

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

©Copyright 2017 Post-Polio Health International (PHI). All rights reserved.

No part of this publication may be reproduced or transmitted in any form without permission in writing from the publisher.

## 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<sub>2</sub>) and carbon dioxide (CO<sub>2</sub>) 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<sub>2</sub> diffuses into the blood and CO<sub>2</sub> 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 by the use of manual techniques such as lung volume recruitment and breath-stacking and/or mechanical devices such as the CoughAssist®.

## 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.

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 smaller and more mobile version of the iron lung that is still used by a small number of people.

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:

① = available only in USA   ② = available only outside USA   ③ = available worldwide

### Hayek RTX (Biphasic cuirass ventilation)

United Hayek Medical, [www.unitedhayek.com](http://www.unitedhayek.com) ③

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<sub>2</sub>O  
Maximum expiratory pressure: +50 cm H<sub>2</sub>O  
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

### Pegaso V

Dima Italia S.r.l., [www.dimaitalia.com](http://www.dimaitalia.com) ②

Rate:                         5-50 CPM  
Negative pressure:        Variable from -5 to -99 cm H<sub>2</sub>O  
Positive/negative  
  pressure E:                Variable from +99 to -25 cm H<sub>2</sub>O  
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](http://www.porta-lung.com)

(Discontinued; still in use; repairs available)

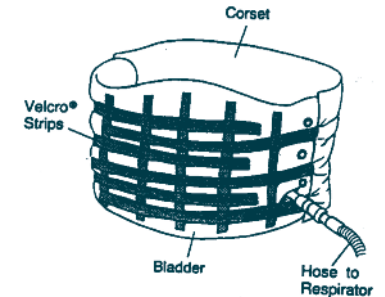
Breathing rate:            4-60 BPM  
Pressure:                    -60 to +20 cm H<sub>2</sub>O  
Sizes:                        X-small, small, medium and large  
AC voltage:                 120 VAC  
External battery:           12 VDC  
Weight:                      72 lbs-138 lbs  
Alarms:                      Low pressure

## 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 alternately 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 should not be used at night in the supine position. The pneumobelt is powered by a volume or combination/multi-mode ventilator. It is available as needed from Philips Respironics. Contact the area representative.

An exsufflation belt is also made in Italy by Dima Italia S.r.l. The LunaBelt (a device) applies IAPV (Intermittent Abdominal Pressure Ventilation) through the use of a defined corset “exsufflation belt” which is available in four sizes.



## 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, and combination/multi-mode 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) provides a continuous flow of air at a constant pressure for both inhalation and exhalation to keep the airway open during sleep. It is the standard of treatment for obstructive sleep apnea, during which the muscles of the throat collapse and block the airway. Auto-titrating CPAP units or APAPs deliver varying pressures based on the detection of sleep-disordered breathing events; the pressure can change breath-by-breath. A nasal or facial mask, connected by tubing to the CPAP unit, is worn during the night.

## What is a bilevel positive airway pressure ventilator?

Bilevel ventilators were developed by modifying CPAP so that both inspiratory positive airway pressure (IPAP) and expiratory positive airway pressure (EPAP) could be delivered. The IPAP/EPAP settings can be adjusted separately.

People with neuromuscular disorders and weak diaphragmatic muscles may have difficulty breathing in and may need IPAP set higher than EPAP, e.g. IPAP of 14, 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. BiPAP® was the name patented and registered by Respironics, Inc., and many bilevels have been incorrectly referred to as BiPAPs.

Bilevels are used primarily during the night with a noninvasive facial, nasal or oral mask, or nasal pillows. Some people use their bilevels continuously, but in the USA, the FDA has not approved them for 24-hour use in the home. They are also not approved for use by people who have tracheostomies.

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

Some physicians prescribe them for infants and children, particularly in developing countries because the bilevel ventilators are more affordable and available than volume, pressure, or combination/multi-mode ventilators.

The bilevel modes are:

- “S” for spontaneous breathing patterns that the unit senses and then switches between prescribed pressures.
- “T” for timed breaths that are delivered at a preset rate.
- “S/T” for spontaneous/timed. The unit switches to a timed mode (also known as a backup rate) when breaths are not spontaneously initiated by the individual. People with neuromuscular disorders should use a bilevel ventilator with a backup rate so that breaths are initiated for them.

The advantages of bilevel ventilators are: small size, light weight and portability, lower cost, and compensation for leaks from masks. Disadvantages include lack of internal batteries, no or few alarms, inadequate pressures for some people, higher electricity operating costs, and discomfort from EPAP. Many of the combination/multi-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.

KEY: ① = available only in USA ② = available only outside USA ③ = available worldwide

Bilevel Positive Airway Pressure Ventilators	Mode	IPAP	EPAP/CPAP	Breath Rate	Trigger/Tidal Volume	AC Voltage	Battery	Dimensions	Weight	Noise	Alarms	Humidifier = H Oxygen = O
<b>BiLevel ST 22</b> Löwenstein Medical <a href="https://loewensteinmedical.de/en/produkt-kategorie-ventilation">https://loewensteinmedical.de/en/produkt-kategorie-ventilation</a> ② 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: Ventipower	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 Venticlick O Venti-O2
<b>BiPAP A30</b> Philips Respironics <a href="http://healthcare.philips.com/main/homehealth/respiratory_care/bipapa30">http://healthcare.philips.com/main/homehealth/respiratory_care/bipapa30</a> ②	CPAP, spontaneous, timed, spontaneous/timed, pressure control	4-30 cm H <sub>2</sub> O	4-25 cm H <sub>2</sub> O	0-40 BPM (4-40 BPM in T mode)	200-1500 ml	100-240 V, 50/60 Hz	12-24 VDC	21.6 cm W x 19 cm L x 11.5 cm H	2.1 kg (with power supply)	<30 dB	Apnea, circuit disconnect, high respiratory rate, low minute ventilation, low tidal volume	H - integrated

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

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

Bilevel Positive Airway Pressure Ventilators	Mode	IPAP	EPAP/CPAP	Breath Rate	Trigger/Tidal Volume	AC Voltage	Battery	Dimensions	Weight	Noise	Alarms	Humidifier = H Oxygen = O
<b>BiPAP A40</b> Philips Respironics <a href="http://www.usa.philips.com/healthcare/">www.usa.philips.com/healthcare/</a> ❷	CPAP, spontaneous, timed, spontaneous/timed, pressure control, AVAPS-AE	4-40 cm H <sub>2</sub> O	4-25 cm H <sub>2</sub> O	0-40 BPM (4-40 BPM in T mode)	200-1500 ml, flow trigger, auto-trak	100-240 V, 50/60 Hz	12 VDC detachable external up to 5 hrs; 24 VDC power supply	21.6 cm W x 19 cm L x 11.5 cm H	2.1 kg (with power supply)	<30 dB	Apnea, low minute ventilation, low tidal volume (with AVAPS/AVAPS-AE only), high respiratory rate, leak, mask disconnect	H
<b>BiPAP AVAPS (Average Volume-Assured Pressure Support)</b> Philips Respironics <a href="http://www.usa.philips.com/healthcare/solutions/sleep-and-respiratory-care/ventilation">www.usa.philips.com/healthcare/solutions/sleep-and-respiratory-care/ventilation</a> ❸  <i>Pediatric use</i>	CPAP, spontaneous, timed, spontaneous/timed, pressure control, average volume-assured ventilator pressure support	4-25 cm H <sub>2</sub> O	4-25 cm H <sub>2</sub> O CPAP: 4-20 cm H <sub>2</sub> O	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
<b>BiPAP Harmony</b> Philips Respironics <a href="http://www.usa.philips.com/healthcare/">www.usa.philips.com/healthcare/</a> ❷	Spontaneous, spontaneous/timed, CPAP	4-30 cm H <sub>2</sub> O	4-25 cm H <sub>2</sub> O CPAP: 4-20 cm H <sub>2</sub> O	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
<b>BiPAP S/T</b> Philips Respironics <a href="http://www.usa.philips.com/healthcare/solutions/sleep-and-respiratory-care/ventilation">www.usa.philips.com/healthcare/solutions/sleep-and-respiratory-care/ventilation</a> ❸  <i>Pediatric use</i>	Spontaneous, spontaneous/timed, CPAP	4-25 cm H <sub>2</sub> O	4-25 cm H <sub>2</sub> O CPAP: 4-20 cm H <sub>2</sub> O	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 battery, power failure	H
<b>BiPAP Synchrony</b> Philips Respironics <a href="http://www.usa.philips.com/healthcare/">www.usa.philips.com/healthcare/</a> ❷	Spontaneous, timed, spontaneous/timed, CPAP, pressure control	4-30 cm H <sub>2</sub> O	4-25 cm H <sub>2</sub> O CPAP: 4-200 cm H <sub>2</sub> O	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

