DATA SHEET

MAQUET

VENTILATION
SERVO-s

CRITICAL CARE

SERVO-s – PROVEN SERVO SIMPLICITY, RELIABILITY AND SENSITIVITY
MAQUET – THE GOLD STANDARD

Leading the way: MAQUET is a premier international provider of medical products for intensive care and operating rooms. A firm commitment to investment in research and development ensures that MAQUET products continue to make significant contributions to improving patient care.

MAQUET SERVO ventilators set the standard for the field of critical care. Based on proven SERVO technology, SERVO-s offers state-of-the-art mechanical ventilation in a straightforward package. It is reliable, sensitive to patient effort, and easy to use. SERVO-s delivers top performance for both pediatric and adult patients in a variety of hospital ventilatory care settings. SERVO-s proudly takes its place in the SERVO ventilator family.

SERVO-s: Proven Servo simplicity, reliability and sensitivity.

MAQUET – The Gold Standard.

HIGHLIGHTS
SERVO-s

- For adult and pediatric patients
- A ventilator system designed to operate in a variety of hospital ventilatory care settings
- Ventilation modes:
  Controlled ventilation:
  – Volume Control (VC)
  – Pressure Control (PC)
  Supported ventilation:
  – Pressure Support (PS)/CPAP
  Combined ventilation:
  – SIMV (VC) + PS
  – SIMV (PC) + PS
- Options:
  – Alarm output connection for external alarm
  – Non Invasive Ventilation (NIV) (Pressure Support, Pressure Control)
- Supports invasive ventilation as well as Non Invasive Ventilation (NIV) with leakage compensation
- High level of sensitivity to your patients efforts
  – Precise gas delivery system
  – Extreme speed in sensing and regulation
- Simple to learn
  – Self-intuitive user interface
- Simple to operate
  – Large color display with clear graphic presentation
  – Selectable between touch screen, direct access knobs or dial
  – Fast/simple start up procedure e.g. automated pre-use check with user configured pre-set ventilator settings
  – Suction Support
  – Previous Mode functionality
  – High-resolution flow, pressure and volume waveforms
- Simple to maintain/clean
  – One-piece interchangeable part for cleaning
  – Extended maintenance interval (5000 hours)
  – Maintenance information given via graphical user interface
- Reliable
  – Battery back-up (60 minutes)
  – Apnea back-up
  – Direct access knobs for vital settings
  – Enhanced alarm system
- Uninterrupted bedside quality ventilatory treatment during in-hospital transportation with Mobile Cart
- Possibility for shelf mounting
- Diagnostic trend tools ensure accurate time and detail recording for up to 24 hours after an event
- Volume/Pressure and Flow/Volume loops
- Non-consumable and maintenance-free ultrasonic O_2 sensor optional to consumable O_2 cell

GENERAL INFORMATION
SERVO-s

The SERVO-s ventilator is based on proven SERVO technology, ensuring safe, reliable and high quality ventilation. By combining state-of-the-art sensitivity and reliability with simplicity, SERVO-s ensures top performance for both adult and pediatric patients in a variety of hospital ventilatory care treatment facilities.

SERVO-s features a range of user interface tools which allow the ventilator to be tailored to the clinical situation. Ease of training, operation and maintenance are key SERVO-s features.

The SERVO Feedback Control System in SERVO-s immediately responds to patient needs in terms of pressure and flow changes. Even the smallest deviations from set values are sensed, fed back to the SERVO-controlled valves and regulated – several hundred times a second. Thus the SERVO Feedback control system gives the patient exactly the ventilation you have chosen.

This improves lung protection, patient interaction and promotes spontaneous breathing by providing timely assistance – thus reducing the work of breathing and improving patient comfort. The results are improved care quality and cost-effective operation.

The intuitive graphical user interface of the SERVO-s facilitates control and rapid system response. Direct access knobs ensure fast changes of vital settings when needed. Staff will be able to make the right decisions and choose the right settings – even in stressful moments.

SERVO-s can be positioned on the Mobile Cart for greater flexibility and mobility.

