Standard Operating Procedure

for using the Hamilton-T1 Ventilator

Hamilton T1 Overview

Front View

Side View

Pneumatic nebuliser output connector

Flow sensor ports

'To patient' / Inspiratory port

'From patient' port with expiratory valve attached

Rear View

Air intake and dust filter

****TAKE CARE NOT TO OBSTRUCT****

The Hamilton T1 is a turbine driven ventilator. This allows it to draw in ambient air through the fresh gas intake port and compress this in combination with oxygen.

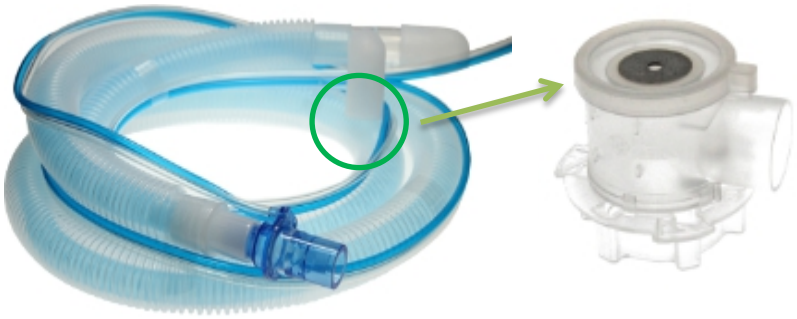
The device therefore *only* needs to be connected to an oxygen source. Use the attached white hose and connect to a standard Schrader port (example shown).

INFANT AND CHILD VENTILATION (>10kgs)

SET UP & CHECKS

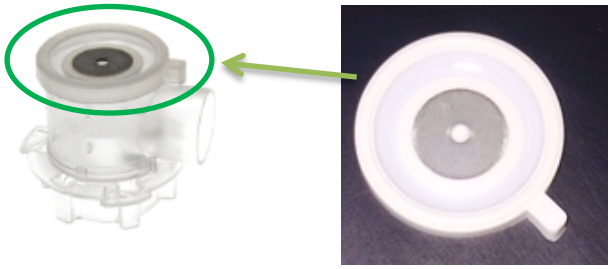
Connecting the ventilator circuit

1.



The standard Hamilton T1 Ventilator circuit used by KIDS comes with an expiratory valve within the packaging.

2.



Ensure that the diaphragm is on the expiratory valve. Failure to do this will cause a leak and the ventilator may fail its safety checks.

3.

Detach the valve from the circuit.

Place the valve in the socket of the 'from patient' port with the diaphragm facing towards the ventilator

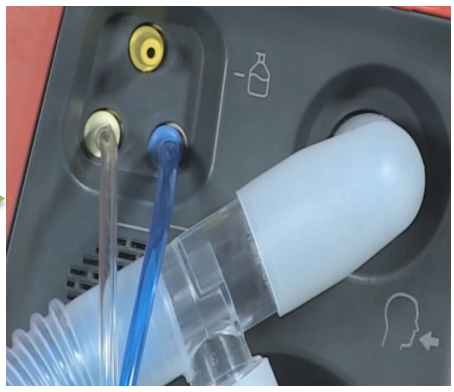
Rotate the locking wheel clockwise to secure the valve in place

4.

Depending on the size of patient and tidal volume used, place a HMEF at the ET tube end.

Adult HMEF For Vt >200mL
Paediatric HMEF For Vt 75mL – 250mL
Neonatal HMEF For Vt<75mL

5.



Connect the flow sensor tubing (integrated into the ventilator circuit) to the flow sensor ports.

These are colour coded i.e. blue-to-blue / clear-to-white

Selecting a mode of ventilation

6.

Turn Ventilator on and if possible connect to mains power. Select appropriate mode for patient. See 'Commonly used modes of ventilation' section of this SOP.

You must complete a pre-operational check before starting ventilation. Do not connect patient at this point.

