



# SERVO-air ventilator

## Datasheet for system version 2.1

# Contents

<b>Technical specifications .....</b>	<b>3</b>
General .....	3
The ventilator – general .....	3
Ventilation – general .....	4
User interface .....	4
Power supply .....	4
Gas supply .....	4
Operating conditions .....	4
Non-operating conditions .....	4
Standards - safety and functionality .....	5
Ventilation modes – invasive ventilation .....	5
Ventilation modes – non invasive ventilation .....	5
Non invasive ventilation .....	5
Parameter settings .....	6
Backup parameter settings .....	6
Special functions .....	6
Disconnection / Suction .....	6
Monitoring and trends .....	7
Alarms .....	7
Autoset (alarm limits) specification .....	8
Aerogen nebulizers .....	8
Communication / Interface .....	8
Log function .....	8
Saving of data .....	8
Optional equipment .....	9
<b>Ordering information .....</b>	<b>9</b>
<b>Dimensional drawings .....</b>	<b>10</b>
SERVO-air on Mobile cart .....	10
SERVO-air on shelf base .....	10
SERVO-air shelf base .....	10

# SERVO-air

## Technical specifications

### General

Intended use	The SERVO-air ventilator system is: <ul style="list-style-type: none"> <li>intended for respiratory support, monitoring and treatment of pediatric and adult patients</li> <li>to be used only by healthcare providers</li> <li>to be used only in professional healthcare facilities and for transport within these facilities</li> </ul>
Instructions for use	Please carefully read the user's manual
Legal manufacturer	Maquet Critical Care AB
Other products	See separate data sheets. Contact your local Getinge supplier for more information.

### The ventilator – general

	SERVO-air	SERVO-air on mobile cart
Base system weight	Approx. 15 kg (33 lbs)	Approx. 30 kg (66 lbs) <ul style="list-style-type: none"> <li>Base system approx. 15 kg (33 lbs)</li> <li>Mobile cart approx. 15 kg (33 lbs)</li> </ul>
Dimensions of base (W x D), see dimensional drawings	375 x 350 mm (14.8"x13.8")	647 x 547 mm (25.5"x21.5") incl. wheels
Height (incl. user interface)	489 mm (19.3")	1335 mm (52.6")
Wheels	N/A	Four wheels with separate brakes
A-weighted sound pressure level ( $L_{pA}$ )	<49 dB, measured at a distance of 1 m (3.3 ft)	
A-weighted sound power level ( $L_{WA}$ )	<57 dB	

## Ventilation – general

Patient range	Tidal volume: <ul style="list-style-type: none"> <li>• Pediatric: 20 – 350 ml</li> <li>• Adult: 100 – 2000 ml</li> </ul>
Bias flow	2 l/min $\pm$ 5 %
Internal compressible factor	Max. 0.1 ml/cmH <sub>2</sub> O
Gas delivery system	Air turbine and O <sub>2</sub> valve
Maximum airway pressure	100 cmH <sub>2</sub> O
Method of triggering	Flow and pressure
Inspiratory flow range	<ul style="list-style-type: none"> <li>• Adult: 0 – 240 l/min</li> <li>• Pediatric: 0 – 80 l/min</li> </ul>
Pressure drop	Max. 3 cmH <sub>2</sub> O at a flow of 60 l/s (exp. channel)
PEEP regulation	Microprocessor controlled valve
Rise time, expiratory flow measurement	<12 ms for 10 – 90 % response at flow of 3 – 192 l/min
Expiratory flow range	0 – 192 l/min

## User interface

Type	TFT-LCD touchscreen
Size	300 x 248 mm (11.8" x 9.8")
Viewing area	12" XGA, 1024x768 pixels with a 24-bit color palette

## Power supply

Power supply, automatic range selection	100 – 240 V AC $\pm$ 10%, 50 – 60 Hz
Plug-in battery module:	
• Battery backup (Li-ion)	• Two battery module slots. One battery is delivered with the ventilator.
• Battery capacity	• Rechargeable, 14.4 V, 6.6 Ah each
• Battery backup time	• Approximately 2 h (factory new battery)
• Recharge time	• Approximately 3 h/battery
External 12 V DC	12.0 V – 15.0 V DC, 15 A

## Gas supply

Inlet gas pressure O <sub>2</sub>	200 – 600 kPa / 2.0 – 6.0 bar / 29 – 87 PSI
Connection standards available	AGA, DISS, NIST, or French standard
Unavailable gas/loss of gas pressure	The flow from an unavailable gas (O <sub>2</sub> ) 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

