

HAMILTON-S1

Technical specifications for SW version 2.80

Ventilation modes

Mode form	Mode name	Mode	Adult/Ped	Neonatal
Volume-controlled, flow-controlled	(S)CMV	Breaths are volume controlled and mandatory, including patient triggered breaths.	✓	--
	SIMV	A fixed rate is set for volume-controlled mandatory breaths. These breaths can be alternated with pressure-supported spontaneous breaths.	✓	--
Volume-controlled, flow cycled	VS	Breaths are flow cycled and deliver a set tidal volume to support patient-initiated breaths.	✓	✓
Volume-targeted, adaptive pressure- controlled	APVcmv	Breaths are volume targeted and mandatory.	✓	✓
	APVsimv	Volume-targeted mandatory breaths can be alternated with pressure-supported spontaneous breaths.	✓	✓
Pressure-controlled	P-CMV	All breaths, whether triggered by either the patient or the ventilator, are pressure controlled and mandatory.	✓	✓
	P-SIMV	Mandatory breaths are pressure controlled. Mandatory breaths can be alternated with pressure-supported spontaneous breaths.	✓	✓
	DuoPAP	Mandatory breaths are pressure controlled. Spontaneous breaths can be triggered at both pressure levels.	✓	✓
	APRV	Spontaneous breaths can be continuously triggered. The pressure release between the levels contributes to ventilation.	✓	✓
	SPONT	Every breath is spontaneous, with or without pressure-supported spontaneous breaths.	✓	✓
Intelligent ventilation	ASV®	Operator sets %MinVol, PEEP, and Oxygen. Frequency, tidal volume, pressure, and I:E ratio are based on physiological input from the patient.	✓	--
	INTELLIVENT®-ASV	Fully automated management of ventilation and oxygenation based on physiological input from the patient. The underlying mode is ASV.	✓	--
Noninvasive ventilation	NIV	Every breath is spontaneous.	✓	--
	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.	✓	--
	nCPAP-PS	Every breath is spontaneous as long as the patient is breathing above the set rate. A backup rate can be set for mandatory breaths.	--	0
	Hi Flow O2	High flow oxygen therapy. No supported breaths.	✓	✓

Standard: ✓ Option: 0 Not applicable: --



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Intelligent Ventilation since 1983

Standard configuration and options (in alphabetical order)

Functions	Adult / Ped	Neonatal
Adjustable O2 enrichment	✓	✓
Adjustable Volume limitation	--	✓
Capnography, mainstream (volumetric) and sidestream	O	O
Communication ports: CompactFlash, USB, DVI, COM (RS-232), Special interface	✓	✓
Communication protocols: for details see Connectivity brochure	O	O
Distributed alarm system (DAS) compatible	✓	✓
Dynamic Lung (real-time visualization of the lungs)	✓	--
Event log (up to 1000 events with date and time stamp)	✓	✓
HAMILTON-H900 humidifier control via ventilator	O	O
Heliox ventilation	O	O
Inspiratory and expiratory hold maneuver	✓	✓
IntelliCuff integrated cuff pressure controller	✓	✓
IntelliSync+ (automatic inspiratory and expiratory trigger synchronization)	✓	--
IntelliTrig (leak compensation)	✓	✓
Languages (English, US English, Bulgarian, Chinese, Croatian, Czech, Danish, Dutch, Finnish, French, German, Greek, Hungarian, Indonesian, Italian, Japanese, Korean, Norwegian, Polish, Portuguese, Romanian, Russian, Serbian, Slovakian, Spanish, Swedish, Turkish)	✓	✓
Manual breath / prolonged inspiration	✓	✓
Nebulization (Aerogen ⁵)	O	O
Nebulization (pneumatic)	✓	--
P/V Tool [®] Pro	✓	✓
Paramagnetic O2 sensor	O	O
Patient group	✓	O
Paux port	✓	✓
Print screen	✓	✓
Screen lock	✓	✓
Second battery (hot-swappable)	O	O
SpO2 monitoring	✓	✓
Standby with timer	✓	✓
Suctioning tool	✓	✓
Transpulmonary pressure monitoring	✓	✓
TRC (tube resistance compensation)	✓	✓
Trends/Loops	✓	✓
Trigger, expiratory: ETS	✓	✓
Trigger, inspiratory: flow, pressure	✓	✓
Vent Status (Visual representation of ventilator dependency)	✓	✓

