

RAPHAEL

Intelligent Ventilation



...new intelligent features

HAMILTON
MEDICAL


A woman and a man are shaking hands in a meeting room. The woman is on the left, wearing a dark blazer, and the man is on the right, wearing a dark suit. They are standing in front of a dark wood-paneled wall. The scene is lit with warm, dramatic lighting. The woman is looking towards the man, and they both have slight smiles. The man's hand is resting on the woman's hand. In the foreground, there is a dark wooden table with a keyboard and some papers on it.

RAPHAEL

In intensive care, subacute care and even in home care, you look for more than world-class technical performance. You demand ventilators that deliver reliable data and easy-to-follow user guidance for better clinical decisions and improved patient outcomes, together with low running costs throughout the working life of your investment.

In short, you need systems that ensure:

- superior performance in complex environments
- improved patient outcomes
- reduced costs of ownership.

HAMILTON MEDICAL was born from a passion to improve the life of ventilated patients and the people who care for them. We began in 1983 with a new generation of intelligent microprocessor-controlled intensive care ventilators featuring revolutionary new modes and diagnostic tools. Today we maintain this tradition with the world's finest ICU ventilation technologies and a total dedication to Intelligent  Ventilation.

Delivering Intelligent Ventilation



RAPHAEL ventilators feature a compact, biphasic design that helps patients to breathe more freely in all modes and phases. Small enough to fit into almost any ICU environment, and competitively priced, they cover the **full range** of clinical requirements: invasive ventilation, automated ventilation with Adaptive Support Ventilation (ASV), and Non-Invasive Ventilation (NIV).

Optimum care for every patient


RAPHAEL ventilators deliver a cost-effective ICU ventilation solution that's appropriate for all patients from children to adults. In the ICU, in the recovery room, and in transit between them, RAPHAEL's fast set-up and easy management ensure the most appropriate treatment for every patient.

Reliability and performance

RAPHAEL systems combine reliability and **high performance** with advanced lung protective strategies and patient-adaptive modes. They are the ideal choice for the ICU special care areas, cardiac surgery recovery rooms, step-down or subacute care units, and long-term care centers.

Improved patient outcomes



Intelligent  Ventilation with RAPHAEL means fewer days on the ventilator, the use of less-invasive ventilation modes ... more time for the patient and shorter stays in ICU.

Adaptive technology

RAPHAEL systems adapt to the changing conditions and needs of each patient. In volume modes adaptive controllers deliver the selected tidal volume at the lowest pressure possible, **combining the benefits** of pressure-controlled ventilation with a volume guarantee.

Biphasic harmony

RAPHAEL technology promotes free breathing for patients in all ventilation modes and phases. Biphasic ventilation encourages spontaneous activity right from the start of mandatory ventilation, while a low-resistance exhalation valve helps **reduce the patient's work of breathing**.

Helpful alarms

RAPHAEL ventilators employ an intelligent alarm system, which, by your choice, automatically adapts alarm thresholds to the actual situation. Clear text alarm messages support you in the identification of adverse conditions.



Maximum patient orientation

RAPHAEL systems are entirely patient-oriented. Data are collected by a Flow Sensor at the airway opening and you can therefore assess the patient based on more precise measurements of flow and pressure. Patients also benefit from the sensitive flow trigger, based on the proximal flow signal.



Superior performance in complex environments

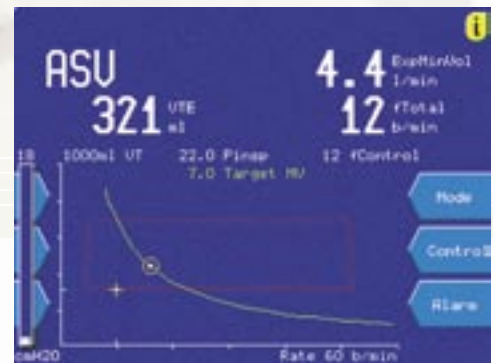


Adaptive Support Ventilation (ASV)

