

PowerTech Vent FAQ



Why Use the PowerTech Vent Power Center with your ventilator?

All ventilators need some form of electrical power to operate. Most portable ventilators require 12Volts DC (Direct Current) to operate properly. It is our hope that the information provided here will help clarify many of your common questions. Richardson Products Inc. is the sole manufacturer of the PowerTech Vent Power Center. It is our sincere prayer that our revolutionary new product will have a significant positive impact in the lives of ventilator patients everywhere. The PowerTech Vent Power Center technology will allow ventilator patients to experience an unparalleled level of freedom and independence in the course of their daily life.

What is the PowerTech Vent Power Center and how safe is it to use?

The PowerTech Vent Power Center is a DC to DC converter specifically designed to power a portable ventilator from your power wheelchair's batteries. The PowerTech Vent Power Center provides safe, clean & stable electric power to your portable ventilator by converting your wheelchair's battery power. Wheelchair batteries have an enormous capacity to store energy. Most of this energy is unused, and therefore wasted. The PowerTech Vent Power Center allows you to tap into this vast store of DC power, and allows you to power any portable ventilator available. This eliminates the need for those big space wasting batteries and extra battery packs or medical battery backpacks.

How do I find an approved ventilator?

Ventilator Tech Support Document ([See Appendix A](#))

How will I know if a low power condition occurs?

If a low power condition occurs you will know the moment you engage the joystick of your wheelchair. An audible alarm will sound from the ventilator if a low power condition occurs. This indicates that the batteries need to be recharged.

What happens if my wheelchair batteries completely fail or a power loss occurs?

In the unlikely for an event of a power failure, but if this happens, all quality ventilators have an emergency battery backup that usually provides power up to 1 hour. So, if power were to ever fail, the Ventilator will automatically switch over to its internal battery.

What happens if I am not anywhere near civilization and I lose battery power?

(See Appendix B at the end of the page)

If the PowerTech Vent Power Center is so safe, why does RPI recommend that I keep my AC wall adapter with me at all times?

We have done everything possible to ensure that the PowerTech Vent Power Center is manufactured from the highest quality electronic components. We think it's the best policy to always keep the AC wall adapter emergency power supply with the user at all times. We also believe that the user should keep the 12Volt DC cigarette lighter adapter with them at all times. This 3 fold system will help eliminate and reduce any chance of a potential power failure to the ventilator.

What happens if the PowerTech Vent Power Center malfunctions?

In the unlikely event of a power failure, the ventilator would automatically switch to its internal battery backup. The ventilator should then be plugged into an AC outlet or cigarette adapter to ensure the users safety. With the patented quick disconnect cable system; this can be accomplished in less than 3 seconds without affecting ventilator operation.

How quickly can I change from the PowerTech Vent Power Center to an alternate source of power in case of such an emergency?

The patented quick disconnect cable system provides a method so cable swapping can be performed in less than 5 seconds without affecting ventilator operation.

How will using this product save me money in battery costs?

The PowerTech Vent Power Center eliminates the need for ventilator batteries or and additional medical battery power packs. Therefore, the only batteries required are the wheelchair batteries.

What Type of Batteries will work best with the PowerTech Vent Power Center?

Use the largest battery possible. Using large batteries such as Group 27's. Basically you want to use the largest batteries that will fit on board your wheelchair. Bigger Batteries mean more run time for the chair and ventilator.

Is it a problem to mix batteries of different chemistries, brands or ages?

The answer is a simple one. Never Mix Battery Types! Use the largest gel cell battery available that will fit in your wheelchair. Mixing battery types in a device is not recommended and can significantly increase the potential for leakage and reduced performance. The biggest problem is an imbalance in available energy between the installed batteries. So, always practice smart battery care and replace used batteries with new, fresh batteries of the same brand.

When should I replace my Wheelchair Batteries?

All Gel Cell and Lead Acid Batteries should be replaced every year with or without the PowerTech Vent Product. On average, deep cycle batteries get about 360 charges. After this, battery performance will derogate and the batteries will not hold a full charge. Great care/caution should be taken to keep a fresh set of batteries in a power wheelchair that is intended to operate a PowerTech Vent Power Center.

