Engström Pro

When does efficiency meet functionality in a ventilator?
Today.

The Engström Pro™, built on the proven platform of the Engström Carestation™, provides you with all the features you expect from a critical care ventilator, while helping clinicians redefine cost savings.

We developed the Engström Pro to be user friendly, help control costs and further improve efficiencies in your ICU and Step-down units.

Features

• Simplified user interface
• Advanced ventilation, including optional BiLevel-VG and SIMV-PCVG
• Patient Spirometry, measured at the ventilator
• Intuitive user interface that is flexible and adaptable, with the ability to quickly switch to your facility’s standards
• Flexible and movable display allows for each repositioning of the display to keep respiratory parameters and controls in view and in reach at all times
• Helping to increase patient comfort, through optional non-invasive ventilation
• Secure access to our Central stations, web viewers and wireless connections, providing seamless flow of information
• Airway Resistance Compensation

Low cost of ownership

• Maintenance-free Paramagnetic (O₂) Sensor comes standard and never needs to be replaced
• Easy to clean quick-release expiratory valve and flow sensor, fully autoclavable to 134°C
• Only one Preventative Maintenance (PM) check required annually, no PM recommended replacement parts or PM kits needed

Aerogen Aeroneb®

• Built-in advanced nebulization system
• Operated inline or independently for pediatric through adults
Physical Specifications

Dimensions
Height: 44.5 cm/17.5 in (Display down)
67.5 cm/26.6 in (Display up)
Height including cart: 122 cm/48 in (Display down)
145 cm/57.1 in (Display up)
Width: 38 cm/15 in
Depth: 36 cm/14 in
Weight: 31 kg/68.3 lb (not including cart);
72 kg/158.7 lb (including cart)

Display motion
Vertical tilt: 160° in raised position
60° in lowered position
Height adjustment: 23 cm/9.1 in

Modes of Ventilation

Volume Controlled (VCV)
Pressure Controlled (PCV)
Pressure Controlled, Volume Guaranteed (PCV-VG)
Synchronized Intermittent Mandatory Ventilation, Volume Controlled (SIMV-VC)
Synchronized Intermittent Mandatory Ventilation, Pressure Controlled (SIMV-PC)
Synchronized Intermittent Mandatory Ventilation, Pressure Controlled, Volume Guaranteed (SIMV-PCVG) (optional)
BiLevel Airway Pressure Ventilation (APRV capable)
BiLevel with Volume Guaranteed (BiLevel-VG) (optional)
Non-Invasive Ventilation (NIV) (optional)
Constant Positive Airway Pressure/Pressure Support Ventilation (CPAP/PSV)
Apnea backup available in SIMV-VC, SIMV-PC, BiLevel, SIMV-PCVG, BiLevel-VG, and CPAP/PSV (institutionally selectable defaults)

Control and Ranges

Maximum peak flow: 200 L/min
Flow: 2 to 90 L/min (0.04 to 1.5 L/sec)
       2 to 160 L/min (0.04 to 2.6 L/sec)
Incremental settings: 2 to 40 L/min (increments of 1 L/min)
        40 to 90 L/min (increments of 5 L/min)
        40 to 160 L/min (increments of 5 L/min)
FiO2: 21 to 100% O2
Rate: 3 to 120 breaths per minute for VCV, PCV, PCV-VG and BiLevel (increments of 1 breath per minute)
        1 to 60 breaths per minute for SIMV-VC, SIMV-PC, SIMV-PCVG and BiLevel-VG
        (increments of 1 breath per minute)
Minimum rate: 0 to 60 breaths per minute for CPAP/PSV and 0 to 40 breaths per minute for NIV (increments of 1 breath per minute)
Inspiratory/expiratory ratio: 1:9 to 4:1 (ventilator setting)
        1:7 to 60:1 in BiLevel
Tidal volume range: 20 to 2000 mL

Key:
Available only when Adult patient type is selected
Available only when Pediatric patient type is selected