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

KEY: ① = available only in USA ② = available only outside USA ③ = available worldwide

Bilevel Positive Airway Pressure Ventilators (continued)	Mode	IPAP	EPAP/CPAP	Breath Rate	Trigger/Tidal Volume	AC Voltage	Battery	Dimensions	Weight	Noise	Alarms	Humidifier = H Oxygen = O
<b>DreamStation BiPAP AVAPS</b> (Average Volume-Assured Pressure Support) Philips Respironics <a href="http://www.usa.philips.com/healthcare/solutions/sleep-and-respiratory-care/ventilation">www.usa.philips.com/healthcare/solutions/sleep-and-respiratory-care/ventilation</a> ③	CPAP, Spontaneous, spontaneous/timed, Timed, Pressure assist control	6-30 cm H <sub>2</sub> O	4-30 cm H <sub>2</sub> O Max 20 cm H <sub>2</sub> O	1-30 BPM	200-1500 ml per breath (increment is 10 ml)	100-240 V, 50/60 Hz	No Internal	15.7 x 19.3 x 8.4 cm 29.7 x 19.3 x 8.4 m with humidifier	1.33 kg, 2.94 lbs 1.98 kg, 4.37 lbs with humidifier	n/a	Low/high pressure; low/high rate/ low/high inspired tidal volume; apnea; malfunction; low internal battery; power failure	H optional
<b>Falco 51</b> Siare Engineering International Group, S.r.l. <a href="http://www.siare.it">www.siare.it</a> ②	Spontaneous, spontaneous/timed, CPAP	6-40 cm H <sub>2</sub> O	0-20 cm H <sub>2</sub> O	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
<b>iSleep™ 25</b> BREAS Medical AB <a href="http://www.breas.com">www.breas.com</a> ②	Spontaneous, CPAP, spontaneous/timed, pressure assist control	4-25 cm H <sub>2</sub> O	4-20 cm H <sub>2</sub> O	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
<b>Monnal T30</b> Air Liquide Medical Systems, Inc. <a href="http://www.device.airliquidehealthcare.com">www.device.airliquidehealthcare.com</a> ②	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

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

KEY: ① = available only in USA ② = available only outside USA ③ = available worldwide

Bilevel Positive Airway Pressure Ventilators (continued)	Mode	IPAP	EPAP/CPAP	Breath Rate	Trigger/Tidal Volume	AC Voltage	Battery	Dimensions	Weight	Noise	Alarms	Humidifier = H Oxygen = O
<b>Multilevel ST-30</b> <b>Multilevel ST-30V</b> <b>Multilevel ST-40V</b> Dima Italia S.r.l. <a href="http://www.dimaitalia.com">www.dimaitalia.com</a> ②	CPAP, Spontaneous, spontaneous/timed, Timed, SP	3-30 cm H <sub>2</sub> O (3-40 cm H <sub>2</sub> O for ST-40V)	0-25 cm H <sub>2</sub> O	5-60 BPM	1-9 autotrack Target volume (ST-30V and ST-40V only): 100-1500 cc/cycle	100-240 V, 50/60 Hz	No Internal External: 50 V	18 cm W x 14 cm D x 19 cm H	1.5 kg	<25 dBA	Apnea, leak/mask disconnect, high respiratory rate, high/low inspiratory pressure, high expiratory rate, low tidal volume, empty battery, malfunction, power failure	
<b>Nippy™ S+</b> B&D Electromedical (now part of BREAS) <a href="http://www.nippyventilator.com">www.nippyventilator.com</a> ②	Pressure support	3-38 cm H <sub>2</sub> O	3-20 cm H <sub>2</sub> O	Fixed Backup 12 BPM	.7-3.0 sec 1-10 inspiratory 1-10 expiratory	100-240 VAC	Internal 4-12 hrs External: 4-12 hrs	297 mm x 223 mm x 132 mm	3.6 kg 4.5 kg with ext. battery		Mask off, power failure	
<b>Nippy™ ST+</b> B&D Electromedical (now part of BREAS) <a href="http://www.nippyventilator.com">www.nippyventilator.com</a> ②	CPAP, pressure support	3-38 cm H <sub>2</sub> O	3-20 cm H <sub>2</sub> O	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	
<b>Puritan Bennett™ Smartair ST</b> Medtronic <a href="http://www.medtronic.com/covidien">www.medtronic.com/covidien</a> ②  <i>Discontinued; serviced through May 2015</i>	Spontaneous, spontaneous/timed, CPAP pressure control	5-30 mbar	4-20 mbar CPAP: 5-25 mbar	4-40 BPM	5 inspiratory, 200 L/min	115-230 V, 50/60 Hz	No internal	200 x 125 x 290 mm	2.7 kg	<30 dB	Optional low pressure, mask leak	
<b>SOMNOvent ST</b> Löwenstein Medical <a href="https://loewensteinmedical.de/en/produkt-kategorie-ventilation">https://loewensteinmedical.de/en/produkt-kategorie-ventilation</a> ②	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 external battery, power failure	H, O
<b>VENTImotion 2</b> Löwenstein Medical <a href="https://loewensteinmedical.de/en/produkt-kategorie-ventilation">https://loewensteinmedical.de/en/produkt-kategorie-ventilation</a> ②	Timed, timed/spontaneous, timed adaptive, CPAP	6-40 hPa	4-20 hPa	6-45 L/m	6 inspiratory 6 expiratory  285 L/m	115-230 V, 50/60 Hz	No internal External: VENTIpower, 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

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

KEY: ① = available only in USA ② = available only outside USA ③ = available worldwide

