SERVO-U[®] Ventilation

DATASHEET





General Specifications

Specifications	
Intended use	The SERVO-U [®] Ventilator system is:
	 Intended for respiratory support, monitoring and treatment of neonatal, pediatric and adult patients
	 To be used only by healthcare providers
	 To be used only in professional healthcare facilities and for transport within these facilities
	For NAVA [®] and Edi monitoring, it is in addition intended: To provide monitoring of the patient's breathing drive
	 To improve synchrony between the ventilator system and patient when the electrical signal from the brain to the diaphragm is active
	 For use on all patients with no contraindication for insertion/exchange of a nasogastric tube
Instructions for use	(See user's manual)
Legal manufacturer	Maquet Critical Care AB
Other products	(See separate data sheets — contact your Maquet Sales Representative for more information)

General Ventilator Specifications

Specifications	SERVO-U	SERVO-U on mobile cart
Base system weight	 Approx. 50 lb 11 oz (23 kg) Patient unit 33 lb 1 oz (15 kg User interface 8 lb 13 oz (4 kg) Handle 7 lb (3 kg) Cable holder and cable 2 lb 3 oz (1 kg) 	 Approximately 77 lb 3 oz (35 kg) Base system approx. 50 lb 11 oz (23 kg) Mobile cart 27 lb 9 oz (12.5 kg)
Dimensions of base (See Technical Drawings on page 13)	14.5 W x 8.1 D in (368 W x 205 D mm)	25.5 W x 21.5 D in (incl. wheels) (647 W x 547 D mm) (incl. wheels)
Height (includes user interface)	32.5 in (826 mm)	53.9 in (1368 mm)
Wheels	N/A	4 wheels with separate brakes
A-weighted sound pressure level (LpA)	<40 dB, measured at a distance of	of 3 ft 3 in (1 m)
A-weighted sound power level (LWA)	<51 dB	

General Ventilation Specifications

Specifications	
Patient range	 Standard configuration: 7 lb to 551 lb 2 oz (3 to 250 kg)
	 Neonatal option: 11 oz to 17 lb 10 oz (0.3 to 8 kg)
Bias flow	Adult: 2 I/min
	 Pediatric and neonatal: 0.5 l/min
Internal compressible factor	Max. 0.2 ml/cmH ₂ O
Gas delivery system	Microprocessor controlled valves
Maximum airway pressure	125 cmH₂O
Method of triggering	Flow, pressure and Edi (with Edi module and Edi catheter)
Inspiratory flow range	 Adult: 0 to 200 l/min
	 Pediatric and neonatal: 0 to 33 I/min
Pressure drop	 Max. 6 cmH₂O at a flow of 60 l/s (insp. channel)
	 Max. 3 cmH₂O at a flow of 60 l/s (exp. channel)
PEEP regulation	Microprocessor controlled valve
Rise time, expiratory flow measurement	<12 ms for 10% to 90% response at flow of 3 to 192 l/min
Expiratory flow range	0 to 192 l/min
User interface	
Туре	TFT-LCD touchscreen
Size	14.4 x 11.8 in (366 x 300 mm)
Viewing area	15 in XGA, 1024 x 768 pixels with a 24-bit color palette
Weight	Approximately 8 lb 13 oz (4 kg)

Power Supply Specifications

Specifications	
Power supply, automatic range selection:	 100V to 120V AC, 2.5 A, 50 to 60 Hz
	 220V to 240V AC, 1.5 A, 50 to 60 Hz
Plug-in battery module:	
Battery backup (nickel-metal hydride, NiMH)	Six battery module slots - two batteries are delivered with the ventilator
Battery capacity	Rechargeable, 12V, 3.5 Ah each
Battery backup time	Ranging from 50 minutes (2 batteries) to 150 minutes (6 batteries)
Recharge time	Approximately 3 hr/battery
External 12V DC	12.0V to 15.0V DC, 10 A
Typical min. power consumption (no optional modules, no ongoing battery charging, normal panel backlight)	110 VA, 40 W
Typical max. power consumption (with CO ₂ , Edi and Y sensor modules, ongoing battery charging, max. panel backlight)	210 VA, 85 W

