

Requerimentos mínimos de performance de ventiladores para cuidado intensivo

Fonte principal: ECRI (*Emergency Care Research Institute*) – www.ecri.org

1. Capacidade de oferecer os modos básicos de ventilação, como CMV (Continuous Mandatory Ventilation); A/C (assist/control); SIMV (synchronized intermittent mandatory ventilation); PSV (pressure support ventilation).

Conceitos:

CMV: Breaths are delivered at preset intervals, regardless of patient effort. This mode is used most often in the paralyzed or apneic patient because it can increase the work of breathing if respiratory effort is present. Continuous mandatory ventilation (CMV) has given way to assist-control (A/C) mode because A/C with the apneic patient is tantamount to CMV. Many ventilators do not have a true CMV mode and offer A/C instead.

A/C: The ventilator delivers preset breaths in coordination with the respiratory effort of the patient. With each inspiratory effort, the ventilator delivers a full assisted tidal volume. Spontaneous breathing independent of the ventilator between A/C breaths is not allowed. As might be expected, this mode is better tolerated than CMV in patients with intact respiratory effort.

PSV: or the spontaneously breathing patient, pressure support ventilation (PSV) has been advocated to limit barotrauma and to decrease the work of breathing. Pressure support differs from A/C and IMV in that a level of support pressure is set to assist every spontaneous effort. Airway pressure support is maintained until the patient's inspiratory flow falls below a certain cutoff (eg, 25% of peak flow). The patient determines the tidal volume, respiratory rate, and flow rate.^[3] With some ventilators, there is the ability to set a back-up IMV rate should spontaneous respirations cease.

PSV is frequently the mode of choice in patients whose respiratory failure is not severe and who have an adequate respiratory drive. It can result in improved patient comfort, reduced cardiovascular effects, reduced risk of barotrauma, and improved distribution of gas.

Fonte: Medscape (<https://www.medscape.com/answers/810126-45467/what-is-pressure-support-ventilation-psv>)

2. Bateria de backup
3. Preferencialmente transportável
4. Recomenda-se implementar modos paciente-responsivos e paciente-adaptivos (verificar clinicamente necessidade para o modelo em questão)
5. Prover alarmes visuais E audíveis, distintos e fáceis de identificar, para:
 - a. FiO₂ (limites inferior E superior)
 - b. *Minute volume* (limites inferior E superior)
 - c. Pressão inspiratória (limites inferior E superior)
 - d. Perda de PEEP (*positive end-expiratory pressure*)
 - e. Alta PEEP

- f. Apneia
 - g. Alta pressão/oclusão contínua
 - h. Razão I/E inversa
 - i. Alta taxa respiratória
 - j. Desconexão de circuito respiratório
 - k. Falha de suprimento de gás
 - l. Falha de energia
 - m. Inoperância do ventilador
 - n. Baixa bateria
 - o. Autoteste
6. Os alarmes silenciados devem ser automaticamente reativados após 2 minutos, caso a condição não seja corrigida. Mesmo silenciados, um aviso em tela deve ser mantido para indicar qual alarme foi desabilitado.
 7. A concentração de oxigênio entregue deve ser continuamente monitorada com um analisador de O₂, que inclua um alarme para reportar se a concentração está fora do range sperado (por exemplo, +/-5% do FiO₂ setado). Idealmente, esse analisador deve ser incorporado ao ventilador; caso não seja possível, um *add-on* é aceitável.
 8. Prover usabilidade a controles e chaves, de forma que sejam claramente identificados, evite confusão de símbolos, disponibilização confusa dos controles no painel e no visor. A função dos controles deve ser intuitiva e auto-evidente.
 9. Prover controle contra acidentes que possam atingir os botões e alterar os parâmetros setados, bem como proteção contra respingos de fluidos.
 10. Fornecer o equipamento já testado com os tipos de circuitos de gás para os quais o sistema seja compatível. Poderá informar nome comercial, registro no Ministério da Saúde, ou parâmetros (ex: calibre, tipos de conexão etc.) que garantam a segurança da conexão. Observar que, pela RDC 356/2020, os circuitos e conexões respiratórias estão extraordinariamente dispensados do registro de AFE (Autorização de Funcionamento). Porém, sua fabricação deve obedecer às boas práticas aplicáveis a produtos para a saúde.

