International Ventilator Users Network

An affiliate of Post-Polio Health International (PHI)

HOME VENTILATOR GUIDE

This project is made possible by a bequest from ventilator user Ira Holland.

What is ventilation? respiration?

Ventilation is the process of moving air in and out of the lungs. Respiration is the process during which the exchange of oxygen (O_2) and carbon dioxide (CO_2) occurs in the alveoli of the lungs. The alveoli are small air sacs at the end of the bronchial tree in the lungs, and it is through the walls of these air sacs that O_2 diffuses into the blood and CO_2 diffuses out of the blood. Ventilation is a constant process of maintaining the proper balance between the two.

What is a ventilator?

A ventilator, also known as a respirator, is the equipment used to mechanically assist breathing by delivering air to the lungs. Many people may be familiar with ventilators in the hospital setting, such as the ICU, where large complex acute care ventilators are used. The ventilators used in the home are small, lightweight and portable; they can be mounted on wheelchairs or carts or put on a bedside stand. Most of these operate on household electric current – some have internal batteries – and can be operated with external batteries. It is advisable to have a backup battery or even a generator readily available in case of power outages or emergencies.

How does mechanical ventilation work?

The diaphragm is the primary muscle for inspiration, along with the intercostal muscles between the ribs. Other muscles of the chest, neck and shoulders play smaller roles. When these breathing muscles are weakened or paralyzed, breathing becomes difficult or impossible. A mechanical ventilator can take over the act of breathing completely or make breathing easier by assisting weakened respiratory muscles.

The muscles of the abdomen are important for breathing out and for an effective cough. Weak expiratory muscles result in impaired cough and inability to clear secretions that can lead to respiratory infections and pneumonias. In certain neuromuscular diseases, the bulbar muscles – those responsible for swallowing, speech and coughing – can become progressively impaired. Cough can be assisted with the use of manual and/or mechanical methods.

How did mechanical ventilation develop?

The iron lung or “tank” was the first effective form of mechanical ventilation, and one of the earliest iron lungs, often used to resuscitate drowning victims, dates from 1838. A century later, in the 1930s, improvements in the iron lung made widespread use of mechanical ventilation possible, particularly during the polio epidemics. Iron lungs are an example of negative pressure ventilators. Other forms of negative pressure ventilation include the chest shell or cuirass, Nu-Mo suit and Pulmo-wrap.

Positive pressure ventilators developed as a more effective breathing option to the larger, bulkier negative pressure devices. Since the 1980s, computer technology has enabled manufacturers to produce even smaller, lightweight ventilators that are easier to transport and operate, and are better suited for people living at home.

What is negative pressure ventilation?

When the pressure around the chest is negative – lower than atmospheric pressure – the chest expands to allow air to enter the nose and mouth. Iron lungs enclose the whole body, except for the head, and create pressure changes between the chest and the encasing shell of the unit.

Other forms of negative pressure ventilation, also known as body ventilators, include the chest shell or cuirass, Nu-Mo suit and Pulmo-wrap. The Porta-Lung™ is a small and more mobile version of the iron lung. Today, some people still use an iron lung, chest shell or Porta-Lung™.

A technologically advanced form of negative pressure ventilation called biphasic cuirass ventilation (BCV) controls both the inspiratory and expiratory phases of breathing. Higher frequencies and tidal volumes allow for higher minute ventilation.

The following equipment specifications are for negative pressure ventilators currently on the markets. There is no “standard” form for specifications. American and European manufacturers differ in the technical information that they provide about their products. Alarms must be a certain volume. Minimum and maximum alarm volume is regulated.

KEY:
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Hayek RTX (Biphasic cuirass ventilation)

United Hayek Medical, www.unitedhayek.com ❸

Pediatric use > 5 kg,
Also used as cough assistant

Modes:	Continuous negative; mandatory control; respiratory synchronized
Rate:	6-1200 cycles per minute
Maximum inspiratory pressure:	-50 cm H_2O
Maximum expiratory pressure:	+50 cm H_2O
I:E ratio:	1:6 - 6:1
AC voltage:	110-230, 50-60 Hz
External battery:	12 VDC
Dimensions:	370 mm W x 260 mm D x 180 mm H
Weight:	9 kg

Italian Iron Lung, Model CA 1001

Officine Coppa S.r.l., www.coppabiella.it ❷

NEV®-100

Philips Respironics, www.respironics.com ❸

Rate:	4-60 BPM
Negative pressure:	5 to -100 ± 2 cm H_2O or 5%, whichever is greater
Base pressure:	-30 to +30 ± 2 cm H_2O or 5%, whichever is greater
No internal battery	
No external battery	
Dimensions:	21” x 12” x 12”
Weight:	31 lbs
Alarms:	Low pressure

Pegaso V

Dima Italia S.r.l., www.dimaitalia.cm ❸

Rate:	5-50 CPM
Negative pressure:	Variable from -5 to -99 cm H_2O
Positive/negative pressure E:	Variable from +99 to -25 cm H_2O
AC voltage:	115V/230V, 50-50 Hz, 400 VA
Dimensions:	30 cm H x 32 cm W x 25 cm D
Weight:	17 lbs.
Alarms:	High/low respiratory pressure, power failure, mechanical failure

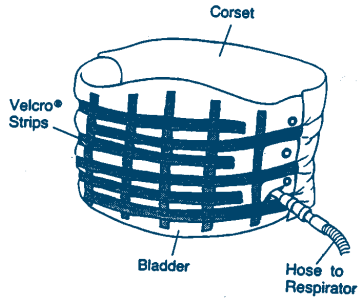
Porta-Lung™

Porta-Lung, Inc., www.porta-lung.com ❸

Breathing rate:	4-60 BPM
Pressure:	-60 to +20 cm H_2O
Sizes:	X-small, small, medium and large
AC voltage:	120 VAC
External battery:	12 VDC
Weight:	72 lbs-138 lbs
Alarms:	Low pressure

Consumer comments. “The NEV®-100 is noisy, somewhat heavy, doesn’t run on batteries. Reliable, easy to use.”
–CP, Massachusetts

What is a pneumobelt?



The pneumobelt, also known as an exsufflation belt, consists of an air bag or bladder inside a cloth corset that is worn around the abdomen and lower chest. The pneumobelt is connected by tubing to a positive pressure ventilator that alternatively inflates and deflates the bladder.

As the belt inflates, the abdominal contents are compressed and the abdomen rises, forcing air out of the lungs. When the belt deflates, the diaphragm is lowered and inhalation occurs passively. Because the pneumobelt works with gravity, it is most effective in the sitting and standing positions and cannot be used at night in the supine position. The pneumobelt is powered by a volume ventilator such as the PLV®-100 or LTV Series.

Exsufflation belt

Philips Respironics, www.respironics.com ❸

Consumer comments. “The pneumobelt is not noisy at all; there is just a whooshing sound as it exhales. However, the ventilator used to power the pneumobelt can be noisy. I use the turbine-driven LTV®950 (Pulmonetic Systems, Inc.) which has a high-pitched whistle and a loud inhaling sound. It can be annoying to some people.

“Care is easy. Circuits are disposable, and I change them about once a month, more often during flu season. The belt requires no cleaning. The only ‘maintenance’ is to be careful to change settings to lower volumes when transitioning from using mouth intermittent positive pressure (which I also use) to the pneumobelt. It is possible to over-inflate the belt and blow a hole in it. The rubber bladder can be replaced, but it’s costly.

What is a pneumobelt? *(continued)*

"The pneumobelt is not very comfortable. The settings can be set to provide a smooth, natural inhale and exhale so that it is not jerky but provides a natural breathing rate for speaking. Because one is breathing normal air through the mouth and nose, a humidifier is not needed with the pneumobelt.

"A commercial version of the pneumobelt is available from Philips Respironics, but custom belts can be made by a prosthetic/orthotic company. The nylon straps on the original casing are narrow and cut into the sides of the body.

A cotton T-shirt under the belt helps. I also use a thin foam pad to prevent pressure sores on my ribs and hipbones – the new Dr. Scholl's gel pads for shoes work well. Similar pads can be obtained from a physical therapy department. I'm experimenting with a new custom pneumobelt using the elastic belting found in low-back support belts with gel pads on wider straps.

"There are no alarms on the pneumobelt, but there are many alarms on the ventilator. I turn the low-pressure alarms off as much as possible because they are annoying and not necessary for me. The alarm in case the belt becomes disconnected is sufficient to summon help.

"The pneumobelt provides hands-free ventilation without any intrusive apparatus around the face. However, the pneumobelt cannot be used in the reclining or supine position so I can't recline in my wheelchair." *–TS, Arizona*

What is positive pressure ventilation?

Positive pressure – higher than atmospheric pressure – pushes air into the lungs. It can be administered either noninvasively via a wide variety of interfaces (nasal, facial and oral masks, nasal pillows, or mouthpieces), with tubing attaching the interface to the ventilator or invasively via tracheostomy.

Examples of equipment that deliver positive pressure ventilation are bilevel positive airway pressure ventilators, pressure support ventilators and volume ventilators.

The high flow of air from positive pressure may cause dryness in the nasal passages and upper airway, and humidifiers may help relieve symptoms of nasal stuffiness, dry mouth and thick nasal secretions. An integrated humidifier is a feature of some ventilators.

What is CPAP?

