

HAMILTON-EM7

Technical specifications for SW version 1.1.x

Ventilation modes

Mode name	Description	Standard: ✓ / Option: 0
Volume-controlled modes, flow controlled		
(S)CMV	Breaths are volume controlled and mandatory, including patient-triggered breaths.	✓
SIMV	Volume-controlled mandatory breaths can be alternated with pressure-supported spontaneous (patient-triggered) breaths.	0
Pressure-controlled modes		
PCV+	All breaths, whether triggered by the patient or the ventilator, are pressure controlled and mandatory.	✓
DuoPAP	Mandatory breaths are pressure controlled. Spontaneous breaths can be triggered at both pressure levels.	0
SPONT	Every breath is spontaneous, with or without pressure support.	0
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, with or without pressure support.	0
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.	0
CPAP	Every breath is spontaneous without pressure support.	✓
O2 therapy	Oxygen therapy. Oxygen concentration and constant flow are set. No supported breaths.	0

Control settings and ranges

Parameter (units)	Range
Pressure	
PBW ¹ (kg)	5 to 139
$\Delta P_{\text{control}}$ ² (mbar)	5 to 60 ³
PEEP/CPAP (mbar)	0–30 ^{4,5} CPAP: 4–30
P high (in DuoPAP) (mbar)	4 to 60
ΔP_{insp} ⁶ (mbar)	5 to 60 ³
Minimum ΔP_{insp} (mbar) ⁷	5 to 15
P limit (mbar) ⁷	20 to 60 ⁸
$\Delta P_{\text{support}}$ ⁹ (mbar)	0 to 60 ³
P-ramp	Slow, medium and fast
Volume	
MinVol ⁷ (l/min)	0.2 to 41.7
Vt ¹⁰ (ml)	50 to 2000
Vt/PBW (ml/kg)	5 to 12 ¹¹
Flow	
ETS ^{12,13}	5 to 80
Flow ¹⁴ (l/min)	2 to 80 ¹⁵
Trigger ¹⁶	1 (low effort), 2, 3 (high effort) (S)CMV, PCV+: 1, 2, 3, Off
Frequency	
Rate ¹⁰ (b/min)	5 to 60 ¹⁷ DuoPAP: 1 to 60 ¹⁷
Time	
I:E	1:9 to 4:1
T high (in DuoPAP) ¹⁸ (s)	0.1 to 40.0 ¹⁹
TI ^{18,20} (s)	0.1–11.8 ¹⁹
TI max ²¹ (s)	0.5 to 3.0

¹ PBW is calculated using height and sex, and is used for adult and pediatric patients.

² Control pressure, added to PEEP/CPAP.

³ Depending on the set PEEP, the range may be different.

⁴ Depending on the set $\Delta P_{\text{support}}$, the range may be different.

⁵ In DuoPAP, depending on the set P high, the range may be different.

⁶ Inspiratory pressure, added to PEEP/CPAP.

⁷ Only in ASV mode.

⁸ Depending on the set PEEP, the range may be different.

⁹ Pressure support, added to PEEP/CPAP.

¹⁰ Startup setting derived from PBW. Does not apply in ASV mode.

¹¹ Limit may be different depending on configured patient height.

¹² Expiratory trigger sensitivity, in % of inspiratory peak flow.

¹³ When changing ventilation modes, the device uses the ETS value set in the previous mode, if available. If the previous mode did not use ETS, the device sets ETS to default values.

¹⁴ Only for O2 therapy.

¹⁵ In some markets, the maximum possible Flow setting may be different.

¹⁶ Trigger is leak compensated.

¹⁷ Depending on the set TI or T high, the range may be different.

¹⁸ Default setting derived from PBW and I:E.

¹⁹ Depending on the set Rate, the range may be different.

²⁰ Only in NIV-ST, SIMV modes.

²¹ Maximum inspiratory time for spontaneous breaths during noninvasive ventilation.

