SLE5000
Neonatal Ventilator with
High Frequency Oscillation

When the smallest thing matters
The smallest thing does matter...
There are still some neonates who cannot be adequately ventilated with even the most sophisticated conventional ventilation.

Indeed, using conventional ventilation with higher rates and airway pressures has often led to an increased incidence of barotrauma and lung tissue damage. High Frequency Oscillation (HFO) has been shown to overcome this problem whilst still allowing excellent gaseous exchange.

A proven technique
Developed in cooperation with nurses and doctors, the SLE5000 uses a unique valveless system that gives both a manageable range of HFO parameters plus the ability to have ‘active exhalation’

Of course, the SLE5000 still has all of the conventional ventilation modes meaning that it can be used on virtually any baby in the NICU

User Interface
SLE has always worked hard to make our ventilators easier to use. Essential functions are never more than a couple of button pushes away. Our own research has shown that users find it much easier to use a ventilator if there are fewer sub-menus.

By reducing the number of menus and sub-menus the SLE5000 is even easier to use when time is critical.

The SLE5000 has a high resolution colour touch-screen that is your interface to all the ventilator controls and functions, but in addition allows you to access many new features including trends and dynamic loops.

The SLE5000 also features parameter presetting, meaning that you can choose a ventilation mode and set up all parameter values before accepting these and confirming the mode change.

Fully Featured
Modes include: CPAP, CMV+ TTVP, PTV, PSV, SIMV+ TTVP + PSV, HFO, HFO+CMV.

Plus, the SLE5000 gives you:
- The ability to preset parameters in all modes of operation
- Powerful HFO with active expiration to cover a wide range of patients
- Full colour, total touch-screen operation
- Integral flow monitoring measuring lung mechanics and displaying of loops and waveforms
- Trending of measured parameters
- Standard patient circuit for all modes including HFO
- Unique, patented valveless technology
- Integral battery with up to 60 minutes operating capability
- Software based, allowing for upgrading to versions with new or improved functions

Advanced Software
If you already use an SLE5000 or SLE4000 ventilator then you will know just how versatile the range of installed modes can be, particularly on the SLE5000 where HFO allows you to include a considerably larger patient demographic than with conventional ventilation.

SLE’s Software Engineers are always working on new algorithms to ensure the ventilators keep up with new developments in medicine and user-feedback.

The latest software, standard on all new SLE5000 and SLE4000 ventilators includes:
- TTVP
- Leak compensation
- MAP in HFO (SLE5000)
- Battery indicator
- Mute all alarms
- CPAP mode alarms
Targeted Tidal Volume plus (TTV\textsuperscript{plus})

The SLE5000 is our first production ventilator to feature TTV\textsuperscript{plus} - an entirely new way of managing the patient’s tidal volume.

Lung protective ventilation strategies in neonates are now accepted as a marker for improved ventilation outcome. One such strategy is the use of a targeted tidal volume in pressure ventilation. The aim of TTV\textsuperscript{plus} is to deliver a stable tidal volume at the lowest possible pressure. All this has to occur in the presence of a changing lung environment, that also has potential for a variable leak around the ET tube.

TTV\textsuperscript{plus} approaches this challenge by assuring a stable expired volume, with a leak adjustment capability within safe limits. TTV\textsuperscript{plus} can be used in all conventional ventilation modes and provides a stable tidal volume control according to your requirements.

Pressure Support Ventilation (PSV)

PSV was developed on the SLE5000 as a method to decrease the work of breathing in-between ventilator mandated breaths by providing an elevated pressure triggered by spontaneous breathing that supports ventilation during inspiration. Thus, SIMV might be combined with PSV so that additional breaths beyond the SIMV programmed breaths are supported.

Whilst the SIMV mandated breaths have a preset volume or peak pressure, the PSV breaths are designed to cut short when the inspiratory flow reaches a percentage of the peak inspiratory flow (e.g. 0 - 50%). It includes automatic leak compensation thereby ensuring the flow termination of inspiration even in the presence of a leak.

All of this means that breathing on the SLE5000 ventilator is even easier for the smallest of babies, allowing them more energy to grow.

High Frequency Oscillation (HFO)

In the SLE5000, HFO is powerful enough to cater for a wide range of patients from 300 g to 20 kg, dependant on lung mechanics.

The SLE5000 provides sinusoidal ventilation with active expiration.

The main benefits of HFO include:

- Improves ventilation at lower pressures
- Higher levels of PEEP can be used without having to use high peak airway pressures to maintain appropriate levels of CO\textsubscript{2}
- Produces more uniform lung recruitment
- Reduces airleaks
- Improved oxygenation in infants with severe RDS (Respiratory Distress Syndrome)
Features and Functions

User Interface
Colour-coded user touch screen. Easy-to-use, logical sequence allowing quick, smooth adjustments.
The SLE5000’s 12.1 inch screen means that all the data you need can be easily seen.