Performing pre-operation checks

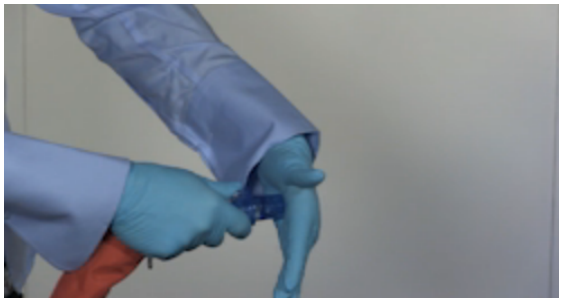
7.

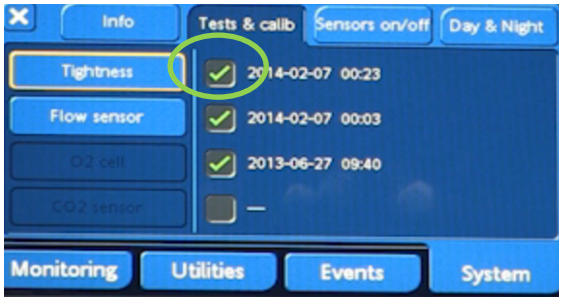
Touch the 'system' button then select the 'Test & Calib' tab

8.

Select the 'Tightness' option. 'Disconnect patient' will be displayed. As no patient will be connected at this point, wait until 'Tighten patient system' is displayed

9.

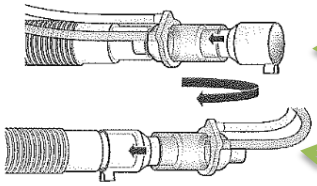




Once 'tighten patient system' appears, occlude the patient end of the ventilator circuit. 'Maneuver in progress' will appear on the screen. Once 'Connect Patient' appears, stop occluding the end of the circuit.

Wait a further few seconds for the test to complete (do not connect the patient). A green tick will appear as shown.

10.



Now perform the 'Flow Sensor' check. Select the 'Flow Sensor' option from the 'Tests & calib' menu. 'Disconnect the patient' will be displayed, followed by 'Turn Flow Sensor'

A clear plastic adapter comes attached to the patient end of each new circuit.

Remove this adapter and place the thinner end on to the end of the flow sensor.

Disconnect and turn the flow sensor with the adapter still attached, and re-attach it to the end of the circuit. 'Manoeuvre in progress' will appear on the screen.

'Turn flow sensor' will then be displayed again. Remove and discard the adapter and simply reconnect the flow sensor to the end of the circuit. 'Manoeuvre in progress' will appear again, followed by 'Connect patient'. A green tick will then appear to indicate that the flow sensor check has been successful.

NEONATAL & INFANT VENTILATION (<10kgs) – SET UP & CHECKS

1.

When using the Hamilton T1 on patients under 10kgs, the neonatal circuits stocked include a disposable expiratory valve.

2.

Ensure the diaphragm is securely attached to the valve and insert into the expiratory port. Secure in to place using the locking wheel (method as shown in 'Step 3' of the Paediatric Ventilation section)

3.

The dark blue and white 'neonatal' circuit is required for patients under 10kgs.

4.

Place appropriate size Humidifying filter device as follows. (HMEF)

For less than Vt 25mL use the Neo-breathe easy with a white connector piece.

For Vt 25mL-75mL use the Neonatal HMEF.

For Vt 75-250mL use the Paed HMEF

If dead space is a significant concern, the Neonatal HMEF and Paediatric HMEF can be used at the inspiratory end of the ventilator tubing.

You may need to increase the ventilator settings to accommodate for this. (Increase Vt to 8mL/kg)

5.