Gas Supply Specifications

Specifications	
Inlet gas pressure air/O ₂	200 to 600 kPa / 2.0 to 6.0 bar / 29 to 87 PSI
Connection standards available	AGA, DISS, NIST, or French standard
Unavailable gas/loss of gas pressure	The flow from an unavailable gas (air or O_2) is automatically compensated for so that the patient gets the preset volume and pressure
Patient system gas connectors	Male 22 mm / female 15 mm — in accordance with ISO 5356-1
Gas exhaust port	Male 30 mm cone

Operating Conditions Specifications

Specifications	
Temperature	50° to 104°F (10° to 40°C)
Relative humidity	15% to 95% non-condensing
Atmospheric pressure	660 to 1060 hPa
Lowest pressure in patient circuit	-400 cmH ₂ O

Non-operating Conditions Specifications

Specifications	
Temperature	-13° to 140° F (-25° to 60°C)
Relative humidity	<95% condensing
Atmospheric pressure	470 to 1060 hPa
Lowest pressure in patient circuit	N/A

Standards-Safety and Functionality Specifications

Specifications	
CE 0123	The device complies with requirements and classification IIb of Medical Device Directive $93/42/EEC - CE$ Mark Notified Body number: 0123
Classification	IEC 60601-1: 2005, Class I, continuous operation
Standards	 ISO 80601-2-12:2011, ISO 80601-2-55:2011, EN 13544-1:2007+A1:2009
	 IEC 60601-1, Type B (equipment making physical contact with the patient and the gas pathways)
	 IEC 60601-1, Type BF (CO₂ analyzer, Y sensor, nebulizer patient unit and cable)
	 IEC 60601-1, Type CF — defibrillation proof (Edi catheter and cable)
Ingress protection	IP 21
Electromagnetic compatibility (EMC)	 According to limits specified in IEC 60601-1-2: 2007 The 'EMC Declaration, Information to the Responsible Organization' is available from Maquet

Display Specifications

Specifications	
Views	BASIC View
	ADVANCED View
	LOOPS View
	DISTANCE View
	FAMILY View
	Each of the screen layout views offers a specific combination of displayed waveforms, loops and presented values
Real time waveforms	Pressure
	• Flow
	Volume
	 CO₂ (with CO₂ analyzer option)
	 Edi (with Edi module and Edi catheter)
Loops	Pressure — Volume
	Pressure — Flow
	Volume — Flow
	A reference loop and three overlaying loops can be displayed

Ventilation Modes Specifications

Invasive Ventilation Modes Specifications	
Controlled ventilation	 PC (Pressure Control) VC (Volume Control) PRVC (Pressure Regulated Volume Control)
Supported ventilation	 PS/CPAP (Pressure Support / Continuous Positive Airway Pressure) VS (Volume Support)
Automode (option)	 Control mode: VC <> Support mode: VS Control mode: PC <> Support mode: PS Control mode: PRVC <> Support mode: VS
Combined ventilation	 SIMV (VC) + PS (Synchronized Intermittent Mandatory Ventilation) SIMV (PC) + PS SIMV (PRVC) + PS Bi-Vent/APRV (Airway Pressure Release Ventilation)
NAVA®	 Neurally Adjusted Ventilatory Assist via endotracheal tube or tracheostomy

NOTE: VC and SIMV (VC) + PS and Automode VC <-> VS are not available in the neonatal patient category.

Non-invasive Ventilation Modes Specifications	
Controlled ventilation	NIV PC (option)
Supported ventilation	NIV PS (option)Nasal CPAP (option)
NIV NAVA	 Neurally Adjusted Ventilatory Assist via non-invasive patient interfaces (option)
NOTE: Nasal CPAP is not available in the adult patient category.	

NOTE: Nasal CPAP is not available in the adult patient category. NOTE: NIV PS is not available in the neonatal patient category.