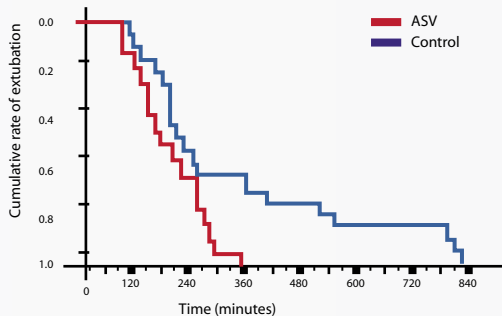
ASV is an easy-to-use and safe mode of ventilation for the respiratory management of your intubated patients. ASV employs **lung-protective rules** and adjusts the ventilatory pattern based on the patient's pulmonary mechanics and spontaneous respiratory activity to maintain **preset minute ventilation**. ASV guides the patient in a favorable breathing pattern and avoids potentially detrimental patterns, all the way from fully supported ventilation to extubation.

ASV applies adaptive 3-step closed loop control

- Assesses the patient breath-by-breath
- Calculates an optimal breath pattern target based on the minimal WOB method
- Approaches the target by automatically adjusting mandatory rate and inspiratory pressure



Studies ⁽¹⁾ show that ASV facilitates shorter time on the ventilator, whilst at the same time less user interaction is required and fewer alarms occur.



ASV target graphics screen

- Minute volume curve showing target volume for optimal breath pattern
- Safety frame showing limits for lung-protective ventilation
- Lets you observe actual minute volume as it approaches target

(1) Sulzer CF, Chiolerio R, Chassot PG, Mueller XM, Revelly JP. Adaptive Support Ventilation for fast tracheal extubation after cardiac surgery: A randomized controlled study. Anesthesiology 2001, 95:1339-45

Reducing costs of ownership

Value and efficiency as well as clinical excellence all support the **Intelligent  Ventilation** proposition from HAMILTON MEDICAL. RAPHAEL systems help you optimize clinical resources and skills while reducing ownership and management overheads.

Complete solutions

RAPHAEL ventilators are powerful, compact and easy to use. With a simple yet **intelligent user interface** they contribute to **short training periods** and **improved staff utilization**, as well as **improved patient outcomes** and **shorter periods in ICU**. They combine battery backup, nebulizer and oxygen monitoring in a single unit, making them easy to deploy.

Non-Invasive Ventilation (NIV) is standard on all models in the RAPHAEL range. As well as making RAPHAEL an even better price/performance proposition, this extended feature set ensures **enhanced flexibility** for better patient care.

Responsive support

Our global network of representative organizations provides expert service, training and support. By providing **'one stop' access** to resources, skills, accessories, parts and maintenance, we help you to keep running costs down and maximize 'up time'. RAPHAEL systems incorporate advanced diagnostics which make troubleshooting and technical resolution **fast and effective**.





1. Monitored values, graphics, and test/calibration functions
2. Alarm silence
3. Pneumatic nebulizer connection
4. To patient
5. Pre-oxygenation
6. Manual breath/inspiratory hold/disconnection suspense
7. Nebulizer
8. Stand-by
9. Integrated oxygen monitor
10. Flow sensor connections
11. Expiratory valve/from patient
12. Control knob (press and turn) and model identification
13. Ventilation mode, ventilation parameters and alarm settings

True value

Compact and complete
 Supplied with battery backup, nebulizer and oxygen monitoring, in a space-saving design

Versatile application
 All conventional and advanced ventilation modes

Ergonomic user interface
 Designed to provide easy access to all functions

Standby mode
 Patient-specific settings are stored by the system and can be restored quickly after interruptions

Fast set-up
 Quick selection of parameters and modalities

Individual presetting
 Customizable to hospital-specific ventilation philosophies

Patient-oriented monitoring
 Unique Flow Sensor at airway opening

Event log
 Stores the last 1000 events

Trending
 Selectable 1-hour, 12-hour or 24-hour trends

Dynamic loops
 Configurable from airway pressure, volume, and flow measurements

Active inspiratory and expiratory valves
 Permit free breathing in all modes

Customizable solution
 Configurable with compressor and/or oxygen bottle holder for maximum flexibility and independence

RAPHAEL Color

RAPHAEL Silver

RAPHAEL

www.hamilton-medical.com

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The RAPHAEL Color ventilator is intended for use at the bedside and for transport within a hospital or hospital-type facility.

