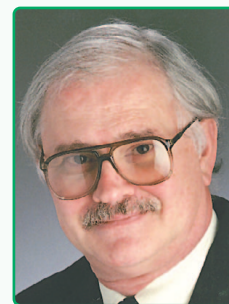


## BIO-MED COLOR CROSSVENT 3+ (Bio-Med Devices Inc.)

Paul Mathews PhD, RRT & Michael Czervinske, BS, RRT



This issue we report on the Bio-Med Color CrossVent 3+® produced by Bio-Med Devices, Inc. of Guilford Connecticut. This device is designed as a transport ventilator and is a descendent of the Bio-Med Devices IC-2A. It isn't often that we get to see a brand new product – the Bio-Med Color CrossVent 3+ was released on October 1, 2005.

In describing the CrossVent series of ventilators the manufacturer cites as a goal "... to pack as much as possible into a small, light weight package." In the Color CrossVent 3+ they have surely met that goal.

The "package" is indeed small and light weight. Its "foot print" is a petite 11" x 10" x 5.5". Its weight is 10.5 pounds (4.8 kg). Within this package are an impressive range of features and abilities. It offers adult thru pediatric ventilation modes, continuous mechanical ventilation (CMV), Pressure Support (PS), Continuous Positive Airway Pressure (CPAP), Synchronized Intermittent Ventilation (SIMV), Pressure Limited and Sigh ventilation options.

The Color CrossVent 3+ (CV-3+) employs a color LCD device with three touch sensitive screens to set and monitor functions. The LCD panel displays text labels and numerical data only. It is easy to read with large displays of the numerical data of the patient's respiratory variables. During alarm conditions,

the parameter which has been violated is highlighted and flashes during an active alarm. Further discussion of the alarms will occur later in this article. It does not provide graphic waveforms yet, which is

not a criticism, since numerical alarm and respiratory variables are much easier to recognize at a glance during transport. Bio-Med is working on waveforms, however, that can be added as a software upgrade later. During inflation there is a pressure bar graph that displays the degree of pressure administered, a feature that lends itself to easy verification of the circuit integrity and ventilator performance at a glance.

The touch screen performance is very well thought out. It requires enough touch pressure to deliberately set the desired parameter without worrying about making an accidental change just by touching the screen. Spacing between the settings also makes accidental changes more difficult. The pneumatic functions, such as maximum pressure, PEEP, and flow settings, requires turning a knob.

The screen is back lit for comfortable and easy viewing under most conditions and the company even includes a feature where the backlighting can be turned off to save battery life – another thoughtful and potentially important feature although turning off the backlight means no displays during the time the backlight is off. Alarm conditions will restore the backlight automatically.

The front panel of the CV-3+ contains the LCD screen, the Max Pressure Control set knob, the PEEP set knob and the Flow control knob. Additionally, the front panel has an audible alarm speaker and the alarm LED, which is located on the front top surface of the CV-3+ allowing full visualization of an alarm condition alert. The right side panel contains the Gas Supply Inlet, the Bleed Exhaust and, depending upon the accessories, either a blender or gas entrainment control. The left side panel has the Power On/Off Switch, External Power Supply Connector, LED Charging Battery Light, Pneumotach/Flow Sensor input, O2 Sensor Connector, Exhalation Valve Connector, Airway Pressure Connector, Patient Gas Connector and Alarm Reset Switch. The rear panel has the Maximum Pressure (120 cm H2O) Relief Valve, the Negative Pressure Relief Valve (machine shutdown opens at – 4 cm H2O) and entrainment inlet.

The control parameters and ranges for each of the basic and advanced variables are listed below;

Parameter	Range
• Rate	5-150 bpm
• Tidal Volume	5-2500 ml
• Flow Rate	1-120 lpm
• Peak Pressure	0-120 cm H2O
• PEEP Pressure	0-35 cm H2O
• Inspiratory Effort	-0.2 to – 10 cm H2O
• Pressure Support	0-50 cm H2O
• SIMV Rate	0.6 – 50 bpm



## FUTUREMED

State-of-the-art spirometers since 1980

### SpiroVision-3+®

- Converts a Windows PC into a complete spirometer
- Intuitive, easy to use software
- Serial / USB connection
- Real-time F/V and t/V graphs
- Bubbles pediatric incentive
- Customized, color reports
- Electronic data management



### Discovery-2®

- Full function, portable spirometer
- Large, color display
- Real time graphs
- Internal printer
- Connects to full page printers
- Pediatric incentive display
- Optional oximetry & ROC

NEW



For more information call **1-800-222-6780**

or visit our web site at: [www.futuremedamerica.com](http://www.futuremedamerica.com)

Futuremed, Granada Hills, CA 91344 Phone 818-830-2500

email: [info@futuremedamerica.com](mailto:info@futuremedamerica.com) Fax: 818-891-4755

CIRCLE READER ACTION CARD # 32

- O2 Sensor 21 – 100%
- Sigh Volume 0-2500 ml
- I Time 0.1 – 3.00 sec.
- E Time 0.2 – 99 sec.