How long does it take to recharge my wheelchair batteries?

Charge your batteries overnight.

How long do batteries last powering my wheelchair and my ventilator?

There are several factors that impact battery run time. All wheelchairs are not the same, nor are the users that drive them. The most critical is the rate at which a device consumes power. Other factors affecting overall battery performance are environmental conditions, device usage patterns (continuous or intermittent) and battery size/chemistry. Most PowerTech Vent users will be able to use the system all day. On average the power center will supply approximately 8hrs - 10hrs of continuous use for both the chair & vent used simultaneously. Remember using larger wheelchair batteries means more run time for the chair and ventilator.

Are lead-acid & gel cell batteries considered hazardous waste?

Yes. In the United States and many other countries, lead acid batteries are classified as hazardous waste. So, be sure to take you old batteries to a recycling center in your area.

How should I dispose of batteries?

Most people will not have to worry about replacing their batteries...When your wheelchair goes in for its annual maintenance checkup; usually the old batteries are replaced with new ones. If you decide to have your chairs batteries replaced, be sure to take your old batteries to one of the many battery recycling centers located in your area. This will ensure that they are properly disposed of in accord with all government and state law regulations.

What if I have a question, but can't find the answer on the RPI website?

Just call 1(815). 464.3575 ext 201 between the hours 8:00am - 4:00pm central standard time. Our customer service experts can answer all your questions. Or email your questions to rpi@richardsonproducts.com and we'll get back to you within 24 hours.

Appendix A:

The information contained on this webpage is provided for educational purposes only. Please consult with your doctor or physician for selecting a ventilator for your specific needs.

Currently, We are only recommending using the Pulmonetics LTV Series Ventilator with the PowerTech Vent Power Center

All ventilators need some form of electrical power to operate. Most portable ventilators require 12Volts DC (Direct Current) to operate properly. It is our hope that the information provided here will help clarify some of the differences in types of ventilators available. Richardson Products Inc. is the sole manufacturer of the PowerTech Vent Power Center. It is our sincere prayer that our revolutionary new product will have a significant positive impact in the lives of ventilator patients everywhere. The PowerTech Vent Power Center technology will allow ventilator patients to experience an unparalleled level of freedom and independence in the course of their daily life.

LTV 950 Ventilator

The LTV Series Ventilator is a lightweight, high performance ventilator that is designed to provide the maximum functionality in the smallest possible package. This product is a restricted medical device designed for use by adults and pediatrics weighing a minimum of 5 kg (11 lbs), needing Positive Pressure ventilation (delivered invasively or non-invasively).

For more information on the LTV Series Ventilators Contact:
Pulmonetic Systems, Inc.
Website:www.pulmoneticsystems.com

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Tutorial Part I

Part I. The Basic Components and Definitions, by Frank Primiano, Jr., PhD, and Robert L. Chatburn, BS, RRT, FAARC. The authors present basic concepts and motivations of mechanical and spontaneous ventilation.

Ventilator Definition: A ventilator is an automatic mechanical device designed to provide all or part of the work the body must produce to move gas into and out of the lungs. The act of moving air into and out of the lungs is called breathing, or, more formally, ventilation.

Ventilator Electrical Requirements: All ventilators require some form of electrical power. Portable ventilators require 12Volts D.C. The PowerTech Vent Power Center can provide your ventilator with this power directly from your wheelchairs batteries.