SERVO-s can also be secured on a shelf, using the shelf base for attachment.

GENERAL INFORMATION
SERVO-s

SERVO-s supports both invasive ventilation and Non Invasive Ventilation (NIV).

SERVO-s supports invasive ventilation and also Non Invasive Ventilation (NIV) with an effective leakage compensation, thus maintaining the pressure set to the patient. NIV supports ventilation in the Pressure Control and Pressure Support modes. In the case of apnea, a ventilator controlled breathing frequency is automatically activated to maintain desired ventilation.

Four different ventilation modes let you tailor patient treatment to individual needs:

Volume Control (VC): Instead of delivering only a set flow as in a traditional volume control mode – which may work against the patient's own effort – SERVO-s senses the patient's demand for higher flow during inspiration. This will ensure improved patient interaction by delivering set tidal volume as a minimum, or a higher tidal volume if demanded by the patient.

Pressure Control (PC): Thanks to the SERVO feedback control system, which constantly reacts to deviations in pressure, the SERVO-s Pressure Control mode ensures that a constant pressure is maintained through the inspiration time and thereby secures an even gas distribution.

Pressure Support / Continuous Positive Airway Pressure (PS) / CPAP: Easy triggering and fast response to changing patient demand is important in assisted breathing. When ventilating a patient in Pressure Support mode with SERVO-s, customization to every patient's needs can easily be achieved by adjusting inspiratory rise time and cycle-off criteria, thus optimizing flow adaptation to patient effort, work of breathing and patient comfort.

A back-up apnea function ensures safe invasive ventilation in the Pressure Support mode.

Synchronized Intermittent Mandatory Ventilation (SIMV): In this combination mode the ventilator will deliver controlled mandatory breaths. These are synchronized with the breathing efforts of the patient. The patient can breathe spontaneously in between the mandatory breaths. SIMV ensures that patient-triggered breaths are always supported.

GENERAL INFORMATION
SERVO-s

The automated pre-use check – which only takes a few minutes – offers a fast and simple start-up procedure with an optimal calibration before connecting to a patient. The user can configure the ventilator to start up exactly the way he wants. The default ventilation mode as well as all the corresponding default ventilation parameters can be set by the user.

The Suction Support function pauses the ventilator from cycling during a tracheal suction procedure. The oxygen concentration can be manually set during pre- and post oxygenation phases.

A Previous Mode functionality allows for easy switching back to the previous ventilation mode with its latest settings.

The Alarm output connection option provides connectivity to an external alarm system.

The monitoring capabilities of SERVO-s ensure more accurate time and detail recording through trend alternatives. Information can be retrieved for further analysis up to 24 hours after an event.

SERVO-s is now available with a non-consumable and maintenance-free O_2 sensor as an option to the consumable O_2 cell, which needs replacement about once a year. The new O_2 sensor is based on ultrasonic technology. Existing SERVO-s ventilators can easily be upgraded.

Built-in rechargeable batteries provide a 60-minute backup in case of mains power failure. Total battery capacity is shown in time on the display for added safety.

Aeroneb Pro is a stand-alone nebulizer system based on vibration technology. It is small and lightweight and can easily be connected to the SERVO-s.

SERVO-s is designed for easy cleaning and maintenance. With a one-piece interchangeable expiratory cassette, you can instantly make the system ready for the next patient.

For added flexibility in hospitals with no central air supply, the Compressor Mini has been designed to supply the ventilator with dry, filtered, compressed air. The quiet, compact design makes it particularly suitable for bedside use.

TECHNICAL SPECIFICATIONS
SERVO-s

The system – general	
CE 0413	The device complies with requirements of Medical Device Directive 93/42/EEC.
Classification:	Class I equipment. According to IEC 60 601-1/EN 60 601-1.
Standards:	EN IEC 60 601-1 (Class I, Type B). EN IEC 60 601-2-12. EN 794-1.
Electromagnetic compatibility (EMC):	
– Emission:	According to EN IEC 60601-1-2 Edition 2.
– Immunity:	According to EN IEC 60601-1-2 Edition 2.
Patient range:	Tidal volume 100 to 2000 ml (patient weight approximately 10 to 250 kg) .

