

HAMILTON-MR1

Technical specification for SW version 3.1.x

Ventilation modes

Standard: ✓ Option: O Not applicable: --

Mode form	Mode name	Mode	Adult/Ped	Neonatal
Volume-targeted modes, adaptive pressure controlled	APVcmv / (S)CMV+	Breaths are volume targeted and mandatory.	✓	✓
	APVsimv / SIMV+	Volume-targeted mandatory breaths can be alternated with pressure-supported spontaneous (patient-triggered) breaths.	✓	✓
	VS	Breaths are flow cycled and deliver a set tidal volume to support patient-initiated breaths.	✓	✓
Pressure-controlled modes	PCV+	All breaths, whether triggered by the patient or the ventilator, are pressure controlled and mandatory.	✓	✓
	PSIMV+	Mandatory breaths are pressure controlled. Mandatory breaths can be alternated with pressure-supported spontaneous (patient-triggered) breaths.	✓	✓
	DuoPAP	Mandatory breaths are pressure controlled. Spontaneous breaths can be triggered at both pressure levels.	O	O
	APRV	Spontaneous breaths can be continuously triggered. The pressure release between the levels contributes to ventilation.	O	O
	SPONT	Every breath is spontaneous, with or without pressure support.	✓	✓
Intelligent ventilation	ASV	Operator sets %MinVol, PEEP, and oxygen. Rate, tidal volume, inspiratory pressure, and I:E ratio are based on physiological input from the patient.	✓	--
Noninvasive modes	NIV	Every breath is spontaneous.	O	O
	NIV-ST	Every breath is spontaneous as long as the patient is breathing above the set Rate. A backup Rate can be set for mandatory breaths.	O	O
	nCPAP	Demand flow nasal continuous positive airway pressure.	--	O
	nCPAP-PC	Breaths are pressure controlled and mandatory.	--	O
	HiFlowO2	High flow oxygen therapy. No supported breaths.	O	O

Standard configuration and options (in alphabetical order)

Standard: ✓ Option: O Not applicable: --

Functions	Adult/Ped	Neonatal
CPR ventilation	✓	✓
Dynamic Lung	✓	--
Event log (up to 10,000 events with date and time stamp)	✓	✓
IntelliSync®+ (inspiratory and expiratory trigger synchronization) ¹	O	--
IntelliTrig (leak compensation)	✓	✓
Languages (English, US English, Chinese, Croatian, Czech, Danish, Dutch, Finnish, French, German, Greek, Hungarian, Indonesian, Italian, Japanese, Korean, Norwegian, Polish, Portuguese, Romanian, Russian, Serbian, Slovak, Spanish, Swedish, Turkish, Ukrainian)	✓	✓
Manual breath/prolonged inspiration	✓	✓
Nebulization, pneumatic	✓	--
O2 enrichment	✓	✓
On-screen help	✓	✓
Patient group	✓	O
Print screen	✓	✓
Screen lock	✓	✓
Speak valve compatibility	O	--
Standby with timer	✓	✓
Suctioning tool	✓	--
TeslaSpy: Integrated magnetic field navigator	✓	✓
Trends/Loops	O	O
USB port	✓	✓
Vent Status (visual representation of patient's ventilator dependence)	✓	✓

¹ Available for HAMILTON-MR1 PN 1610100 only.

Technical performance

Description	Specification
Automatic expiratory base flow	<i>Adult/Ped:</i> Fixed at 3 l/min <i>Neo:</i> Fixed at 4 l/min
Inspiratory pressure	0 to 60 cmH ₂ O
Maximum limited pressure	60 cmH ₂ O
Maximum working pressure	<i>Adult/Ped:</i> 60 cmH ₂ O (total inspiratory pressure); ensured through pressure limiting <i>Neo:</i> 45 cmH ₂ O (limitation depending on frequency)
Maximum inspiratory flow	260 l/min (120 l/min with 100% O ₂)
Means of inspiratory triggering	Flow trigger control
Minimum expiratory time	20% of cycle time; 0.2 to 0.8 seconds
Minute volume capability	Up to 60 l/min
Oxygen mixer accuracy	± (volume fraction of 2.5% + 2.5% of actual reading)
Tidal volume	<i>Adult/Ped:</i> 20 to 2000 ml <i>Neo:</i> 2 to 300 ml
Preoperational checks	Leak test, flow sensor/circuit/O ₂ sensor calibration
Display device	Display of settings, alarms, and monitored data <i>Type:</i> Color TFT <i>Size:</i> 640 x 480 pixels, 8.4 in (214 mm) diagonal
Brightness setting for display	The range is 10% to 100% brightness. By default, Day = 80%; Night = 40%.
Alarm volume (loudness) ²	The range is 1 to 10. The default setting is 5.
Sound power level ³	50 dB(A) ± 3dB(A)
Sound pressure level ³	42 dB(A) ± 3dB(A)