Bilevel Positive Airway Pressure Ventilators (continued)	Mode	IPAP	EPAP/CPAP	Breath Rate	Trigger/Tidal Volume	AC Voltage	Battery	Dimensions	Weight	Noise	Alarms	Humidifier = H Oxygen = O
<b>VPAP™ COPD</b> ResMed www.resmed.com ③	Spontaneous, CPAP	4-30 cm H <sub>2</sub> O	3-25 cm H <sub>2</sub> O		5 trigger settings	100-240 V, 50/60 Hz	No internal External: 24 VDC	153 mm L x 172 mm W x 86 mm H	1.04 kg		Low SpO <sub>2</sub> , low minute ventilation, apnea, high leak, non-vented mask, circuit occlusion/disconnect, malfunction, power failure	H, O
<b>VPAP™ ST (S7)</b> ResMed www.resmed.com ③ <i>Discontinued in USA &amp; Canada</i>	Spontaneous, timed, spontaneous/timed, CPAP	4-25 cm H <sub>2</sub> O	3-25 cm H <sub>2</sub> O CPAP: 4-20 cm H <sub>2</sub> O	5-30 BPM	Flow 5 inspiratory 5 expiratory	100-240 V, 50/60 Hz	No internal External: 24 VDC	112 L x 145 H x 164 W mm	1.3 kg	<26 dB	Mask off, leak	H
<b>VPAP™ ST-A with iVAPS (S9)</b> (intelligent Average Volume Assured Pressure Support) ResMed www.resmed.com ③ <i>Pediatric use &gt; 13 kg</i> <i>Discontinued</i>	Spontaneous, spontaneous/timed, CPAP, pressure assist control, intelligent volume-assured pressure support	3-30 cm H <sub>2</sub> O	3-25 cm H <sub>2</sub> O CPAP: 4-20 cm H <sub>2</sub> O	5-50 BPM	5 trigger settings 5 inspiratory 5 expiratory	100-240 V, 50/60 Hz	No internal External: 24 VDC	153 mm L x 172 mm W x 86 mm H; 6" L x 6.8" W x 3.4" H	2.3 lbs, 1.045 kg	<26 dB	Power failure, block tube, tube disconnect, high leak, non-vented mask, low minute volume, apnea, low SpO <sub>2</sub>	H
<b>VPAP™ III ST-A (S7)</b> ResMed www.resmed.com ③ <i>Discontinued in USA &amp; Canada</i>	Spontaneous, timed, spontaneous/timed, CPAP	3-30 cm H <sub>2</sub> O	3-25 cm H <sub>2</sub> O CPAP: 4-20 cm H <sub>2</sub> O	5-30 BPM	Flow 3 inspiratory 3 expiratory	100-240 V, 50/60 Hz	No internal External: 24 VDC	270 L x 230 W x 141 mm H	2.3 kg		Power failure, over pressure, over use, mask alarm, low pressure, high pressure, low minute ventilation, non-vented mask	H
<b>VPAP™ III ST-A with QuickNav (S7)</b> ResMed www.resmed.com ② <i>Discontinued</i>	Spontaneous, timed, spontaneous/timed, CPAP	2-30 cm H <sub>2</sub> O	2-25 cm H <sub>2</sub> O CPAP: 4-20 cm H <sub>2</sub> O	5-30 BPM	3 sensitivity triggers; 50-3,000 mL	100-240 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, IPAP lower pressure, check tube, leak, non-vented, low minute ventilation, high pressure, low pressure	H
<b>VPAP™ IV ST</b> ResMed www.resmed.com ② <i>Discontinued</i>	Spontaneous, timed, spontaneous/timed, CPAP	4-25 cm H <sub>2</sub> O	2-25 cm H <sub>2</sub> O CPAP: 4-20 cm H <sub>2</sub> O	5-30 BPM	5 levels. 170 L/min max. flow	100-240 V, 50/60 Hz	No internal External: 24 VDC	112 mm L x 164 mm W x 145 mm H	1.3 kg	<28 dB	None	H, O



## What is a volume-cycled ventilator?

Volume-cycled ventilators deliver a preset volume of air in a constant flow during inspiration. Volume ventilators can deliver higher volumes and pressures than bilevel units; 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.*

KEY: ① = available only in USA ② = available only outside USA ③ = available worldwide

Volume-cycled Ventilators	Mode	Tidal Volume	Inspiratory Flow Rate	Breath Rate	PEEP	Trigger	AC Voltage	Battery	Dimensions	Weight	Alarms	Humidifier = H Oxygen = O
<b>LTV®800</b> CareFusion <a href="http://www.carefusion.com/our-products/browse-brands/ltv">www.carefusion.com/our-products/browse-brands/ltv</a> Pediatric use > 5 kg <i>Discontinued; serviced through October 2016</i>	Spontaneous, control, assist/control, SIMV	50-2000 ml	10-100 LPM	0-80 BPM	0-20 cm H <sub>2</sub> O	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

**What is a volume-cycled ventilator?** (continued)

KEY: ① = available only in USA ② = available only outside USA ③ = available worldwide

Volume-cycled Ventilators	Mode	Tidal Volume	Inspiratory Flow Rate	Breath Rate	PEEP	Trigger	AC Voltage	Battery	Dimensions	Weight	Alarms	Humidifier = H Oxygen = O
<b>LTV®1100</b> CareFusion <a href="http://www.carefusion.com/our-products/browse-brands/ltv">www.carefusion.com/our-products/browse-brands/ltv</a> <i>Pediatric use &gt; 5 kg</i>	Volume; controlled, assist/controlled, SIMV; Pressure support: S, T, ST; CPAP	50-2000 ml	10-100 LPM	0-80 BPM	0-20 cm H <sub>2</sub> O; Internal	Flow-Off; 1-9 lpm	100-250 V, 50/60 Hz	Internal, up to 1 hr External: 11-15 VDC; SpringPack up to 6 hrs Automobile cigarette lighter adapter	10.5" W x 13.5" D x 3.25" H; 27 cm W x 38 cm D x 8.4 cm H	14.5 lbs, 6.5 kg	High pressure limit, high breath rate, low peak pressure, low minute volume, high/low PEEP, high/low O inlet pressure, apnea, disconnect, low/empty internal battery, malfunction, power failure	O
<b>PLV®-100</b> Philips Respironics <a href="http://www.usa.philips.com/healthcare/solutions/sleep-and-respiratory-care/ventilation">www.usa.philips.com/healthcare/solutions/sleep-and-respiratory-care/ventilation</a> ③ <i>Discontinued; serviced through 2014</i>	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
<b>PLV®-102</b> Philips Respironics <a href="http://www.usa.philips.com/healthcare/solutions/sleep-and-respiratory-care/ventilation">www.usa.philips.com/healthcare/solutions/sleep-and-respiratory-care/ventilation</a> ③ <i>Discontinued; serviced through 2014</i>	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 <sub>2</sub> O		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
<b>PLV®-102b</b> Philips Respironics <a href="http://www.usa.philips.com/healthcare/solutions/sleep-and-respiratory-care/ventilation">www.usa.philips.com/healthcare/solutions/sleep-and-respiratory-care/ventilation</a> ③ <i>Discontinued; serviced through 2014</i>	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 <sub>2</sub> O		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
<b>UniVent™ Eagle™ 754</b> ZOLL Medical Corporation <a href="http://www.zoll.com">www.zoll.com</a> ③ <i>Discontinued (2014); service as long as parts available</i>	Assist/control, SIMV, CPAP	0-3000 ml		1-150 BPM	1-20 cm H <sub>2</sub> O	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

## 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. Pressure control means that the ventilator, rather than the individual, controls the breathing rate. Pressure control maintains a preset inspiratory pressure.

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.

KEY: ① = available only in USA ② = available only outside USA ③ = available worldwide

Pressure Support Ventilators	Mode	Tidal Volume	Pressure Range	Breath Rate	IPAP, EPAP, PIP, PEEP	Trigger	AC Voltage	Battery	Dimensions	Weight	Alarms	Humidifier = H Oxygen = O
<b>Falco 101</b> Siare Engineering International Group, S.r.l. <a href="http://www.siare.it">www.siare.it</a> ②  <i>Pediatric use &gt;5 kg</i>	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 <sub>2</sub> O	5-50 BPM	EPAP/ PEEP: 0-20 cm H <sub>2</sub> O  IPAP: 6-40 cm H <sub>2</sub> O	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
<b>iVent™ 101 Performance</b> GE Healthcare <a href="http://www.gerespiratorycarecentral.com/home_care.php">www.gerespiratorycarecentral.com/home_care.php</a> ③  <i>Pediatric use</i>	CPAP, PSV pressure support, Adaptive Bi-Level™, A/C assist/control in VCV volume-controlled or PCV pressure-controlled	40-2500 ml	3-60 cm H <sub>2</sub> O	1-80 BPM	PEEP: 0-45 cm H <sub>2</sub> O	Flow and pressure 9 levels	100-240 VAC, 50/60 Hz	Internal: up to 4 or 6 hrs  External: 24-28 VDC up to 10 hrs	7.5" H x 10" W x 10" D; 19 cm H x 25.5 cm W x 25.3 cm D	13.4 lbs; 6.1 kg	Low/high respiratory rate; apnea; low/high minute volume; low/high FiO <sub>2</sub> ; low/high pressure; leak/occlusion; set pressure or Vt not delivered; low O <sub>2</sub> pressure; disconnect; overheat; low/empty battery; battery charge; AC disconnect; battery failure; remote; power failure	O
<b>Multilevel VP</b> Dima Italia S.r.l. <a href="http://www.dimaitalia.com">www.dimaitalia.com</a> ②  <i>Pediatric use</i>	Control, Assist/control, pressure control, pressure support, SIMV	10 cc - 2500 cc		5-99 BPM	IPAP: 3-60 cm H <sub>2</sub> O EPAP: 0-15 cm H <sub>2</sub> O 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