Parameter (units)	Range
Other	
Oxygen (%)	21 to 100
Pat. height (cm)	<i>Adult:</i> 130 to 250 <i>Pediatric:</i> 58 to 150 ²²
Sex (Adult only)	Male, Female

Monitoring parameters

Parameter (units)	Description
Pressure	PEEP/CPAP (mbar) PEEP (positive end-expiratory pressure) and CPAP (continuous positive airway pressure) are constant pressures applied during both the inspiratory and expiratory phases
	ΔP_{insp} (mbar) Inspiratory pressure
	P_{mean} (mbar) Mean airway pressure
	P_{peak} (mbar) Peak airway pressure
	P_{plateau} (mbar) Plateau or end-inspiratory pressure
Flow	Flow (l/min) The measured flow of gas to the patient when using O2 therapy
	Insp Flow (l/min) Peak inspiratory flow, spontaneous or mandatory. Measured every breath
	Exp Flow (l/min) Peak expiratory flow
Volume	ExpMinVol ²³ or MinVol NIV ²⁴ (l/min) Expiratory minute volume
	VTE ²³ or VTE NIV ²⁴ (ml) Expiratory tidal volume
	VTI (ml) Inspiratory tidal volume
	VLeak (%) Leakage percent
	Vt/PBW (ml/kg) Tidal volume per predicted body weight (PBW)
CO2 ²⁵	PetCO2 (mmHg) End-tidal CO2 pressure
Oxygen	O2 consumption (in STPD) (l/min) The estimated oxygen consumption rate based on the current ventilation settings
Time	I:E Inspiratory:expiratory ratio
	fSpont (b/min) Spontaneous breathing frequency
	fTotal (b/min) Total breathing frequency
Other calculated/ displayed parameters	CPR timer (hours:minutes:seconds) How long CPR ventilation has been on
	RSI apnea timer (minutes:seconds) How long intubation has been active when using rapid sequence induction (RSI)
	RSI preoxygenation timer (minutes:seconds) How long preoxygenation has been in progress when using rapid sequence induction (RSI)

²² Limit may be different depending on configured Vt/PBW.

²³ Only for invasive modes.

²⁴ Only for use with noninvasive modes.

²⁵ CO2 option required.

Alarms

Priority	Alarm
High priority	Apnea, Blower temperature high, Check breathing circuit set, Check for blockage, Device temperature critical, Disconnection on ventilator or patient side, High pressure: breath terminated, Low pressure, Minute volume high/low, Oxygen supply failed, Preop check needed, Pressure not released, RSI apnea timer, Self-test failed, Sensor failure, Technical event:xxxxxx, Technical state failed, Unknown part number, Ventilation canceled, Vent outlet temperature high <i>Battery:</i> Battery communication error, Battery defective, Battery power loss, Battery temperature high, Battery totally discharged, Wrong battery
Medium priority	Battery low, Check for blockage, Function key not operational, High frequency, High PEEP, Loss of PEEP, Low frequency, Oxygen mixer failure, Performance limited by high altitude, Real-time clock failure, RSI apnea timer, Technical event:xxxxxx, Vt high/low, Vt high: breath terminated CO2: PetCO2 high/low
Low priority	Alarm lamp defective, Apnea ventilation, Apnea ventilation ended, Backup alarm lamp defective, Blower service required, Blower temperature high, Buzzer defective, Check breathing circuit set, Check settings, Device temperature high, External connections disabled, HCM communication lost, Inverse I:E ratio ventilation (IRV), Loss of external power, Loudspeaker defective, Performance limited by high altitude (low after Audio pause is activated), Preop check needed (in Standby), Pressure limitation, Settings file error, Technical event:xxxxxx, Touch not functional, Unable to meet target, Ventilator outlet temperature high <i>Battery:</i> Battery calibration required, Battery low, Battery not charging, Battery replacement recommended, Battery replacement required, Battery temperature high CO2: Check CO2 airway adapter, CO2 calibration needed, CO2 poor signal, CO2 sensor disconnected, CO2 sensor faulty, CO2 sensor over temperature, CO2 sensor warmup