Standard: ✓ Option: O Not applicable: --

Technical performance data (in alphabetical order)

Description	Specification
Automatic expiratory base flow	<p>Adult/Pediatric.</p> <p>Pressure trigger: 1 l/min</p> <p>Flow trigger setting ≤ 2 l/min: 4 l/min</p> <p>Flow trigger setting > 2 l/min: 2 * Flow trigger</p> <p>Trigger OFF: 1 l/min</p> <p>IntelliSync+: 4 l/min</p> <p>Neonatal.</p> <p>Pressure trigger: 1 l/min</p> <p>Flow trigger setting ≤ 1 l/min: 2 l/min</p> <p>Flow trigger setting > 1 l/min: 2 * Flow trigger max. 6 l/min</p> <p>Trigger OFF: 1 l/min</p>
Inspiratory pressure	0 to 120 cmH ₂ O
Maximum inspiratory flow	180 l/min peak flow, max. 120 l/min continuous flow
Means of inspiratory triggering	Flow, pressure, or optional IntelliSync+ trigger control
Means of expiratory triggering	ETS or optional IntelliSync+ control
Minimum expiratory time	20% of cycle time; 0.1 to 0.8 s
Oxygen mixer accuracy	± (Volume fraction of 2.5% + 2.5% of actual reading)
Preoperational checks	Tightness test, Flow Sensor/O ₂ sensor/CO ₂ sensor calibration
Tidal volume	<p>Adult/Ped: 20 to 2000 ml</p> <p>Neonatal: 2 to 200 ml</p>

Standards and approvals

Classification	Class IIb, continuously operating according to EC directive 93/42/EEC
Certification	EN 60601-1:2006/A1:2013, IEC 60601-1-2:2014, ANSI/AAMI ES60601-1:2005/(R)2012, ISO 80601-2-12:2011, CAN/CSA-C22.2 NO. 60601-1:14, EN ISO 5356-1:2015, ISO 80601-2-55:2011
Declaration	The HAMILTON-S1 was developed in accordance with pertinent international standards and FDA guidelines. The ventilator is manufactured within an EN ISO 13485 and EN ISO 9001, Council Directive 93/42/EEC, Annex II, Article 1 certified quality management system. The ventilator meets the Essential Requirements of Council Directive 93/42/EEC, Annex I.
Electromagnetic compatibility	According to IEC 60601-1-2:2014
Safety Class	Class I, Type B applied part (ventilator breathing system, VBS), type BF applied parts CO ₂ sensor including CO ₂ module connector, humidifier, Aerogen [®] system, nebulizer, and SpO ₂ sensor including SpO ₂ adapter, continuous operation according to IEC 60601-1
Degree of protection	IP21

Pneumatic specifications

O ₂	Input pressure	2 to 6 bar / 29 to 87 psi
	Connector	DISS (CGA 1240) or NIST (optional), NF (optional)
Air supply	Input pressure	2.8 to 6 bar / 41 to 87 psi
	Connector	CGA 1160-A
Heliox	Input pressure	2.8 to 6 bar / 41 to 87 psi
	Connector	CGA 1180-A (optional)
Inspiratory outlet (To patient port)	Connector	ISO ID15/OD22 conical
Expiratory outlet (From patient port)	Connector (on expiratory valve)	ISO ID15/OD22 conical
	Exhaust port	OD30

Electrical specifications

Input power	100 to 240 VAC ±10%, 50/60 Hz	
Power consumption	210 VA maximum	
Battery	Electrical specifications:	12 V DC, 15 Ah
	Type:	Lead-acid
	Normal operating time:	Backup time: typical 1 h, Recharge time: 15 h
External hot-swappable battery (optional):	Electrical specifications:	14.4 V DC, 6.6 Ah
	Type:	Lithium Ion
	Normal operating time:	Backup time typically 1 h, Recharge time: 7 h With external charger: 3 h

Graphical patient data

Graphic type/Tab name	Options
Waveforms	Paw, Flow, Volume, Off, PCO ₂ ¹ , FCO ₂ ¹ , Plethysmogram ² , Pes (Paux) ³ , Ptranspulm ³
Intelligent panels	Dynamic Lung ⁴ , Vent Status, ASV Graph ⁵ , ASV Monitor, SMPs (Secondary monitoring parameter)
Trends	1-, 3-, 12-, 24-, or 96-h trend data for a selected parameter or combination of parameters
Loops	Paw/Volume, Paw/Flow, Volume/Flow, Volume/PCO ₂ ¹