² Volume at 1 meter distance from ventilator. A setting of 1 = 62 dB(A), 5 = 76 dB(A), and 10 = 85 dB(A), with accuracy of ±3 dB(A).

³ Per ISO 80601-2-12.

Approvals

Description	Specification
Classification	Class IIb, according to Regulation (EU) 2017/745
Declaration	The HAMILTON-MR1 was developed in accordance with pertinent international standards and FDA guidelines. The ventilator is manufactured under a QMS system as required by EN ISO 13485, ISO 9001, and article 10(9) of Regulation (EU) 2017/745. The ventilator meets the general safety and performance requirements according to Regulation (EU) 2017/745, Annex I.
Electromagnetic compatibility	The HAMILTON-MR1 complies with the IEC 60601-1-2 EMC (Electromagnetic Compatibility) Collateral Standard.
Safety class	Class I, Type B applied part (ventilator breathing system, VBS, and CO2 sensor including CO2 module connector), continuous operation according to IEC 60601-1

Pneumatic performance

Component	Specifications
High-pressure oxygen inlet	Pressure: 2.8 to 6 bar / 41 to 87 psi
	Flow: Maximum of 200 l/min
	Connector: DISS (CGA 1240) or NIST
Air supply	Integrated blower
Gas mixing system	Delivered flow: <ul style="list-style-type: none"> > 260 l/min \pm10% against ambient pressure (at sea level) > 200 l/min with 100% oxygen
	Delivered pressure: <ul style="list-style-type: none"> <i>Adult/Ped</i>: 0 to 60 cmH2O <i>Neo</i>: 0 to 45 cmH2O
	Flow accuracy: \pm 10% or \pm 300 ml/min (whichever is greater)
	Connector: ISO ID15/OD22 conical
Inspiratory outlet (<i>To patient</i> port)	Connector: ISO ID15/OD22 conical
Expiratory outlet (<i>From patient</i> port)	Connector (on expiratory valve): ISO ID15/OD22 conical

Electrical specifications

Element	Specifications
Input power	100 to 240 VAC, 50/60 Hz
Power consumption	90 VA typical, 180 VA maximum
Battery	<p>Hamilton Medical provides two high-capacity batteries⁴.</p> <p>Electrical specifications: 10.8 VDC, 6.7 Ah, 72 Wh</p> <p>Type: Lithium-ion, supplied by Hamilton Medical only</p> <p>Recharge time: While the ventilator is connected to primary power, approximately 3.25 h to fully recharge one battery, approximately 6.25 h to fully recharge two batteries.</p> <p>Storage: -20°C to 60°C, ≤ 85% relative humidity. The storage location should be free from vibration, dust, direct sunlight, moisture, and corrosive gases, and with a recommended temperature range < 21°C.</p> <p>Extended exposure to temperatures above 45°C can degrade battery performance and life.</p> <p>Normal operating time: Operating times are measured with two fully charged batteries, the blower in use, and with the following settings: Mode = PCV+, Rate = 10 b/min, ΔPcontrol = 10 cmH₂O, I:E = 1:4, PEEP = 5 cmH₂O, Flow trigger = 5 l/min, FiO₂ = 40%.</p> <p>Approximate operating times under these conditions are as follows:</p> <ul style="list-style-type: none"> • Display brightness = 80%: 8 h • Display brightness = 20%: 9.25 h <p>This operating time applies to new, fully charged Li-ion batteries that have not been exposed to extreme temperatures. The actual operating time depends on battery age and on how the battery is used and recharged. To ensure maximum battery life, maintain a full charge and minimize the number of complete discharges.</p>

MR Clearance

MR Conditional	1.5 and 3.0 T static magnetic field
Maximum proximity to MRI scanner	50 mT
Gaussmeter	TeslaSpy

⁴ PN 369108, revision 4 and later.