Non-invasive Ventilation Specifications

Specifications	
Maximum leakage compensation level	 Neonatal/pediatric: 25 l/min (20 l/min Nasal CPAP) Adult: 65 l/min
Disconnection flow (configurable)	 Low: 7.5 l/min High: Adult — 40 l/min Neonatal/pediatric — 15 l/min Disabled: Deactivates disconnection detection
Connection detection	Manual or automatic via bias flow

Parameter Settings

Settings	Neonatal Range	Pediatric Range	Adult Range
Tidal volume	2 to 50 ml	10 to 350 ml	100 to 4000 ml
Minute volume	0.1 to 7.5 l/min	0.3 to 20 l/min	0.5 to 60 l/min
Apnea, time to alarm	2 to 45 s	2 to 45 s	15 to 45 s
Maximum apnea time in Automode	3 to 15 s	3 to 15 s	7 to 12 s
Pressure level above PEEP	0 to 80 cmH ₂ O	0 to 80 cmH ₂ O	0 to 120 cmH ₂ O
Pressure level above PEEP in NIV	0 to 30 cmH ₂ O	0 to 30 cmH ₂ O	0 to 30 cmH ₂ O
PEEP	1 to 50 cmH ₂ O	1 to 50 cmH ₂ O	1 to 50 cmH ₂ O
PEEP in NIV	2 to 20 cmH ₂ O	2 to 20 cmH ₂ O	2 to 20 cmH ₂ O
CPAP pressure	2 to 20 cmH ₂ O	2 to 20 cmH ₂ O	-
Respiratory rate	4 to 150 breaths/min	4 to 150 breaths/min	4 to 100 breaths/min
SIMV rate	1 to 60 breaths/min	1 to 60 breaths/min	1 to 60 breaths/min
Breath cycle time, SIMV	0.5 to 15 s	0.5 to 15 s	1 to 15 s
P _{High}	2 to 50 cmH ₂ O	2 to 50 cmH ₂ O	2 to 50 cmH ₂ O
T _{High}	0.2 to 30 s	0.2 to 30 s	0.2 to 30 s
T _{PEEP}	0.1 to 10 s	0.1 to 10 s	0.1 to 10 s
PS above P _{High}	0 to 79 cmH ₂ O	0 to 79 cmH ₂ O	0 to 119 cmH ₂ O
O ₂ concentration	21% to 100%	21% to 100%	21% to 100%
I:E ratio	1:10 to 4:1	1:10 to 4:1	1:10 to 4:1
Ti	0.1 to 5 s	0.1 to 5 s	0.1 to 5 s
NAVA level	0 to 15 cmH ₂ O/μV	0 to 15 cmH ₂ O/µV	0 to 15 cmH ₂ O/ μ V
Edi trigger	0.1 to 2.0 μV	0.1 to 2.0 µV	0.1 to 2.0 µV
T _{Pause}	-	0 to 1.5 s	0 to 1.5 s
T _{Pause} (% of breath cycle time)	_	0% to 30%	0% to 30%
Flow trigger	0 to 0.5 l/min	0 to 0.5 l/min	0 to 2.0 l/min
Pressure trigger	-1 to -20 cmH ₂ O	-1 to -20 cmH ₂ O	-1 to -20 cmH ₂ O
Insp. rise time (% of breath cycle time)	0% to 20%	0% to 20%	0% to 20%
Insp. rise time	0 to 0.2 s	0 to 0.2 s	0 to 0.4 s
End inspiration (% of peak flow)	1% to 70%	1% to 70%	1% to 70%
End inspiration (% of peak flow) in NIV	10% to 70%	10% to 70%	10% to 70%

Back-up Parameter Settings

Settings	Neonatal Range	Pediatric Range	Adult Range
Inspiratory tidal volume	2 to 50 ml	10 to 350 ml	100 to 4000 ml
Pressure level above PEEP in back-up	5 to 80 cmH ₂ O	5 to 80 cmH ₂ O	5 to 120 cmH ₂ O
Pressure level above PEEP in NIV back-up	5 to 30 cmH ₂ O	5 to 30 cmH ₂ O	5 to 30 cmH ₂ O
Respiratory rate in back-up	4 to 150 breaths/min	4 to 150 breaths/min	4 to 100 breaths/min
I:E ratio	1:10 to 4:1	1:10 to 4:1	1:10 to 4:1
Ti	0.1 to 5 s	0.1 to 5 s	0.1 to 5 s