**What is a pressure support ventilator?** (continued)

KEY: ① = available only in USA ② = available only outside USA ③ = available worldwide

Pressure Support Ventilators	Mode	Tidal Volume	Pressure Range	Breath Rate	IPAP, EPAP, PIP, PEEP	Trigger	AC Voltage	Battery	Dimensions	Weight	Alarms	Humidifier = H Oxygen = O
<b>Nippy 3+</b> B&D Electromedical (now part of BREAS) <a href="http://www.nippyventilator.com">www.nippyventilator.com</a> ②	Pressure control, pressure support, IPPV, CPAP		0-30 cm H <sub>2</sub> O	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	
<b>Nippy Junior+</b> B&D Electromedical (now part of BREAS) <a href="http://www.nippyventilator.com">www.nippyventilator.com</a> ②  <i>Pediatric use</i>	CPAP, Pressure Support (PS), Pressure Control (PC), IPPV			6-60 BPM	IPAP: 3-30 cm H <sub>2</sub> O  EPAP: 3-20 cm H <sub>2</sub> O	Inspiratory: 1-10  Expiratory (PS only): 1-10	100-240 VAC	Internal: 4-12 hours autonomy dependent on settings and leak, 18.75 Vdc 116 Whr  External: 4-12 hours autonomy dependent on settings and leak, 18.75 Vdc 116 Whr	297 L x 223 W x 132 H mm	4.5 kg	Mask off, power failure, low flow, high flow	
<b>Puritan Bennett™ Smartair Plus</b> Medtronic <a href="http://www.medtronic.com/covidien/support/product-manuals">www.medtronic.com/covidien/support/product-manuals</a> ②  <i>Discontinued; serviced through May 2015</i>	Pressure control, pressure support, volume control, spontaneous, spontaneous/timed, CPAP	100-1250 ml	0-30 mbar	4-40 BPM in ST; 5-60 BPM in PC and AC	IPAP: 5-30 mbar EPAP: 0-20 mbar	Inspiratory: 1-5  Expiratory: -5 to -75%	115-230 V, 50/60 Hz	Internal, 2-5 hrs  External: 24 V	200 x 125 x 290 mm	3.2 kg	Low/high pressure, low/high tidal volume, maximum rate, apnea, disconnect	O
<b>Puritan Bennett™ 520</b> Medtronic <a href="http://www.medtronic.com/covidien/support/product-manuals">www.medtronic.com/covidien/support/product-manuals</a> ②  <i>Pediatric use &gt;5 kg</i>	CPAP, pressure support, pressure assist/control	50-2000 ml	5-55 mbar	1-60 BPM	PIP & PEEP: 0-99 mbar	Inspiratory: 1-5  Expiratory: 5-95%	100-240 V, 50/60 Hz	Internal, <5 hrs  External: 12-30 VDC  Car adapter	23.5 cm W x 31.5 cm D x 15.4 cm H	4.5 kg	Apnea, high/low inspiratory tidal volume, high/low pressure, high breath rate, high/low battery temperature, leak/occlusion/patient disconnect, low/empty battery, unit overheat/malfunction, remote call, power failure	H, O

**What is a pressure support ventilator?** (continued)

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

Pressure Support Ventilators	Mode	Tidal Volume	Pressure Range	Breath Rate	IPAP, EPAP, PIP, PEEP	Trigger	AC Voltage	Battery	Dimensions	Weight	Alarms	Humidifier = H Oxygen = O
<p><b>PV 403 PEEP</b> BREAS Medical AB www.breas.com ❷</p> <p><i>Pediatric use</i></p> <p><i>Discontinued; service until February 2019; spare parts are sold</i></p>	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	
<p><b>Stellar™ 100</b> ResMed www.resmed.com www.stellar100.com ❸</p> <p><i>Pediatric use &gt;13 kg, 2 years old</i></p>	CPAP, S spontaneous, T timed, S/T spontaneous timed; pressure assist control	Maximum flow >200 L/min at 20 cm H <sub>2</sub> O		5-60 BPM	IPAP: 2-40 cm H <sub>2</sub> O EPAP: 2-25 cm H <sub>2</sub> O CPAP: 4-20 cm H <sub>2</sub> O	5 settings	100-240 V, 50/60 Hz	Internal, up to 2 hrs External: 24 VDC or ResMed Power Station II up to 8 hrs	230 mm L x 170 mm W x 120 mm H	2.1 kg	Apnea, high/low pressure, high/low respiratory rate, low minute ventilation, high leak, occlusion, circuit disconnect, non-vented mask, high/low FiO <sub>2</sub> , low SpO <sub>2</sub> , empty internal battery, external battery switchover, unit overheat/ malfunction, power failure	H4i™, O
<p><b>Stellar™ 150</b> ResMed www.resmed.com www.stellar150.com ❸</p> <p><i>Pediatric use &gt;13 kg, 2 years old</i></p>	CPAP, S spontaneous, T timed, S/T spontaneous timed; pressure assist control, iVAPS (intelligent volume assured pressure support)	Maximum flow >200 L/min at 20 cm H <sub>2</sub> O	2-4 cm H <sub>2</sub> O Targets minute ventilation	5-60 BPM	IPAP: 2-40 cm H <sub>2</sub> O EPAP: 2-25 cm H <sub>2</sub> O CPAP: 4-20 cm H <sub>2</sub> O	5 settings	100-240 V, 50/60 Hz	Internal, up to 2 hrs External: 24 VDC or ResMed Power Station II up to 8 hrs	230 mm L x 170 mm W x 120 mm H	2.1 kg	Apnea, high/low pressure, high/low respiratory rate, low minute ventilation, high leak, occlusion, circuit disconnect, non-vented mask, high/low FiO <sub>2</sub> , low SpO <sub>2</sub> , empty internal battery, external battery switchover, unit overheat/ malfunction, power failure	H4i™, O

**What is a pressure support ventilator?** (continued)

KEY: ① = available only in USA ② = available only outside USA ③ = available worldwide

Pressure Support Ventilators	Mode	Tidal Volume	Pressure Range	Breath Rate	IPAP, EPAP, PIP, PEEP	Trigger	AC Voltage	Battery	Dimensions	Weight	Alarms	Humidifier = H Oxygen = O
<b>Vivo® 30</b> BREAS Medical AB www.breas.com ③	Pressure support, pressure control, CPAP			4-40 BPM	IPAP: 4-30 cm H <sub>2</sub> O EPAP: 2-20 cm H <sub>2</sub> O	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
<b>Vivo® 40</b> BREAS Medical AB www.breas.com ③  <i>Pediatric use</i>	Pressure support, pressure control, CPAP, target volume	200-1500 ml		4-40 BPM	IPAP: 4-40 cm H <sub>2</sub> O EPAP: 2-20 cm H <sub>2</sub> O	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 & internal battery, low power, internal function failure	H
<b>VS Integra™</b> ResMed www.resmed.com ②  <i>Pediatric use</i>	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 <sub>2</sub> O EPAP: 4-20 cm H <sub>2</sub> O	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.