Graphical patient data

Graphic type/tab name	Options
Waveforms	Pressure, Volume, Flow
Intelligent panels	Dynamic Lung ⁵ , Vent Status, ASV Graph ⁶
Trends	1-, 6-, 12-, 24-, or 72-h ⁷ trend data for a selected parameter or combination of parameters
Loops	Pressure/Volume, Pressure/Flow, Volume/Flow

Alarms

Priority	Alarm
High priority	Apnea, Oxygen high/low, Minute volume high/low, Pressure high/low, High Pressure during Sigh, Pressure not released, Flow sensor calibration needed (during ventilation), Check flow sensor tubing, Check flow sensor, Check patient interface, External flow sensor failed, Replace O2 sensor, Oxygen supply failed, Buzzer defective, Loudspeaker defective, Disconnection on patient/ventilator side, Exhalation obstructed, Obstruction, Options not found, Self test failed, Blower fault, Device temperature high, Vent outlet temperature high Battery low, Battery power loss, Battery totally discharged, Battery 1,2: Temperature high, Battery communication error, Battery 1,2: Defective TeslaSpy service required, TeslaSpy defective, Service required
Medium priority	High Flow, Frequency high/low, Vt high/low, Inspiratory volume limitation, High PEEP, Loss of PEEP, Pressure limitation, Wrong expiratory valve, Circuit calibration needed, Flip the flow sensor, Check flow sensor for water (Neo), Check for blockage, Fan failure, Function key not operational, Performance limited by high altitude, Real-time clock failure, Battery low, Check TeslaSpy communication, Move away from MRI scanner
Low priority	Check Plimit, ASV: Cannot meet the target, Maximum leak compensation, Pressure limit has changed, CPR ON, JTAG not working, SpeakValve ON/OFF, Suctioning maneuver, Apnea ventilation/Apnea ventilation ended, Preventive maintenance required, Replace HEPA filter, Blower service required, Loss of external power, IRV (inverse ratio ventilation), Release valve defective, Touch not functional, Check settings, Flow sensor calibration needed (in Standby) Battery 1,2: Calibration required, Battery 1,2: Replacement required, Battery 1,2: Wrong battery, Battery low O2 sensor calibration needed, O2 sensor defective, O2 sensor missing, O2 sensor not system compatible

⁵ Only for adult/pediatric patients.

⁶ Only in ASV mode.

⁷ 72-hour trend not available in all markets

Control settings and ranges

Parameter (units)	Range Adult/Ped ⁸	Range Neonatal ⁸
%MinVol (%) ⁹	25 to 350	--
Apnea backup	On, Off	On, Off
ETS (%)	5 to 80	5 to 80
Flow (l/min) ¹⁰	2 to 100 ¹¹	2 to 30
I:E ¹²	1:9 to 4:1	1:9 to 4:1
IBW (kg) (<i>calculated</i>)	3 to 139	--
Oxygen (%)	21 to 100	21 to 100
P high (cmH2O) (in APRV)	0 to 60	0 to 45
P high (cmH2O) (in DuoPAP)	0 to 60	3 to 45
P low (cmH2O) (in APRV)	0 to 35	0 to 25
Pat. height		
(cm)	30 to 250	--
(in)	12 to 98	
PEEP/CPAP (cmH2O)	0 to 35	3 to 25
Plimit (cmH2O)	5 to 60	5 to 45
P-ramp (ms) ¹³	0 to 2000 <i>ASV, NIV, NIV-ST, SPONT, VS: max = 200</i>	0 to 600 <i>NIV, NIV-ST, SPONT, nCPAP-PC, VS: max = 200</i>
Rate (b/min) ¹⁴	1 to 80 <i>APVcmv, PCV+: 4 to 80</i> <i>PSIMV+, NIV-ST: 5 to 80</i>	1 to 80 <i>PSIMV+: 5 to 80</i> <i>APVcmv, PCV+, PSIMV+PSync, nCPAP-PC, NIV-ST, APVsimv + Apnea backup: 10 to 80</i>
Sex	Male, Female	--
Sigh	On, Off	--
SpeakValve	On, Off	--
T high (s) (in APRV and DuoPAP) ¹⁴	0.1 to 40.0	0.1 to 40.0
T low (s) (in APRV)	0.2 to 40.0	0.2 to 40.0
TI (s) ^{12,14,15}	0.1 to 12.0	0.1 to 12.0
TI max (s)	0.5 to 3.0	0.25 to 3.0
Trigger, expiratory: ETS (Expiratory trigger sensitivity)	ETS, IntelliSync+ ¹⁶	ETS
Trigger, flow (l/min) ¹⁷	0.5 to 20.0 <i>APVcmv, PCV+: 0.5 to 20.0 / Off</i>	0.1 to 5.0 <i>APVcmv, PCV+: 0.1 to 5.0 / Off</i>
Trigger, inspiratory: flow	Flow trigger, IntelliSync+ ¹⁶	Flow trigger