Operating conditions	
Operating temperature:	+10 to +40ºC
Relative humidity:	15 to 95% non-condensing
Atmospheric pressure:	660 to 1060 hPa
Lowest pressure in breathing system:	–400 cm H_2O

Non-operating conditions	
Impact:	Peak acceleration: 15 g. Pulse duration: 6 ms. Number of impacts: 1000.
Storage temperature:	–25 to +60 ºC (–13 to 140 ºF)
Storage Relative Humidity:	< 95%
Storage Atmospheric Pressure:	470 to 1060 hPa

Power supply	
Power supply, automatic range selection:	100 – 120 V AC ±10%, 50 – 60 Hz, or 220 – 240 V AC ±10%, 50 – 60 Hz.
External 12 V DC:	12.0 to 15.0 V DC, 10 A
Battery capacity:	Rechargable, 12 V, 7 Ah
Battery backup time:	Approximately 1 h
Battery recharge time:	Approximately 6 h
Max power consumption:	At 100 – 120 V: 2 A, 190 VA, 140 W. At 220 – 240 V: 1 A, 190 VA, 140 W.

The ventilator – general	
Dimensions:	(See dimensional drawings page 13–14)
– User Interface and Patient Unit:	W 380 x D 300 x H 520 mm
– User Interface:	W 355 x D 53 x H 295 mm
– Patient Unit:	W 380 x D 300 x H 210 mm
Weight:	Approximately 18 kg
Method of triggering:	Flow and pressure
Max. operating pressure:	Approximately 115 cm H_2O
Bias flow:	2 l/min

Screen	
Type:	TFT-LCD module
Size:	31 cm (12.1”) diagonal
Viewing area:	246.0 x 184.5 mm

TECHNICAL SPECIFICATIONS
SERVO-s

Gas supply	
Inlet gas pressure:	200 – 650 kPa / 2.0 – 6.5 bar / 29 – 94 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	
Conical fittings:	Male 22 mm / female 15 mm. In accordance with ISO 5356-1.
Gas exhaust port:	Male 30 mm cone

Inspiratory channel	
Pressure drop:	Max. 6 cm H_2O at a flow of 1 l/s
Internal compressible factor:	Max. 0.1 ml/cm H_2O
Gas delivery system:	Microprocessor controlled valves
Inspiratory flow range:	0 to 3.3 l/s

Expiratory channel	
Pressure drop:	Max. 3 cm H_2O at a flow of 1 l/s
Internal compressible factor:	Max. 0.1 ml/cm H_2O
PEEP regulation:	Microprocessor controlled valves
Expiratory flow range:	0 to 3.2 l/s
Rise time, expiratory flow measurement:	<12 ms for 10 – 90 % response at a flow of 0.05 – 3.2 l/s

Alarms	
Airway pressure (upper):	
– Invasive ventilation:	16 – 120 cm H_2O
– Non Invasive Ventilation:	16 – 60 cm H_2O
High continuous pressure:	Set PEEP level +15 cm H_2O exceeded for more than 15 seconds.
O_2 concentration:	Set value ±6 vol% or <18 vol%
Expired minute volume (Upper alarm limit):	0.5 – 60 l/min
Expired minute volume (Lower alarm limit):	0.5 – 40 l/min
Gas supply:	Below 200 kPa / 2.0 bar / 29 PSI and above 650 kPa / 6.5 bar / 94 PSI
Apnea:	15 – 45 s
Respiratory frequency:	1 – 160 breaths/min
Battery:	Limited battery capacity: 10 min. No battery capacity: less than 3 min. Low battery voltage.
High end expiratory pressure:	0 – 55 cm H_2O
Low end expiratory pressure:	0 – 47 cm H_2O. Note: Setting the alarm to 0 (zero) is equal to alarm off.
Leakage out of range in NIV:	Yes. Described in the User's manual.
No patient effort in NIV:	45 s
Technical:	Yes. Described in the User's manual.
Autoset (alarm limits) specification*:	* Invasive ventilation, controlled modes only.
– High airway pressure:	Mean peak pressure +10 cm H_2O or at least 35 cm H_2O.
– Upper minute volume:	Expiratory minute volume + 50%.
– Lower minute volume:	Expiratory minute volume – 50%.
– Upper respiratory frequency:	Breathing frequency + 40%.
– Lower respiratory frequency:	Breathing frequency – 40%.
– High end expiratory pressure:	Mean end expiratory pressure + 5 cm H_2O.
– Low end expiratory pressure:	Mean end expiratory pressure – 3 cm H_2O.