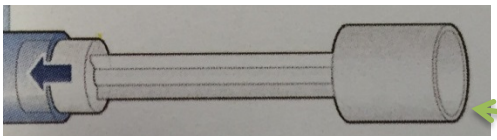
Turn Ventilator on and if possible connect to mains power. Select appropriate mode for patient. See 'Commonly used modes of ventilation' section of this SOP.

You must complete a pre-operational check before starting ventilation. Do not connect patient at this point.

6.

Perform a Tightness Test - Please refer to steps 7, 8 and 9 of the 'Paediatric Ventilation' section (neonatal circuit test procedure is the same)

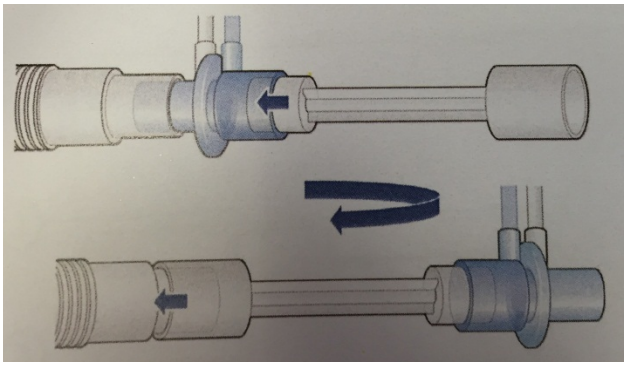
7.



Now perform the 'Flow Sensor' check. Select the 'Flow Sensor' option from the 'Tests & calib' menu. 'Disconnect the patient' will be displayed, followed by 'Turn Flow Sensor'

A clear plastic adapter comes in each neonatal circuit pack. This differs in shape from the paediatric adapter, as shown.

Remove this adapter and place the thinner end on to the end of the flow sensor.



Disconnect and turn the flow sensor with the adapter still attached, and re-attach it to the end of the circuit. 'Manoeuvre in progress' will appear on the screen.

'Turn flow sensor' will then be displayed again. Remove and discard the adapter and simply reconnect the flow sensor to the end of the circuit. 'Manoeuvre in progress' will appear again, followed by 'Connect patient'. A green tick will then appear to indicate that the flow sensor check has been successful.

COMMONLY USED MODES OF VENTILATION

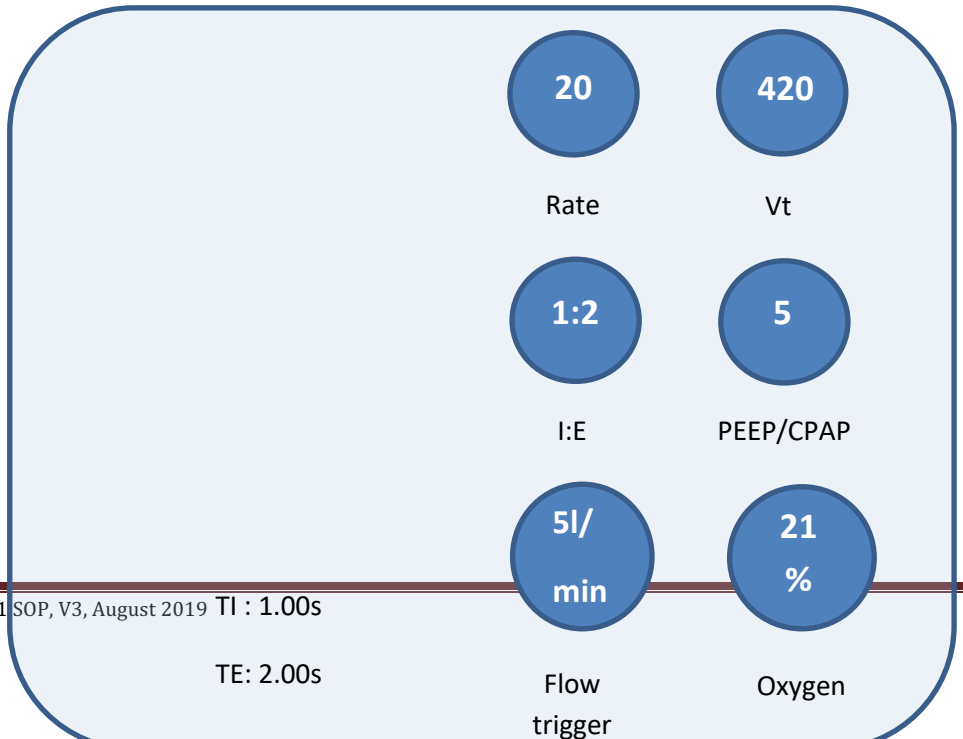
To toggle between the modes of ventilation offered by the T1, press the 'Modes' button. Make a choice, then press confirm.