- Biphasic ventilation concept
- Compact design
- Noninvasive ventilation (NIV)
- Unique user interface
- Proximal flow/pressure measurement
- Bidirectional apnea backup
- Comprehensive monitoring
- Individual presetting
- Easy last startup
- Adaptive Support Ventilation mode (ASV)
- Tube resistance compensation (TRC)
- Loops and trends

Controls	
Bodyweight	5 - 200 kg
Ventilation modes	(S)CMV+, SIMV+, PCV+, PSIMV+, SPONT
Special modes	NIV, ASV, DuoPAP, APRV
Mode additions	Tube resistance compensation (TRC) 0 - 100% compensation, ET tube, trach tube
Special functions	Manual breath, inspiratory hold, disconnection suppression, nebulizer, 100% O ₂ , stand-by, sigh, bidirectional apnea backup, leak compensation, last setup
(S)CMV+ rate	8 - 80 b/min
PCV+ rate	4 - 80 b/min
SIMV+, PSIMV+, DuoPAP rate	1 - 80 b/min
Tidal volume	50 - 2000 ml
PEEP/CPAP and P low	0 - 35 cmH ₂ O
Oxygen	21 - 100%
I:E ratio	1:9 - 4:1 (I:E, TE, and TI are always visible)
Inspiratory time	0.1 - 9.6 s (PSIMV+, SIMV+)
T low (APRV)	0.2 - 30 s
T high (DuoPAP and APRV)	0.1 - 30 s
Trigger (flow)	Off, 1 - 10 l/min
Baseflow	0 - 10
ETS	5 - 70% of inspiratory peak flow
Pramp	50 - 200 ms
Pressure control	5 - 50 cmH ₂ O above PEEP/CPAP
Pressure support	0 - 50 cmH ₂ O above PEEP/CPAP
P high (DuoPAP and APRV)	0 - 75 cmH ₂ O
Pasvlimit	5 - 70 cmH ₂ O
% minute volume (ASV)	25 - 350%
Apnea time	15 - 60 s
Flow (automatic)	0 - 120 l/min typical, 180 l/min maximum
Patient monitoring	
Pressures	PEEP/CPAP, Ppeak, P _{insp} , P _{mean}
Volume	Spontaneous and total expiratory minute volume, VTE, leak in %
Flow	Inspiratory peak flow, expiratory peak flow
Time	I:E ratio, TI, TE, total and spontaneous frequency
Others	Resistance, compliance, AutoPEEP, trigger, O ₂ , RCexp

Real-time curves	Volume, flow, pressure
Loops	Pressure-volume, volume-flow, pressure-flow
Trends	1 h, 12 h, 24 h, of 19 monitored parameters
ASV graphics	Target and actual values for minute ventilation, tidal volume, and rate
Alarms	
Low/high ExpMinVol	0.1 - 50 l/min
Pmax	15 - 80 cmH ₂ O
Low/high fTotal	0 - 99 b/min
O ₂ %	± 5% of setting, 18% minimum, 105% maximum
Apnea	15 - 60 s
Other	Disconnection, pressure limitation, Flow Sensor, gas supply, electrical supply, battery low, exhalation obstructed, user messages, technical alarms
Event log	Storage and display of up to 1000 events with time stamp
Electrical and gas supplies	
Input voltage	100 to 125 and 200 to 240 V~, 50/60 Hz
Power consumption	40 VA typical
Backup battery time	Typically 60 minutes
O ₂ and air supply	200 to 600 kPa (29 to 86 psi), 120 l/min
Physical dimensions	
W x D x H	23 x 53 x 35 cm (9.1 x 20.9 x 13.8 in.) 46 x 66 x 140 cm (18.1 x 28.0 x 55.1 in.) on trolley with compressor
Weight	17 kg (37 lb) ventilator only 46 kg (101 lb) ventilator on trolley 77 kg (170 lb) ventilator on trolley with compressor
Display	5.7 in., backlit, TFT color
Standards	IEC 601-1/EN 60601-1, IEC 601-1-2/ EN 60601-1-2, EN 794-1, SN EN 12598, EN 60601-2-12
Hardware options	Communications interface (RS-232, nurse call, I:E ratio)
Note	1 hPa = 1 mbar ≈ 1 cmH ₂ O

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