Note: Ranges and Settings without an icon pertain to both Adult and Pediatric patient types.
### Control and Ranges (continued)

#### Incremental settings:
- 20 to 50 mL (increments of 0.5 mL)
- 50 to 100 mL (increments of 1 mL)
- 100 to 300 mL (increments of 5 mL)
- 300 to 1000 mL (increments of 25 mL)
- 1000 to 2000 mL (increments of 50 mL)

For VCV, PCV-VG, SIMV-VC, SIMV-PCVG and BiLevel-VG

#### Patient weight:
- 5 to 15 kg (increments of 0.5 kg)
- 15 to 100 kg (increments of 1 kg)
- 100 to 200 kg (increments of 2 kg)
- 10 to 34 lb (increments of 1 lb)
- 34 to 220 lb (increments of 2 kg)
- 220 to 440 lb (increments of 5 lb)

#### Inspiratory pressure
- $P_{\text{insp}}$ range: 1 to 98 cm H$_2$O (increments of 1 cm H$_2$O)
- $P_{\text{high}}$: 1 to 98 cm H$_2$O (increments of 1 cm H$_2$O)
- $P_{\text{low}}$: Off, 1 to 50 cm H$_2$O (increments of 1 cm H$_2$O)

#### Pressure limit
- $P_{\text{level}}$ range: 7 to 100 cm H$_2$O for VCV and SIMV-VC (increments of 1 cm H$_2$O)

#### Max. inspiratory pressure
- $P_{\text{max}}$: 7 to 100 cm H$_2$O (increments of 1 cm H$_2$O)
- 9 - 100 cm H$_2$O (increments of 1 cm H$_2$O) in NIV

#### PEEP:
- Off, 1 to 50 cm H$_2$O (increments of 1 cm H$_2$O)
- 2 - 20 cm H$_2$O (increments of 1 cm H$_2$O) in NIV

#### Inspiratory time:
- 0.25 to 15 sec
- 0.25 to 1 sec (increments of 0.05)
- 1 to 4 sec (increments of 0.10)
- 4 to 15 sec (increments of 0.25)

#### $T_{\text{high}}$:
- 0.25 to 15 sec
- 0.25 to 1 sec (increments of 0.05)
- 1 to 4 sec (increments of 0.1)
- 4 to 15 sec (increments of 0.25)

#### $T_{\text{low}}$:
- 0.25 to 18 sec
- 0.25 to 1 sec (increments of 0.05)
- 1 to 4 sec (increments of 0.1)
- 4 to 18 sec (increments of 0.25)

#### $T_{\text{supp}}$:
- 0.25 to 4 sec for NIV
- 0.25 to 1 sec (increments of 0.05)
- 1 to 4 sec (increments of 0.1)

#### Expiratory time:
- 0.25 to 59.75 sec
- 0.5 to 59.75 sec in NIV

#### Rise time:
- 0 to 500 ms of inspiratory period for either flow or pressure depending on the mode

#### PSV rise time:
- 0 to 500 ms of inspiratory period for pressure supported breaths only. Active in SIMV-VC, SIMV-PC, SIMV-PCVG, BiLevel, BiLevel-VG and CPAP/PSV (increments of 50 ms)

#### Trigger window:
- 0 to 80% of expiration time (increments of 5%)

#### Flow trigger:
- 1 to 9 L/min (increments of 0.5 L/min)
- 1 to 3 L/min (increments of 0.1 L/min)
- 3 to 9 L/min (increments of 0.5 L/min)

#### Pressure trigger:
- $-10$ to $-3$ cm H$_2$O (increments of 0.5 cm H$_2$O)
- $-3$ to $-0.25$ cm H$_2$O (increments of 0.25 cm H$_2$O)

#### Bias flow rate:
- 2 to 10 L/min (increments of 0.5 L/min)
- 8 to 20 L/min for NIV (increments of 0.5 L/min)

#### Insp. pause:
- 0 to 75% of inspiration time (increments of 5%)

#### $T_{\text{pause}}$:
- 0 to 11 sec
- 0 to 1 sec (increments of 0.05)
- 1 to 4 sec (increments of 0.1)
- 4 to 11 (increments of 0.25)