TECHNICAL SPECIFICATIONS
SERVO-s

Ventilation Modes – Invasive ventilation	
Controlled ventilation:	
– Volume Control (VC):	Volume controlled ventilation.
– Pressure Control (PC):	Pressure controlled ventilation.
Supported ventilation:	
– Pressure Support (PS)/ CPAP:	Pressure supported ventilation / Continuous Positive Airway Pressure ventilation.
Combined ventilation:	
– SIMV (VC) + PS:	Synchronized Intermittent Mandatory Ventilation based on volume controlled ventilation with pressure support.
– SIMV (PC) + PS:	Synchronized Intermittent Mandatory Ventilation based on pressure controlled ventilation with pressure support.

Ventilation Modes – Non Invasive Ventilation (optional)	
– NIV Pressure Control:	Non invasive pressure controlled ventilation.
– NIV Pressure Support:	Non invasive pressure supported ventilation.

Loop and waveform presentations	
Loops:	Volume / Pressure. Flow / Volume.
Real time waveforms:	Pressure waveform. Flow waveform. Volume waveform.

Monitoring	Displayed value	Trended value* * Stored trend values for up to 24 hours
Breathing frequency:	Yes	Yes
Spontaneous breaths per minute (RRsp):	Yes	Yes
Peak Airway Pressure:	Yes	Yes
Mean Airway Pressure:	Yes	Yes
Pause Airway Pressure:	Yes	Yes
End Expiratory Pressure:	Yes	Yes
End Expiratory Flow:	Yes	Yes
Inspired Tidal Volume:	Yes	Yes
Expired Tidal Volume:	Yes	Yes
Inspired Minute Volume:	Yes	Yes
Expired Minute Volume:	Yes	Yes
Ti/Ttot:	Yes	No
I : E Ratio:	Yes	No
Measured O_2 Concentration:	Yes	Yes
Spontaneous Exp. Minute Volume (MV_e sp):	No	Yes
Leakage fraction in NIV (%):	Yes	Yes
Supply pressure (O_2 and air):	Yes	No
Battery remaining time:	Yes	No
Barometric pressure:	Yes	No

Log function	
Event log:	Alarms. Ventilator settings. Apnea periods. Immediate functions.
Service log:	Technical alarms. Test results. Preventive maintenance. Service report history. Configuration log.

TECHNICAL SPECIFICATIONS
SERVO-s

Parameter settings	
Parameter:	Setting range:
Inspiratory tidal volume (ml):	100 – 2000
Inspiratory minute volume (l/min):	0.5 – 60
Apnea, time till alarm (s):	15 – 45
Pressure level (cm H_2O):	0 – (120 – PEEP)
PEEP (cm H_2O):	0 – 50
PEEP in NIV (cm H_2O):	2 – 20
CMV frequency (breaths/min):	4 – 100
SIMV frequency (breaths/min):	1 – 60
Breath cycle time, SIMV (s):	1 – 15
PS above PEEP (cm H_2O):	0 – (120 – PEEP)
PS above PEEP in NIV (cm H_2O):	0 – (32 – PEEP)
Back-up pressure above PEEP (cm H_2O):	5 – (120 – PEEP)
NIV Back-up rate (breaths/min):	4 – 20
O_2 concentration (%):	21 – 100
T_{Insp} (s):	0.1 – 5
NIV Back-up T_{Insp} (s):	0.5 – 2
I:E Ratio:	1:10 – 4:1
T_{Pause} (% of breath cycle time):	0 – 30
Flow trigger sensitivity level (fraction of bias flow):	0 – 100%
Press. trigg sensitivity (cm H_2O):	–20 – 0
Insp. rise time (% of breath cycle time):	0 – 20
Insp. rise time (s):	0 – 0.4
Insp. cycle off (% of peak flow):	1 – 70
Insp. cycle off in NIV (% of peak flow):	10 – 70
Oxygen breaths:	100% for 1 minute
Start breath:	Initiation of 1 breath (In SIMV mode initiation of 1 mandatory breath)
Pause hold:	Insp. or exp. (0 – 30 seconds)
Alarm silence/reset:	2 minute silence and reset of latched alarms
Compliance compensation:	On/Off