Mode Panel
The mode panel is the user’s interface to all mode related functions.

Audible and Visual Alarms
The alarm panel provides an immediate audible and pictorial view of the alarm condition, thus allowing easy monitoring, plus an alarm history of the last 100 conditions.

Pre-Setting Facility
Parameters can be preselected for the next mode whilst continuing to ventilate the patient in the current mode of ventilation.

Patient Circuit Connections
Front panel mounted patient circuit connections with (autoclavable) exhalation block.

Principles of operation of the SLE5000 valveless system

A constant flow of fresh gas is supplied to the patient circuit at 8 l/min. The expiratory manifold has three jets (1, 2 and 3). The front jet (1) is used to generate an opposing flow to the fresh gas in the exhalation manifold and thereby creates CPAP/PEEP.
The rear jet (2) is used to generate the Peak Inspired Pressure (PIP) in the same way.
A third (reverse) jet (3) is used during High Frequency Oscillation (to produce an active negative pressure) in addition to helping eliminate excess circuit pressure.
To avoid gas dilution these jets are supplied with the same oxygen concentration as the fresh gas supply. Sophisticated software controls the rate and duration of the flow of driving gas into the exhalation manifold in opposition to the fresh gas flow. The opposing flow acts as a pneumatic piston and creates a pressure wave at the ET manifold.
Since the opposing flow pressure is set by pressure regulators it automatically compensates for patient and circuit compliance changes.
How does it work...?

The illustration shows the exhalation block removed from its mountings in the ventilator. When replaced, the jets (➊ and ➋) can create a positive pressure on flow from the patient circuits's expiratory limb.

Jet ➌ is used to create a negative pressure and gives true active expiration.

Since there are no valves or other blockages in the system, there is minimal resistance to the patient.

Fewer moving parts means there is less to clean and less risk in terms of wrong assembly or infection.
### SLE5000 Patient Circuits

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>BC5188/100/15</td>
<td>Single use breathing circuit for use with SLE4000 and SLE5000 infant ventilators. Temperature port 100 mm from ET manifold (single use). Circuit comes complete with filter connection kit and adaptors.</td>
<td>Box of 15</td>
</tr>
<tr>
<td>BC5188/400/15</td>
<td>Single use breathing circuit for use with SLE4000 and SLE5000 infant ventilators. Temperature port 400 mm from ET manifold (single use). Circuit comes complete with filter connection kit and adaptors.</td>
<td>Box of 15</td>
</tr>
<tr>
<td>BC5488/DHW/15</td>
<td>Dual heated wire smooth bore breathing circuit for use with SLE4000 and SLE5000 infant ventilators. Temperature port 170 mm from ET manifold (single use). Circuit comes complete with filter connection kit and adaptors.</td>
<td>Box of 15</td>
</tr>
<tr>
<td>BC6216</td>
<td>Nitric Oxide delivery kit. Set of connectors.</td>
<td></td>
</tr>
<tr>
<td>BC2506/25</td>
<td>Nebuliser Kit suitable for 15 mm diameter patient circuits. For use with the BC5188, BC2188, BC5198 &amp; BC2198 circuits.</td>
<td>Box of 25</td>
</tr>
<tr>
<td>BC2508/15</td>
<td>Nebuliser Kit suitable for 10 mm diameter patient circuits. For use with the BC5488 Circuit.</td>
<td>Box of 15</td>
</tr>
<tr>
<td>BC4110/KIT</td>
<td>Nitric Oxide adaptor kit for BC5188/100 and BC5188/400 breathing circuits (SLE4000 and SLE5000 infant ventilators).</td>
<td>Box of 5</td>
</tr>
<tr>
<td>BC4110/ASY</td>
<td>Nitric Oxide dual hose scavenging filter assembly for SLE4000 and SLE5000 infant ventilators.</td>
<td>Box of 1</td>
</tr>
</tbody>
</table>
Ventilation Modes: Conventional
CPAP / PTV / PSV
Inspiratory Time: 0.1 to 3.0 sec
CPAP Pressure: 0 to 20 mbar
Inspiratory Pressure: 0 to 65 mbar
Volume Targeting: 2 to 200 ml
FiO2: 21% to 100%

CMV / SIMV
BPM: 1 to 150
I:E Ratio: (11.2:1 to 1:600)
Inspiratory Time: 0.1 to 3.0 sec
PEEP Pressure: 0 to 20 mbar
Inspiratory Pressure: 0 to 65 mbar
Volume Targeting: 2 to 200 ml
FiO2: 21% to 100%

