuit and verify that after two breaths an audible and visual Low Paw alarm occurs.

- Attach the test lung to the breathing circuit and verify that the audible alarm ceases and the ▼Paw LED latches. Press Silence / Reset button to clear the alarm and the message in the Message Display Window.

Humidifier Alarm (on HT50-H, HT50-HB model only)

- Read the temperature displayed in the humidifier temperature window. Press the Humidifier On button once and use the ▼Down control to lower the set humidifier temperature by 5º. Verify that an audible alarm sounds and the Message Display Window reads “High Prox Temp” and the humidifier is powered off. Press the Silence/Reset button to clear the alarm.

- Press the Humidifier On button and adjust the set temperature back to the desired temperature. Unclamp the humidifier bottle and remove it from the heating element. Verify that an audible alarm sounds and Message Display Window reads “Humidifier Fail” and the humidifier is powered off. Press the Silence/Reset button to clear the alarm. Reconnect the humidifier bottle.

- Press the Humidifier On button. Disconnect the temperature probe from the side of the HT50. Verify that an audible alarm sounds and the Message Display Window reads “Check Temp Probe” and the humidifier is powered off. Press the Silence/Reset button to clear the alarm.

3. Paw Monitor / Pressure Meter Check

- The purpose of this check is to compare the pressure reading of the Paw meter to the airway pressure displayed in the Message Display Window.
- Press the ▲Up control until “Paw/P/M/B” is displayed. Wait for two or three breaths for pressures to display. Verify that both the Paw meter and the Message Display Window peak pressure are within 10% or ± 2 cmH_2O/mbar of each other, whichever is greater.
- Adjust PEEP/CPAP to 5 cmH_2O/mbar. Verify that both the Paw meter and the Message Display Window show the baseline pressure within ± 2 cmH_2O/mbar. Reduce PEEP/CPAP to zero.
- Select Pressure Control and set pressure at 20 cmH_2O/mbar. Verify that both the Paw meter and the Message Display Window read a peak pressure that is within ± 3 cmH_2O/mbar of each other.
- Place the ventilator in Volume Control by pressing the Volume Control button twice.

4. Volume/Frequency Monitor Check

- Press the ▲Up control until “VT/$\dot{V}i$/f” is displayed. Verify that VT= 450-550, $\dot{V}i$ = 6-9 and f = 13-17 is displayed.

5. Internal Battery Check

- Unplug the HT50 from AC power, clear the alarm with the Alarm/Silence button and then press and hold the Int. Battery (Push to Test) button while powered on internal battery. Verify that the Int. Battery charge level needle on the Paw (airway pressure) meter is in the blue zone. This indicates the dual internal battery is charged.

THIS CONCLUDES THE QUICK CHECK PROCEDURE

Newport MEDICAL

HT50 Ventilator Quick Check
Pass / Fail Check-Off Sheet

Preparation for Use Tests		**Indicate result for each test**
Pre-Test Inspection Check		Pass _____ Fail _____
1.	Power Switchover Alarm Check	Pass _____ Fail _____
2.	Alarm & Indicators Check	Pass _____ Fail _____
	High ▲Paw Alarm	Pass _____ Fail _____
	Low ▼Paw Alarm	Pass _____ Fail _____
	Humidifier Alarm (HT50-H,HT50-HB only)	Pass _____ Fail _____
3.	Paw Monitor / Pressure Meter Check	Pass _____ Fail _____
4.	Volume/Frequency Monitor Check	Pass _____ Fail _____
5.	Internal Battery Check	Pass _____ Fail _____

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

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

Completed by: **Date:**

Facility: **Serial #:** **Unit hours:**

NOTE: HOME CAREGIVERS: Initial set up and verification of the ventilator operation should be done by the caregiver in conjunction with the Homecare Dealer or hospital provided clinician. The Abbreviated Check Procedure may be performed in the homecare environment to ensure proper set up and function of the ventilator.

ABBREVIATED CHECK PROCEDURE

Inspection Check

NOTE: Do this Inspection Check each time you turn on the HT50.

1. Remove the three screws from the inlet filter cover. Inspect the filter. Replace if dirty. Re-install screws.

2. Examine the test lung and patient breathing circuit to ensure there is no degradation of material which might cause leaks.

3. Examine the Oxygen Blending Bag (if used) to ensure there is no degradation of material which might cause leaks.

4. Verify that the condition of the A.C. power cord is acceptable, i.e. no frays. Connect the power cord to A.C. power source.