KEY: ① = available only in USA ② = available only outside USA ③ = available worldwide

Combination or Multi-Mode Ventilators	Mode	Tidal Volume	Pressure Range	Breath Rate	PEEP	Trigger/Circuits	AC Voltage	Battery	Dimensions	Weight	Alarms	Humidifier = H Oxygen = O
<b>Astral 100</b> ResMed <a href="http://www.resmed.com">www.resmed.com</a> ③  <i>Life Support for patients &gt;5 kg</i>	Volume and pressure; Valve circuit: CPAP, ACV, PACV, P-SIMV, V-SIMV, PS  Leak circuit therapy: CPAP, ST, PAC  2 preset programs	100-2500 ml, adult  50-300 ml, pediatric	2-50 cm H <sub>2</sub> O, leak circuit  0-50 cm of H <sub>2</sub> O, valve circuit	Off, 2-50 BPM, adult  Off, 5-80 BPM, pediatric	Off, 0-20 cm H <sub>2</sub> O	Single circuit with leak (Vsync)  Single circuit with valve (NIV+)  TiControl™  Adjustable trigger and cycle	AC 100-240V, 50-60Hz, 90 W 3.75 A continuous, 120 W / 5A peak  115V/400 Hz	Internal: Lithium-Ion battery, 14.4 V, 6.6 Ah, 95 Wh.  8 hr run time, rechargeable  External: Two external (8 hr each) batteries, rechargeable	285 mm x 215 mm x 93 mm	3.2 kg	Numerous, including Low-battery, Total power failure, Low/High Pressure, Obstruction, Low/high Resp rate, High leak, Low/High SpO <sub>2</sub> , Low/High FiO <sub>2</sub> , Ventilation not started/stopped, Circuit fault, Low/High PEEP, Pressure line disconnected	H, O
<b>Astral 150</b> ResMed <a href="http://www.resmed.com">www.resmed.com</a> ③  <i>Life Support for patients &gt;5 kg</i>	Volume and pressure  Valve circuit: CPAP, ACV, PACV, P-SIMV, V-SIMV, PS  Leak circuit therapy: CPAP, ST, PAC  Manual breath Sigh breath (recruitment)  4 preset programs	100-2500 ml, adult  50-300 ml, pediatric	2-50 cm H <sub>2</sub> O, leak circuit  0-50 cm of H <sub>2</sub> O, valve circuit	Off, 2-50 BPM, adult  Off, 5-80 BPM, pediatric	Off, 0-20 cm H <sub>2</sub> O	Single circuit with leak  Single circuit with valve  Double circuit	AC 100-240V, 50-60Hz, 90 W 3.75 A continuous, 120 W / 5A peak  115V/400 Hz	Internal: Lithium-Ion battery, 14.4 V, 6.6 Ah, 95 Wh.  8 hr run time, rechargeable  External: Two external (8 hr each) batteries, rechargeable	285 mm x 215 mm x 93 mm	3.2 kg	Numerous, including Low-battery, Total power failure, Low/High Pressure, Obstruction, Low/high Resp rate, High leak, Low/High SpO <sub>2</sub> , Low/High FiO <sub>2</sub> , Ventilation not started/stopped, Circuit fault, Low/High PEEP, Pressure line disconnected	H, O

**What is a combination or multi-mode ventilator?** (continued)

KEY: ① = available only in USA ② = available only outside USA ③ = available worldwide

Combination or Multi-Mode Ventilators	Mode	Tidal Volume	Pressure Range	Breath Rate	PEEP	Trigger/Circuits	AC Voltage	Battery	Dimensions	Weight	Alarms	Humidifier = H Oxygen = O
<b>ATHENA</b> Dima Italia S.r.l. www.dimaitalia.com ②  <i>Pediatric use</i>	Volume: controlled, assist/controlled, SIMV; Pressure: controlled, assist/control, SIMV, support -S, T, ST; CPAP	10 cc-2500 cc	3-60 cm H <sub>2</sub> O	5-60 BPM	0-25 cm H <sub>2</sub> O	9 inspiratory and Auto Track; 10-90% expiratory	100-240 V, 50/60 Hz	Internal, up to 12 hrs Rechargeable	240 mm W x 290 mm D x 180 mm H	3.5 kg	High/low inspiratory, high expiratory pressure, high/low breath rate, minimum volume guarantee, low expiratory volume, high/low FiO <sub>2</sub> , high/low SpO <sub>2</sub> , high/low pulse rate, low battery, power failure	O
<b>Elisée 150™</b> ResMed www.resmed.com ②  <i>Pediatric use</i>	Assist/control in volume, assist pressure control, SIMV, IPPV, pressure support with backup, pressure support with tidal volume	50-500 ml, pediatric 300-2500 ml, adult	3-40 cm H <sub>2</sub> O, pediatric 5-60 cm H <sub>2</sub> O, adult	2-80 BPM, pediatric 2-50 BPM, adult	0-20 cm H <sub>2</sub> O, 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 dependent on internal 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
<b>Falco 202</b> Siare Engineering International Group, S.r.l. www.siare.it ②  <i>Pediatric use &gt;5 kg</i>	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 <sub>2</sub> O	5-50 BPM	0-20 cm H <sub>2</sub> O	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
<b>Falco 202 New</b> Siare Engineering International Group, S.r.l. www.siare.it ②	Pressure; CPAP; pressure control - assist control; pressure support with guaranteed tidal volume; volume: assist control; APCV; V-SIMV+PS; P-SIMV+PS	50-3000 ml	2-80 cm H <sub>2</sub> O	4-80 BPM	Off, 2-50 cm H <sub>2</sub> O	Pressure: .1-20 cm H <sub>2</sub> O, Flow: .3-152/min	100-240 V, 50/60 Hz	Integrated External optional	240 L x 245 D x 215 mm	5.5 kg		O



**What is a combination or multi-mode ventilator?** (continued)

KEY: ① = available only in USA ② = available only outside USA ③ = available worldwide

<b>Combination or Multi-Mode Ventilators</b> (continued)	Mode	Tidal Volume	Pressure Range	Breath Rate	PEEP/CPAP	Trigger	AC Voltage	Battery	Dimensions	Weight	Alarms	Humidifier = H Oxygen = O
<b>Flight 60®</b> Flight Medical Innovations, Ltd. <a href="http://www.flight-medical.com">www.flight-medical.com</a> ③  <i>Pediatric use</i>	Volume control, assist/control, SIMV, pressure control, pressure support, spontaneous, CPAP/BiPAP, target tidal volume	30-2,200 ml	0-60 cm H <sub>2</sub> O	1-99 BPM	3-30 cm H <sub>2</sub> O	Pressure - 9.9 to -0.1 cm H <sub>2</sub> O, Flow 1-10 LPM	100-240 V, 50/60 Hz	Internal: up to 12 hrs, rechargeable  External: 12-30 VDC	29 cm W x 28 cm D x 25 cm H	6.3 kg	High/low pressure, high/low minute ventilation, high/low FiO <sub>2</sub> , apnea, low/empty battery, power failure, high respiratory rate, low tidal volume	O
<b>Flight 60® i O2</b> Flight Medical Innovations, Ltd. <a href="http://www.flight-medical.com">www.flight-medical.com</a> ③	Advanced pressure, volume, PRVC, ARPV	30-2,200 ml	5-80 cm H <sub>2</sub> O	1-99 BPM	0-40 cm H <sub>2</sub> O	Pressure - 20.0 to -0.1 cm H <sub>2</sub> O, Flow 1-20 LPM	100-240 V, 50/60 Hz	Internal: up to 12 hrs, Hot Swappable	29 cm W x 28 cm D x 25 cm H	6.3 kg, 6.9 kg	High/low pressure, high/low minute ventilation, high/low FiO <sub>2</sub> , apnea, low/empty battery, power failure, high respiratory rate, low tidal volume, check circuit, O <sub>2</sub> supply failed, check O <sub>2</sub> , target volume not reached	O
<b>iVent 101™ Expert</b> GE Healthcare <a href="http://www.gerespiratorycarecentral.com/home_care.php">www.gerespiratorycarecentral.com/home_care.php</a> ③  <i>Pediatric use</i>	CPAP, PSV pressure support, Adaptive Bi-Level™, A/C assist/control in VCV volume-controlled or PCV pressure-controlled or PRVC pressure regulated volume control; SIMV in VCV, PCV, or PRVC	40-2,500 ml	3-60 cm H <sub>2</sub> O	1-80 BPM	0-45 cm H <sub>2</sub> O	Flow and pressure 9 levels	100-240 VAC, 50/60 Hz	Internal, up to 4 or 6 hrs  External: 24-28 VDC up to 10 hrs	7.5" H x 10" W x 10" D; 19 cm H x 25.5 cm W x 25.3 cm D	13.4 lbs; 6.1 kg	Low/high respiratory rate; apnea; low/high minute volume; low/high FiO <sub>2</sub> ; low/high pressure; leak/occlusion; set pressure or Vt not delivered; low O <sub>2</sub> pressure; disconnect; overheat; low/empty battery; battery charge; AC disconnect; battery failure; remote; power failure	O