Special Functions Settings

Special Functions	Setting Range
Manual breath	Initiation of 1 breath (In SIMV mode initiation of 1 mandatory breath)
Static measurements	Insp. or exp. hold (0 to 30 seconds)
Nebulization	5 to 30 min/Continuous/Off
O ₂ boost level	Off, 1% to 79%
O ₂ boost function	Activate O ₂ boost up to 1 minute
Leakage compensation	On/Off
Circuit compensation	On/Off
Edi monitoring	In all ventilation modes and in Standby (with Edi module and Edi catheter)
Previous mode	Activates previously used mode
Backup ventilation	Back-up On/Off
Apnea management	Several parameters

Disconnection / Suction Specifications

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Specifications	
Pre-oxygenation time	Maximum 2 minutes
Post-oxygenation time	Maximum 1 minute
Patient disconnected	High priority alarm activated after 1 minute
Adjustable oxygen level	21% to 100%

Monitoring and Trends Specifications

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Alarms Specifications

Alarms	Neonatal Range	Pediatric Range	Adult Range
Airway pressure (upper alarm limit)	16 to 90 cmH ₂ O	16 to 90 cmH₂O	16 to 120 cmH₂O
Airway pressure NIV (upper alarm limit)	16 to 40 cmH ₂ O	16 to 40 cmH ₂ O	16 to 40 cmH ₂ O
Respiratory rate (upper and lower alarm limits)	1 to 160 breaths/min	1 to 160 breaths/min	1 to 160 breaths/min
Expired minute volume (upper alarm limit)	0.02 to 30 l/min	0.02 to 30 l/min	1 to 60 l/min
Expired minute volume (lower alarm limit)	0.01 to 20 l/min	0.01 to 20 l/min	0.5 to 40 l/min
End expiratory pressure (upper alarm limit)	1 to 55 cmH₂O	1 to 55 cmH ₂ O	1 to 55 cmH ₂ O
End expiratory pressure (lower alarm limit)	Off, 1 to 47 cmH ₂ O	Off, 1 to 47 cmH₂O	Off, 1 to 47 cmH₂O
No patient effort (Apnea) alarm	2 to 45 s	2 to 45 s	15 to 45 s
	Automatic return to sup	oport mode on patient tri	ggering
No consistent patient effort	Yes (See User's manua	l)	
High continuous pressure	Yes (See User's manua	<i>l</i>)	
O ₂ concentration	Set value ±5 vol% or ≤18 vol%		
Gas supply	Below 200 kPa (2.0 bar/29 PSI), above 600 kPa (6.0 bar/87 PSI)		
Battery	 Limited battery capacity: 10 minutes 		
	 No battery capacity: 	less than 3 minutes	
	 Low battery voltage 		
End tidal CO ₂ (upper and lower limit)	0.5% to 20%, 4 to 100 mmHg, 0.5 to 14 kPa		
Leakage too high	Yes (See User's manual)		
Technical	Yes (See User's manual)		
Autoset (Alarm Limits) Specifications	Invasive Ventilation — Controlled Modes Only		1
High airway pressure	Mean peak pressure +10 cmH ₂ O or at least 35 cmH ₂ O		cmH ₂ O
Inspiratory tidal volume too high	The greater of VTi + 30	% or VTi + 2 ml	
Expiratory minute volume (upper alarm limit)	Mean expiratory minut	e volume + 50%	
Expiratory minute volume (lower alarm limit)	Mean expiratory minute volume - 50%		
Respiratory rate (upper alarm limit)	Mean respiratory rate + 40%		
Respiratory rate (lower alarm limit)	Mean respiratory rate - 40%		
End expiratory pressure (upper alarm limit)	Mean end expiratory pressure + 5 cmH ₂ O		
	Mean end expiratory pressure - 3 cmH ₂ O		
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Optional Equipment Specifications