#### Pressure support from PEEP level:
- 0 to 60 cm H$_2$O for SIMV-VC, SIMV-PC, SIMV-PCVG, BiLevel, BiLevel-VG and CPAP/PSV (increments of 1 cm H$_2$O)
- 0 to 30 cm H$_2$O for NIV (increments of 1 cm H$_2$O)

#### End flow level:
- 5 to 80% of peak flow for NIV, SIMV-VC, SIMV-PC, SIMV-PCVG, BiLevel, BiLevel-VG and CPAP/PSV (increments of 5%)

### Alarm Settings

<table>
<thead>
<tr>
<th>Tidal volume</th>
<th>Low: Off, 5 to 1950 mL</th>
<th>High: 10 to 2000 mL, Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minute volume</td>
<td>Low: 0.01 to 40 L/min</td>
<td>High: 0.4 to 99 L/min</td>
</tr>
<tr>
<td>Respiratory rate</td>
<td>Low: Off, 1 to 99/min</td>
<td>High: 2 to 120/min, Off</td>
</tr>
<tr>
<td>Inspired oxygen (FiO$_2$)</td>
<td>Low: 18 to 99%</td>
<td>High: 24 to 100%, Off</td>
</tr>
<tr>
<td>$P_{\text{max}}$: High: 7 to 100 cm H$_2$O</td>
<td>9 - 100 cm H$_2$O (increments of 1 cm H$_2$O) in NIV</td>
<td></td>
</tr>
</tbody>
</table>
**Alarm Settings** (continued)

- **P_{peak}**: Low: 1 to 97 cm H₂O
- **PEEP_{a}**: Low: Off, 1 to 20 cm H₂O
  - High: 5 to 50 cm H₂O, Off
- **P_{limi}**: 7 to 100 cm H₂O
- **Apnea alarm**: User adjustable: 10 to 60 sec
- **Circuit leak**: 10 to 90%, Off

**Ventilation soft limit indicators**: When adjusting selected ventilator parameters, color indicators show when parameters are approaching their setting limits.

**Parameters with soft limits**: P_{max}, PEEP, P_{insp}, P_{supp}, T_{insp}, RR, I:E, P_{high}, P_{low}, T_{high}, and T_{low}

**Alarm System**

**Escalating alarms**: High priority alarms escalate to a higher pitch if unattended for specified time

**Adjustable to**: 0, 10, 20 and 30 sec, Off

**Auto limits**: Alarm limits calculated on the current measured values for selected parameters

**Procedures**

**Suction**

**Program routine**: Automatic

**Pre-oxygenation**: ≤ 2 minutes with 100% O₂ with automatic disconnection detection

**Standby pause**: ≤ 2 minutes with automatic patient (re-connection) detection

**Post-oxygenation**: ≤ 2 minutes with 100% O₂

**Note**: FiO₂ can be set to level other than 100%

**Manual breath**

**Intrinsic PEEP (includes PEEP, Volume)**

**Lung Mechanics**: P_{0.1}, NIF, Vital Capacity

**Inspiratory hold**: 2 to 15 sec (increments of 1 sec)

**Expiratory hold**: 2 to 20 sec (increments of 1 sec)

**Spontaneous Breathing Trial (SBT)** (Adjustable range: 2 to 120 minutes)

**Spirometry**

**Data source**: Ventilator

**Loop types**: Pressure-Volume, Pressure-Flow and Flow-Volume

**Saved loop**: Up to six loops can be saved

**Reference loop**: A saved loop can be selected as the reference loop to compare with the current loop being displayed

**Cursor**: Freezes current loops and provides numeric display of X and Y axis as cursor moves across loops

**Pulmonary mechanics**: P_{peak}, P_{plat}, P_{mean}, PEEP, PEEP{e}, TV_{insp}, TV_{exp}, MV_{insp}, MV_{exp}, Compliance and Resistance