CPAP (continuous positive airway pressure) units provide a continuous flow of air at the same level of pressure during inhalation and exhalation to help keep the airway open. CPAP is the standard treatment for obstructive sleep apnea; it does not assist with breathing and is not considered ventilation. New auto-titrating CPAP units or APAPs deliver varying levels of pressures based on the detection of sleep-disordered breathing events and can change pressure on a breath-by-breath basis. Many of the combination mode ventilators can provide CPAP.

What is a bilevel positive airway pressure ventilator?

Bilevel ventilators developed by modifying CPAP to also provide inspiratory positive airway pressure (IPAP) to assist inspiration (breathing in). IPAP and expiratory positive airway pressure (EPAP) settings are adjusted separately. People with neuromuscular disease and weak diaphragmatic muscles often may have difficulty breathing in and need IPAP set higher than EPAP, e.g. an IPAP of 14 and an EPAP of 3. The difference between IPAP and EPAP is called the span, and in these cases should be at least 10.

Bilevel ventilators are made by several manufacturers and are often generically referred to as BiPAP. The only bilevels that can be called BiPAP® are the units patented and registered by Respironics, Inc.

Bilevels are used mainly at night with a nasal, facial, oral mask or nasal pillows. Some people use them continuously, but there is no US FDA approval for such use in the home. (An alternative for 24-hour use is a volume-cycled or pressure-cycled ventilator – See page 8.) The FDA has not approved them for off-label use by people with tracheostomies, although some US physicians prescribe them, particularly for infants and children. In other parts of the world, bilevels are often used by people with tracheostomies.

Three modes are available with bilevel ventilators:

- "S" or spontaneous breathing patterns that are sensed so that the unit switches between prescribed pressures
- "T" or timed mode that delivers IPAP and EPAP at a predetermined breathing rate
- "S/T" or spontaneous/timed that operates in spontaneous mode but switches to timed mode (referred to as a backup rate) when breaths are not initiated by the individual.

What is a bilevel positive airway pressure ventilator? *(continued)*

People with neuromuscular disease should use a bilevel ventilator with a spontaneous timed mode or backup rate that initiates breaths for them, particularly at night.

The advantages of bilevel ventilators are small size, light weight, lower cost and compensation for interface leaks. The disadvantages include lack of internal batteries, no or few alarms, inadequate pressures for some people, use of more electricity to operate, and discomfort from EPAP. Many of the combination mode ventilators can provide bilevel ventilation.

The following equipment specifications are for bilevel ventilators currently on the markets. There is no "standard" form for specifications. American and European manufacturers differ in the technical information that they provide about their products. Alarms must be a certain volume. Minimum and maximum alarm volume is regulated.

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Bilevel Positive Airway Pressure	**Mode**	**IPAP**	**EPAP/ CPAP**	**Breath Rate**	**Trigger/ Tidal Volume**	**AC Voltage**	**Battery**	**Dimensions**	**Weight**	**Noise**	**Alarms**	**Humidifier** Optional = H Oxygen = O
BiLevel ST 22 Weinmann GmbH & Co. KG www.weinmann.de ❷ *Available only outside USA*	CPAP, spontaneous, timed, spontaneous/timed	6-22 hPa	4-20 hPa	6-45 BPM	6	115-230 V, 50/60 Hz	No internal External: Venti*power*	230 mm W x 120 mm H x 280 mm D	3.7 kg	<26 dB	Leak/mask disconnect, apnea,high pressure, high temperature, device failure, malfunction, low external batteries, power failure	H Ventic*lick* O Venti-O_2
BiPAP AVAPS (Average Volume Assured Pressure Support) Philips Respironics www.respironics.com ❸ Pediatric use	CPAP, Spontaneous, timed, spontaneous/ timed, pressure control	4-25 cm H_2O	4-25 cm H_2O CPAP: 4-20 cm H_2O	0-30 BPM	200-1500 ml	110-240 V, 50/60 Hz	No internal External: 12 V	7" L x 5.5" W x 4" H; 18 cm x 14 cm x 10	3 lbs, 1.36 kg	<30 dB	Low Vte, mask disconnect, apnea, low minute ventilation, unit malfunction, low/empty external battery, power failure	H
BiPAP Harmony Philips Respironics www.respironics.com ❷	Spontaneous, spontaneous/ timed, CPAP	4-30 cm H_2O	4-25 cm H_2O CPAP: 4-20 cm H_2O	0-30 BPM		100-240 V	No internal External: 12-24 V with inverter	24 L x 17 W x 11 H cm	2.6 kg	<30 dB	Disconnect, apnea, device failure, low external battery	H, O
BiPAP S/T Philips Respironics www.respironics.com ❸ Pediatric use	Spontaneous, spontaneous/ timed, CPAP	4-25 cm H_2O	4-25 cm H_2O CPAP: 4-20 cm H_2O	0-30 BPM		100-240 V	No internal External: 12 V with inverter	7" L x 5.5" W x 4" H; 18 cm x 14 cm x 10	3 lbs, 1.36 kg	<30 dB	Mask disconnect, apnea, low minute ventilation, unit malfunction, low/empty internal bettery, power failure	H

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Bilevel Positive Airway Pressure Ventilators *(continued)*	**Mode**	**IPAP**	**EPAP/ CPAP**	**Breath Rate**	**Trigger/ Tidal Volume**	**AC Voltage**	**Battery**	**Dimensions**	**Weight**	**Noise**	**Alarms**	**Humidifier** Optional = H Oxygen = O
BiPAP Synchrony Philips Respironics www.respironics.com ❷ *See Consumer Comments at end of specifications*	Spontaneous, timed, spontaneous/ timed, CPAP, pressure control	4-30 cm H_2O	4-25 cm H_2O CPAP: 4-200 cm H_2O	0-30 BPM (S/T); 4-30 BPM (T)	200-1500 ml	100-240 V, 50/60 Hz	No internal External: 12 V with inverter	4.4" H x 6.625" W x 9.75" H	4.2 lbs	<30 dB	Low Vte, mask disconnect, apnea, low minute ventilation, low external battery, power failure	H
Delta 2 Air Liquide Medical Systems, S.A. www.airliquidemedical	Spontaneous, spontaneous/ timed, CPAP	4-30 hPa	2-25 hPa	0, and from 6-40 BPM	4 inspiratory; 3 expiratory	100-240 V, 50/60 Hz	External: 12 V	185 x 280 x 170 mm	3.8 kg	<32 dB	Low battery, disconnect, power failure, leak/mask disconnect	H
Delta 2 VT Air Liquide Medical Systems, S.A. www.airliquidemedicalsystems.com	Spontaneous, spontaneous/ timed, CPAP	4-30 hPa	2-25 hPa	0, and from 6-40 BPM	4 inspiratory; 3 expiratory; 0.2-1L±25%	100-240 V, 50/60 Hz	External: 12 V	185 x 280 x 170 mm	3.8 kg	<32 dB	Low battery, disconnect, power failure, leak/mask disconnect	H
Falco 51 Siare Engineering International Group, S.r.l. www.siare.it ❷	Spontaneous, spontaneous/ timed, CPAP	6-40 cm H_2O	0-20 cm H_2O	5-50 BPM	50-2500 ml; 1-9 L/min inspiratory trigger; 5-90% expiratory	100-240 V, 50/60 Hz	Internal: NiMH up to 5 hrs	240 L x 330 D x 210 H mm	3.9 lb	n/a	Low/high pressure; low/high rate/ low/high inspired tidal volume; apnea; malfunction; low internal battery; power failure	n/a
***GoodKnight*® 425ST *Bi-Level*® Device** Puritan Bennett Covidien Ltd. www.puritanbennett.com ❸	CPAP, spontaneous, timed, spontaneous/ timed	3-25 cm H_2O	3-20 cm H_2O	0, 4-25 BPM		100-240 V, 50/60 Hz	No internal External: 12 V, cigarette lighter adapter for auto	3" H x 5.6" W x 7.7" D	1.68 lb	≤30 dB	Leak, mask disconnect, apnea, low external battery, power failure	H
iSleep™ 25 BREAS Medical AB GE Healthcare www.breas.com ❷	Spontaneous, CPAP, spontaneous/ timed, pressure	4-25 cm H_2O	4-20 cm H_2O	4-30 BPM	1-9 inspiratory 1-9 expiratory	100-240 V	No internal External: 24 V DC, 12V adapter	173 mm W x 172 mm H x 201 mm D	1.9 kg	<28 dB	Device failure, malfunction, high pressure leak, power failure	H, integrated
Monnal T30 Air Liquide Medical Systems, S.A. www.airliquidemedicalsystems.com ❷	CPAP, S, ST, T, Pressure assist control	4-30 hPa	EPAP: 2-25 hPa CPAP: 4-20 hPa	0, and 6-40 BPM	4 inspiratory; 3 expiratory	110-230 VAC, 50/60 Hz	No internal External: 12 V	175 H x 338 L x 196 mm W	3.8 kg	30 dB	Leak, patient disconnect, power failure	H