Background on Ventilation: During breathing, a volume of air is inhaled through the airways (mouth and/or nose, pharynx, larynx, trachea, and bronchial tree) into millions of tiny gas exchange sacs (the alveoli) deep within the lungs. There it mixes with the carbon dioxide-rich gas coming from the blood. It is then exhaled back through the same airways to the atmosphere. Normally this cyclic pattern repeats at a breathing rate, or frequency, of about 12 breaths a minute (breaths/min) when we are at rest (a higher resting rate for infants and children). The breathing rate increases when we exercise or become excited. Gas exchange is the function of the lungs that is required to supply oxygen to the blood for distribution to the cells of the body, and to remove carbon dioxide from the blood that the blood has collected from the cells of the body. Gas exchange in the lungs occurs only in the smallest airways and the alveoli. It does not take place in the airways (conducting airways) that carry the gas from the atmosphere to these terminal regions. The size (volume) of these conducting airways is called the anatomical "dead space" because it does not participate directly in gas exchange between the gas space in the lungs and the blood. Gas is carried through the conducting airways by a process called "convection". Gas is exchanged between the pulmonary gas space and the blood by a process called "diffusion". One of the major factors determining whether breathing is producing enough gas exchange to keep a person alive is the 'ventilation' the breathing is producing. Ventilation is expressed as the volume of gas entering, or leaving, the lungs in a given amount of time. It can be calculated by multiplying the volume of gas, either inhaled or exhaled during a breath (called the tidal volume), times the breathing rate (e.g., 0.5 Liters x 12 breaths/min = 6 L/min). Therefore, if we were to develop a machine to help a person breathe, or to take over his or her breathing altogether, it would have to be able to produce a tidal volume and a breathing rate which, when multiplied together, produce enough ventilation, but not too much ventilation, to supply the gas exchange needs of the body. During normal breathing the body selects a combination of a tidal volume that is large enough to clear the dead space and add fresh gas to the alveoli, and a breathing

rate that assures the correct amount of ventilation is produced. However, as it turns out, it is possible, using specialized equipment, to keep a person alive with breathing rates that range from zero (steady flow into and out of the lungs) up to frequencies in the 100's of breaths per minute. Over this frequency range, convection and diffusion take part to a greater or lesser extent in distributing the inhaled gas within the lungs. As the frequency rates are increased, the tidal volumes that produce the required ventilation get smaller and smaller. We will consider two classes of ventilators here, those that produce breathing patterns that mimic the way we normally breathe (i.e., at rates our bodies produce during our usual living activities: 12 - 25 breaths/min for children and adults; 30 - 40 breaths/min for infants) - these are called conventional ventilators; and those that produce breathing patterns at frequencies much higher than we would or could voluntarily produce for breathing - called high frequency ventilators. There are two sets of forces that can cause the lungs and chest wall to expand: the forces produced when the muscles of respiration (diaphragm, inspiratory intercostal, and accessory muscles) contract, and the force produced by the difference between the pressure at the airway opening (mouth and nose) and the pressure on the outer surface of the chest wall. Normally, the respiratory muscles do the work needed to expand the chest wall, decreasing the pressure on the outside of the lungs so that they expand, which in turn enlarges the air space within the lungs, and draws air into the lungs. The difference between the pressure at the airway opening and the pressure on the chest wall surface usually does not play a role in this activity because, both of these locations being exposed to the same pressure (atmospheric), this difference is zero. However, when the respiratory muscles are unable to do the work required for ventilation, either or both of these two pressures can be manipulated to produce breathing movements. It is not difficult to visualize that, if the pressure at the mouth and nose of an individual were increased while the pressure surrounding the rest of the person's body remained at atmospheric, the person's chest would expand as air is literally forced into the lungs. Likewise, if the pressure on the person's body surface were lowered as the pressure at the person's open mouth and nose remained at atmospheric, then again the pressure at the mouth would be greater than that on the body surface and air would be forced into the lungs. Thus, we have two approaches that can be used to mechanically ventilate the lungs: apply positive pressure (relative to atmospheric) to the airway opening - devices that do this are called positive pressure ventilators; or, apply negative pressure (relative to atmospheric) to the body surface (at least the rib cage and abdomen) - such devices are called negative pressure ventilators.