Technical performance

Description	Specification
Alarm loudness (volume)	The range is 1 to 10. The default is 8.
Expected lifetime	10 years lifetime of the device with approximately 11,500 hours use time.
Maximum inspiratory time (spontaneous breaths)	0.5 to 3 seconds
Means of inspiratory triggering	Combined flow and pressure trigger
Oxygen mixer accuracy	±5% (±10% if Oxygen 93 is used)
Patient predicted body weight (PBW, determined from Patient height setting)	5 to 139 kg (11 to 306 lb) ²⁶
Preoperational checks and special functions	Preoperational check/CO2 sensor zero calibration, O2 enrichment, leak compensation, CO2 sensor port, compensation of breathing circuit resistance and compliance

²⁶ Actual patient weight can be much greater (e.g., 300 kg or 661 lb).

Electrical specifications

Element	Specification
Input power	12 V DC to 28 V DC (total range: 10 V DC to 36 V DC)
Max inlet power	10 A
Power consumption	15 VA typical, 120 VA maximum
Battery	Hamilton Medical provides a high-capacity battery. Electrical specifications: 14.4 V DC, 6.8 Ah, 97.9 Wh Type: Lithium-ion, supplied by Hamilton Medical only Normal operating time: Typically ≥ 6 hours. Operating times are measured with a fully charged battery, the blower in use, without CO₂ monitoring or Bluetooth, and with the following settings²⁷: Mode = PCV+, Rate = 20 b/min, $\Delta P_{\text{control}}$ = 10 mbar, I:E = 1:2, PEEP = 5 mbar, Trigger = 2, Oxygen = 30%, V_t = 500 ml, Temperature = 25°C ($\pm 3^\circ\text{C}$), Altitude = 940 mbar (± 30 mbar). Approximate operating times under these conditions are as follows: • Display brightness = 80%: 7.5 hours • Display brightness = 20%: 9.0 hours This operating time applies to new, fully charged Li-ion batteries not exposed to extreme temperatures. The actual operating time depends on battery age and on how the battery is used and recharged. Recharge time: While the ventilator is connected to primary power, approximately 3 hours to recharge the battery at a temperature of 25°C. Storage: -20°C to 50°C, $\leq 85\%$ relative humidity. The storage location should be free from vibration, dust, direct sunlight, moisture, and corrosive gases, and with a recommended temperature of -20°C to 25°C. Extended storage at temperatures above 40°C can degrade battery performance and life.

²⁷ Laboratory Bonaduz

Pneumatic performance

Component	Specification	
Air intake port	NATO-compliant standard thread, RD 40 x 1/7, EN 148-1	
Air supply	Integrated blower	
Inspiratory outlet (To patient)	Connector:	ISO 5356-1 (ID15/OD22 conical)
High-pressure oxygen inlet ²⁸	Input pressure:	2.8 to 6 bar / 41 to 87 psi
	Flow average:	≤ 40 l/min (10 seconds average) according to ISO 80601-2-84
	Peak flow at device input:	At least 120 l/min at 2.8 bar / 41 psi
	Connectors:	DISS (CGA 1240) or NIST O2-specific quick coupling
Gas mixing system	Pressure	
	Delivered pressure:	0 to 60 mbar (altitude < 4000 m) ≥ 30 mbar (altitude 4,000 m to < 8,000 m)
	Inspiratory pressure:	4 to 60 mbar
	Flow	
	Maximum inspiratory flow:	215 l/min
	Flow accuracy:	±20% or ±1 l/min (whichever is greater)
	Volume	
	Tidal volume / Target tidal volume:	50 to 2000 ml

Environmental specifications

Environment	Specification	
Temperature	Operation ^{29,30} :	-10°C to 40°C (14°F to 104°F) continuous operation
		-20°C to 50°C (-4°F to 122°F) transient operation, for a maximum of 20 minutes
	Shipment/storage:	-20°C to 60°C (-4°F to 140°F)
Altitude	-650 to 4,000 m (-2,132 to 13,123 ft)	
	4,000 to 8,000 m (13,123 to 26,247 ft)	
Atmospheric pressure	Operation, ³¹ shipment, and storage:	376 to 1,100 hPa
Relative humidity	Operation, ³¹ shipment, and storage:	5% to 95%, noncondensing
Ingress protection	IP54	
For specifications related to any external devices and sensors, refer to the manufacturer's <i>Instructions for use</i> .		