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Bilevel Positive Airway Pressure Ventilators *(continued)*	**Mode**	**IPAP**	**EPAP/ CPAP**	**Breath Rate**	**Trigger/ Tidal Volume**	**AC Voltage**	**Battery**	**Dimensions**	**Weight**	**Noise**	**Alarms**	**Humidifier** Optional = H Oxygen = O
Multilevel ST-30 Dima Italia S.r.l. www.dimaitalia.com ❷	Spontaneous, spontaneous/ timed, Timed, CPAP	3-25 cm H_2O	0-15 cm H_2O	5-99 BPM	1-9 inspiratory, "auto-track" triggers	230 V, 50/60 Hz	No Internal External: 50 V	15 x 30 x 22 cm	3.0 kg		Low/high inspiratory pressure, apnea, high expiratory pressure, low battery, power failure	
Nippy™ ST + B & D Electromedical www.nippyventilator.com ❷	Spontaneous, spontaneous/ timed, CPAP	3-38 cm H_2O	3-20 cm H_2O	6-43 BPM	Flow, 200 L/min	100-240 V, 47-63 Hz	Opt. internal 4-12 hrs External: 24 V, 4-12-hrs	30 L x 22 W x 13 H cm	3.6 kg 4.5 kg with battery		Mask off, apnea, power failure, low battery, low/high pressure, device malfunction	
Smartair™ ST Puritan Bennett Covidien Ltd. www.puritanbennett.com ❷	Spontaneous, spontaneous/ timed, CPAP pressure	5-30 mbar	4-20 mbar CPAP: 5-25	4-40 BPM	5 inspiratory, 200 L/min	115-230 V, 50/60 mz	No internal	200 x 125 x 290 mm	2.7 kg	<30 dB	Optional low pressure, mask leak	
SOMNO*vent* ST Weinmann GmbH & Co. KG www.weinmann.de ❷	Spontaneous, timed, spontaneous/ timed, CPAP	4-20 mbar	4-18 mbar	5-45 BPM	5 inspiratory 5 expiratory	115-230 V, 50/60 Hz	No internal External: 12 V, 24 converters	18 W x 9 H x 32 D cm	4 kg	26 dB	Mask leak, disconnect, apnea, low extternal battery, power failure	H, O
VENTI*logic* Weinmann GmbH & Co. KG www.weinmann.de ❷	Spontaneous, timed, spontaneous/ timed, timed adaptive, CPAP, SX and SXX	6-35 hPa	4-20 hPa	6-45 BPM	6 inspiratory 6 expiratory 300 L/min	115-230 V, 50/60 Hz	No internal External: VENTI*power*, 7 hrs	23 W x 12.5 H x 34 D cm	4.5 kg	25 dB	Low/high pressure, low minute ventilation, power failure, disconnect, overheat, pressure measuring	H, O
VENTI*motion* Weinmann GmbH & Co. KG www.weinmann.de ❷	Spontaneous, timed, spontaneous/ timed, CPAP, SX and SXX	6-35 hPa	4-20 hPa	6-45 L/M	6 inspiratory 6 expiratory 300 L/min	115-230 V, 50/60 Hz	No internal External: VENTI*power*, 7 hrs	23 W x 12.5 H x 34 D cm	4.5 kg	25 dB	Low/high pressure, apnea, low minute ventilation, power failure, disconnect, overheat, pressure measuring	H, O

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Bilevel Positive Airway Pressure Ventilators *(continued)*	**Mode**	**IPAP**	**EPAP/ CPAP**	**Breath Rate**	**Trigger/ Tidal Volume**	**AC Voltage**	**Battery**	**Dimensions**	**Weight**	**Noise**	**Alarms**	**Humidifier** Optional = H Oxygen = O
VENTI*motion* 2 Weinmann GmbH & Co. KG www.weinmann.de ❷	Spontaneous, timed, spontaneous/ timed, CPAP	6-30 hPa	4-20 hPa	6-45 L/m	6 inspiratory 6 expiratory 285 L/m	115-230 V, 50/60 Hz	No internal External: VENTI*power*, 7 hrs	230 W x 120 H x 280 D mm	3.7 kg	26 dB	Low minute ventilation, low/high pressure, apnea, disconnect, device malfunction, overheating, low/empty external battery, power failure	H, O
VPAP™ ST ResMed Corp. www.resmed.com ❸	Spontaneous, timed, spontaneous/ timed, CPAP	4-25 cm H_2O	3-25 cm H_2O CPAP: 4-20 cm H_2O	5-30 BPM	Flow 3 inspiratory 3 expiratory	110-240 V	No internal External: 12 V	112 L x 145 H x 164 W mm	1.3 kg	<26 dB	Mask off, leak, apnea	H
VPAP™ III ST-A ResMed Corp. www.resmed.com ❸	Spontaneous, timed, spontaneous/ timed, CPAP	3-30 cm H_2O	3-25 cm H_2O CPAP: 4-20 cm H_2O	5-30 BPM	Flow 3 inspiratory 3 expiratory	110-240 V	No internal External: 12-24 V	270 L x 230 W x 141 H mm	2.3 kg		Low/high pressure, mask off, low minute ventilation, non-vented circuit, disconnect, apnea, malfunction, power failure	H
VPAP™ III ST-A with QuickNav ResMed Corp. www.resmed.com ❷	Spontaneous, timed, spontaneous/ timed, CPAP	2-30 cm H_2O	2-25 cm H_2O CPAP: 4-20 cm H_2O	5-30 BPM	3 sensitivity triggers; 50-3,000 mL	110-240 V, 50/60 Hz	ResMed Power Station up to 12 hrs	270 mm L x 230 mm W x 141 mm H	2.3 kg	<30 dB	Power failure, low/high pressure, mask leak/ disconnect, low minute ventilation	H
VPAP™ IV ST ResMed Corp. www.resmed.com ❷	Spontaneous, timed, spontaneous/ timed, CPAP	4-25 cm H_2O	2-25 cmH_2O CPAP: 4-20 cm	5-30 BPM	5 levels. 170 L/min max. flow	100-240 V, 50/60 Hz	No internal External: 12-24 VDC	112 mm L x 164 mm W x 145 mm H	1.3 kg	<28 dB	None	H, O
VS Serena™ ResMed Corp. www.resmed.com ❷	Spontaneous, timed, spontaneous/ timed, CPAP	4-20 hPa CPAP: 5-30 hPa	4-20 hPa	5-50 BPM	0-2500 ml inspiratory Expiratory	110-240 V	No internal External: Battery Pack up to 8 hrs	5.3” x 11.2” x 8.0”	5.5 lb		Disconnect, malfunction, apnea, power failure, nonvented circuit, low/high pressure	H

Consumer comments for bilevel positive airway pressure ventilators: *(continued)*

BiPAP Synchrony

"The BiPAP Synchrony works very well, and its size makes it easy to carry when you are traveling. However, it is not geared to mount on a wheelchair. It is noisy and draws a lot of energy. Even when you connect it to an external battery, the battery drains very quickly. It would be better if the water chamber were much simpler to handle. It needs to be an integrated part of the overall design." *–AJK, Canada*

"I use a BiPAP Synchrony with AVAPS. Good points: it is very small; it uses an external power supply that helps to keep the equipment cooler; easy maintenance. Bad points: it is a bit noisy; the turn-on switch should not be 'electronic' – it should be a normal open/close switch. Once turned on, it takes too long to send the first breath." *–MDPO, Brazil*

VPAP™ III ST

"I've been using VPAP™ III ST with built-in humidifier for more than a year. It replaced the Philips Respironics BiPAP Pro 'S' that I used for a year and a half.

"The BiPAP, though kind of noisy, is a dependable machine with a very nice filter. It served me well through my early recovery from the 10+ years of hypoventilation, but the need for the 'timed' feature became more and more evident. I still use it for traveling and for emergency use because, unlike the VPAP, it has a 12 V port built in.

"VPAP™ III ST advantages:
1. It is so quiet that I forget I'm hooked up.
2. I am fortunate to be able to set the machine myself. The smaller IPAP and EPAP increment of .2 (compared to .5 on the BiPAP) taught me that my polio-weakened diaphragm and intercostals are more sensitive to the pressure setting than I previously thought. Understanding the way the machine settings need to balance has helped me visualize my exact breathing needs and make corrections accordingly for a greater improved quality of life.
3. The built-in humidifier gives the unit a small footprint compared to my old setup which included a separate humidifier.

"VPAP™ III ST disadvantages:
1. The filter is much too small, it can't be washed, and a finer pollen filter could be added.
2. The lowest EPAP setting is 4. Since I don't have the classic mechanical obstructive problem I prefer 3 or even 2. The lower EPAP setting also makes it easier to start a breath, increasing the percentage of self-initiated breaths." **–***RDVL, California*

What is a volume-cycled ventilator?

Volume-cycled ventilators deliver a preset volume of air during inspiration. Volume ventilators can deliver higher volumes and pressures than bilevel units, although the volume remains constant despite interface leaks. The pressure limit can be adjusted by increasing the volume and lowering the high-pressure alarm. Volume-cycled ventilators can be used for breath stacking (adding one breath to another without exhaling) to enable deeper breaths for improved cough. They also have alarms and internal batteries, but they are larger, heavier and more expensive than bilevel units, although some use less electricity to operate. If an individual needs 24-hour ventilation, a volume ventilator is recommended because it is approved by the FDA for this purpose and has the necessary safety features.

MODE DEFINITIONS:

Control: Delivers only controlled breaths at specified tidal volume and prescribed respiratory rate. Ventilator is triggered by pre-set machine rate, and the individual cannot take any spontaneous breaths.

Assist/Control: Allows individual to initiate/trigger a machine-assisted breath and to take additional breaths at prescribed tidal volume.

SIMV (Synchronized Intermittent Mandatory Ventilation): Prescribed tidal volume and respiratory rate but individual can breathe spontaneously in between delivered breaths.

PEEP (Positive End Expiratory Pressure): Airway pressure is maintained at the end of the ventilator breaths to increase volume of air remaining in the lungs at the end of expiration.

IPPB (Intermittent Positive Pressure Breathing): Intermittent delivery of deep insufflations.

Sigh: Provides an increased amount of volume at intervals to simulate a normal sigh breath.