Mechanical Ventilators: The simplest mechanical device we could devise to assist a person's breathing would be a hand-driven, syringe-type pump that is fitted to the person's mouth and nose using a mask. A variation of this is the self-inflating, elastic breathing bag. Both of these require one-way valve arrangements to cause air to flow from the device into the lungs when the device is compressed, and out from the lungs to the atmosphere as the device is expanded. Also, it can be appreciated that such arrangements are not automatic, requiring an operator to supply the energy to push the gas into the lungs through the mouth and nose. Automating the ventilator so that continual operator intervention is not needed for safe, desired operation requires 1) a stable attachment (interface) of the device to the patient, 2) a source of energy to drive the device, 3) a control system to make it perform appropriately, and 4) a means of monitoring the performance of the device and the condition of the patient.

Patient Interface. Positive Pressure Ventilators, The ventilator delivers gas to the patient through a set of flexible tubes called a patient circuit. Depending on the design of the ventilator, this circuit can have one or two tubes. The circuit connects the ventilator to either an endotracheal or tracheostomy tube that extends into the patient's throat (causing this arrangement to be called invasive ventilation), or a mask covering the mouth and nose or just the nose (referred to as noninvasive ventilation). Each of these connections to the patient may have a balloon cuff associated with it to provide a seal - either inside the trachea for the tracheal tubes or around the mouth and nose for the masks.

Negative Pressure Ventilators: The patient is placed inside a chamber with his or her head extending outside the chamber. The chamber may encase the entire body except for the head (e.g., iron lung), or it may enclose just the rib cage and abdomen (cuirass). It is sealed to the body where the body extends outside the chamber. Although it is not generally necessary, the patient may have an endotracheal or tracheostomy tube in place.

Power Sources. Positive Pressure Ventilators are typically powered by electricity or compressed gas. Electricity is used to run compressors of various types. These provide compressed air both for motive power as well as air for breathing. More commonly, however, the power to expand the lungs is supplied by compressed gas from tanks, or from wall outlets in the hospital. The ventilator is generally connected to separate sources of compressed air and compressed oxygen. This permits the delivery of a range of oxygen concentrations to support the needs of sick patients. Because compressed gas has all moisture removed, the gas delivered to the patient must be warmed and humidified in order to avoid drying out the lung tissue. A humidifier placed in the patient circuit does this. A humidifier is especially needed when an endotracheal or tracheostomy tube is used since these cover or bypass, respectively, the warm, moist tissues inside of the nose and mouth and prevent the natural heating and humidification of the inspired gas.

Negative Pressure Ventilators are usually powered by electricity used to run a vacuum pump that periodically evacuates the chamber to produce the required negative pressure. Humidification is not needed if an endotracheal tube is not used. Oxygen enriched inspired air can be provided as needed via a breathing mask.

Control System. A control system assures that the breathing pattern produced by the ventilator is the one intended by the patient's caregiver. This requires the setting of control parameters such as the size of the breath, how fast and how often it is brought in and let out, and how much effort, if any, the patient must exert to signal the ventilator to start a breath. If the patient can control the timing and size of the breath, it is called a spontaneous breath. Otherwise, it is called a mandatory breath. A particular pattern of spontaneous and mandatory breaths is referred to as a mode of ventilation. Numerous modes, with a variety of names, have been developed to make ventilators produce breathing patterns that coordinate the machine's activity with the needs of the patient.

Monitors. Most ventilators have at least a pressure monitor (measuring airway pressure for positive pressure ventilators, or chamber pressure for negative pressure ventilators) to gauge the size of the breath and whether or not the patient is properly connected to the ventilator. Many positive pressure ventilators have sophisticated pressure, volume and flow sensors that produce signals both to control the ventilator's output (via feedback in the ventilator's control system) and to provide displays (with alarms) of how the ventilator and patient are interacting. Clinicians use such displays to follow the patient's condition and to adjust the ventilator settings.