Alarms⁶

Priority	Alarm
High priority	Apnea time (s), ExpMinVol high/low (l/min), Oxygen high/low (%), Pressure high/low (cmH ₂ O), Flow sensor calibration needed, Exhalation obstructed, Disconnection, Oxygen supply failed
Medium priority	fTotal high/low (b/min), PetCO ₂ high/low (mmHg), Pressure limitation (cmH ₂ O), Vt high/low (ml), SpO ₂ high/low, SpOC high/low, %leak, High PEEP, Loss of PEEP, Pulse high/low, Check flow sensor for water
Low priority	High SpO ₂ , Loss of external power, Cuff leak

¹ CO₂ option required | ² SpO₂ option required | ³ Data is available only when an esophageal catheter is connected to the Paux port on the ventilator
⁴ For adult/pediatric patients only | ⁵ Only available in ASV mode | ⁶ For complete list of alarms see the Operator's manual

Control settings and ranges⁷

Parameter (units)	Range Adult/Ped	Range Neonatal
Additional O ₂ for enrichment (%)	0 to 79	0 to 79
Apnea backup	Enabled, disabled	Enabled, disabled
End PEEP (cmH ₂ O)	0 to 35 ⁸	0 to 35 ⁸
Expiratory trigger sensitivity ETS (%)	5 to 70	5 to 70
Flow for Hi Flow O ₂ therapy (l/min)	1 to 60	1 to 12
Flow pattern	Square, 50% decelerating, Sine, 100% decelerating	--
Gender (sex)	Male, Female	--
I:E	1:9 to 4:1	--
%MinVol (%)	25 to 350	--
Nebulizer Duration (min)	5 to 40	5 to 40
Nebulizer Synchronization	Inspiration, Exhalation, Insp. and Exh.	Inspiration, Exhalation, Insp. and Exh.
Oxygen (%)	21 to 100	21 to 100
P high (cmH ₂ O)	0 to 50	0 to 50
P low (cmH ₂ O)	0 to 50	0 to 25
P ASV limit (cmH ₂ O)	10 to 110	--
Pat. height (cm)	130 to 250 / 30 to 150	--
Pat. height (in)	50 to 100 / 12 to 60	--
Pause (%)	0 to 70	--
Pcontrol (cmH ₂ O)	5 to 100	3 to 50
Peak flow (l/min)	1 to 180 ⁴	--
PEEP/CPAP (cmH ₂ O)	0 to 50	0 to 25
P-ramp (ms)	0 to 200	0 to 200
Ramp speed (cmH ₂ O/s)	2 to 5	2 to 5
Pstart (cmH ₂ O)	0 to 35 ⁸	0 to 35 ⁸
Psupport (cmH ₂ O)	0 to 100	0 to 50
Ptop (cmH ₂ O)	25 to 60	25 to 60
Rate (b/min)	1 to 120	1 to 150
Sigh	Enabled, disabled	Enabled, disabled
%TI (%)	4 to 80 ⁴	--
TI (s)	0.1 to 9.6	0.1 to 3
T high (s)	0.1 to 30	0.1 to 30
T low (s)	0.1 to 30	0.1 to 30
TI max (s)	0.5 to 3.0	0.25 to 3.0
Tip (s)	0 to 8 ⁴	--
Tpause (s)	0 to 30	0 to 30
TRC compensation (%)	10 to 100	10 to 100
TRC Tube size (I.D.) (mm)	3 to 10	2.5 to 5

⁷ Parameter settings and ranges can change depending on the mode

Control settings and ranges⁷

Parameter (units)	Range Adult/Ped	Range Neonatal
Trigger, Expiratory	ETS, IntelliSync+	ETS
Trigger, Inspiratory	P-trigger, Flowtrigger, IntelliSync+, Trigger OFF	P-trigger, Flowtrigger, Trigger OFF
Trigger, flow (l/min)	0.5 to 15	0.1 to 5.0
Trigger, pressure (P-trigger) (cmH ₂ O)	-0.5 to -15.0 (below PEEP/CPAP)	-0.1 to -5.0 (below PEEP/CPAP)
V limit (ml)	--	4 to 400
Vt (ml)	20 to 2000	--
Vtarget (ml)	20 to 2000	2 to 200
Weight (kg)	--	0.2 to 15.0