The following equipment specifications are for volume-cycled ventilators currently on the markets. There is no "standard" form for specifications. American and European manufacturers differ in the technical information that they provide about their products. Alarms must be a certain volume. Minimum and maximum alarm volume is regulated.

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Volume-cycled Ventilators	Mode	Tidal Volume	Inspiratory Flow Rate	Breath Rate	PEEP	Trigger	AC Voltage	Battery	Dimensions	Weight	Alarms	Humidifier Optional = H Oxygen = O
LP10 Volume Ventilator Puritan Bennett Covidien Ltd. www.puritanbennett.com *Discontinued*	Assist/control, SIMV, pressure cycle	100-2200 ml	2-100 LPM	1-20 BPM in increments of 1 BPM and 22-38 BPM in increments of 2 BPM			110 V, 220-240 V, 50/60 Hz (Power usage: Maximum 679 kW hrs per yr)	Internal, up to 1 hr External: 10-20 hrs, depending on 12 V deep-cycle battery	9.75" H x 14.5" W x 13.25" D	35 lbs	Low/high pressure, low battery, power failure, malfunction	H, O
LTV®800 CareFusion www.pulmonetic.com ❸ Pediatric use > 5 kg *See Consumer Comments at end of specifications*	Spontaneous, control, assist/control, SIMV	50-2000 ml	10-100 LPM	0-80 BPM	0-20 cm H_2O	Pressure	90-250 V, 47/63 Hz	Internal, 1 hr External: 3 hrs, 4 hrs, 9 hrs automobile cigarette lighter adapter	3" H x 10" W x 12" D	12.85 lbs	Low/high pressure, empty/low battery, low minute ventilation, apnea, power failure, malfunction, disconnect	H, O
PLV®-100 Philips Respironics www.respironics.com *Discontinued*	Control, assist/control, SIMV	0.05-3.00 L ± 10%	10-120 LPM	2-35 BPM ± 5; 36-40 ± 2			120 V, 50/60 Hz, 220-240 V, 50/60 Hz	Internal, 1 hr External: 12 V	9" H x 12.25" W x 12.25" D	28.2 lbs	Low/high pressure, apnea, low battery, power failure, malfunction	H
PLV®-102 Philips Respironics www.respironics.com *Discontinued*	Control, control + sigh, assist/control, assist/control + sigh, SIMV	0.05-0.20 ± 0.02 L; 0.20-3.00 L ± 10%	10-120 LPM	2-35 BPM ± 0.5; 36-40 ± 2	0-20 cm H_2O		120 V, 50/60 Hz, 220-240 V, 50/60 Hz	Internal, 1 hr External: 12 V	9" H x 12.25" W x 12.25" D	28.9 lbs	Low/high pressure, apnea, low battery, power failure, malfunction	H, O
PLV®-102b Philips Respironics www.respironics.com *Discontinued*	Control, control + sigh, assist/control, assist/control + sigh, SIMV	0.05-0.20 ± 0.02 L; 0.20-3.00 L ± 10%	10-120 LPM	2-35 BPM ± 0.5; 36-40 ± 2	0-20 cm H_2O		120 V, 50/60 Hz, 220-240 V, 50/60 Hz	Internal, 1 hr External: 12 V	9" H x 12.25" W x 12.25" D	28.9 lbs	Low/high pressure, apnea, low battery, power failure, malfunction	H
TBird® Legacy CareFusion www.carefusion.com *Discontinued*	Pressure control, pressure support, assist/control, SIMV, CPAP	50-2000 ml	1-60 cm H_2O	2-80 BPM	PEEP: 0-30 cm H_2O	Flow	100-240 V, 47/63 Hz	Internal, 25 min External: 48 (4 x 12) V	12.6" W x 14" D x 13" H	12.6" W x 14" D x 13" H	Low/high pressure, malfunction, low minute ventilation, apnea	O with Legacy O_2

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Volume-cycled Ventilators *(continued)*	**Mode**	**Tidal Volume**	**Inspiratory Flow Rate**	**Breath Rate**	**PEEP**	**Trigger**	**AC Voltage**	**Battery**	**Dimensions**	**Weight**	**Alarms**	**Humidifier** Optional = H Oxygen = O
UniVent™ Eagle™ 754 Impact Instrumentation, Inc. www.impactinstrumentation.com ❸	Assist/control, SIMV, CPAP	0-3000 ml		1-150 BPM	1-20 cm H_2O	Flow	90-265 V, 47/440 Hz	Internal, 3 hrs max External: 11-15 V	8.87" x 11.5" x 4.5" D	13 lbs	Low/high pressure, low battery, malfunction, disconnect, power failure, tidal volume	O
V-Leonardo Dima Italia S.r.l. www.dimaitalia.com ❷ Pediatric use	Controlled, assist, assist/control, SIMV	0.1-1.6 L		5-99 BPM	0-15 cm H_2O	Pressure 0.5-5 cm H_2O; Flow	110/220 V, 50/60 Hz	Internal, 10 hrs External: 12 VDC	38W x 33L x 23H cm	9.5 kg	Low/high inspiratory pressure, high expiratory pressure, apnea, low battery, power failure, malfunction	H, O

CONSUMER COMMENTS FOR VOLUME-CYCLED VENTILATORS:

LTV®800

"The LTV®800 is easy to carry anywhere – lightweight, reasonably small and durable. I can hold it on my lap during airplane flights.

"During the day when I use mouth intermittent positive pressure with a mouthpiece. I did not need or want to use the long, multi-tubed circuits that came with the LTV®800 so I substituted simple ones (that I used with another volume ventilator). However, I now require PEEP for sleeping, and I use Pulmonetic's circuit with PEEP valve with my custom-made face mask. My husband changes the night circuit monthly and cleans/disinfects the day circuit weekly.

"The LTV®800 sits on the car's front seat beside me as I drive. It is simple to hook up to the cigarette lighter or the small battery pack. My husband thinks there's sometimes an annoying whistle to the vent when it's in the car but I'm not bothered by the sound, although it does vary more than when it is hooked to AC.

"At first, the on/off and reset buttons were very difficult for me to use because I have little push-down power in my fingers. I put little pads on the buttons to raise them just enough to provide an area my fingers can push down on. The filters are washable and easy to reach. The Pulmonetic people have been very accessible when I needed help or had questions. There are many bells and whistles to this vent that I still have not fully explored. I miss the deep breath sigh that the Bear 33 delivered to me for 15 years." *–JG, Kansas*

"I have owned an LTV®800 for about five years. The manufacturer (Pulmonetic Systems, Inc.) has a policy of dealing only through home health care companies, and they deal only in rentals. Therefore I cannot get maintenance and repair service for it through the manufacturer. Its relatively small size and dual voltage makes it good for travel. It is noisier than my PLV®-100 and has a smaller limit of volume delivery." *–AF, Virginia*

What is a pressure support ventilator? What is pressure control?

Pressure support ventilators supplement the inspiratory effort of individuals who can breathe spontaneously by providing a preset amount of positive airway pressure throughout the complete inspiration. The tidal volume can vary from breath to breath. These ventilators also offer pressure control with the ventilator, rather than the individual, controlling the breathing rate. Pressure control sets the pressure rather than the flow.

The following equipment specifications are for pressure support ventilators currently on the markets. There is no "standard" form for specifications. American and European manufacturers differ in the technical information that they provide about their products. Alarms must be a certain volume. Minimum and maximum alarm volume is regulated.

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Pressure Support Ventilators	Mode	Tidal Volume	Pressure Range	Breath Rate	IPAP, EPAP, PIP, PEEP	Trigger	AC Voltage	Battery	Dimensions	Weight	Alarms	Humidifier Optional = H Oxygen = O
Falco 101 Siare Engineering International Group, S.r.l. www.siare.it ❷ Pediatric use >5 kg	CPAP, bilevel-S, bilevel-ST, pressure support (PSV), pressure assist/control (PCV, APCV), pressure support ventilation with guaranteed tidal volume (PSTv), Volumetric option available	50-2500 ml	6-40 cm H_2O	5-50 BPM	EPAP/ PEEP: 0-20 cm H_2O IPAP: 6-40 cm H_2O	1-9 l/min inspiratory; 20-50% expiratory	100-240 V, 50/60 Hz	Internal: up to 4 hrs External: up to 10 hrs, 12V	210 mm H x 240 mm W x 330 mm D	3.9 kg	High/low pressure, high/low rate, high/low insp. tidal volume, overheating, malfunction, apnea, power failure, low battery, batter disconnect	H, O
Multilevel VP Dima Italia S.r.l. www.dimaitalia.com ❷ Pediatric use	Control, Assist/control, pressure control, pressure support, SIMV	10 cc - 2500 cc		5-99 BPM	IPAP: 3-60 cm H_2O EPAP: 0-15 cm H_2O PEEP	Inspiratory; expiratory	110-240 V, 50/60 Hz 80 VA	Internal: 12 V, 1-1/2 hrs External	16 x 30 x 22 cm	3.5 kg	Low/high inspiratory pressure, high expiratory pressure, apnea, low battery, power failure	H, O
Nippy 3+ B & D Electromedical www.nippyventilator.com ❷	Pressure control, pressure support, IPPV, CPAP		0-30 cm H_2O	6-60 BPM			100-240 VAC, 50/60 Hz	No internal External: 24 V, 2- & 8-hr portable, 4- & 8-hr backup	297 L x 223 W x 132 H mm	3.5 kg	Low/high pressure, flat/low battery, disconnect, power failure	
PV 403 PEEP BREAS Medical AB GE Healthcare www.breas.com ❷	Pressure support, pressure control, volume control	0.3-1.6 L	6-50 mbar	4-40 BPM	Optional: 0-10 cm mbar	Inspiratory; expiratory	100-240 V, 50/60 Hz	Internal, up to 15 hrs External: 12-24 V, 8-10 hrs	35 W x 18 H x 26 D cm	5.5 kg	Low/high pressure, leak, low battery, power failure, malfunction, low tidal volume	