Suction Support	
Pre oxygenation time:	Max. 2 min
Post oxygenation time:	Max. 1 min
Suction phase time:	No maximum level
Adjustable oxygen level:	21 – 100 %

Communication/Interface	
Serial port:	RS-232C - isolated. For data communication via the Communication Interface Emulator (CIE).
Network connection (optional):	MIB (Medical Information Bus) monitor connection

Non Invasive Ventilation (NIV) (optional)	
Ventilation modes:	Pressure Support. Pressure Control.
Max. leakage compensation level:	50 l/min
Leakage overrange detection:	Automatic
Disconnect detection:	Automatic
Connect detection:	Manual, or automatic via bias flow
Backup rate (in NIV Pressure Support):	Manually adjustable breathing rate. The breathing rate is controlled by the ventilator in the event of apnea.

Alarm output connector (optional)	
Connector:	4-pole Modular connector
Ratings:	Max 40 V DC, Max 500 mA, Max 20 W

Service	
Regular maintenance:	Once every 12 months or at least after 5000 hours of operation.

Note

For inaccuracies and more detailed technical specifications please refer to the User's manual.

TECHNICAL SPECIFICATIONS
SERVO-s

ACCESSORIES

Aeroneb® Pro Nebulizer System (optional)

See separate data sheet.

Mobile Cart SERVO-s (optional)

Weight:	25 kg
Dimensions:	H 830 mm (with handles 1,040 mm) x L 650 mm x W 500 mm (see dimensional drawing below)

Shelf base SERVO-s (optional)

Weight:	0.1 kg
Dimensions:	H 8 mm x L 160 mm x W 60 mm (see dimensional drawing below)

Gas cylinder restrainer SERVO-s (optional)

Max load:	2 x 5-liter bottles

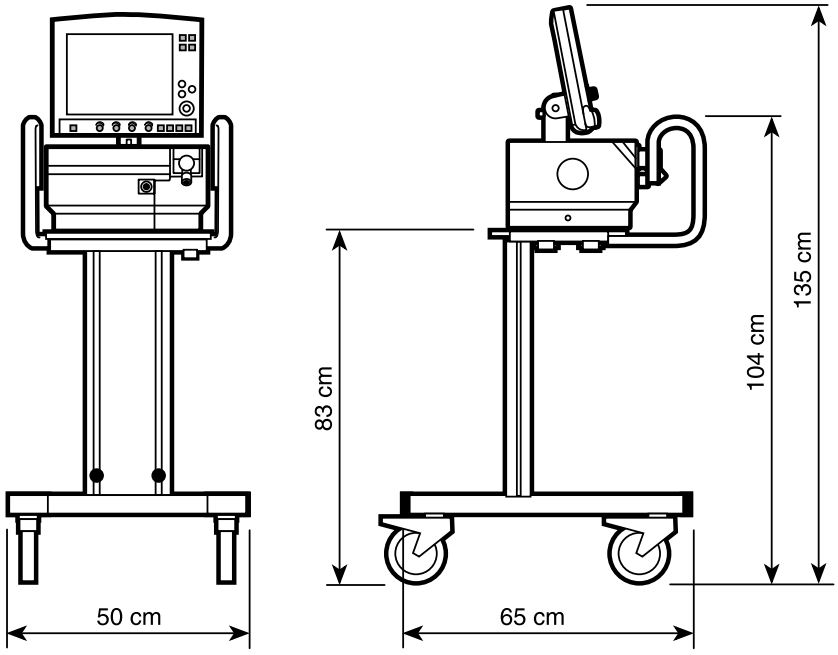
Compressor Mini (optional)

See separate data sheet.