Once a selection has been made, the various options for this mode of ventilation (e.g. Rate, Tidal Volume, Inspiratory pressure) will appear on the screen. Once parameters have been set select 'Confirm' again. To make further subsequent changes, use the 'Controls' button.

VOLUME CONTROLLED MODES OF VENTILATION

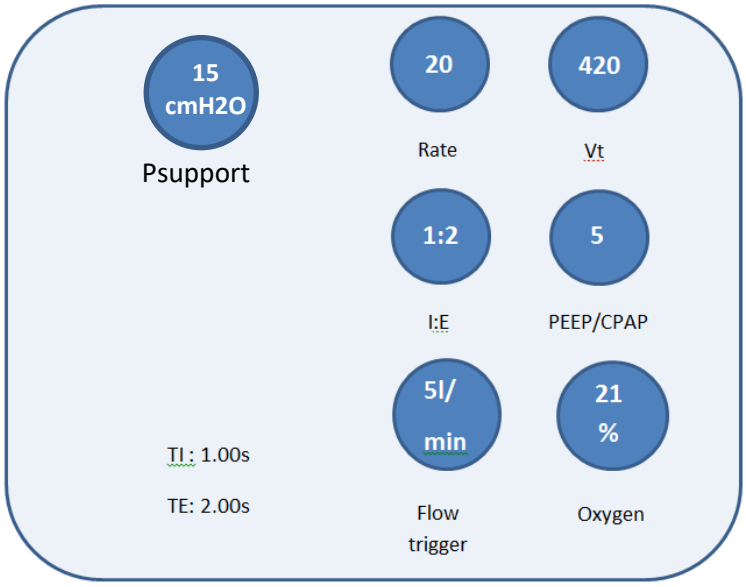
Synchronised Controlled Mandatory Ventilation "(S)CMV+"

- The default mode of ventilation on the KIDS Team T1 ventilator
- Delivers volume targeted mandatory breaths at the lowest possible pressure to achieve this. The default setting will calculate Vt at 6mL/kg based on the weight of the patient as entered on the opening screen, but this can be altered manually as well.
- Adjustable parameters screen display in (S)CMV+ mode (example values only)



Synchronised Intermittent Mandatory Ventilation "SIMV+"