Operating temperature	+5 to +40°C (+41 to +104°F)
Relative humidity	5 to 95% non-condensing
Atmospheric pressure	660 to 1060 hPa
Lowest pressure in patient circuit	-400 cmH <sub>2</sub> O

## Non-operating conditions

Storage temperature	-25 to +60°C (-13 to +140°F)
Storage relative humidity	<95% condensing
Storage atmospheric pressure	470 to 1060 hPa

## Standards - safety and functionality

	<p>The device complies with requirements and classification IIb of Medical Device Directive 93/42/EEC.</p> <p>CE Mark Notified Body number: 0123.</p>
Classification	<p>IEC 60601-1: 2005 + A1:2012, Class I, continuous operation.</p> <p>Applied parts:</p> <ul style="list-style-type: none"> <li>- Equipment making physical contact with the patient and the gas pathways. Type B</li> <li>- Nebulizer patient unit and cable. Type BF</li> </ul>
Standards	<ul style="list-style-type: none"> <li>• Applied parts, i.e. equipment making physical contact with the patient, are described in <b>Ventilation patient connection – System flowchart.</b></li> <li>• ISO 80601-2-12:2011</li> <li>• ISO 80601-2-55:2011</li> <li>• EN 13544-1:2007 + A1:2009</li> </ul>
Ingress protection	IP 21
Electromagnetic compatibility (EMC)	According to limits specified in IEC 60601-1-2:2007
<p>The '<b>EMC Declaration, Information to the Responsible Organization</b>' is available from Getinge.</p>	

## Display

Views	<ul style="list-style-type: none"> <li>• Basic view</li> <li>• Advanced view</li> <li>• Loops view</li> <li>• Distance view</li> <li>• Family view</li> </ul> <p>Each of the screen layout views offers a specific combination of displayed waveforms, loops and presented values.</p>
Real time waveforms	<ul style="list-style-type: none"> <li>• Pressure</li> <li>• Flow</li> <li>• Volume</li> </ul>
Loops	<ul style="list-style-type: none"> <li>• Pressure – Volume</li> <li>• Pressure – Flow</li> <li>• Volume – Flow</li> </ul> <p>A reference loop and three overlaying loops can be displayed.</p>

## Ventilation modes – invasive ventilation

Controlled ventilation	<ul style="list-style-type: none"> <li>• PC (Pressure Control)</li> <li>• VC (Volume Control)</li> <li>• PRVC (Pressure Regulated Volume Control), option</li> </ul>
Supported ventilation:	<ul style="list-style-type: none"> <li>• PS/CPAP (Pressure Support / Continuous Positive Airway Pressure)</li> <li>• VS (Volume Support), option</li> </ul>
AUTOMODE (option)	<ul style="list-style-type: none"> <li>• Control mode: VC &lt;--&gt; Support mode: VS</li> <li>• Control mode: PC &lt;--&gt; Support mode: PS</li> <li>• Control mode: PRVC &lt;--&gt; Support mode: VS</li> </ul>
Combined ventilation	<ul style="list-style-type: none"> <li>• SIMV (VC) + PS (Synchronized Intermittent Mandatory Ventilation)</li> <li>• SIMV (PC) + PS</li> <li>• SIMV (PRVC) + PS (option)</li> <li>• Bi-Vent/APRV (Airway Pressure Release Ventilation), option</li> </ul>

## Ventilation modes – non invasive ventilation

Controlled ventilation	NIV PC, option
Supported ventilation:	NIV PS, option

## Non invasive ventilation

Max. leakage compensation level	<ul style="list-style-type: none"> <li>• Adult: <ul style="list-style-type: none"> <li>- INSPIRATORY: up to 240 l/min*</li> <li>- EXPIRATORY: up to 65 l/min</li> </ul> </li> <li>• Pediatric: <ul style="list-style-type: none"> <li>- INSPIRATORY: up to 240 l/min*</li> <li>- EXPIRATORY: up to 25 l/min</li> </ul> </li> </ul> <p>* up to 180 l/min with 100% O<sub>2</sub> concentration</p>
Disconnection flow (configurable)	<ul style="list-style-type: none"> <li>• Low: 7.5 l/min</li> <li>• High: 40 l/min</li> <li>• Disabled: Deactivates disconnection detection</li> </ul>
Connection detection	Manual or automatic via bias flow