⁸ Parameter settings and ranges can vary depending on the selected mode.

⁹ Only in ASV mode.

¹⁰ Only for high flow oxygen therapy.

¹¹ In some markets, the maximum possible Flow setting may be limited.

¹² In PCV+, (S)CMV+, and APVcmv modes, mandatory breath timing can be controlled by using a combination of inspiratory time (TI) and Rate, or by the I:E ratio; set the method in Configuration. All other modes are controlled by using a combination of inspiratory time (TI) and Rate.

¹³ P-ramp is limited to one-third (1/3) of TI time. Adjustment of TI time can override the P-ramp setting.

¹⁴ Startup setting derived from IBW (adult/pediatric), body weight setting (neonatal). Does not apply in ASV mode.

¹⁵ Inspiratory time; used with Rate to set the breath cycle time.

¹⁶ Not available in all markets.

¹⁷ Flow trigger is leak compensated.

Parameter (units)	Range Adult/Ped ⁸	Range Neonatal ⁸
Vt (ml)	20 to 2000	2 to 300
Vt/IBW	5 to 12	5 to 12
Vt/Weight (ml/kg) ¹⁸		
Weight (kg)	--	0.2 to 30.0
$\Delta P_{control}$ (cmH ₂ O) ¹⁹	5 to 60	3 to 45 <i>nCPAP-PC</i> : 0 to 45
ΔP_{insp} (cmH ₂ O) ¹⁹	3 to 60	3 to 45
$\Delta P_{support}$ (cmH ₂ O) ¹⁹	0 to 60	0 to 45

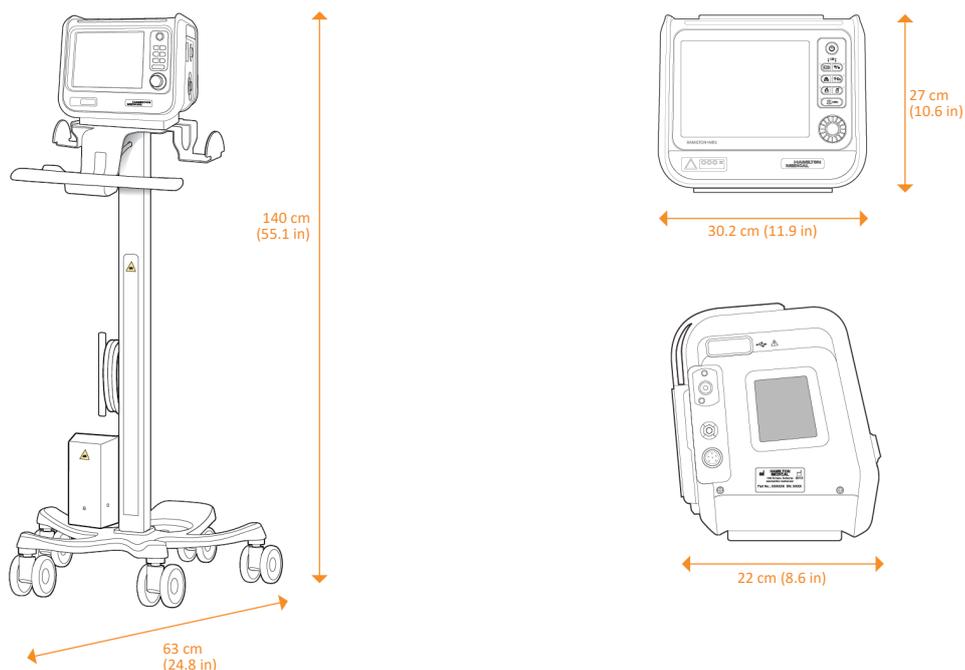
¹⁸ IBW is calculated using height and sex, for adult and pediatric patients. Actual body weight is used for neonates.