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Pressure Support Ventilators	Mode	Tidal Volume	Pressure Range	Breath Rate	IPAP, EPAP, PIP, PEEP	Trigger	AC Voltage	Battery	Dimensions	Weight	Alarms	Humidifier Optional = H Oxygen = O
Smartair™ Plus Puritan Bennett Covidien Ltd. www.puritanbennett.com ❷	Pressure control, pressure support, volume control, spontaneous, spontaneous-timed, CPAP	100-1250 ml			IPAP: 5-30 mbar EPAP: 0-20 mbar	Inspiratory: 5 mbar Expiratory: 4 mbar	115-230 V, 50/60 mz	Internal, 2-5 hrs External: 24 V	200 x 125 x 290 mm	3.2 kg	Low/high pressure, disconnect	O
Vivo® 30 BREAS Medical AB GE Healthcare www.breas.com ❸	Pressure support, pressure control, CPAP			4-40 BPM	IPAP: 4-30 cm H_2O EPAP: 2-20 cm H_2O	Inspiratory 1-9; Expiratory 1-9	100-240 V	External: 12/24 V DC	185 mm W x 230 mm H x 227 mm D	3.3 kg	Low/high pressure, low volume, low/high leakage, low external & internal battery, low power, internal function failure	H
Vivo® 40 BREAS Medical AB GE Healthcare www.breas.com ❸ Pediatric use	Pressure support, pressure control, CPAP, target volume	200-1500 ml		4-40 BPM	IPAP: 4-40 cm H_2O EPAP: 2-20 cm H_2O	Inspiratory 1-9; Expiratory 1-9	100-240 V	Internal: 3.8 Ah capacity External: 12.5/24 V DC	185 mm W x 240 mm H x 227 mm D	4 kg (with internal battery and humidifier)	Low/high pressure, low volume, low/high breath rate, low/high leakage, low external & i nternal battery, low power, internal function failure	H
VS Integra™ ResMed Corp. www.resmed.com ❷ Pediatric use	Pressure control, pressure support, spontaneous, spontaneous/timed	50-2500 ml	5-50 hPa	5-50 BPM adult; 5-60 BPM pediatric	IPAP: 5-50 cm H_2O EPAP: 4-20 cm H_2O	Flow; pressure	100-230 V, 110-230 V	Internal, up to 4 hrs External, up to 8 hrs	135 x 285 x 204 mm	2.6 kg without internal battery	Minimum/maximum tidal volume, power supply, low/empty battery, low/high pressure, disconnect	O

What is a combination or multi-mode ventilator?

The current generation of ventilators can provide many modes of ventilation: pressure support, pressure control, volume control, bilevel pressure or CPAP.

The following equipment specifications are for combination ventilators currently on the markets. There is no "standard" form for specifications. American and European manufacturers differ in the technical information that they provide about their products. Alarms must be a certain volume. Minimum and maximum alarm volume is regulated.

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Combination or Multi-Mode Ventilators	Mode	Tidal Volume	Pressure Range	Breath Rate	PEEP	Trigger	AC Voltage	Battery	Dimensions	Weigh t	Alarms	Humidifie r Optional = H
***Achieva*® Portable Ventilator** Puritan Bennett Covidien Ltd. www.puritanbennett.com ❸	Volume con-trol, pressure support, pres-sure control, control, assist/control, SIMV	50-2200 ml	0-50 cm H_2O	1-80 BPM	0 and 3-20 cm H_2O	Inspiratory/ Flow and pressure	100-240 V, 50/60 Hz	Internal, at least 4 hrs under normal load; backup use only External: 24 V, approx 20 hrs under normal load	10.75" H x 13.30" W x 15.60" D	31 lbs	Low/high pressure, low battery, power failure, malfunction, setting error, power switchover O2 fail-ure (PSO2)	H, O
Carina® *home* Draeger Medical www.draeger.com ❸	CPAP, PSV, PCV (assist) and VCV-PR (assist)	50-4000 ml	5-50 cm H_2O	5-50 BPM	PIP: 0-80 cm H_2O PEEP: 3-20 cm H_2O	SyncPlus: Flow gradient, Flow and pressure	100-240 V, AC, 50/60 Hz, max 0.9 A	Internal, 2 hrs External: fully charged 10 hrs 12-24 V	15.2" L x 6.9" W x 10.8" H (38.5 L x 17.5 W x 27.5 H cm)	10.8 lbs (4.9 kg)	High/low pressure, high/low tidal vol-ume, apnea, bat-tery low, discon-nect/leakage, filter removal, illegal power shut-off, fre-quency high, etc.	
Elisée 150™ ResMed Corp. www.resmed.com ❷ Pediatric use	Assist/control in volume, assist pres-sure control, SIMV, IPPV, pressure sup-port with backup, pres-sure support with tidal vol-ume	50-500 ml, pediatric 300-2500 ml, adult	3-40 cm H_2O, pediatric 5-60 cm H_2O, adult	2-80 BPM, pediatric 2-50 BPM, adult	0-20 cm H_2O, pediatric 0-25 cm, adult	Inspiratory/ Flow and pressure Expiratory/ Flow	110-230 V, 50/60 Hz	Internal, up to 14 hrs External: 12-28 V, 20 hrs	260 x 240 x 130 mm	4-4.8 kg depen-dent on inter-nal battery option	Low/empty battery, low high pressure both insp. & exp., low/ high tidal volume both insp & exp., low/high minute ventilation both insp & exp., leaks, malfunction, power failure	O

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Combination or Multi-Mode Ventilators *(continued)*	**Mode**	**Tidal Volume**	**Pressure Range**	**Breath Rate**	**PEEP**	**Trigger**	**AC Voltage**	**Battery**	**Dimensions**	**Weight**	**Alarms**	**Humidifier** Optional = H Oxygen = O
Falco 202 Siare Engineering International Group, S.r.l. www.siare.it ❷ Pediatric use >5 kg	Pressure; spontaneous, spontaneous/timed, CPAP; pressure control -- assist control; pressure support with guaranteed tidal volume; Volume: assist control, SIMV	50-2500 ml	6-60 cm H_2O	5-50 BPM	PEEP: 0-20 cm H_2O	1-9 l/min inspiratory; 5-90% expiratory	100-240 V, 50/60 Hz	Internal: NiMH up to 2.5 hrs External: NiMH up to 10 hrs	240 L x 330 D x 210 mm	3.9 kg	Low/high pressure; low/high rate; low/high inspired tidal volume; apnea; overheating; malfunction; low internal battery; battery disconnect; power failure	O
HT50® Newport Medical Instruments www.ventilators.com ❸ Pediatric use > 5 kg *See Consumer Comments at end of specifications*	Volume control, A/CMV & SIMV w/or w/o pressure support, pressure control A/CMV & SIMV w/or w/o pressure support. Spontaneous (CPAP) w/ or w/o pressure support. Backup ventilation in all modes (responds to low-minute volume alarm)	100-2,200 ml (in Volume Control)	Pressure control; 5-60 cm H_2O, Volume control; 0-100 cmH_2O	1-99 BPM	0-30 cm H_2O (leak compensated)	9.9-0 cmH_2O relative to built-in PEEP/ CPAP	110-240 V, 50/60/400 Hz	Internal, up to 10 hrs, charges to 80% charge in 5-7 hrs from either AC or DC (12-24 V battery). Newport Supplemental Power Pack (24 V): Adds 50% more use time to internal battery. External battery: 12-30 V with autmotobile cable	10.63” W x 7.87” D x 10.24” H	15 lbs	High/low pressure, high/low minute volume, high/low PEEP, circuit occlusion, apnea, press control level not reached, check prox line, battery low, battery empty, power swithcover, device alert, shut down alert	H, O
iVent 201™ VersaMed GE Healthcare www.versamed.net ❸	Volume control, pressure control, pressure support, spontaneous, assist/control, SIMV, CPAP	100-2,000 ml	0-60 cm H_2O	1-50 BPM	0-20 cm H_2O	Flow and pressure	100-240 V, 50/60 Hz	Internal, up to 2 hrs External: 12-15 V	13” H x 9.5” W x 10.3” D	22 lbs	Low/high pressure, low battery, leak, power failure, malfunction, disconnect, low minute ventilation	O