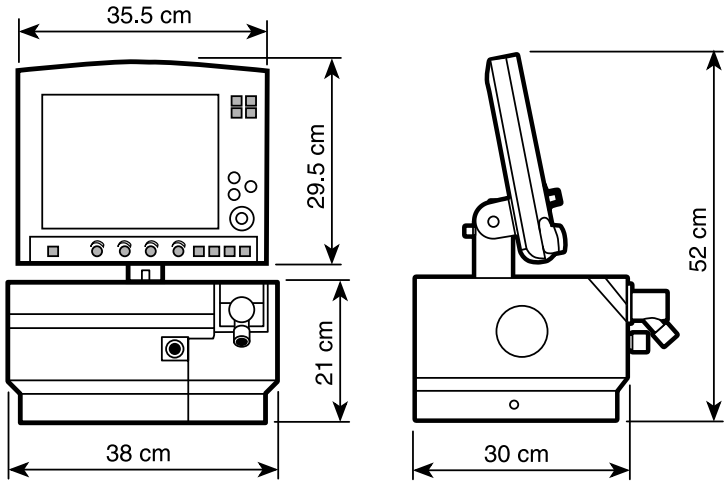
TECHNICAL SPECIFICATIONS
SERVO-s

DIMENSIONAL DRAWINGS

SERVO-s on Mobile Cart

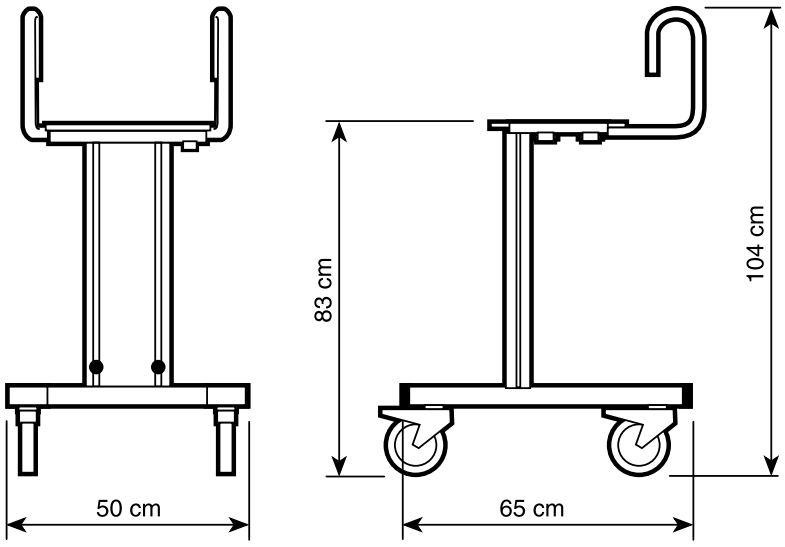


SERVO-s on Shelf base

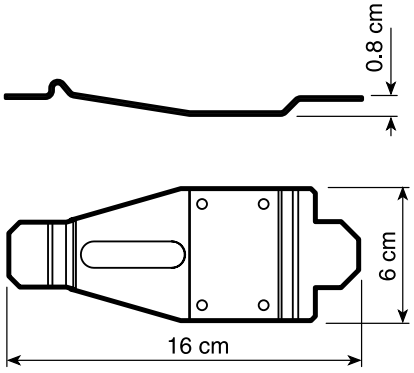


TECHNICAL SPECIFICATIONS
SERVO-s

Mobile Cart SERVO-s



Shelf Base SERVO-s



ORDERING INFORMATION
SERVO-s

SERVO-s, Ventilator and accessories: See separate information: “SERVO-s, System Version 3.1 — System Flow Chart” (Order no: 66 70 112).

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