Ventilation Modes: HFO Ventilation
HFO Only
Frequency Range: 3-20 Hz
I:E Ratio: 1:1
Delta Pressure range: 4 to 180 mbar
Mean airway range: 0 to 35 mbar
FiO2: 21% to 100%

HFO+CMV
BPM: 1 to 150
Inspiratory Time: 0.1 to 3.0
Frequency Range: 3-20 Hz
I:E : (11.2:1 to 1:600)
Inspiratory Pressure: 0 to 65 mbar
Delta Pressure range: 4 to 180 mbar
Mean airway range: 0 to 35 mbar
FiO2: 21% to 100%

Monitoring Parameters
Measurement of Flow and Volume
Flow Sensor Type: 10 mm dual-hot-wire anemometer (autoclavable or single use)
Flow Rate: 0.2 to 32 l/min (Accuracy ±8%)
Expiratory Tidal Volume: 0 to 999 ml
Expiratory Minute Volume: 0 to 18 litres
Deadspace: 1 ml
Weight: 10 g

Conventional Ventilation and combined modes only:
Tube Leakage: 0 to 50% (Resolution: 5%, averaged over 5 breaths)
Breath Rate (total): 0 to 150 BPM
Dynamic Compliance: 0 to 100 ml/mbar (Resolution: 1 ml/mbar)
C20/C: Resolution 0.1
Sampling Time: 2 ms
Resistance: 0 to 1000 mbar /l/second
Triggering: Inspiratory flow (0.2 to 10 l/min)

The above values are measured under ATPD (ambient temperature and pressure, dry) conditions.

Oxygen Concentration
Range: 21 to 100% (Resolution 1%)

Pressure
Real-time Pressure measurement: Resolution 1 mbar
Sampling time: 2 ms
Peak Pressure: 0 to 175 mbar (resolution 1 mbar)
PEEP Pressure: 0 to 175 mbar (resolution 1 mbar)
Mean Pressure: -175 to 175 mbar (resolution 1 mbar)

In HFO combined mode, Delta P is measured during expiration only

User Settable Alarms:
High Pressure
Autoset when patient pressure controls are adjusted or can be manually adjustable
Range: 10 to 110 mbar
Resolution: 0.5 mbar

Cycle Fail
Autoset when patient pressure controls are adjusted or may be manually adjusted

Low Pressure
Autoset when patient pressure controls are adjusted or can be manually adjustable
Range: -10 mbar (Conventional)
-70 mbar (HFO modes) to 10 mbar below high pressure threshold

Low Tidal Volume
Range: 0 to 200 ml
Resolution: 0.2 ml

Low Minute Volume
Range: 0 to 0.02 litres below High Minute Volume threshold
Resolution: 0.1 litre

High Minute Volume
Range: 0.02 to 18 litres
Resolution: 0.1 litre

Apnoea time
Settable only in CPAP or when Backup rate is less than 20 BPM
Range: 3 to 60 sec
Resolution: 1 second

Power, Dimensions, Standards etc.
Power Requirements
Voltage: 100-250 V
50-60 Hz
Power: 115 VA
Battery back up: 45-60 minutes (dependant on mode of operation)
Battery charging: Full charge 24 hours, 80% charge after 8 hours

Outputs
RS-232C

Air and O2 input
Pressures: 2.8 - 6 bar
Fresh Gas Flow: 8 litres/min
Maximum gas flow: 60 litres/min

Operating Environment
Temp: 10-40 ºC
Humidity: 0-90% (non-condensing)

Dimensions
Size, ventilator only: 330mm W x 330mm H x 470mm D
Height on trolley: 131 cm
Weight, ventilator only: 22.4 kg

Constructed to conform to:
BS EN 60101-2-12: 2006
Medical Devices Directive (93/42/EEC)
EMC
BS EN 60601-1-2: 2001+A1
BS EN 61000-3-2: 2006
BS EN 61000-3-3: 1995 +A1
European conformity mark: CE 0120

Environmental storage conditions
When packed for transport or storage:
Ambient Temperature: -40 ºC to +70 ºC
Relative Humidity : 10% to 90% (non-condensing)
Atmospheric Pressure: 500 hPa to 1060 hPa
SLE is a world leader in the design and manufacture of neonatal ventilators.

Years of ventilation experience have given the company an understanding of the challenges facing nurses and clinicians when caring for the tiniest and most critical babies.

From being the pioneers of neonatal Patient Triggered Ventilation (PTV) in the 1980’s, to the introduction of combined HFO (High Frequency Oscillation) in the 1990’s, SLE has maintained a position of strength in neonatal ventilation.

The company’s guiding principle is to support clinical and nursing staff in their everyday work.

The knowledge and experience gained during years of development is evident in the SLE5000 ventilator: the result of SLE’s ongoing commitments to innovation, competency and care.