**What is a combination or multi-mode ventilator?** (continued)

KEY: ① = available only in USA ② = available only outside USA ③ = available worldwide

<b>Combination or Multi-Mode Ventilators</b> (continued)	Mode	Tidal Volume	Pressure Range	Breath Rate	PEEP	Trigger	AC Voltage	Battery	Dimensions	Weight	Alarms	Humidifier = H Oxygen = O
<b>iVent 101™ Signature</b> GE Healthcare <a href="http://www.gehealthcare.com/respiratorycare">www.gehealthcare.com/respiratorycare</a> ③  <i>Pediatric use</i>	CPAP, PSV pressure support, Adaptive Bi-Level™, A/C assist/control in VCV volume-controlled or PCV pressure-controlled; SIMV in VCV, PCV	40-2,500 ml	3-60 cm H <sub>2</sub> O	1-80 BPM	0-45 cm H <sub>2</sub> O	Flow and pressure 9 levels	100-240 VAC, 50/60 Hz	Internal, up to 4 or 6 hrs  External: 24-28 VDC up to 10 hrs	7.5" H x 10" W x 10" D; 19 cm H x 25.5 cm W x 25.3 cm D	13.4 lbs; 6.1 kg	Low/high respiratory rate; apnea; low/high minute volume; low/high FiO <sub>2</sub> ; low/high pressure; leak/occlusion; set pressure or Vt not delivered; low O <sub>2</sub> pressure; disconnect; overheat; low/empty battery; battery charge; AC disconnect; battery failure; remote; power failure	O
<b>LTV®900</b> CareFusion <a href="http://www.carefusion.com/our-products/browse-brands/ltv">www.carefusion.com/our-products/browse-brands/ltv</a> ③  <i>Pediatric use &gt; 5 kg</i>  <i>Discontinued; serviced through October 2016</i>	Volume control, pressure support, control, assist/control, SIMV, Spontaneous, CPAP	50-2000 ml	Pressure support; 0-60 cm H <sub>2</sub> O	0-80 BPM	0-20 cm H <sub>2</sub> O	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
<b>LTV®950</b> CareFusion <a href="http://www.carefusion.com/our-products/browse-brands/ltv">www.carefusion.com/our-products/browse-brands/ltv</a> ③  <i>Pediatric use &gt; 5 kg</i>  <i>Discontinued; serviced through December 2016</i>	Volume control, pressure control, pressure support, control, assist/control, SIMV, spontaneous, CPAP	50-2000 ml	Pressure control 1-99 cm H <sub>2</sub> O; Pressure support 0-60 cm H <sub>2</sub> O	0-80 BPM	0-20 cm H <sub>2</sub> O	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

**What is a combination or multi-mode ventilator?** (continued)

KEY: ① = available only in USA ② = available only outside USA ③ = available worldwide

Combination or Multi-Mode Ventilators (continued)	Mode	Tidal Volume	Pressure Range	Breath Rate	PEEP/ CPAP	Trigger	AC Voltage	Battery	Dimensions	Weight	Alarms	Humidifier = H Oxygen = O
<b>LTV®1000</b> CareFusion <a href="http://www.carefusion.com/our-products/browse-brands/ltv">www.carefusion.com/our-products/browse-brands/ltv</a> ③ <i>Pediatric use &gt; 5 kg</i>	Volume control, pressure control, pressure support, control, assist/control, SIMV, CPAP	50-2000 ml	Pressure control 1-99 cm H <sub>2</sub> O; Pressure support 0-60 cm H <sub>2</sub> O	0-80 BPM	0-20 cm H <sub>2</sub> O	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
<b>LTV®1150</b> CareFusion <a href="http://www.carefusion.com/our-products/browse-brands/ltv">www.carefusion.com/our-products/browse-brands/ltv</a> ③ <i>Pediatric use &gt; 5 kg</i>	Volume control, pressure control, pressure support, control, assist/control, SIMV, CPAP, spontaneous breathing trial	50-2000 ml	Pressure control 1-99 cm H <sub>2</sub> O; Pressure support 0-60 cm H <sub>2</sub> O	0-80 BPM	0-20 cm H <sub>2</sub> O; 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
<b>Monnal T50</b> Air Liquide Medical Systems, Inc. <a href="http://www.device.airliquidehealthcare.com">www.device.airliquidehealthcare.com</a> ② <i>Pediatric use</i>	PSV pressure support and SIMV; (A)CMV assisted controlled and SIMV; (A) PCV assisted pressure controlled and SIMV	Adult: 100-2000 mL; Child 50-500 mL	5-50 cm H <sub>2</sub> O	Adult: 5-40 BPM Child: 5-60 BMP	0-20 cm H <sub>2</sub> O	Inspiratory off, then 0.5-10 L/min; Expiratory 10-90%	100-240 VAC, 50/60 Hz	Internal: Up to 6 hrs External: Up to 18 hrs	33 cm x 25 cm x 18 cm	5.3 kg	N/A	O
<b>Newport™ HT50</b> Medtronic <a href="http://www.medtronic.com/covidien/products/portable-ventilation">www.medtronic.com/covidien/products/portable-ventilation</a> ③ <i>Pediatric use &gt; 10 kg</i>  <i>Discontinued; support until 2021</i>	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 <sub>2</sub> O, Volume control; 0-100 cm H <sub>2</sub> O	1-99 BPM	0-30 cm H <sub>2</sub> O (leak compensated)	9.9-0 cmH <sub>2</sub> O 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 automobile 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

**What is a combination or multi-mode ventilator?** (continued)

KEY: ① = available only in USA ② = available only outside USA ③ = available worldwide