Exhalation Valve Calibration

NOTE: Each time an exhalation valve is maintained or replaced by another, such as when the complete circuit is changed, it must be recalibrated. The valve must pass the calibration procedure before it is used.

1. Connect the HT50 patient breathing circuit to the ventilator. Connect the patient connection (exhalation valve) of the breathing circuit to an adult (500 mL) test lung with restrictor (LNG500A) or occlude the patient connection of the breathing circuit.

2. Press the On/Standby button once to enter Settings condition.

3. Press the Manual Inflation button once, then again within three seconds.

4. The HT50 will start the EZ Cal and the ventilator will automatically test the exhalation valve. If it passes the test, the messages "Cal Completed", then "Press ON to Vent" will be displayed.

4a. If the test fails, the message "Cal Failed" will be displayed.

4b. Press the Silence/Reset button.

4c. If using a test lung during the EZ Cal, remove the test lung and occlude the patient connection instead.

4d. Check the integrity of the circuit and connections, then press the Manual Inflation button twice to initiate calibration again.

5. When calibration is finished, remove the test lung from the patient connection (if used) and press Silence/Reset to exit.

WARNING Inadequate ventilation may result if the exhalation valve is not calibrated properly. If the circuit/exhalation valve fails the calibration procedure, try another circuit/exhalation valve or use an alternate method of ventilation.

Battery Function and Charge Level Verification

1. While the HT50 is connected to AC power, disconnect the ventilator from A.C. power. An audible alarm should be heard (Power Switchover Alarm). Press the Silence/Reset button to cancel alarm.

2. While the HT50 is operating on the dual internal battery, push and hold the Int. Battery Test button. Observe the needle indicator on the Paw meter. If the battery charge level is medium to full charge, the needle will read in the blue area. If the battery charge is low, the needle will read in the red area. Reconnect to A.C. power.

NOTE: The HT50 should not be used on internal battery unless the battery is charged to its full level. If the internal battery system charge level is low, connect the HT50 to an external power source. The HT50 dual internal battery system is charged when the ventilator is connected to external power.

Operation Verification

1. Press On/Standby button once to place the HT50 into Setting condition. Check settings on the HT50 to be sure that they match the physician's prescription.

2. Press the On/Standby button once again to start ventilation. Connect the ventilator to the patient and observe the patient and ventilator for at least 10 minutes to ensure that there is adequate ventilation.

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

APPENDIX B:
HT50 ACCESSORIES

HT50 Ventilator Parts and Accessories

For more details contact your NEWPORT MEDICAL representative or NEWPORT MEDICAL Customer Service.

No.	Part number	Description	Quantity
HUMIDIFIER ACCESSORIES			
1.	HT460910	**Humidifier Bottle – upper**	1
2.	HT460920	**Humidifier Bottle – lower**	1
3.	HT460930	**Humidifier – heat sink**	1
4.	HT460940	**Humidifier – airway temperature probe**	1
5.	HT460950	**Humidifier – hose connection (12 in)**	1
6.	V12-34001-62	**Humidifier – absorbent paper**	10/ea
AIR/OXYGEN MIXER			
7.	HT460700	**Air/oxygen mixer – DISS 1240**	1
8.	HT600044	**Oxygen blending bag kit (1L)**	1
PATIENT BREATHING CIRCUITS			
9.	51006000	**Patient breathing circuit – disposable ped/adult** 6'/1.8m, non-heated, J-circuit with exh. valve	10/case
10.	51006700	**Abbreviated patient circuit – disposable ped/adult** J-circuit without inspiratory limb, for use with disp. heated wire inspiratory limbs	20/case
11.	RT114 **(use with 51006700)**	**Heated inspiratory limb - disposable** 5'/1.5m, 2 temp. probe ports and 2'/0.6m humidifier tubing	10/case
12.	003762	**Patient breathing circuit – disposable ped/adult** 6'/1.8m, non-heated**,** single limb with exh. valve	15/case
13.	10862-701	**Patient breathing circuit – disposable pediatric** 8'/2.4m, non heated, single limb with exh. valve	20/case
14.	10855-855	**Patient breathing circuit – disposable ped/adult** 8'/2.4m, non-heated, J-circuit with exh. valve	20/case
15.	10856-H08	**Patient breathing circuit – disposable ped/adult** 8'/2.4m, heated-wire, J-circuit with exh. valve	20/case
16.	HT600047	**Patient breathing circuit – reuseable** with prox line, water trap, exh. valve	1
17.	HT600048	**Patient breathing circuit – reuseable** with prox line, water trap	1
18.	HT600045	**Patient breathing circuit – reuseable** with prox line, exh. valve	1
19.	HT600049	**Patient breathing circuit – reuseable** with prox line	1
20.	HT600039	**Exhalation valve**	1
MOUNTING ACCESSORIES			
21.	HT460231	**Compact stand assembly** with support arm and breathing circuit hanger	1
22.	HT460200	**Rail / bed bracket**	1
			continued

Contact NEWPORT MEDICAL or your local NEWPORT MEDICAL representative for pricing and availability on all accessories and parts listed.