Conventional Ventilators: The vast majority of ventilators used in the world provide conventional ventilation. This employs breathing patterns that approximate those produced by a normal spontaneously breathing person. Tidal volumes are large enough to clear the anatomical dead space during inspiration and the breathing rates are in the range of normal rates. Gas transport in the airways is dominated by convective flow and mixing in the alveoli occurs by molecular diffusion. This class of ventilator is used in the ICU, for patient transport, for home care and in the operating room. It is used on patients of all ages from neonate to adult

High Frequency Ventilators: It has been known for several decades that it is possible to adequately ventilate the lungs with tidal volumes smaller than the anatomic dead space using breathing frequencies much higher than those at which a person normally breathes. This is actually a common occurrence of which we may not be fully aware. Dogs do not sweat. They regulate their temperature when they are hot by panting as you probably know. When a dog pants he takes very shallow, very fast, quickly repeated breaths. The size of these panting breaths is much smaller than the animal's anatomical dead space, especially in dogs with long necks. Yet, the dog feels no worse for this type of breathing (at least all the dogs interviewed for this article).

Devices have been developed to produce high frequency, low amplitude breaths. These are generally used on patients with respiratory distress syndrome (lungs will not expand properly). These are most often neonates whose lungs have not fully developed, but can also be older patients whose lungs have been injured. High frequency ventilators are also used on patients that have lungs that leak air. The very low tidal volumes produced put less stress on fragile lungs that may not be able to withstand the stretch required for a normal tidal volume.

There are two main types of high frequency ventilator: high frequency jet ventilators (HFJV) and high frequency oscillatory ventilators (HFOV). The HFJV directs a high frequency pulsed jet of gas into the trachea from a thin tube within an endotracheal or tracheostomy tube. This pulsed flow entrains air from inside the tube and directs it toward the bronchi. The HFOV uses a piston arrangement that moves back and forth rapidly to oscillate (vibrate lengthwise) the gas in the patient's breathing circuit and airways. Both of these techniques cause air to reach the alveoli and carbon dioxide to leave the lungs by enhancing mixing and diffusion in the airways. Convection plays a minor role in gas transport with these ventilators while various forms of enhanced diffusion predominate.

Although high frequency devices that drive the pressure on the chest wall have been developed, most high frequency ventilators in use today are applied to the airway opening. In future articles, the authors will explore topics such as how ventilators work, the controls and monitors that can be available on a ventilator, interpretation of graphical displays of ventilatory variables, as well as various clinical aspects of ventilator use.

Tutorial Part II

Part II. Indications for, and Complications of, Mechanical Ventilation, by Frank Primiano, Jr., PhD. This article summarizes the clinical indications for the use of mechanical ventilators

General Indications for Mechanical Ventilation (3, 4, 5): Acute or Impending Ventilatory Failure (elevated PaCO₂ [> 50 mmHg] with pH < 7.30) Severe Oxygenation Deficit in Spite of Administration of Enriched Oxygen Mixtures (PaO₂ < 60 mmHg on FiO₂ > 0.6) Secretion/Airway Control Apnea, Respiratory Arrest (especially in neonates) Conditions that could Necessitate Mechanical Ventilation (1, 2, 3, 6, 7).

Diseases: Acute Obstructive Disease (e.g., acute severe asthma, airway mucosal edema) Altered Ventilatory Drive (e.g., hypothyroidism, idiopathic central alveolar hypoventilation, dyspnea-related anxiety, apnea of prematurity, intracranial hemorrhage) Cardiopulmonary Problems (e.g., congestive heart failure; in neonates: persistent bradycardia, massive pulmonary hemorrhage) Chest Wall Deformities (e.g., kyphoscoliosis, severe obesity, rheumatoid spondylitis; in neonates: hypercompliant rib cage [prematurity], large diaphragmatic hernia) Chronic Obstructive Pulmonary Disease (e.g., emphysema, chronic bronchitis, asthma, bronchiectasis, cystic fibrosis) Chronic Restrictive Pulmonary Disease (e.g., pulmonary fibrosis) Neuromuscular Disease (e.g., polio myelitis, Duchenne muscular dystrophy, amyotrophic lateral sclerosis, Guillain-Barre syndrome, peripheral neuropathies, malnutrition, cancer, infections) Atelectatic Disease (e.g., ARDS, neonatal RDS, hyaline membrane disease, pneumonia) External Interventions Burns and Smoke Inhalation (e.g., surface burns, inhalation injury) Chest Trauma (e.g., blunt chest injury, penetrating injuries, flail chest, rib fractures, thoracotomy) Fatigue/Atrophy (muscle overuse, disuse) Head/Spinal Cord Injury (e.g., neurogenic pulmonary edema, Cheyne-Stokes breathing, apnea from severe insult, medullary brainstem injury) Postoperative Conditions (e.g., thoracic and cardiac surgeries, apnea from unreversed anesthesia) Pharmacological Agents/Drug Overdose (e.g., long-term adrenocorticosteroids, aminoglycoside antibiotics, Ca⁺ channel blockers, muscle relaxants, barbiturates) Complications of Mechanical Ventilation (1, 3, 4, 6)