Exemplos de range de parâmetros de equipamentos no mercado

Tidal volume, mL	10-2,000
Respiratory rate, breaths/min	0-180
Trigger mechanism	Pressure, flow
FiO ₂ , %	21-100
Inspiratory flow rate, L/min	2-120 (controlled), 0-150 (demand)

Flow pattern/waveform adjustment	Square, decreasing
Inspiratory pressure, cm H2O	5-80
IE ratio	1:99 to 3:1 (indirectly adjustable)
Sigh breath function	Yes
PEEP/CPAP, cm H2O	0-50
Pressure support, cm H2O	0-80
Leak compensation	Yes
Auto 100%/Increase O2 button	No
Control panel lock	No
PATIENT ASSESSMENT TOOLS	
Maximum waveforms displayed	5 (2 simultaneous)
Maximum trending time	24 hr
Lung recruitment tools (PV loops)	Yes
Lung mechanics visualization tool	No
Capnography/CO2 monitoring	No
Esophageal/transpulmonary pressure monitoring	No
Other patient assessment tools	Waveforms differentiation by color (inspiratory/expiratory)
INTEGRATED CAPABILITIES	
Integrated nebulizer	Yes
Pulse oximetry	No
Heliox compatibility	No

Other integrated capabilities	TGI
MONITORED/DISPLAYED PARAMETERS	
Peak inspiratory pressure	Yes
Mean airway pressure	Yes
PEEP pressure	Yes
Tidal volume	Yes
Minute volume	Yes
Spontaneous minute volume	No
FiO2 (analyzed %)	Yes
Respiratory rate	Yes
Inspiratory time	Yes
Expiratory time	No
IE ratio	Yes
Others	Plateau pressure, peak flow (inspiratory and expiratory), patient resistance (inspiratory and expiratory), patient compliance (static and dynamic), work of breathing index (RSBI), negative inspiratory pressure, WOB, graphics (PxT, FxT, VxT, FxV), trends (PIP, PEEP, rate, tidal volume, resistance, compliance)
PATIENT ALARMS	
Low/high FiO2	Yes
Low minute volume	Yes
High minute volume	No
Low inspiratory pressure	Yes
High pressure	Yes
Loss of PEEP	Yes

Apnea	Yes
Continuous high pressure/occlusion	Yes
Inverse IE ratio	No
High respiratory rate	No
High PEEP	Yes
Breathing circuit disconnect	Yes
Others	None
EQUIPMENT ALARMS	
Gas supply failure	Yes
Power failure	Yes
Vent inoperative	Yes
Low battery	Yes
Self-diagnostics	No
Others	None
DISPLAY	
Type	LCD (320 x 240 pixels)
Size, cm (in)	14.4 (5.7)
PATIENT TRANSPORT CAPABILITY	
Optional equipment required for patient transport	Cart
Hand-carried during transport	No
APPROVED FOR AIRCRAFT USE	No

Approved by	NA
ON-BOARD AIR COMPRESSOR OR TURBINE	No
Power source	NA
MRI CONDITIONAL	No
Magnetic field strength, T	NA
Gauss line restriction, G	NA
LINE POWER, VAC	100-240
Current, amps	0.22-0.5
Watts	50
INTERNAL BACK-UP BATTERY	Yes
Type (number)	Lead-acid 12 V/2.2 A-h (1)
Operating time, hr	2
Rechargeable	Yes
Recharging time, hr	10
EXTERNAL BACK-UP BATTERY	No
Type (number)	NA
Operating time, hr	NA
Rechargeable	NA
Recharging time, hr	NA
PHYSICAL FEATURES	
H x W x D, cm (in)	33.5 x 29 x 31.5 (13.1 x 11.4 x 12.4)
Weight, kg (lb)	16 (35.3)
PREVENTIVE MAINTENANCE	Yes

Recommended frequency

1 year