Optional Equipment	Weight	Dimensions	Maximum load
Mobile cart	27 lb 9 oz (12.5 kg)	25.5 W x 21.5 L x 21.9 H in (647 W X 547 L x 557 H mm)	_
Drawer for mobile cart	1 lb 5 oz (0.6 kg)	9.7 W x 4.6 L x 11.9 H in (247 W x 118 L x 302 H mm)	-
Shelf base	5 lb 8 oz (2.5 kg)	8.1 W x 11.9 L x 1.7 H in (207 W x 302 L x 43 H mm	_
Pendant/bed holder	7 lb (3.2 kg)	11.9 W x 11.9 L x 15.5 H in (302 W x 302 L x 393 H mm)	-
Humidifier holder	1 lb 2 oz (0.5 kg)	9.6 W x 1.5 L x 7.3 H in (243 W x 38 L x 185 H mm)	26 lb 7 oz (12 kg)
Support arm 178	5 lb 8 oz (2.5 kg)	35.4 L in (900 L mm)	2 lb 3 oz to 7 lb (1 to 3 kg) depending on angle
User interface holder	1 lb 5 oz (0.6 kg)	1.8 W x 3.5 L x 4.8 H in (46 W x 90 L x 123 H mm)	_
Cable holder for handle	4 oz (0.1 kg)	5.4 W x 3.6 L x 6.1 H in (138 W x 92 L x 155 H mm)	22 lb 1 oz (10 kg)
Waterbag/IV pole	14 oz (0.4 kg)	5.8 W x 1.0 L x 39.6 H in (148 W x 26 L x 1007 H mm)	3 lb 5 oz (1.5 kg)
Gas cylinder restrainer kit	1 lb 2 oz (0.5 kg)	Upper: 4.1 W x 2.6 L x 1.9 H in (104 W x 65 L x 48 H mm) Lower: 4.2 W x 6.4 L x 3.0 H in (106 W x 162 L x 76 H mm)	Two 4.5 liter bottles
Y piece holder		1.0 W x 2.0 L x 1.8 H in (26 W x 52 L x 46 H mm)	

Y Sensor (option) Specifications

Specificiations	Size	Weight
Y sensor module	6.1 W x 3.5 L x 0.8 H in (154 W x 90 L x 21 H mm)	10 oz (280 g)
Y sensor	0.7 W x 2.0 L x 1.1 H in (18 W x 50 L x 27 H mm)	0.4 oz (11 g)
Connectors and cables	 15 mm male and female conical c to ISO 5356-1 Pressure port on module, pressure Flow sensor cable, 6 ft 6.7 in (2.0 	e line, 2.0 m, phthalate free PVC
Sensor material	 Single use: PC, Polycarbonate 	
Power source	Powered by the ventilator system, 4.5 W during normal operation.	
Measuring method	Hot Wire Anemometer (HWA)	
Parameters	 Airway pressure Airway flow Inspiratory and expiratory volume Trigger and End inspiration 	S
Measuring range	 Flow: 0.12 to 32 l/min Pressure: -40 to 120 cmH₂O 	
Y sensor resistance	10 cmH ₂ O/I/s at 30 I/min	
Dead space	≤1 ml	
Pressure line connector	Gable mounted bulk head connector of 0.1 to 0.16 in (3 to 4 mm)	or to fit tubing with an inner diameter

CO₂ Analyzer (option) Specifications

Specifications	Size	Weight	
•			
CO ₂ analyzer module	6.1 W x 3.5 L x 1.7 H in (154 W x 90 L x 43 H mm)	16 oz (0.45 kg)	
Sensor (Capnostat 5)	1.3 x 1.9 x 0.9 in	0.7 oz	
	(32 x 47 x 21.6 mm)	(20 g)	
Operating temperature	50°F to 91°F (10°C to 33°C)	-	
Airway adapter	-	0.4 oz (10 g)	
Power source	Powered by the ventilator		
Connectors and cables	 CO₂ analyzer module: 15-pole D-s Sensor: 9 ft 2 in (2.8 m) cable 	sub female connector	
Measuring method	Mainstream, dual-wavelength, non-dispersive infrared		
Parameters	 CO₂ end tidal concentration (etCO₂) 		
	• CO ₂ minute elimination (VCO ₂)		
	 CO₂ tidal elimination (VTCO₂) 		
Measuring range	• 0 to 150 mmHg CO ₂ partial press	ıre	
	 0 to 20 kPa CO₂ partial pressure 		
	 0 to 19.7% CO₂ volume (at a baro 	metric pressure of 1013 hPa)	
System response time CO ₂	The total system response time of t	he CO ₂ monitor when exposed first	
	to air and then to a gas mix with 5.0	0% CO₂ is <250 ms	
Warm-up time	15 s to initial CO_2 indication		
	maximum 2 minutes to full specifica		
Oxygen concentration compensation	Automatic — values supplied from the ventilator system		
Barometric pressure compensation	Automatic – values supplied from	the ventilator system	
Digitizing rate	100 Hz		
Airway adapter dead space	• Neonatal/pediatric: <1 cm ³		
	• Adult: <5 cm ³		