**Auxiliary Pressure**

**Auxiliary pressure (P_{aux})**: Measured range: -20 to +120 cm H₂O
  - Alarm range: 12 to 100 cm H₂O

**Purge flow**: Low flow to clear the P_{aux} line, can be turned Off

**Non-Invasive Ventilation (NIV) (optional)**

**Mask ventilation**: Yes

**Integrated unique leak recognition algorithm**

**Automatic Patient Detection (APD)**

**Patient re-connection**: Automatic detection in standby

**Detection by**: Back pressure to Bias-flow

**100% O₂ (↑O₂)**

Delivers 100% O₂ for ≤ 2 minutes

Can be adjusted to other O₂ %

**Take Snapshot**

**Immediate capture and storage of critical data currently on the Engström’s display**

**Stored data**: 3 waveform segments
  - Alarm messages (up to 5, currently active)
  - All measured parameters
  - All set ventilator parameters

**Maximum stored Snapshots**: 10 most recent

**Cursor**: Ability to cursor across waveforms for specific measured values
**Ventilator Preferences**

*Back-up Mode:* Establishes the specific ventilator mode and parameters used in the event that the ventilator switches to Back-up ventilation.

*ARC:* Allows control and setting of the airway resistance compensation.

*Assist Control:* Allows the user to turn the Assist Control capability On or Off.

*Leak Compensation:* Allows the user to turn the Leak Compensation capability On or Off.

*Trigger Compensation:* Allows the user to turn On or Off compensation for flow triggering.

*TV Based Conditions:* Allows setting between ATPD (Ambient Temperature Pressure Dry) or BTPS (Body Temperature Pressure Saturated).

**Airway Resistance Compensation (ARC)**

*Type of compensation:* Electronic tube compensation

*Compensation for:* Endotracheal and tracheostomy tubes

*Tube diameter:* 5 to 10 mm

*Level of compensation:* 25 to 100%

**Mode Families**

Allows user adjustment to specify certain parameters that align with the hospital’s current ventilator usage.

*Adjustable parameters:* Flow and Inspiratory timing

*Family 1:* Flow control is On/Insp. Timing is I:E

*Family 2:* Flow control is Off/Insp. Timing is I:E

*Family 3:* Flow control is On/Insp. Timing is Tinsp

*Family 4:* Flow control is Off/Insp. Timing is Tinsp

*Family 5:* Flow control is On/Insp. Timing is Tpause

**Help**

Help screens are available for any recent or active alarm. Help will provide the cause of the alarm and the action to resolve the alarm conditions.

**Ventilator Monitoring**

*Airway pressure:* –20 to +120 cm H2O

*Patient flow:* 1 to 200 L/min

*Tidal volume:* 5 to 2,500 mL

*Minute volume:* 0 to 99.9 L/min

*Compliance:* 0.1 to 150 mL/cm H2O

*Resistance:* 1 to 500 cm H2O/L/s

*Rate:* 0 to 120 breaths per minute (increments of 1 breath per minute)

*FiO2:* 10 to 100%

*Rapid Shallow Breathing Index (RSBI):* 1 to 999 bpm/L

**Oxygen Monitoring**

*Technology:* Dynamic Paramagnetic Oxygen monitoring system

*Life span:* Unlimited operating life due to the use of non-depleting technology

**Screen**

*Display type:* 30.5 cm/12 inch touch screen full color LCD adjustable viewing angle

*Waveforms in screen:* Three at a time

*Waveform parameters:* Pressure, flow, volume, CO2, O2 and auxiliary pressure

*Graphic scaling:* Automatic scaling for optimal size or independent scaling

*Data:* Control parameters, patient data, alarm settings and messages

*Status indicator:* Ventilation mode, battery level, clock

*Favorites:* 23 Hyperlink shortcuts to choose from 7 selectable at one time
**Monitoring Accuracy***