Combination or Multi-Mode Ventilators (continued)	Mode	Tidal Volume	Pressure Range	Breath Rate	PEEP	Trigger/Circuits	AC Voltage	Battery	Dimensions	Weight	Alarms	Humidifier = H Oxygen = O
<b>Newport™ HT70</b> Medtronic <a href="http://www.medtronic.com/covidien/products/portable-ventilation">www.medtronic.com/covidien/products/portable-ventilation</a> ③  <i>Pediatric use &gt; 5 kg</i>	Volume and pressure: A/C MV; SIMV; pressure support; pressure control; spontaneous	50-2,200 ml	Pressure control: 5-60 cm H <sub>2</sub> O Pressure support: 0-60 cm H <sub>2</sub> O	1-99 BPM	0-30 cm H <sub>2</sub> O	Flow: 6-100 L/min  Pressure trigger sensitivity	100-240 V, 50/60/400 Hz	Internal, up to 10 hrs; backup battery 30 minutes External battery: 12-24 VDC	9.75" W x 11" D x 10.25" H; 24.74 cm W x 27.94 cm D x 26.04 cm H	15.4 lbs, <7 g	High/low baseline and airway pressure, high/low inspiratory minute volume, high respiratory rate; apnea; high/low FIO <sub>2</sub> ; device malfunction; low battery	H, O
<b>Newport™ HT70 Plus</b> Medtronic <a href="http://www.medtronic.com/covidien/products/portable-ventilation">www.medtronic.com/covidien/products/portable-ventilation</a> ③  <i>Pediatric use &gt; 5 kg</i>	Volume and pressure: A/C MV; SIMV; pressure support; pressure control; spontaneous	50-2,200 ml	Pressure control: 5-60 cm H <sub>2</sub> O Pressure support: 0-60 cm H <sub>2</sub> O	1-99 BPM	0-30 cm H <sub>2</sub> O	Flow: 6-100 L/min  Pressure trigger sensitivity	100-240 V, 50/60/400 Hz	Internal, up to 10 hrs; backup battery 30 minutes External battery: 12-24 VDC	9.75" W x 11" D x 10.25" H; 24.74 cm W x 27.94 cm D x 26.04 cm H	15.4 lbs, <7 g	High/low baseline and airway pressure, high/low inspiratory minute volume, high respiratory rate; apnea; high/low FIO <sub>2</sub> ; device malfunction; low battery, high/low inspiratory minute ventilation, low O <sub>2</sub> , high tidal volume, airway flow sensor disconnect	H, O
<b>Puritan Bennett™ Achieva® Portable Ventilator</b> Medtronic <a href="http://www.medtronic.com/covidien/products/portable-ventilation">www.medtronic.com/covidien/products/portable-ventilation</a> ③  <i>Discontinued; serviced through September 2015</i>	Volume control, pressure support, pressure control, control, assist/control, SIMV	50-2200 ml	0-50 cm H <sub>2</sub> O	1-80 BPM	0 and 3-20 cm H <sub>2</sub> O	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 O <sub>2</sub> failure (PSO <sub>2</sub> )	H, O
<b>Puritan Bennett™ Legendair</b> Medtronic <a href="http://www.medtronic.com/covidien/products/portable-ventilation">www.medtronic.com/covidien/products/portable-ventilation</a> ②  <i>Pediatric use &gt; 5 kg</i>  <i>Discontinued; serviced through May 2015</i>	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

**What is a combination or multi-mode ventilator?** (continued)

KEY: ① = available only in USA ② = available only outside USA ③ = available worldwide

<b>Combination or Multi-Mode Ventilators</b> (continued)	Mode	Tidal Volume	Pressure Range	Breath Rate	PEEP	Trigger	AC Voltage	Battery	Dimensions	Weight	Alarms	Humidifier = H Oxygen = O
<b>Puritan Bennett™ 540 Ventilator</b> Medtronic <a href="http://www.medtronic.com/covidien/products/portable-ventilation">www.medtronic.com/covidien/products/portable-ventilation</a> ①  <i>Pediatric use &gt;5 kg</i>	CPAP, pressure support, pressure assist/control, volume assist/control, volume SIMV, pressure SIMV	50-2000 ml	5-55 cm H <sub>2</sub> O	1-60 BPM	0-20 cm H <sub>2</sub> O	5 inspiratory	100-240 V, 50/60 Hz	Internal: up to 11 hrs  External: 12-30 V	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
<b>Puritan Bennett™ 560 Ventilator</b> Medtronic <a href="http://www.medtronic.com/covidien/products/portable-ventilation">www.medtronic.com/covidien/products/portable-ventilation</a> ②  <i>Pediatric use &gt; 5 kg</i>	CPAP assist/control, SIMV, volume control, pressure support	50-2000 ml	5-55 cm H <sub>2</sub> O	1-60 BPM	0-20 cm H <sub>2</sub> O	5 inspiratory, 5-95% expiratory	100-240 V, 50/60 Hz	Internal: up to 11 hrs  External: 12-30 VDC  Car adapter	23.5 cm W x 31.5 cm D x 15.4 cm H	4.5 kg	Apnea, high/low inspiratory tidal volume, high/low expiratory tidal volume, high/low pressure, high breath rate, high/low battery temperature, high leak/occlusion/patient disconnect, valve detection error, high/low FiO <sub>2</sub> , low/empty battery, unit overheat/malfunction, remote call, power failure	H, O
<b>Trilogy100</b> Philips Respironics <a href="http://www.usa.philips.com/healthcare/solutions/sleep-and-respiratory-care/ventilation">www.usa.philips.com/healthcare/solutions/sleep-and-respiratory-care/ventilation</a> ①  <i>Pediatric use &gt;5 kg</i>	CPAP, bilevel S, S/T, T; volume assist/control, volume control, SIMV with pressure support, pressure control SIMV, AVAPS, AVAPS-AE	50-2000 ml	IPAP: 4-50 cm H <sub>2</sub> O EPAP: 0-25 cm H <sub>2</sub> O active circuit; 4-25 cm H <sub>2</sub> O passive circuit; CPAP: 4-20 cm H <sub>2</sub> O, Pressure differential: 0-40 cm H <sub>2</sub> O	0-60 BPM in AC mode; 1-60 in all other modes	0-25 cm H <sub>2</sub> O active circuit; 4-25 cm H <sub>2</sub> O passive circuit	Flow trigger sensitivity; Digital Auto-Trak; Passive circuit with exhalation port; active circuit with exhalation valve with proximal pressure, "Kiss"	100-240 VAC, 50/60 Hz	Internal: up to 3 hrs  Detachable external: up to 3 hrs  Vehicle cable adapter  External: 12 VDC	6.6" L x 11.2" W x 9.3" H	11 lb	Circuit disconnect, apnea, low internal battery, high/low tidal volume, high/low minute ventilation, high/low respiratory rate, remote capability, high/low inspiratory pressure, high/low expiratory pressure, power failure, device malfunction	H, O

**What is a combination or multi-mode ventilator?** (continued)

KEY: ① = available only in USA ② = available only outside USA ③ = available worldwide

Combination or Multi-Mode Ventilators (continued)	Mode	Tidal Volume	Pressure Range	Breath Rate	PEEP	Trigger	AC Voltage	Battery	Dimensions	Weight	Alarms	Humidifier = H Oxygen = O
<b>Trilogy200</b> <b>Trilogy202</b> (integrated O <sub>2</sub> blender) Philips Respironics <a href="http://www.usa.philips.com/healthcare/solutions/sleep-and-respiratory-care/ventilation">www.usa.philips.com/healthcare/solutions/sleep-and-respiratory-care/ventilation</a> ①  <i>Pediatric use &gt;5 kg</i>	CPAP, bilevel S, S/T, T; pressure control with SIMV; volume assist/control; volume control; volume SIMV with pressure support, AVAPS, AVAPS-AE	50-2000 ml	IPAP: 4-50 cm H <sub>2</sub> O EPAP: 0-25 cm H <sub>2</sub> O active circuit; 4-25 cm H <sub>2</sub> O passive circuit; CPAP: 4-20 cm H <sub>2</sub> O Pressure differential: 0-40 cm H <sub>2</sub> O	0-60 BPM in AC mode; 1-60 in all other modes	0-25 cm H <sub>2</sub> O active circuit; 4-25 cm H <sub>2</sub> O passive circuit	Flow trigger; proximal flow trigger; Digital Auto-Trak; Passive circuit with exhalation port; active circuit with exhalation valve and proximal sensor, "Kiss"	100-240 VAC, 50/60 Hz	Internal: up to 3 hrs Detachable battery backup to 3 hrs External 12 VD; Vehical cable adapter	6.6" x 11.2" x 9.3"; 16.68 cm x 28.45 cm x 23.52 cm	11 lb, 5 kg	Circuit leak/disconnect, apnea, high/low tidal volume; high/low minute ventilation, high/low respiratory rate, high/low inspiratory pressure, high/low expiratory pressure, low internal battery, power failure, device malfunction, remote	O <sub>2</sub> integrated blender with Trilogy202
<b>Ventilogic LS</b> Löwenstein Medical <a href="https://loewensteinmedical.de/en/produkt-kategorie-ventilation">https://loewensteinmedical.de/en/produkt-kategorie-ventilation</a> ②	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: VENTIpower, 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: VENTIclick O: VENTI-O2
<b>Ventilogic plus</b> Löwenstein Medical <a href="https://loewensteinmedical.de/en/produkt-kategorie-ventilation">https://loewensteinmedical.de/en/produkt-kategorie-ventilation</a> ②  <i>Pediatric use</i>	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: VENTIpower, 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: VENTIclick O: VENTI-O2