## Parameter settings

Parameter	Adult range	Pediatric range
Tidal volume (ml)	100 – 2000	20 – 350
Minute volume (l/min)	0.5 – 60	0.3 – 20
Apnea, time to alarm (s)	15 – 45	2 – 45
Max. apnea time in Automode (s)	7 – 12	3 – 15
Pressure level above PEEP (cmH <sub>2</sub> O)	0 – 99	0 – 79
Pressure level above PEEP in NIV (cmH <sub>2</sub> O)	0 – 30	0 – 60
PEEP (cmH <sub>2</sub> O)	1 – 50	1 – 50
PEEP in NIV (cmH <sub>2</sub> O)	2 – 20	2 – 20
Respiratory rate (breaths/min)	4 – 100	4 – 150
SIMV rate (breaths/min)	1 – 60	1 – 60
Breath cycle time, SIMV (s)	1 – 15	0.5 – 15
P <sub>High</sub> (cmH <sub>2</sub> O)	2 – 50	2 – 50
T <sub>High</sub> (s)	0.2 – 30	0.2 – 30
T <sub>PEEP</sub> (s)	0.1 – 10	0.1 – 10
PS above P <sub>High</sub> in Bi-Vent/APRV (cmH <sub>2</sub> O)	0 – 98	0 – 78
O <sub>2</sub> concentration (%)	21 – 100	21 – 100
I:E ratio	1:10 – 4:1	1:10 – 4:1
Ti (s)	0.1 – 5	0.1 – 5
T <sub>Pause</sub> (s)	0 – 1.5	0 – 1.5
T <sub>Pause</sub> (% of breath cycle time)	0 – 30	0 – 30
Flow trigger (l/min)	0 – 2	0 – 2
Pressure trigger (cmH <sub>2</sub> O)	-1 to -20	-1 to -20
Insp. rise time (% of breath cycle time)	0 – 20	0 – 20
Insp. rise time (s)	0 – 0.4	0 – 0.2
End inspiration (% of peak flow)	1 – 70	1 – 70
End inspiration (% of peak flow) in NIV	10 – 70	10 – 70

## Backup parameter settings

Parameter	Adult range	Pediatric range
Inspiratory tidal volume (ml)	100 – 2000	20 – 350
Pressure level above PEEP in backup (cmH <sub>2</sub> O)	5 – 99	5 – 79
Pressure level above PEEP in NIV backup (cmH <sub>2</sub> O)	5 – 60	5 – 60
Respiratory rate in backup (breaths/min)	4 – 100	4 – 150
I:E ratio	1:10 – 4:1	1:10 – 4:1
Ti (s)	0.1 – 5	0.1 – 5

## Special functions

Special function	Setting range
Manual breath	Initiation of 1 breath (In SIMV mode initiation of 1 mandatory breath)
Static measurements	Insp. or exp. hold (0 – 30 seconds)
Nebulization	5 – 30 min/Continuous/Off
O <sub>2</sub> boost level	Off, 1 – 79 %
O <sub>2</sub> boost function	Activate O <sub>2</sub> boost up to 1 minute
Leakage compensation	Automatic in all non invasive modes
Circuit compensation (not available in NIV)	On/Off
Previous mode	Activates previously used mode
Backup ventilation	Backup On/Off
Apnea management	Several parameters

## Disconnection / Suction

Pre-oxygenation time	Max. 2 min
Post-oxygenation time	Max. 1 min
Patient disconnected	High priority alarm activated after 1 min
Adjustable oxygen level	21 – 100 %

## Monitoring and trends

Peak airway pressure	Ppeak
Pause airway pressure	Pplat
Mean airway pressure	Pmean
Driving pressure	Pdrive
Positive end expiratory pressure	PEEP
Spontaneous breaths per minute	RR sp
Respiratory rate	RR
Spontaneous expiratory minute volume	MVe sp
Inspired minute volume	MVi
Expired minute volume	MVe
Leakage fraction (%)	Leakage
Inspired tidal volume	VTi
Expired tidal volume	VT <sub>e</sub>
End expiratory flow	Flow <sub>ee</sub>
Measured oxygen concentration	O <sub>2</sub> conc.
Dynamic compliance	C <sub>dyn</sub>
Static compliance	C <sub>static</sub>
Inspiratory resistance	R <sub>i</sub>
Expiratory resistance	R <sub>e</sub>
Work of breathing, ventilator	WOB <sub>vent</sub>
Work of breathing, patient	WOB <sub>pat</sub>
Elastance	E
P 0.1	P 0.1
Shallow Breathing Index	SBI
Ratio of expired tidal volume to predicted body weight	VT/PBW
Ratio of expired tidal volume to body weight	VT/BW
Switch to backup (/minute)	Trended value only
Backup (%/min)	Trended value only