- **Pressure readings:** ±2 cm H₂O
- **Volume readings:** ±10% or ±15 mL, whichever is greater
- **O₂ concentration monitor:** ±3%

**Delivery Accuracy***

- **Inspired pressure control:** ±2 cm H₂O
- **Oxygen – Air mixing:** ±3% V/V of setting
- **Tidal volume delivery:** ±10% of setting or ±5 mL, whichever is greater

**Nebulization**

- **Nebulizer:** Aeroneb Nebulizer System built-in
- **Nebulizer technology:** Electronic micro pump
- **Nebulizer run time:** 10, 15, 20 or 30 minutes
- **Auto-repeat capability:** Cycles: 1 to 10, Pause Time: 30 sec to 8 hr, 1 to 5 minutes (increments of 1 minute), 5 to 55 minutes (increments of 5 minutes), 1 to 8 hours (increments of 0.5 hour)
- **Nebulizer volume setting:** 2.5, 3, 5 or 6 mL
- **Particle size:**
  - Aeroneb Pro: average 2.1 microns MMAD (Mean Mass Aerodynamic Diameter)
  - Aeroneb Solo: 3.4 microns MMAD
- **Residual volume:**
  - Aeroneb Pro: average 0.3 mL
  - Aeroneb Solo: average < 0.1 mL

* Ventilation delivery specifications requirements:
  - Operating at EN794 and ASTM F1100 patient conditions
  - Operating at 21°C and at 1000 mbar ambient pressure
  - All volumes are at ambient temperature and pressure, dry (ATPD)

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**Pneumatic nebulizer**

- **Flow compensation:** 1 to 12 L/min (increments of 0.5 L/min)

**Trends**

- **Trend data:** All set parameters and measured data
- **Trend styles:** Measured and graphic
- **Maximum trending:** 14 days (336 hours)
- **Trend scaling:** 12 min, 1h, 2h, 4h, 6h, 8h, 10h, 12h, 24h, 36h, 48h and 72h
- **Resolution:** 1 minute intervals for most recent 12 hours, 5 minute intervals for 12 to 48 hours, 30 minute intervals after 48 hours
- **Mini-Trends:** Waveform values can be displayed as a trend in a split screen view

**External Communications**

- **Communication ports:** Serial port (RS-232), RS-485 port, RS-422 port, 1 USB port, Ethernet port, Compact flash card socket, nurse call

**EView (optional)**

- **Data Available:**
  - 10 snapshots
  - 7 days of vent data
  - Optional breath to breath waveform data

**Electrical Specifications**

- **Line supply**
  - **Line voltage:** 85 to 132 Vac, 47/63 Hz
  - 190 to 264 Vac, 47/63 Hz
  - **Power consumption:** < 200 W
Electrical Specifications (continued)

Battery supply
Back-up battery: Built-in
Type: Lead acid gel
Battery back-up time: 120 minutes typical, 30 minute minimum, battery fully charged

Gas supply
Single gas operation: Yes
Emergency air valve: Built-in

Oxygen supply
Pressure range: 240 to 641 kPa/35 to 94 psi
Flow: 160 L/min

Air supply
Pressure range: 240 to 641 kPa/35 to 94 psi
Flow: 160 L/min

Environmental Specifications

Thermal
Operating range: 10° to 40°C
Storage range: –20° to 65°C

Humidity
Operating range: 15 to 95% RH Non-condensing
Storage range: 15 to 95% RH Non-condensing
In accordance with IEC 68-2-3

Vibration and shock
Random vibration: 9.5 grms @ 30 min unpacked
2 to 5000 Hz

Altitude
Operating range: –440 to 3565 m/500 to 800 mmHg
Storage range: –440 to 5860 m/375 to 800 mmHg

GE Healthcare
P.O. Box 900, FIN-00031 GE, Finland
Tel. +358 10 394 11
Fax +358 9 146 3310

www.gehealthcare.com