**What is a combination or multi-mode ventilator?** (continued)

KEY: ① = available only in USA ② = available only outside USA ③ = available worldwide

<b>Combination or Multi-Mode Ventilators</b> (continued)	Mode	Tidal Volume	Pressure Range	Breath Rate	PEEP	Trigger	AC Voltage	Battery	Dimensions	Weight	Alarms	Humidifier = H Oxygen = O
<b>Vivo® 50</b> BREAS Medical AB www.breas.com ② <i>Pediatric use</i>	PSV, PSV (T), PCV, PCV (T), PCV (A), PCV (A+T), VCV, VCV (A), CPAP	100-2500 ml	4-40 cm H <sub>2</sub> O	5-50 BPM	0-30 cm H <sub>2</sub> O	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 FiO <sub>2</sub> , apnea; rebreathing, disconnect, low/empty internal/external battery, malfunction, power failure	O
<b>Vivo® 60</b> BREAS Medical AB www.breas.com ② <i>Adult and Pediatric use</i>	PSV, PSV (TgV), SIMV PCV, PCV, PCV (TgV), SIMV VCV, PCV (A), PCV (A+TgV), CPAP, VCV, VCV (A)	50-2500 ml	4-60 cm H <sub>2</sub> O	(PCV, VCV) 4-60 BPM	0-30 cm H <sub>2</sub> O for Adult, 0-20 cm paediatric insp pressure, 2 cm H <sub>2</sub> O or Min Insp Pressure - 2 H <sub>2</sub> O	1-9 Inspiratory; 1-9 expiratory	100-240 V AC	Internal: up to 4 hrs External (click-on): 24 V DC up to 8 hrs	343 W x 125 H x 264 D mm 343 W x 125 H x 285 D mm with click-on battery	5.2 kg	High pressure, low pressure, high PEEP, low PEEP, high Vte/Vti, low Vte/Vti, high MVe/Mvi, low MVe/MVi, high breath rate, low breath rate, apnea, disconnect, rebreathing, high FiO <sub>2</sub> , Low FiO <sub>2</sub> , High SpO <sub>2</sub> , 2ow SpO <sub>2</sub> , High EtCO <sub>2</sub> , Low EtCO <sub>2</sub> , High Insp CO <sub>2</sub> , High pulse rate, Low pulse rate, low last power source	O

**What is a combination or multi-mode ventilator?** (continued)

KEY: ① = available only in USA ② = available only outside USA ③ = available worldwide

<b>Combination or Multi-Mode Ventilators</b> (continued)	Mode	Tidal Volume	Pressure Range	Breath Rate	PEEP	Trigger	AC Voltage	Battery	Dimensions	Weight	Alarms	Humidifier = H Oxygen = O
<b>VS III™</b> ResMed www.resmed.com ②  <i>Pediatric use</i>	Leak - CPAP; spontaneous; spontaneous/timed; assisted pressure controlled ventilation; Valve-assisted volume controlled ventilation; pressure support with guaranteed tidal volume; assisted pressure controlled ventilation	50-2500 ml	IPAP/PS: 5-30 cm H <sub>2</sub> O 6-30 H <sub>2</sub> O; 5-50 H <sub>2</sub> O  EPAP: 4-20 cm H <sub>2</sub> O	5-50 BPM; 5-60 BPM pediatric in PS.Vt &A/CV	CPAP/ PEEP: 4-20 cm H <sub>2</sub> O	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 V <sub>t</sub> , low V <sub>t</sub> e, maximum frequency, high V <sub>t</sub> , low battery	O
<b>VS Ultra™</b> ResMed www.resmed.com ②  <i>Pediatric use</i>	Assist/control volume, assist pressure control, pressure support with or without backup, pressure support with tidal volume, spontaneous, spontaneous/timed	50-2500 ml	5-50 hPa	5-50 adult; 5-60 pediatric	4-20 cm H <sub>2</sub> O	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



## 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 include the Newport HT50<sup>®</sup> and Newport HT70<sup>®</sup>, LTV<sup>®</sup> series, Trilogy100, and Stellar™ 100 and 150™ with Pixi<sup>®</sup> mask system. The Nippy Junior + is the only ventilator **specifically manufactured** for infants and children (for use in the UK and Europe). In many developing countries, bilevel ventilators are often the only ventilators that are affordable and available to use.

### KEY:

① = available only in USA   ② = available only outside USA   ③ = available worldwide

### Nippy Junior +

B & D Electromedical, [www.nippyventilator.com](http://www.nippyventilator.com) ②

Mode:	Pressure control, pressure support, CPAP, IPPV (NIV and tracheostomy)
Pressure range:	0-30 cm H <sub>2</sub> O IPAP; 3-20 cm H <sub>2</sub> O EPAP
BPM:	6-60
Maximum flow rate:	200L/min
AC voltage:	100-240 V, 47-63 Hz
Internal battery:	4-12 hours depending on settings and leak
External battery:	24 VDC, 4-12 hours depending on settings and leak
Dimensions:	30 L x 22 W x 13 H cm
Weight:	4.5 kg
Alarms:	Low/high pressure, low/high flow, low/empty battery, malfunction, disconnect, power failure
Humidifier:	External
O:	No

## 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 them in order to find the most comfortable and effective system.

Some ventilator users alternate modes and interfaces during the day and 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 and generator are 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 continually.  
[www.fda.gov/MedicalDevices/safety](http://www.fda.gov/MedicalDevices/safety)

## Home ventilator manufacturers

### **Air Liquide Healthcare, Inc.**

[www.device.airliquidehealthcare.com](http://www.device.airliquidehealthcare.com)

### **BD Worldwide (CareFusion, Pulmonetics)**

[www.carefusion.com/our-products/respiratory-care/mechanical-ventilation/portable-ventilation-solutions](http://www.carefusion.com/our-products/respiratory-care/mechanical-ventilation/portable-ventilation-solutions)

### **BREAS Medical AB (B&D Electromedical)**

[www.nippyventilator.com](http://www.nippyventilator.com); [www.breas.com](http://www.breas.com)

### **Dima Italia S.r.l.**

[www.dimaitalia.com](http://www.dimaitalia.com)

### **Flight Medical Innovations Ltd.**

[www.flight-medical.com](http://www.flight-medical.com)

### **GE Healthcare (VersaMed)**

[www.gerespiratorycarecentral.com/home\\_care.php](http://www.gerespiratorycarecentral.com/home_care.php)

### **Löwenstein Medical Technology GmbH + Co. KG (Weinmann.de)**

<https://loewensteinmedical.de/en/produkt-kategorie/ventilation>

### **Metronic (Covidien, Newport, Puritan Bennett)**

[www.medtronic.com/covidien/support/product-manuals](http://www.medtronic.com/covidien/support/product-manuals)

### **Philips Respironics**

[www.usa.philips.com/healthcare/solutions/sleep-and-respiratory-care/ventilation](http://www.usa.philips.com/healthcare/solutions/sleep-and-respiratory-care/ventilation)

### **Porta-Lung, Inc.**

[www.portalung.com](http://www.portalung.com)

### **ResMed**

[www.resmed.com](http://www.resmed.com)

### **Siare Engineering International Group, S.r.l.**

[www.siare.it](http://www.siare.it)

### **United Hayek Medical**

[www.unitedhayek.com](http://www.unitedhayek.com)

### **ZOLL Medical Corporation**

[www.zoll.com/ventilator-aspirators](http://www.zoll.com/ventilator-aspirators)

IVUN

INTERNATIONAL VENTILATOR USERS NETWORK

an affiliate of Post-Polio Health International

4207 Lindell Boulevard, #110  
Saint Louis, MO 63108-2930 USA  
314-534-0475, 314-534-5070 fax  
info@ventusers.org  
www.ventusers.org, www.ventnews.org