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Combination or Multi-Mode Ventilators	Mode	Tidal Volume	Pressure Range	Breath Rate	PEEP	Trigger	AC Voltage	Battery	Dimensions	Weight	Alarms	Humidifier Optional = H Oxygen = O
Legendair™ Puritan Bennett Covidien Ltd. www.puritanbennett.com ❷ Pediatric use > 5 kg	Pressure control, pressure support with and without tidal volume, volume control, SIMV	100-1400 ml	Insp: 5-40 mbar Exp: 0-20 mbar	6-60 BPM		5 inspiratory	115-230 V, 50/60 Hz	Internal, up to 10 hrs External: 24 V	230 x 305 x 150 mm	4.5 kg	Low/high pressure, low battery, power failure, malfunction, low minute ventilation, disconnect	O
LTV®900 CareFusion www.pulmonetic.com ❸ Pediatric use > 5 kg *See Consumer Comments at end of specifications*	Volume control, pressure support, control, assist/control, SIMV, Spontaneous, CPAP	50-2000 ml	Pressure support; 0-60 cm H_2O	0-80 BPM	0-20 cm H_2O	Flow	90-250 V, 47/63 Hz	Internal, 1 hr External: 11-15 V, 3 hrs, 4 hrs, 9 hrs, automobile cigarette lighter adapter	3" H x 10" W x 12" D	13.4 lbs	Low/high pressure, low/empty battery, power failure, malfunction, low minute ventilation, apnea, disconnect	H, O
LTV®950 CareFusion www.pulmonetic.com ❸ Pediatric use > 5 kg *See Consumer Comments at end of specifications*	Volume control, pressure control, pressure support, control, assist/control, SIMV, spontaneous, CPAP	50-2000 ml	Pressure control 1-99 cm H_2O; Pressure support 0-60 cm H_2O	0-80 BPM	0-20 cm H_2O	Flow	90-250 V, 47/63 Hz	Internal, 1 hr External: 11-15 V, 3 hrs, 4 hrs, 9 hrs, automobile cigarette lighter adapter	3" H x 10" w x 12" D	13.4 lbs	Low/high pressure, low/empty battery, power failure, malfunction, low minute ventilation, apnea, disconnect	H, O
LTV®1000 CareFusion www.pulmonetic.com ❸ Pediatric use > 5 kg *See Consumer Comments at end of specifications*	Volume control, pressure control, pressure support, control, assist/control, SIMV, CPAP	50-2000 ml	Pressure control 1-99 cm H_2O; Pressure support 0-60 cm H_2O	0-80 BPM	0-20 cm H_2O	Flow	90-250 V, 47/63 Hz	Internal, 1 hr External: 11-15 V, 3 hrs, 9 hrs, automobile cigarette lighter adapter	3" H x 10" W x 12" D	13.4 lbs	Low/high pressure, low/empty battery, power failure, malfunction, low minute ventilation, apnea, disconnect	H, O

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Combination or Multi-Mode Ventilators *(continued)*	**Mode**	**Tidal Volume**	**Pressure Range**	**Breath Rate**	**PEEP**	**Trigger**	**AC Voltage**	**Battery**	**Dimensions**	**Weight**	**Alarms**	**Humidifier** Optional = H Oxygen = O
LTV®1150 CareFusion www.pulmonetic.com ❸ Pediatric use > 5 kg	Volume control, pressure control, pressure support, control, assist/control, SIMV, CPAP, spontaneous breathing trial	50-2000 ml	Pressure control 1-99 cm H_2O; Pressure support 0-60 cm H_2O	0-80 BPM	0-20 cm H_2O Internal	Flow	100-250 V, 50/60 Hz	Internal, 1 hr External: 11-15 V, 3 hrs, 9 hrs, automobile cigarette lighter adapter	3" H x 10" W x 12" D	13.4 lbs	Low/high pressure, low/empty battery, power failure, malfunction, low minute ventilation, apnea, disconnect	H, O
Neftis Air Liquide Medical Systems, S.A. www.airliquidemedicalsystems.com ❷	Volume assist/control, pressure assist/control, pressure support with	50-2000 ml		5-60 BPM	0-20 cm H_2O	4 inspiratory	93.5-253 V, 47/63 Hz	Internal External: 10.5 to 30 V	300 L x 248 W x 320 D mm	14 kg	Pressure, volume, power failure, low minute ventilation, disconnect	H, O
Neftis 2 Air Liquide Medical Systems, S.A. www.airliquidemedicalsystems.com ❷ Pediatric use	Volume assist/control, pressure assist/control, pressure support with PEEP, SIMV support with PEEP, SIMV	50-2000 ml		5-60 BPM	0-20 cm H_2O	5 inspiratory	93.5-253 V, 47/63 Hz	Internal External: 10.5 to 30 V	300 L x 248 W x 320 D mm	14 kg	Pressure, volume, power failure, low minute ventilation, disconnect	H, O
Puritan Bennett 540™ Ventilator Puritan Bennett Covidien Ltd. www.puritanbennett.com ❶ Pediatric use >5 kg	CPAP, pressure support, pressure assist/control, volume assist/control, volume SIMV, pressure SIMV	50-2000 ml	5-55 cm H_2O	1-60 BPM	0-20 cm H_2O	5 inspiratory	100-240 V, 50/60 Hz	Internal: up to 11 hrs External: 12-30V	6" H x 9.25" W x 12.4" D	9.9 lb	Apnea, circuit occlusion, internal battery malfunction/failure, device malfunction, high/low pressure, high/low VTE, high/low minute ventilation, high device temperature, low/empty internal battery, power disconnect/failure	O

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Combination or Multi-Mode Ventilators *(continued)*	**Mode**	**Tidal Volume**	**Pressure Range**	**Breath Rate**	**PEEP**	**Trigger**	**AC Voltage**	**Battery**	**Dimensions**	**Weight**	**Alarms**	**Humidifier** Optional = H Oxygen = O
Trilogy100 Philips Respironics www.respironics.com ❶ Pediatric use >5 kg *See Consumer Comments at end of specifications*	CPAP, bilevel S, S/T, T; volume assist/control, volume control, SIMV with pressure support, pressure control SIMV	50-2000 ml	IPAP: 4-50 cm H_2O EPAP: 0-25 cm H_2O	0-80 BPM	0-25 cm H_2O active circuits; 4-25 cm H_2O passive circuits	Flow trigger sensitivity	100-240 V, 50/60 Hz	Internal: up to 3 hrs External: 12-30 VDC, 3 hrs Vehicle cable adapter	4.5" x 6.88" x 9.5"	11 lb	Circuit disconnect, apnea, low internal battery, high/low tidal volume, high/low minute ventila-tion, high/low respiratory rate, remote capability	O
Venti*logic* LS Weinmann GmbH & Co. KG www.weinmann.de ❷	CPAP; S spontaneous; T timed; ST spontaneous/timed; TA timed adaptive; SX and SXX; PSV; PCV; aPCV; VCV	5-3,000 ml	4-45 hPa	5-45 L/min		8 levels for separate inspiratory and expiratory	115-230 VAC; 50/60 Hz	Internal, 3 hrs External: VENTI*power*, 7 hrs	230 mm W x 145 mm H x 340 mm D	6.5 kg	Low minute ventilation, high tidal volume, low/high respiratory rate, low/high control pressure, low/high oxygen; apnea, leak, mask disconnect, device malfunction, overheating, low/empty internal, external battery, power failure	H: VENTI*click* O: VENTI-*O2*
Venti*logic* plus Weinmann GmbH & Co. KG www.weinmann.de ❷ Pediatric use	Leak: Spontaneous, timed, spontaneous/timed, timed adaptive, CPAP; Valve: Pressure control, assist/pressure control; pressure support; SIMV	5-3,000 ml	6-35 hPa leakage; 4-45 hPa valve	5-45 L/min		8 levels for separate inspiratory and expiratory; 300 l/min leakage, 270 l/min valve	115-230 VAC; 50/60 Hz	Internal, 3 hrs External: VENTI*power*, 7 hrs	230 W x 145 H x 340 D mm	6.5 kg	Low minute ventilation, high tidal volume, low/high respiratory rate, low/high control pressure, low/high oxygen; apnea, leak, mask disconnect, malfunction, overheating, low/empty internal or external battery, power failure	H: VENTI*click* O: VENTI-*O2*

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Combination or Multi-Mode Ventilators *(continued)*	**Mode**	**Tidal Volume**	**Pressure Range**	**Breath Rate**	**PEEP**	**Trigger**	**AC Voltage**	**Battery**	**Dimensions**	**Weight**	**Alarms**	**Humidifier** Optional = H Oxygen = O
Vivo® 50 BREAS Medical AB GE Healthcare www.breas.com ❷ Pediatric use	PSV, PSV (T), PCV, PCV (T), PCV (A), PCV (A+T), VCV, VCV (A), CPAP	100-2500 ml	4-40 cm H_2O	5-50 BPM	0-30 cm H_2O	Off and 1-9 Inspiratory; 1-9 expiratory	100-240 V, 50/60 Hz	Internal: up to 4 hrs External: 24 V up to 8 hrs	348 W x 120 H x 264 D mm 348 W x 120 H x 290 D mm with external battery	5.2 kg; 6.7 kg with external battery	Low/high pressure, low/high PEEP; low/high breath rate, low/high inspired tidal volume, low/high minute ventilation, low/high pulse rate, low/high FiO2, apnea; rebreathing, disconnect, low/empty internal/external battery, malfunction, power failure	O
VS III™ ResMed Corp. www.resmed.com ❷ Pediatric use	Leak - CPAP; spontaneous; spontaneous/timed; assisted pressure controlled ventilation; Valve-assisted volume controlled ventilation; pressure support with guaranteed tidal volume; assisted pressure con-	50-2500 ml	IPAP/PS: 5-30 cm H_2O 6-30 H_2O; 5-50 H_2O EPAP: 4-20 cm H_2O	5-50 BPM; 5-60 BPM pediatric in PS.Vt &A/CV	CPAP/ PEEP: 4-20 cm H_2O	Inspiratory flow; 3-8; pressure: Auto, 1-6	100-240 V, 47-63 Hz	Internal, 2-4 hrs External: 26 VDC	14.5 cm x 27.5 cm x 22.1 cm	2.9 kg	High/low pressure, low Vti, low Vte, maximum frequency, high Vt, low battery	O
VS Ultra™ ResMed Corp. www.resmed.com ❷ Pediatric use	Assist/control volume, assist pressure control, pressure support with or without backup, pressure support with tidal volume, spontaneous, spontaneous/time	50-2500 ml	5-50 hPa	5-50 adult; 5-60 pediatric	4-20 cm H_2O	Inspiratory & Expiratory	100-230 V	Internal, 4 hrs External: 24 V, 8 hrs	135 x 285 x 204 mm	3.5 kg with battery	Low/high pressure, low/empty battery, power failure, disconnect, malfunction, remote, low/high tidal volume	O

CONSUMER COMMENTS FOR COMBINATION OR MULTI-MODE VENTILATORS:

HT50®

"The noise level of the HT50® is slightly louder than most other vents, but one gets accustomed to it. I have had no complaints at conferences, church services or movies.