²⁸ Flow value measurements expressed in STPD (standard temperature and pressure, dry).

²⁹ If the device is stored below -10°C, it must warm up for 30 minutes at a temperature of 20°C.

³⁰ If therapy is performed at a temperature below -10°C, the device must warm up for 45 minutes at a temperature of 20°C.

³¹ The stated operating conditions apply to both continuous and transient operation of the ventilator within the limitations specified in the Intended use.

Standards and approvals

Description	Specification
Classification	Class IIb, according to (EU) 2017/745
Certification	ISO 13485:2016 + A11 (2021), ISO 14971:2019 + A11 (2021), IEC 60601-1:2005+A1:2012+A2:2020, IEC 60601-1-2:2015/A1:2020, IEC 60601-1-6:2010/A2:2020, IEC 60601-1-8:2006/A2:2020, IEC 60601-1-12:2014/A1:2020, IEC 62304:2006/A1:2015, IEC 62366-1:2015/A1:2020, ISO 5356:2015, EN 13718-1:2014+A1:2020, ISO 80601-2-55:2018/A1:2023, ISO 80601-2-84:2023, RTCA DO 160 Rev. B Chapter 7: Category B, Chapter 8: Vibration, EUROCAE ED 14G, EN 1789, SAE J 3043, CISPR 25, MIL-STD 461 Rev. G, MIL-STD 704 Rev. F, MIL-STD 810 Rev. H Rapid Decompression: Method 500.6 (Procedure III)
Declaration	The HAMILTON-EM7 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 EC 2017/745. The ventilator meets the general safety and performance requirements according to (EU) 2017/745, Annex I.
Electromagnetic compatibility	The HAMILTON-EM7 complies with the IEC 60601-1-2 EMC (Electromagnetic Compatibility) Collateral Standard.
Safety class	Class II, Type BF applied part (ventilator breathing system, VBS, and CO2 sensor including CO2 module connector), continuous operation according to IEC 60601-1

Standard configuration and options

Function	Standard: ✓ / Option: O
CPR ventilation	✓
Event log (up to 10,000 events with date and time stamp)	✓
Hamilton Connect Module (HCM)	O
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)	✓
O2 enrichment (adjustable)	✓
On-screen help	✓
Patient group: Adult/Ped	✓
Pause / resume therapy	✓
Rapid sequence induction (RSI)	✓
Screen lock	✓
Trigger sensitivity	✓
Hardware configuration and options	
A variety of wall, rail, ceiling, and shelf mounts/adapters	O
CO2 monitoring	O
USB port ³²	✓
Night vision compatibility (NVG)	O ³³
NBC filter compatibility	✓

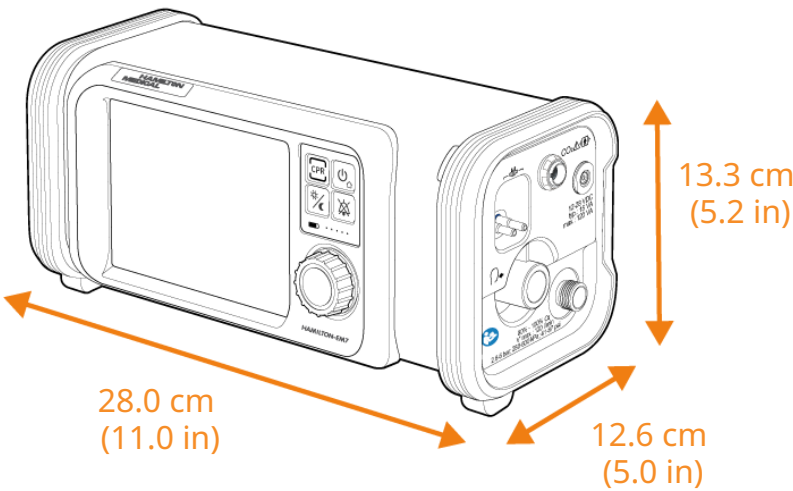
³² To be used for software updates or log file export only.