Edi Module (option) Specifications

Specifications	Size	Weight
Edi module	3.5 W x 6.1 L x 0.8 H in (90 W x 154 L x 21 H mm)	8.8 oz (0.25 kg)
Edi catheter cable	6 ft 6.7 in (2.0 m)	-
Power source	Powered by the ventilator	
Power consumption	<3 W during normal operation	
Parameters	Edi waveform ECG leads waveforms	

ECG leads waveforms
 NAVA[®] estimated pressure waveform (Pest)

Aeroneb Nebulizers Specifications

Specifications	Pro	Solo	
Size	2.0 W x 2.0 L x 1.8 H in (50 W x 50 L x 45 H mm)	(1.9 W x 1.0 L x 2.6 H in (48 W x 25 L x 67 H mm)	
Weight	Approx. 0.9 oz (25 g)	Approx. 0.5 oz (14 g)	
Particle size	1 to 5 µm mass median aerod	1 to 5 µm mass median aerodynamic diameter (MMAD)	
Flow rate	>0.2 (average: ~0.4) ml/min		
Maximum volume	10 ml	6 ml	
Residual volume	<0.1 ml for 3 ml dose		
Control cable	5 ft 10.9 in (1.8 m)		

Communication/Interface Specifications

Communication/Interface		
Serial ports	Isolated	
	 Two RS-232C ports. For data communication via the SERVO Communication Interface (SCI) 	
Servo Communication Interface (SCI)	A protocol for data communication with external devices	
Alarm output connection (option)	 Isolated 	
	 4-pin modular connector for communication of all active alarms 	
	 Switching capability: Max. 40 V DC, max. 500 mA, max. 20 W 	
Data transfer via USB port	Non-isolated	
	 For transfer of trends, logs, screenshots and recordings to a 	
	USB memory stick	
VGA port	Non-isolated	
	 External monitors should be isolated from the ventilator system — this can be achieved if the connected monitor is powered via a medical grade transformer 	
Eth sup studies with	Isolated	
Ethernet port	 The network connection (LAN) port is for service use 	

Log Function

Specifications	
Event log	• Alarms
	 Ventilator settings
	 Apnea periods
	 Immediate functions
Diagnostic log	Technical information
	Test results
	Service records
	Software installation
	 Configuration information

Saving of Data

Specifications		
Recording of current waveform and parameter values	30 seconds of data will be recorded (15 seconds before and 15 seconds after activation) — up to 40 recordings can be stored	
Saving screenshots	Up to 40 screenshots can be stored	
Export files	Recordings, screenshots and the event log can be saved together in an export file and transferred to a USB memory stick	

Compressor Mini (option)

Specifications

See separate data sheet

Service

Specifications

Regular maintenance

Once every 12 months or at least after 5000 operating hours

Ordering Information

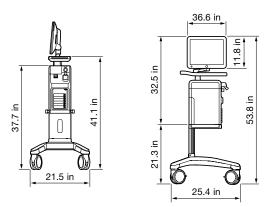
Specifications

SERVO-U, ventilator system and accessories

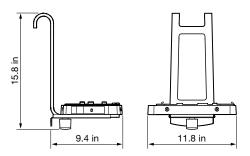
Contact your local Maquet representative

Technical drawings

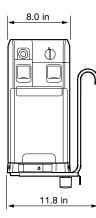
SERVO-U® on Mobile Cart

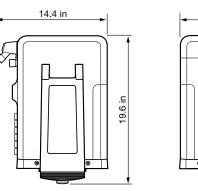


SERVO-U Holder

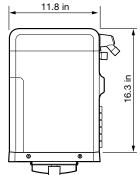


SERVO-U (patient unit) on SERVO-U Holder

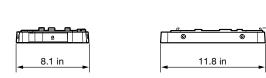




1.6 in



SERVO-U Shelf Base



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GETINGE GROUP

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