Positive Pressure Ventilation: Because of the positive pressure it produces, positive pressure ventilation causes some degree of hemodynamic compromise (e.g., hypotension, decreased cardiac output). This can be controlled usually by administration of fluids, or, in severe cases, vasoactive drugs. Other complications of positive pressure ventilation include: pulmonary barotrauma (pneumothorax, subcutaneous emphysema, interstitial pulmonary emphysema, pneumomediastinum, pneumopericardium, pneumoperitoneum [transdiaphragmatic], and air embolus), localized pulmonary hyperinflation, nosocomial infections (pneumonia), and increased intracranial pressure (cerebral edema). In addition to these conditions, non-invasive positive pressure ventilation can also produce its own unique complications, such as skin breakdown and gastric distension. However, these do not occur often and, when they do, are generally not severe.

Negative Pressure Ventilation: It is possible that negative pressure ventilation could cause localized pulmonary hyperinflation. It can be uncomfortable and cumbersome, can elicit upper airway obstruction, and can fail to suppress inspiratory muscle activity. Depending on how the negative pressure ventilation is administered, e.g., full body capsule (iron lung), venous pooling in the gut may occur.

High Frequency Ventilation: Air trapping is a potential problem when high frequency ventilation is used in obstructive lung disease because of the short expiratory times at the frequencies employed. High Frequency Oscillatory Ventilation (HFOV) can decrease cardiac output compared to conventional ventilation if, as often happens, its administration is begun at higher mean airway pressures than those used for conventional ventilation. Mucus can build up in the airways during HFOV. High frequency jet ventilation can cause airway injury if humidity is insufficient.

Information on Authors/Articles & References

Information on Authors/Articles:

Education: VentWorld Series

What is a Ventilator?

Part II. Indications for, and Complications of, Mechanical Ventilation

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General Indications for Mechanical Ventilation

Conditions that could Necessitate Mechanical Ventilation

Complications of Mechanical Ventilation

Introduction

Mechanical ventilatory support should be initiated whenever a patient is unable to maintain gas exchange such that death would occur were support not provided

(1). Respiratory failure can be arbitrarily defined to exist, for sea level, when two or more of the following four conditions exist (2):

I) Acute dyspnea

II) $\text{PaO}_2 < 50$ mmHg in room air

III) A $\text{PaCO}_2 > 50$ mmHg

IV) Significant respiratory acidemia.

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Ventilator Definition

Background on Ventilation

Mechanical Ventilators

Conventional Ventilators

High-Frequency Ventilators

Ventilator Definition complications of, Mechanical Ventilation >>>

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Appendix B

⚠ DANGER Warning misuse of this product can cause serious injury or death **⚠ DANGER**

INTENDED USE:

The PowerTech Vent Power Center is life support device and a restricted medical device. The PowerTech Vent is suitable for services in the homecare, institution, and transportation settings as a source of continuous or intermitted power for a ventilator support. However, it is mandatory that the ventilator AC wall adapter be accessible at all times at the event of an emergency. The PowerTech Vent Power Center is intended to supply a ventilator with safe, filtered voltage. The ventilator is intended for operation only by Respiratory Therapist or other properly trained qualified personnel, and only under the direction of a physician and in accordance with the applicable state of laws and regulations. **Do not use this product away from reliable sources of electricity!** (Example: An operating 110VAC wall outlet). Richardson Products Incorporated does not recommend the PowerTech Vent Power Center be used outside of its intended use.