⁸ In some markets, the maximum is 20 cmH₂O

Monitoring parameters

Parameter (units)	Description	
Pressure	AutoPEEP (cmH ₂ O)	Unintended positive end-expiratory pressure
	Paux (cmH ₂ O)	Auxiliary pressure
	ΔP (cmH ₂ O)	Driving pressure
	Pcuff (cmH ₂ O)	Cuff pressure
	Ptrans I (cmH ₂ O)	The arithmetic mean value of Ptranspulm over the last 100 ms of the last inspiration.
	Ptrans E (cmH ₂ O)	The arithmetic mean value of Ptranspulm over the last 100 ms of the last expiration.
	PEEP/CPAP (cmH ₂ O)	PEEP (positive end-expiratory pressure) and CPAP (continuous positive airway pressure)
	Pmean (cmH ₂ O)	Mean airway pressure
	Ppeak (cmH ₂ O)	Peak airway pressure
	Pplateau (cmH ₂ O)	Plateau or end-inspiratory pressure
Flow	Pminimum (cmH ₂ O)	Minimum airway pressure of the previous breath cycle
	Insp Flow (l/min)	Peak inspiratory flow, spontaneous or mandatory
	Exp Flow (l/min)	Peak expiratory flow
Volume	Flow (l/min)	Flow of gas to the patient during high flow oxygen therapy
	ExpMinVol or MinVol NIV (l/min)	Expiratory minute volume
	MVSpont or MVSpO 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
	VT/IBW	Tidal volume according to ideal body weight (IBW) for adult/ pediatric patients and
	VT/Wt (ml/kg)	according to the actual body weight for neonatal patients
	VLeak (%) or MVLeak (l/min)	Leakage percent
	VLeak (ml)	Leakage volume

Monitoring parameters (continued)

Parameter (units)	Description	
CO2	FetCO2 (%)	Fractional end-tidal CO2 concentration
	PetCO2 (mmHg)	End-tidal CO2 pressure
	slopeCO2 (%CO2 / l)	Slope of the alveolar plateau in the PetCO2 curve, indicating the volume/flow status of the lungs
	Vtalv (ml)	Alveolar tidal ventilation
	V'alv (l/min)	Alveolar minute ventilation
	V'CO2 (ml/min)	CO2 elimination
	VDaw (ml)	Airway dead space
	VDaw/VTE (%)	Airway dead space fraction at the airway opening
	VeCO2 (ml)	Exhaled CO2 volume
	ViCO2 (ml)	Inspired CO2 volume
SpO2	SpO2 (%)	Oxygen saturation
	HLI (%)	Heart-Lung interaction index
	Pulse (1/min)	Pulse
	Plethysmogram	The waveform that visualizes the pulsating blood volume, which is delivered by the pulse oximeter
	SpO2/FiO2	The SpO2/FiO2 ratio is an approximation of the PaO2/FiO2 ratio, which, in contrast to PaO2/FiO2, can be calculated noninvasively and continuously
	PI (%)	Perfusion index
	PVI (%)	Pleth variability index
	SpCO (%)	Carboxyhaemoglobin saturation
	SpMet (%)	Methaemoglobin saturation
	SpHb (g/dl) (mmol/l)	Total haemoglobin
SpOC (ml/dl)	Oxygen content	
Oxygen	Oxygen (%)	Oxygen concentration of the delivered gas
Time	I:E	Inspiratory:expiratory ratio
	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
	RCinsp (s)	Inspiratory time constant
	Rexp (cmH2O/l/s)	Expiratory flow resistance
	Rinsp (cmH2O/l/s)	Inspiratory flow resistance
	RSB (1/(l*min))	Rapid shallow breathing index
	VarIndex (%)	Variability index
	WOBimp (J/l)	Imposed work of breathing



Physical characteristics

Weight	Ventilation unit, monitor and shelf mount: 38 kg (83.8 lb) 57 kg (125.6 lb) with standard trolley, monitor, ventilation unit The standard trolley can accommodate a maximum safe working load of 80 kg (176 lb). The universal trolley can accommodate a maximum safe working load of 140 kg (308 lb).
Dimensions	See graphic above
Monitor	15" XGA, TFT color, LCD touchscreen, 3m (10 ft) cable with optional 7 m (23 ft) extension, 6.4 kg (14.1 lb)
Monitor mounting	Pole mount, rail mount, handle mount

Manufacturer:

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