HT50 ACCESSORIES

No.	Part number	Description	Quantity
MOUNTING ACCESSORIES			
23.	HTBKT01	Bracket, humidifier pole mount (for stand)	1
24.	HTECH01	Bracket, e-cylinder holder (for stand)	1
25.	HTECH02	Bracket, dual e-cylinder holder (for stand)	1
MISCELLANEOUS ACCESSORIES			
26.	HT460300	Air inlet particle filter (disposable)	5/ea
27.	LNG500A	Adult test lung (500 mL) with R20 restrictor	1
28.	V24-00900-60	Electrical power cord / A.C. with Ferrite	1
29.	HT460400	Power cord ferrite	1
30.	HT460085	Automobile 12 V accessory power cord	1
31.	OPRHT50NA	Operating manual for HT50	1
32.	SERHT50NA	Service manual for HT50	1
33.	HT6004701	Prox inline filters (disposable)	5/ea
34.	BAT3300A	External Batttery Pack Assy	1
35.	CHG3313P	Battery Charger for BAT3300A	1

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APPENDIX C:
HT50 HELP GUIDE

QUESTIONS AND ANSWERS

1. Can I use the HT50 to deliver BiPAP (Mask Ventilation)?

- Yes. Use a standard anesthesia-style of mask and NOT a mask with a vent/hole in it. Minimizing leaks will improve successful ventilation with a mask. Any mode can be used, but follow physicians orders. If specific parameters are ordered, then Pressure Control pressure is the same as High PAW, PEEP is the same as Low PAW, t_I is the same as High Time. Set the rate (f) to set Low Time using this formula: f = 60 divided by (High Time plus Low Time). Set Ptrig as in regular ventilation – reduce until the ventilator auto triggers, then increase slowly until auto triggering stops.

2. Why do I need to place a filter inline with the proximal pressure tubing?

- The proximal pressure tubing does not have a purge flow therefore it would be possible for fluid/contaminants in the breathing circuit to enter the HT50 through the proximal tubing. The filter provides a contamination barrier.

3. Can I use a single patient use breathing circuit on the HT50?

- Yes. There are several good single use breathing circuits available from Newport Medical and other suppliers. A good quality circuit is important in controlling PEEP, patient trigger sensitivity and patient comfort. You can access a list of circuits that have been tested for use on the HT50 at www.ventilators.com/Bulletins.asp

- Newport recommends that you perform an exhalation valve calibration each time you install a clean disposable circuit, just as you would with a reusable circuit. This is to accommodate circuit and exhalation valve performance variations. Do not use a circuit that fails the exhalation valve calibration.

4. What size of breathing circuit should I use on pediatric patients?

- Breathing circuit tubing should always be 22 mm ID. For small patients, use pediatric-sized, low deadspace tubing / connectors from the exhalation valve to the patient for a single limb and from the wye connector to the patient for a "J" circuit.

5. How does the HT50 handle leaks in the airway/breathing circuit?

- The HT50 can manage to maintain the set PEEP/CPAP level when the patient has a small airway leak by generating a low flow (~7.5 L/min) in the breathing circuit. Also, the pressure in the exhalation valve is servo controlled to maintain the set baseline (PEEP) pressure.

6. Is it possible to use a heat moisture exchanger (HME) with the HT50's single-limb breathing circuit? Is the continuous flow generated when PEEP is added a problem?

- Yes, you can use a heat moisture exchanger (HME) whenever it is appropriate for the patient. The continuous flow generated by the HT50 when PEEP > 0 will exit the exhalation valve prior to the HME.

7. How do I obtain hours of operation?

- Press the ▲Up arrow until the information is displayed. The Message Display Window displays the following: H xxxxx Sxxxx L or Q. Where H is hours of operation, S is Software revision and L or Q is alarm loudness setting (Loud or Quiet).

8. Why does the HT50 Ventilator make a vibration noise?

- The dual micro-pistons that generate gas within the HT50 move back and forth very quickly and therefore make a vibration under normal circumstances. They will vibrate more when generating higher flows since they will be moving faster. You may notice this during pressure support or pressure control -- or particularly when there is a leak or disconnect.

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