The Color CrossVent 3+ is powered by a rechargeable NiMH battery with a 6 hour life. The LCD screen has a LCD charging indicator and a visually large Low Battery alarm. O2 is added via cylinders or by an optional O2 blender with a 2% accuracy rating. Power supply requirements are 31-75 psig, compressed, dry medical grade gas from cylinders or a piped source. If an air/O2 blender is used 45-75 psig power to the blender must be used. Electrical power is supplied by the interior battery which can be recharged using the Bio-Med 16VDC 3A charger/converter which also allows for AC operation.

In addition to the above settings and controls, the Color CrossVent 3+ incorporates the following alarms: Peak Pressure, Respiratory Rate, Oxygen and Low Battery. The CrossVent 3+ is also equipped with PEEP, Exhaled Tidal Volume (EHTV/EXHMT), Mean Airway Pressure and Low Gas Supply alarms. When an alarm condition occurs, the parameter for the out of limit condition will flash red. If more than one alarm condition happen simultaneously both LCDs flash red. All of the audible alarms are silenced when the Alarm Quiet key is activated. The Alarm Quiet Key when pushed once, invokes a 60 second audible pause and when pushed twice, sets a 120 second audible silence condition.

If a new alarm condition should occur during the silence the Alarm Quiet disengages and indicates the new condition. During alarm conditions the LCD screen "locks" on to the screen containing the controls and indicators for the current alarm condition. This can only be released by solving the problem or pressing the Alarm Quiet key.

Alarms are divided into a three tiered hierarchy; in tier 1 are the Primary Alarms and are indicated on the Alarm1 screen – Respiratory Rate, Peak Pressure, EXHVT and EXHMT. EXHVT and EXHMT can be turned off if they are not to be used. Tier 2 alarms or Secondary Alarms appear on the Alarm2 screen. These include PEEP, CPAP, Mean Pressure and O2%. O2% and Mean Pressure can be switched off. Tier three alarms appear on the Alarm3 screen. These alarms and the Alarm3 screen only appear when the alarm condition exists. These alarms consist of the Low Gas Supply Pressure, Low Battery and Ventilator Failure Alarms.

The combined Operations and Service Manual provided to us was presented in a three ring binder containing 91 (8 1/2 x 11") pages printed single sided allowing plenty of room for notes and easy updating. Additionally, the manual came with a companion CD-ROM highlighting the entire CrossVent series including the new Color CrossVent 3+. Both the Service and Operations portions of the manual were detailed and easy to read. The Manual consists of ten sections and 7 appendices plus a comprehensive table of contents and an alphabetized index.

The graphics in the manual are clear and easily legible. 40 pages of the manual are devoted to Operations and the remainder to Service.

The CV-3+ comes in several configurations ranging from the CV-3+ 3300C that runs on and provides only 100% O2\*\*, the 3300AC runs on 100% but allows provision of 50 or 100% O2, 3300EC has exhaled tidal volume measurements – delivers only 100% O2\*\*, 3300AEC exhaled tidal volume\* and air entrainment, 3300BEC exhaled tidal volume and air/O2 blender. The cost of these devices runs from the mid \$6500 to the \$7900 dollar range.

\* Using a Novamatrix pneumotachometer.

\* Can be used with a blender separate from the unit to provide 21 –100% O2.

When connected to a 100% O2 source gas, the CV-3+ has a unique feature that allows for entrainment of air to dilute the gas to 50% O2. During entrainment operations, the tidal volumes remained consistent during volume ventilation with a decelerating wave form.

During our tests, the ventilator performed well with each test condition. The It (?) provided enough head pressure to prevent attenuation of the flow wave form when introduced to high impedance conditions, such as high resistance or low compliance. Clinically the CV-3+ provided consistent flow rates during each breath sufficient for all test conditions, with and without entrainment. During high load periods, tidal volume delivery was consistent and within 50 mL of the target volume on an adult test lung. The control ventilation modes operated admirably and as expected. While we did not reach the published limits on flow and pressure, this was related to test conditions and not a limitation of the ventilator.

Since the CV-3+ utilizes a balloon type Bennett exhalation valve, it "honks" loudly during high load conditions with PEEP. The solution was to snap the exhalation port cap off of the valve, which also served to stream line the circuit. With the pneumotach in line, it was not necessary to measure exhaled tidal volumes at this port.

During spontaneous breathing modes, the CV-3+ performed well and measured flow, pressure and volume measurements were consistent across all test conditions. Since the sensitivity is a pressure setting, the CV-3+ does not perform with the same response as most flow triggered ventilators. In our laboratory tests, response time was slightly perceptible at the lowest sensitivity setting without causing auto-cycling. We calculated response times at approximately 65 milliseconds which is certainly adequate.

The CV-3+ is a very good choice as a portable ventilator due to its size and ease of use. It performed very consistently from breath to breath, and handled a variety of lung conditions without sacrificing performance during changing conditions. We liked the versatile and predictable nature of this ventilator and recommend that you give it a good look next time you're in the market for a transport ventilator. The company is well-respected, has been around for quite awhile and is known for excellent customer service as well. One can visit their website located at [www.biomeddevices.com](http://www.biomeddevices.com) or contact them toll-free at 800-224-6633.