"Maintenance is just as easy as any other vent that I have used. It is easy to use and easy to move. The technology is good. The HT50 is comfortable, feels fine and delivers air smoothly. The auto DC adaptor works fine, and the internal battery usually lasts for four to five hours before the two-hour warning alarm sounds. It is somewhat annoying when the alarm repeats and repeats.

"The HT50's light weight, small size and portability are its best features." *–HH, Virginia*

"The noise does not bother me when I'm in my own home but it does when I'm out in the public, such as the doctor's waiting room. I do not require 24-hour ventilator use so I've never used it in church.

"I find it very easy to use at home. It is light enough for me to move it without help. I place mine on the back of my wheelchair during the day. I change my own filters easily; the circuits are disposable and not hard to change.

"I use the assist control mode, volume ventilation. The air is delivered smoothly and consistently. I do not use the humidifier that comes with the unit. I use a unit that sets beside the HT50®. This works fine for me.

"My van is equipped with an inverter, so I have never used the cigarette lighter adapter in my vehicle.

"The alarms are more forgiving that some because I can actually miss one breath without creating alarms. I do this often when I'm talking and using the vent. Moving about in bed does not cause alarms as long as I keep my breathing normal. The alarms are easy to turn off.

"The portability of the HT50® and the comfortable airflow are its most favorite features. I wish it was quieter." *–MD, Arkansas*

"It's a lot quieter than my old Bantams. However, I only use it for sleeping so I can't comment on how distracting the noise would be in churches or concert halls or conference rooms. I use a PLV®-100 as a backup, and I find the Newport just slightly louder.

“There are only two maintenance procedures for this unit. One is replacing the filter that is located on the side of the unit. The filter cover is attached by three thumb screws. The other is to calibrate the unit whenever you change the circuits. This is done by blocking the user end of the circuit and pressing two buttons consecutively. Not very difficult.

"I find breathing very comfortable with it. One model has a built-in humidifier which would be great if you use the vent during the day. However, it is small and requires refilling every four hours or so. You can get an adapter for your car's cigarette lighter. The HT50® has an internal battery that is claimed to last for 10 hours, but I haven't tested it that long yet.

"I can breathe on my own so I wish there was a way to shut off the alarms, but they do reset themselves quickly when the problem is fixed.

"The HT50's 10-hour internal battery and small size are its best features. I am not crazy about the calibration." *–DV, New Hampshire*

"With Newport’s HT50®, I feel like I'm on thick, lovely satin. It's quiet and user friendly. There is a handle on the top, which I think gives the appearance that it's portable and more conducive to my mobility needs. The Newport has enough contrasting colors and simple operations panel so that I can adjust the settings myself. Also with the HT50, I can actually talk wearing the full face mask." *–CT, Texas*

LTV® series

"The main drawbacks of the LTV are its costs, its energy draw, and the noisiness of it. It is difficult to have a conversation or to talk on the telephone when using it, and it would be a challenge going to a concert or even a movie. Its best features are its ability to switch between volume and pressure modes and, of course, its size, which enables you to carry it on the back of your chair or easily take it with you on an airplane. Another problem with it is the size of the circuits. The vent is so lovely and small while is all the tubing is quite extensive and difficult to conceal if you are a fashion conscious." *–AJK, Canada*

LTV®900

"The LTV®900 is moderately noisy. I modify the circuit for my son's needs because it is difficult to change. The Y valve is very bulky especially if you use a heated wire circuit and need to add a temperature probe at the Y valve.

"The adapter for the car's cigarette lighter is a good feature. The size, of course, is the best feature." *–JS, Florida*

"The LTV®900 is quiet during the day and in big rooms, but it is loud in a small room and at night.

"The entire ventilator tubing circuit is changed once a week. It is easily done as it has designated connections that only fit into specifics ports. You can't connect it wrong. There are two little filters. One is the computer exhaust and the other is the inlet for the air. They are both washed easily with regular water and air dried.

"I use an inline HME instead and like the Portex 1200 HME the best, which I change every day. The HME provides a little resistance (compared to the LP10 humidification chamber), but is so much smaller and convenient.

"The car adapter and three-hour battery packs are great. My AC adaptor plug has had two breakages at the connection site in the last year. This is a poor design that is too fragile for this vital connection.

"The alarm could be louder, but the alarm resets itself if the problem of high or low pressure is fixed automatically. The cover over the controls is a nice feature as it leaves only the alarm reset button available for pushing by caregivers. However, the cover needs to be able to be clipped on somehow as it just falls off sometimes – we have to tape it into place. The locking feature on the setting of all the control parameters is also nice.

"My most favorite feature is the wonderful portability. I swim with my vent connected during aquatic therapy. It also attaches easily to the back of my wheelchair and takes very little additional space.

"Its least favorite feature is the loudness during the night. Customer service with both my local medical device company and the manufacturer has been poor." *–EO, Alabama*

"I use a Pulmonetic LTV®900. I wish it were lighter for traveling purposes, but it is certainly more compact and portable than other models I have used. I do not mind the noise, however, it is distracting to another person when I share a room with a guest. I would like it to be quieter.

"I have had problems with my PEEP valve. The RRT will set it at 5, but it fluctuates and sometimes goes up as high as 9. Even a replacement machine fluctuated but only to 7. I wish the PEEP valve settings were more stable and reliable. At times, the alarm for "High PEEP" even sets off.

"Sometimes, the "High Pressure" alarm goes off. When I get up and suction myself, often there are very few secretions. Sometimes the "Low Pressure" alarm will go off when nothing in the circuits is disconnected. Therefore, I find that the alarms go off without apparent cause. " *–LB, Illinois*

"I use an LTV®900 and love it. It is relatively quiet and extremely portable." *–LG, New York.*

LTV®950

"During the day I rarely hear it unless I happen to pull my chair up near a wall where the sound is reflected. At night the bedside machine is mounted on a stand slightly above my head, but the noise does not interfere with either watching television or going to sleep.

"The only maintenance required is the weekly changing of two filters. I need to use a pair of tweezers to pull the grate over the fan motor filter. I am sure that someone with weaker arms/hands than I have would find it very difficult. For an able-bodied person it is easy. The filters are then rinsed in warm water, squeezed dry and left to totally dry for use the following week. I use disposable circuits and changing them is not difficult. I have permanent circuits to use in an emergency and find washing them to be very exhausting.

"I find the LTV®950 to be a very 'natural' way to breathe. To me it is very smooth and comfortable and the machine always seems to be in synch with me.

"I use the following accessories (also from Pulmonetic Systems, Inc.) – AC power adapter, external 12V nine-hour batteries (I use three and rotate them through charging and resting), external battery DC cord, automotive lighter power cord that also works with my Husky Jump Start System, Model HSK020HD if I get in a pinch, and a table stand that supports the vent on a tabletop at bedside. I also use a heated humidifier (Fisher & Paykel Healthcare Inc.) at night.

"I particularly like the adjustable alarm volume, which I set to an audible but not ear-shattering 60db so I don't frighten people when an alarm goes off when I'm out and about.

"For me, the most favorite feature of the LTV®950 is the profile of the vent, which allows me to hang it on my wheelchair, right below the right arm of the chair. This allows me to see the vent if an alarm goes off, discover what the problem is, most often be able to fix the problem, and always be able to reset the alarm. Without this profile, the vent would have to mount on the back of my chair and I would require someone with me all the time. As it is, I am able to be by myself for major periods while my wife is at work (she works within 90 seconds of our home if I were to need her in an emergency).

"The least favorite feature is the way the low-battery power alarm goes off. It begins to signal low power when the battery is only about at 50% and then continues to go off every 90 seconds or so for an hour or more. It will then go quiet until the external battery fails and the internal battery takes over. I would prefer ONE warning at 50%, probably a warning at 10%, and the warning at fail over. While this is a real nuisance and sometimes very embarrassing, it doesn't quite overshadow my most favorite feature."
–LK, Minnesota

"I use the LTV®950 on my power chair. I prefer to be able to operate ventilator controls myself, but with this ventilator I just barely am able to do so. The ON/OFF control requires you to push down and hold for several seconds. Also true for many other controls which is difficult if you have weak hand muscles.

"The alarm level sound is adjustable which is great. The LTV®950 has so many features that it's almost overwhelming to learn how to run it at first.

"Circuits are a tad too long and more involved to clean. I'm told valves cannot be immersed in water.

"I find the breath it delivers a little jerky, but nothing too bad. The adaptor for the car's cigarette lighter is easy to use, and the charger unit is compact.

"The most favorite feature is its size and weight. It takes up considerably less space on the back of my wheelchair and of course is super for travel.