## Alarms

Alarm	Adult range	Pediatric range
Airway pressure (upper alarm limit)	16 – 100 cm-H <sub>2</sub> O	16 – 90 cmH <sub>2</sub> O
Airway pressure NIV (upper alarm limit)	16 – 70 cmH <sub>2</sub> O	16 – 70 cmH <sub>2</sub> O
Respiratory rate (upper alarm limit)	2 – 160 breaths/min	2 – 160 breaths/min
Respiratory rate (lower alarm limit)	1 – 159 breaths/min	1 – 159 breaths/min
Expired minute volume (upper alarm limit)	1 – 60 l/min	0.02 – 30 l/min
Expired minute volume (lower alarm limit)	0.5 – 40 l/min	0.01 – 20 l/min
End expiratory pressure (upper alarm limit)	1 – 55 cmH <sub>2</sub> O	1 – 55 cmH <sub>2</sub> O
End expiratory pressure (lower alarm limit)	0 – 47 cmH <sub>2</sub> O	0 – 47 cmH <sub>2</sub> O
No patient effort (Apnea) alarm	15 – 45 s	2 – 45 s
	Automatic return to support mode on patient triggering	
No consistent patient effort	Yes, described in User's manual	
High continuous pressure	Yes, described in User's manual	
O <sub>2</sub> concentration	Set value ±5 vol% or 18 vol% ** ** When the set O <sub>2</sub> concentration is higher than 90%, the O <sub>2</sub> concentration low alarm is set to 85%.	
Gas supply	Below 200 kPa (2.0 bar/29 PSI), above 600 kPa (6.0 bar/87 PSI)	
Battery	<ul style="list-style-type: none"> <li>Limited battery capacity: 10 min</li> <li>No battery capacity: less than 3 min</li> <li>Low battery voltage</li> </ul>	
Leakage too high	Yes, described in User's manual	
Technical	Yes, described in User's manual	

## Autoset (alarm limits) specification

Autoset (alarm limits) specification	Invasive ventilation, controlled modes only
High airway pressure:	Mean peak pressure +10 cmH <sub>2</sub> O or at least 35 cmH <sub>2</sub> O
Expiratory minute volume (upper alarm limit)	Mean expiratory minute 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 <sub>2</sub> O
End expiratory pressure (lower alarm limit)	Mean end expiratory pressure -3 cmH <sub>2</sub> O

## Aerogen nebulizers

Aerogen nebulizers	Pro	Solo
Size	W 50 x L 50 x H 45 mm (W 2.0" x L 2.0" x H 1.8")	W 48 x L 25 x H 67 mm (W 1.9" x L 1.0" x H 2.6")
Weight	Approx. 25 g (0.88 oz)	Approx. 14 g (0.49 oz)
Particle size	1 – 5 µm mass median aerodynamic diameter (MMAD)	
Flow rate	>0.2 (average: ~0.4) ml/min	
Max. volume	10 ml	6 ml
Residual volume	<0.1 ml for 3 ml dose	
Control cable	1.8 m (5.9 ft)	

## Communication / Interface

Serial ports	<ul style="list-style-type: none"> <li>Isolated</li> <li>Two RS-232C ports. For data communication via the Servo Communication Interface (SCI).</li> </ul>
Servo Communication Interface (SCI)	A protocol for data communication with external devices
Alarm output connection (option)	<ul style="list-style-type: none"> <li>Isolated</li> <li>4-pin modular connector for communication of all active alarms</li> <li>Switching capability: Max. 40 V DC, max. 500 mA, max. 20 W</li> </ul>
Data transfer via USB port	<ul style="list-style-type: none"> <li>Non-isolated</li> <li>For transfer of trends, logs, screenshots and recordings to a USB memory stick</li> </ul>
Ethernet port	<ul style="list-style-type: none"> <li>Isolated</li> <li>The network connection (LAN) port is for service use</li> </ul>

## Log function

Event log	<ul style="list-style-type: none"> <li>Alarms</li> <li>Ventilator settings</li> <li>Apnea periods</li> <li>Immediate functions</li> </ul>
Service log	<ul style="list-style-type: none"> <li>Technical alarms</li> <li>Test results</li> <li>Service records</li> <li>Software installation</li> <li>Configuration information</li> </ul>

## Saving of data

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.