³³ Standard feature on the gray HAMILTON-EM7 ventilator (PN 10163814).

Physical characteristics

Dimensions	Specification		
Size (cm)	Width (cm)	Height (cm)	Depth (cm)
Device (see Figure 1)	28.0	13.3	12.6
Device, handle, hooks, breathing circuit, and O2 supply hose (90°)	34.6	21.6	14.2
Device, handle, hooks, breathing circuit, O2 supply hose (90°), mounted on wall mount	34.6	21.6	16.9
Additional depth by rotation module	N/a	N/a	+1.7
Weight: Device (kg)	Weight: Device (kg)		
Device only	3.5		
Device plus handle	4.4		
Device, handle, hooks, rotation module, and charging module	4.95		
Weight: Accessories (kg)	Weight: Accessories (kg)		
Breathing circuit (1.80 m)	0.25		
Breathing circuit (2.40 m)	0.3		
Oxygen supply hose (depending on length)	0.5 (or more)		
Single rail adapter	0.33		
Wall mount plate	1.0		

Figure 1. HAMILTON-EM7 dimensions



Device options

Device	Part number (PN)
HAMILTON-EM7 (red)	10101723
HAMILTON-EM7 (gray)	10163814

DC power cable / charger	Part number (PN)
HAMILTON-EM7 DC power car cable	10175228
HAMILTON-EM7 DC power cable open end	10175229
HAMILTON-EM7 Battery charger/calibrator	369104

Filter	Part number (PN) Single	Part number (PN) Box / Set
Ultipor 25, HEPA filtration mechanical-hydrophobic, HMEF, dead space 35 ml	BB25	N/a
Ultipor 100 (REF BB100E), HEPA filtration mechanical-hydrophobic, dead space app. 85 ml	279963	N/a
HAMILTON-EM7 Filters		
HAMILTON-EM7 HEPA inlet filter	10156644	N/a
HAMILTON-EM7 Dust filter, set of 5	N/a	10180358

Handle	Part number (PN)
Option without handle	10189448
Handle (red)	10189138
Handle (gray)	10189107
Handle with rotation module (red)	10189128
Handle with rotation module (gray)	10189106
Handle with hooks (red)	10189142
Handle with hooks (gray)	10189446
Handle with hooks & rotation module (red)	10189143
Handle with hooks & rotation module (gray)	10189447
Handle with hooks & charging module (red)	10189141
Handle with hooks & charging module (gray)	10189445
Handle with hooks, charging & rotation module (red)	10189140
Handle with hooks, charging & rotation module (gray)	10189444
Handle with charging module (red)	10189139
Handle with charging module (gray)	10189443
Handle with charging & rotation module (red)	10189127
Handle with charging & rotation module (gray)	10189105
Charging module	10188172

Handle	Part number (PN)
Rotation module	10175237
Sealing module	10175238

Mounting adapter	Part number (PN)
Pole mount adapter	10189146
Single rail adapter	10189147
Ceiling mount adapter	10172806

Mounting option	Part number (PN)
Wall mount with charging block	10165198
Wall mount without charging block	10172963
Shelf mount with charging block	10172805
Shelf mount without charging block	10199462

Mounting strap	Part number (PN)
Shoulder strap (red)	10188176
Shoulder strap (gray)	10192199

High pressure Oxygen inlet	Part number (PN)
O2 DISS connector	10187224
O2 quick coupling connector	10187225
O2 DISS connector plus quick coupling adapter	10191251
O2 quick coupling adapter	10171047
O2 NIST connector	10204564