¹⁹ $\Delta P_{control}$: Control pressure, added to PEEP/CPAP. ΔP_{insp} : Inspiratory pressure, added to PEEP/CPAP. $\Delta P_{support}$: Pressure support, added to PEEP/CPAP.

Monitoring parameters

Parameter (units)	Description		
Pressure	AutoPEEP (cmH2O)	Unintended positive end-expiratory pressure	
	PEEP/CPAP (cmH2O)	PEEP (positive end-expiratory pressure) and CPAP (continuous positive airway pressure)	
	Driving pressure, ΔP (cmH2O)	Driving pressure, calculated value reflecting the difference between Pplateau and PEEP	
	ΔP_{insp} (cmH2O)	Inspiratory pressure	
	Pmean (cmH2O)	Mean airway pressure	
	Ppeak (cmH2O)	Peak airway pressure	
	Pplateau (cmH2O)	Plateau or end-inspiratory pressure	
	Pprox (cmH2O)	Airway pressure at proximal patient interface	
Flow	Flow (l/min)	HiFlowO2: The set flow of gas to the patient nCPAP: The average flow updated every second nCPAP-PC: The average flow during expiration, updated every breath	
	Insp Flow (peak) (l/min)	Peak inspiratory flow, spontaneous or mandatory	
	Exp Flow (peak) (l/min)	Peak expiratory flow	
	Volume	ExpMinVol or MinVol NIV (l/min)	Expiratory minute volume
		MVSpont or MVSpont NIV (l/min)	Spontaneous expiratory minute volume
VTE or VTE NIV (ml)		Expiratory tidal volume	
VTESpont (ml)		Spontaneous expiratory tidal volume	
VTI (ml)		Inspiratory tidal volume	
VLeak (%)		Leakage percent or total minute volume leakage	
MVLeak (l/min)		Leakage percent or total minute volume leakage	
Vt/IBW or Vt/Weight (ml/kg)		Tidal volume is calculated by ideal body weight (adult/pediatric patients) or actual body weight (neonatal patients)	
Oxygen	Oxygen (%)	Oxygen concentration of the delivered gas	
	O2 consumption (l/min)	The current oxygen consumption rate	
Time	CPR timer	MMP during CPR ventilation showing duration of CPR ventilation	
	I:E	Ratio of the patient's inspiratory time to expiratory time for every breath cycle	
	fControl (b/min)	Mandatory breath frequency	
	fSpont (b/min)	Spontaneous breathing frequency	
	fTotal (b/min)	Total breathing frequency	
	TI (s)	Inspiratory time	
	TE (s)	Expiratory time	
	Lung mechanics	Cstat (ml/cmH2O)	Static compliance
P0.1 (cmH2O)		Airway occlusion pressure	
PTP (cmH2O*s)		Pressure time product	
RCexp (s)		Expiratory time constant	
Rinsp (cmH2O / (l/s))		Inspiratory flow resistance	
RSB (1 / (l*min))		Rapid shallow breathing index	

Physical characteristics



Dimension	Specifications
Weight	6.8 kg (15 lb) 21 kg (46.2 lb) with trolley The trolley can accommodate a maximum safe working load ²⁰ of 44 kg (97 lb).
Dimensions	See figures above
Monitor	Type: Color TFT Size: 640 x 480 pixels, 8.4 in (214 mm) diagonal
Trolley accessories	MR1 safety tether for trolley
Gas cylinder	
Diameter	100 to 140 mm (3.9 to 5.5 inches)
Height	≤ 820 mm (32 inches)
Weight	≤ 8 kg (17.6 lb)

²⁰ The maximum safe working load applies to a stationary, properly load-balanced trolley.



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