## Optional equipment

Optional equipment	Weight	Dimensions	Maximum load
Mobile cart	15.0 kg (33.0 lbs)	W 647 x L 547 x H 860 mm (W 25.5" x L 21.5" x H 33.9")	-
Shelf base	3.0 kg (6.6 lbs)	W 340 x L 270 x H 43 mm (W 13.4" x L 10.6" x H 1.7")	-
Humidifier holder	0.5 kg (1.1 lbs)	W 76 x L 125 x H 140 mm (W 3.0" x L 4.9" x H 5.5")	12 kg (26.5 lbs)
Support arm 179	2.5 kg (5.5 lbs)	Length 900 mm (35.4")	<ul style="list-style-type: none"> <li>• 1 kg (2.2 lbs) at 180°</li> <li>• 1.5 kg (3.3 lbs) at 90°</li> <li>• 3 kg (6.6 lbs) at 45°</li> </ul>
Cable holder for handle	0.1 kg (0.2 lbs)	W 138 x L 92 x H 155 mm (W 5.4" x L 3.6" x H 6.1")	10 kg (22.0 lbs)
Waterbag/IV pole	0.4 kg (0.9 lbs)	W 148 x L 26 x H 1007 mm (W 5.8" x L 1.0" x H 39.6")	1.5 kg (3.3 lbs)
Gas cylinder restrainer kit	0.5 kg (1.1 lbs)	Upper: W 104 x L 65 x H 48 mm (W 4.1" x L 2.5" x H 1.9") Lower: W 106 x L 162 x H 76 mm (W 4.1" x L 6.4" x H 3.0")	Two 4.5-liter bottles
Y piece holder	-	W 26 x L 52 x H 46 mm (W 1.0" x L 2.0" x H 1.8")	-

## Service

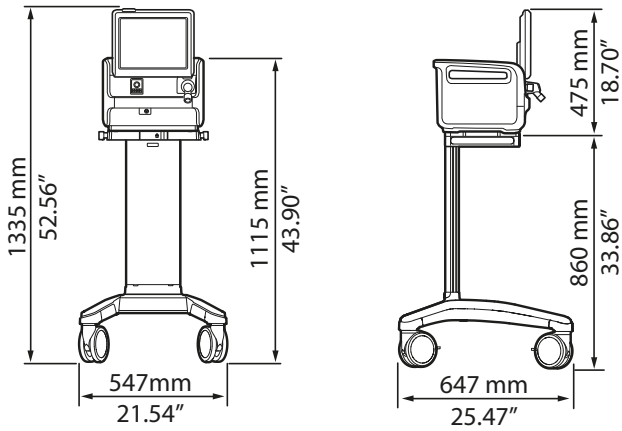
Regular maintenance	Once every 12 months or at least after 5000 operating hours
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## Ordering information

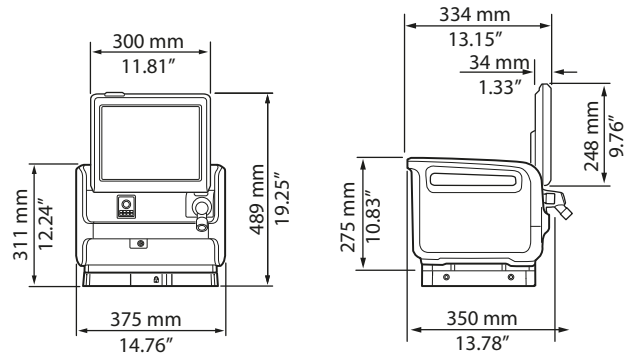
SERVO-air, ventilator system and accessories: See separate information:  
"System Flow Chart, SERVO-air" (Order no: MX-7012).

# Dimensional drawings

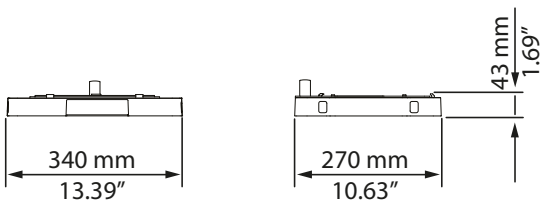
## SERVO-air on Mobile cart



## SERVO-air on shelf base



## SERVO-air shelf base



\*Country specific part and directly removable parts excluded

# Notes

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Getinge is a global provider of innovative solutions for operating rooms, intensive care units, sterilization departments and for life science companies and institutions. Based on our firsthand experience and close partnerships with clinical experts, healthcare professionals and medtech specialists, we are improving the everyday life for people, today and tomorrow.

SERVO-air may be pending regulatory approvals to be marketed in your country. Contact your Getinge representative for more information. This document is intended to provide information to an international audience outside of the US.

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