"Least favorite feature is the noise level at which it operates. The noise level is very loud compared to the PLV®-102b." *–IG, Minnesota*

"The small size and portability of the LTV®950 are extremely important features for an active vent user who travels frequently. The small lightweight 'flatpack' batteries are a brilliant solution to the problem of powering the unit when you're on the move and don't have access to electrical outlets. The air delivery is sophisticated and comfortable, seeming to sense what you need and readily adjust to changing breathing requirements. I fall asleep instantly with the LTV®950, and the noise of its turbine-driven operation does not bother me at all during the night.

"The multi-modal operation of the LTV®950 is definitely an asset for the person who requires the regularity and consistency of pressure ventilation at night but during the day uses intermittent volume ventilation to assist and augment regular respiration and periodically take deeper breaths. This is especially helpful during a respiratory infection.

"During daytime use, however, the noise is definitely a problem. It interferes with conversation and prevents use of my speaker phone – a dangerous safety issue when one is alone and dependent on the phone as a lifeline. Another problem is the excessive and clinically obvious tubing, which seems strangely contradictory to the non-ICU look of the LTV®950 motor unit itself – especially when it's in its backpack. Perhaps it is possible to re-engineer the tubing so as to make it less cumbersome, more cosmetic and easier to handle.

"The alarms are adjustable, and you can even turn them off, as I did during the day so I could use the volume mode intermittently.

"Most favorite features are the size, portability and natural feeling/comfort of the pressure ventilation mode. Least favorite are the noise and cumbersome, excessive tubing." *–AK, Canada*

"I have been using the LTV®950 for about six years. While this vent may not suit everyone, I think it is terrific. The main reason is size. I have the vent hung under the arm of my chair where I can access it and read and correct alarms. In this way, I can remain independent, only calling for help when and if it is really needed.

“Some complain about the noise, but the noise doesn’t bother me in the least. I do admit that it is a bit louder than the LP10 I used as a backup vent for a number of years. But that vent doesn’t allow the needed independence."
–LK, Minnesota

"We use a Pulmonetic LTV®950, and it's far less noisy than the old LP10, except for a person sitting right next to the user. Then, I find it's hard to hear over the vent sometimes. Other than that, I have nothing but good things to say about the LTV." *–DC, Canada*

LTV®1000

"I have been using the LTV®1000 for about five and a half years. I have had very little trouble with it, and it has met all my needs. Breathing with the vent feels very smooth and natural.

"The sound of the ventilator is similar to white noise. It is a constant, low noise with a slight increase with each breath. Most of the time I don't even notice the sound. It doesn't seem to annoy others when I am out and about.

"The maintenance of the LTV®1000 is easy. For the bedside vent, I use disposable circuits that are changed weekly. For the vent on my wheelchair,

I use the reusable circuits that we clean weekly. The filters are easy to clean and change.

"The stand for the vent at bedside is sturdy and easy to move about. We occasionally use the adapter for the car's cigarette lighter when going on long trips to save the external battery. All the connections to use the external batteries, adapter for car, and electrical power are easy to use and switch from one to another.

"The alarms work well and are easy to reset. There is a message that tells you why the vent is alarming. I have not had any problems with it alarming unnecessarily.

"The thing I like best about the LTV is the size. It fits nicely against the seat back of my wheelchair and does not interfere in any way with my ability to get around and go places.

"The thing that we have had the most difficulty with is the length of time I am able to get with the external batteries. I am usually up in my wheelchair for about 15 hours a day. I have to replace the external batteries on a fairly regular basis because over time they don't seem to hold the charge. I am very active and don't like to have to plug into an electrical source while I am in my chair so the external batteries are very important to me.

“I have been trached and vented, 24/7, for the past eight years. I have used the Pulmonetics LTV®1000 and have had great success with this vent. I haven’t used anything else so I can’t compare the differences. I have one vent that is attached to the back of my wheelchair and two external batteries to power it during the day. I am usually up in my chair for about 16 hours. At night I have a vent by my bed and powered by electricity with a backup battery in case of power failure. During the night the external batteries on my chair are charged so that they are ready for my next day." *–BW, Maine*

"I used the LTV®1000 and still would be except for the short battery life, in spite of the added three hours with the lithium back-up external battery. In addition, I found it virtually impossible to make any setting changes myself, as did a nurse who also tried." *–CT, Texas*

Trilogy100

"The Trilogy100 is smaller, more portable, and has much better batteries. I use it about 15 hours a day. It’s mounted on the back of my wheelchair, small enough to look like a backpack. The Trilogy 100’s operation is a little bit different from a user’s standpoint. Instead of delivering a constant amount of air, it monitors the volume and adjusts it so that the user gets the correct tidal volume when averaged over time. Another plus is the alarm -- it’s not nearly as annoying as the PLV’s. It does tweedle (my term!) with different problems, but the alarm resets itself after a short while. The only downside is that it clicks on every breath.” *–CE, California*

Ventilators for infants and children

The choice of a ventilation system in infants and children involves several factors such as the child's age; degree of respiratory impairment; need for positive end expiratory pressure (PEEP), pressure support, and higher respiratory rates; and the resources and support systems at home.

Infants who are born prematurely often need a ventilator to help them breathe while in the Neonatal Intensive Care Unit (NICU). Others may have progressive and severe muscle weakness or severe aspiration that caused lung injury. These children usually require a tracheostomy to establish an artificial airway and to protect their developing airways.

Children's ventilatory needs can vary from full respiratory support to partial respiratory support with some ventilator-free time. In children who can initiate a breath and only require night-time support, the use of noninvasive ventilation is increasing. Popular ventilators for pediatric use in the USA include LP10, Achieva®, PLV®-100, the LTV® series, HT50®, and TBird® Legacy; in the UK and Europe, the Nippy Junior and Neftis and Neftis 2 are popular. In many developing countries, bilevel ventilators are often the only ventilators that are affordable and available for use.

KEY:
❶ = available only in USA ❷ = available only outside USA ❸ = available worldwide

The following equipment specifications are for combination ventilators currently on the markets. There is no "standard" form for specifications. American and European manufacturers differ in the technical information that they provide about their products. Alarms must be a certain volume. Minimum and maximum alarm volume is regulated.

Nippy Junior +

B & D Electromedical, www.nippyventilator.com ❷

For infants and children over 10 lbs.

Mode:	Pressure control, pressure support, CPAP, IPPV (NIV and tracheostomy)
Pressure range:	3-30 cm H_2O IPAP; 3-20 cm H_2O EPAP
BPM:	6-60
AC voltage:	100-240 V, 50-60 Hz, no internal battery
External battery:	24 V, 2- to 8-hour portable, 4-12 hours
Dimensions:	30 L x 22 W x 13 H cm
Weight:	4.5 kg
Alarms:	Low/high pressure, disconnect, flat/low battery, power failure

Which method and ventilator should be used?

The choice of ventilator can be made by an individual's primary physician, or the primary physician may make a referral to a pulmonologist (also known as a respirologist) who specializes in breathing-related disorders and lung conditions, and often sleep medicine. Some physical medicine and rehabilitation physicians, known as physiatrists, and some neurologists may also specialize in breathing disorders. In some countries only a pulmonologist can prescribe a ventilator.

After careful evaluation and pulmonary function tests to assess breathing and lung function and capacity (and sometimes a sleep study), the physician recommends a type of ventilator and appropriate interfaces. Individuals who need to use ventilation only at night have different equipment requirements than those who need to use a ventilator around the clock. Sometimes an individual may not be comfortable with a specific ventilator or interface and may need to change the ventilator or interface in order to find the most comfortable and effective system.

Some ventilator users combine different methods and ventilators and alternate them, such as using mouthpiece intermittent positive pressure during the day and then a nasal mask at night.

What if something goes wrong with the ventilator?

Ventilator users and their caregivers must be prepared for equipment failure, disconnects, and power outages, especially if using 24-hour ventilation, in which case a backup ventilator is prudent. Practicing regular safety drills helps prepare for emergencies. Keeping a manual resuscitator, such as an Ambu® bag, handy at all times is strongly advised.

Where do I find information about ventilator safety and reported incidents?

The FDA maintains a database for reports of problems with medical equipment, including ventilators, that is updated quarterly. www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfMAUDE/search.cfm.

Home ventilator manufacturers in USA

CareFusion
www.carefusion.com

Dräger Medical, Inc.
www.draeger.com

Impact Instrumentation, Inc.
www.impactinstrumentation.com

Newport Medical Instruments
www.ventilators.com

Philips Respironics
www.respironics.com

Porta-Lung, Inc.
www.porta-lung.com

Pulmonetic Systems, Inc.
Division of CareFusion
www.carefusion.com

Puritan Bennett
Division of Covidien Ltd.
www.puritanbennett.com

ResMed Corp.
www.resmed.com

VersaMed, Inc.
Division of GE Healthcare
www.versamed.net

Home ventilator manufacturers outside USA

Air Liquide Medical Systems, S.A.
www.airliquidemedicalsystems.com

B & D Electromedical
www.nippyventilator.com

BREAS Medical AB
Division of GE Healthcare
www.breas.com

Dima Italia S.r.l.
www.dimaitalia.com

Dräger Medical, Inc.
www.draeger.com

Officine Coppa, S.r.l.
www.coppabiella.it

ResMed Corp.
www.resmed.com

Siare Engineering International Group, S.r.l.
www.siare.it

United Hayek Medical
www.unitedhayek.com

Weinmann GmbH & Co. KG
www.weinmann.de

IVUN
International Ventilator Users Network

An affiliate of Post-Polio Health International (PHI)

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