Battery power	Part number (PN)
Li-Ion Battery 14.40 V	10173841

Power cord	Part number (PN)
Power cord US/JP	355198
Power cord UK	355199
Power cord EU	355200
Power cord CN	355308
Power cord AUS/NZ	10195270

Power supply	Part number (PN)
AC power supply 100-240 VAC / 24 VDC 110 W	10173840

Protective cap	Part number (PN)
HAMILTON-EM7 red cover cap, covers the <i>To patient</i> port and the flow sensor pressure plug connection ports, box of 10	10186908

Software configuration	Part number (PN)
EtCO2 Module	10162539
NVG	10162567
Bluetooth	10162569
O2 therapy 2-15 l/min	10162566
Extension O2 therapy (FDA) 2-60 l/min	10162776
Extension O2 therapy (ROW) 2-80 l/min	10162779
NIV/NIV-ST	10200822
SIMV/DuoPAP/ SPONT	10200823

Compatible consumables and accessories

Adapter	Part number (PN)
Adapter OD15/ID15, single use, neonatal, box of 25	281803

Breathing circuit set	Part number (PN)
HAMILTON-EM7 Breathing circuit set, 180 cm	10145821
HAMILTON-EM7 Breathing circuit set, 240 cm	10145823

Catheter mount	Part number (PN)
Flexi-Lock Catheter Mount Short 15OD and 15ID/22OD connectors	038-61-319

CO2 mainstream measurement	Part number (PN)
CAPNOSTAT-5 CO2 sensor	1149368
CO2 mainstream airway adapter, single use, adult/pediatric, box of 10	281719
CO2 mainstream airway adapter, reusable, adult/pediatric, box of 1	281721

Filter	Part number (PN) Single	Part number (PN) Box / Set
Aero-Sat Filter Compact Straight, HMEF, 150-1000 ml TV	10161581	N/a
Bacterial/Viral HME filter, dead space 55 ml, 150-1500 ml TV	AL08016	N/a
Bacterial/Viral HME filter, dead space 10 ml, 50-100 ml TV	AL08032	N/a

Nasal cannula	Part number (PN)
i-flo™ high flow nasal cannula, small adult	7300000
i-flo™ high flow nasal cannula, medium adult	7301000
i-flo™ high flow nasal cannula, large adult	7302000
Nuflow nasal cannula, large pediatric	10072356
Nuflow nasal cannula, extra large pediatric	10072357
Adapter for nasal cannula	
Airway Connector OD15/ID22 for i-flo™ high flow nasal cannulas	G-311003

Nebulizer	Part number (PN)
Aerogen Solo T piece, 22 mm	AGAS3010
Aerogen Solo nebulizer (x5)	AGAS3100
Aerogen Solo nebulizer (x10)	AGAS3200
Aerogen Solo convenience kit (+ T-piece 22 mm), (x10)	AGAS3350
Aerogen USB Controller with AC/DC adapter	AGUC1000NE
AC/DC power cord adapter UK	AGUC1040UK
AC/DC power cord adapter USA	AGUC1040US
AC/DC power cord adapter EU	AGUC1040EU

NIV Mask	Part number (PN)
BiTrac™ Select Full Face, Adult Small, Interchangeable Standard Elbow	10161769
BiTrac™ Select Full Face, Adult Medium, Interchangeable Standard Elbow	10161770
BiTrac™ Select Full Face, Adult Large, Interchangeable Standard Elbow	10161771
BiTrac™ Select Full Face, Adult Extra Large, Interchangeable Standard Elbow	10161772
BiTrac MaxShield™ Select, Adult Small, Interchangeable Standard Elbow, Qty. 10	10161778
BiTrac MaxShield™ Select, Adult Large, Interchangeable Standard Elbow, Qty. 10	10161777
BiTrac MaxShield™ Select, Adult Extra Large, Interchangeable Standard Elbow, Qty. 10	10161776
Interchangeable Standard Elbow	10161785
Interchangeable Standard Nebulizer Elbow	10161781

Protective cap	Part number (PN)
Flow sensor protective cap, ID 15 for Flow sensor, HMEF (box of 30)	10082911



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