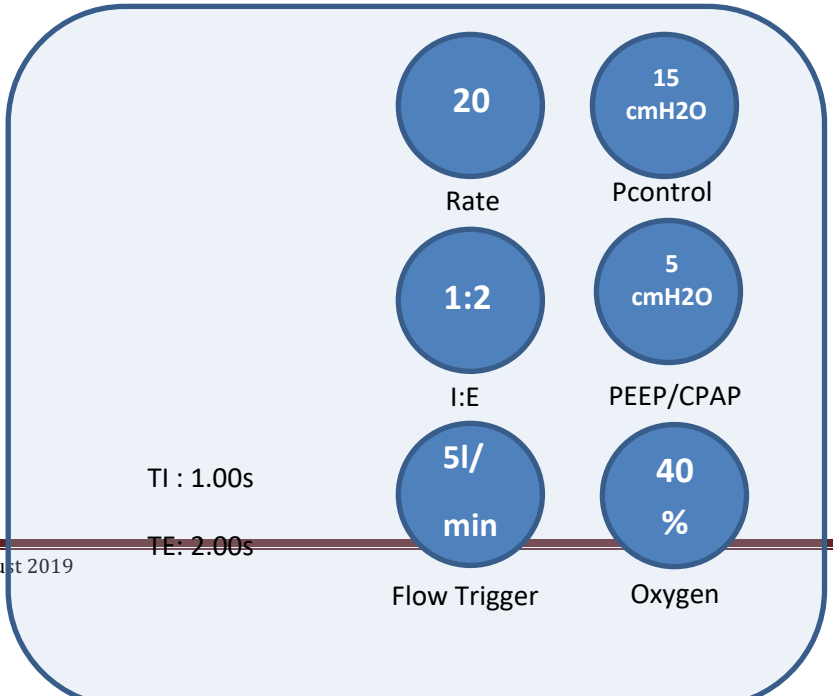
- Delivers volume targeted, time-cycled mandatory breaths, as with (S)CMV+
- Also provides pressure supported, flow cycled spontaneous breaths
- Adjustable parameters as for (S)CMV – Also allows control of pressure support for spontaneous breaths



PRESSURE CONTROLLED MODES OF VENTILATION

Pressure Controlled Ventilation (PCV+)

- Provides pressure controlled mandatory breaths
- Screen display as shown (example values only)



'SPONT'

- For spontaneously breathing intubated patients only
- Allows pressure support and CPAP/PEEP to be set for spontaneous breaths
- Rate, tidal volume and inspiratory time for 'back-up' breaths can be set

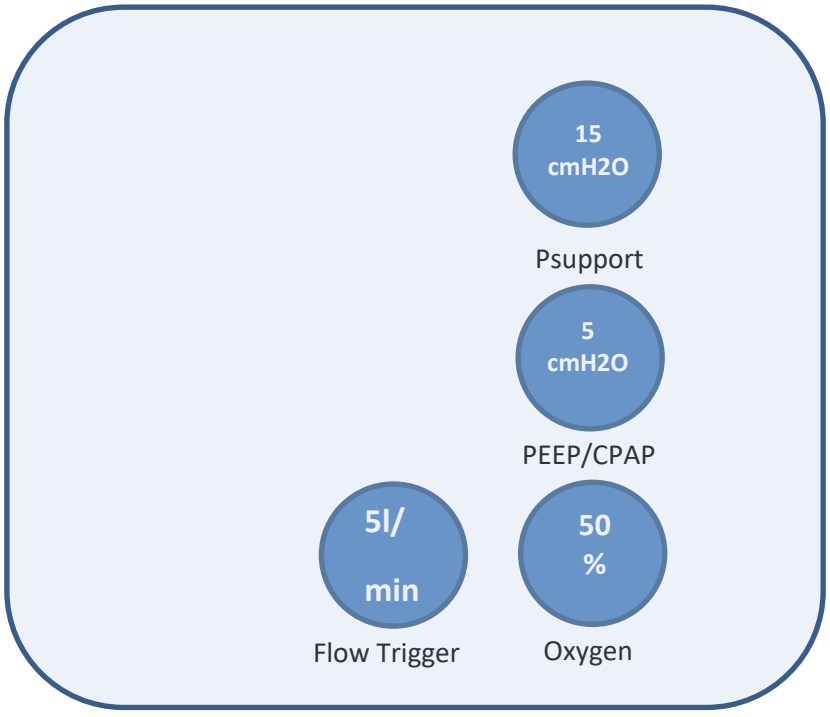
NON-INVASIVE MODES OF VENTILATION (NIV)

To use the NIV (non-invasive ventilation) modes, the patient must be:

- Having regular spontaneous breaths in order to trigger the ventilator
- Conscious and maintaining their own airway

'NIV' Mode

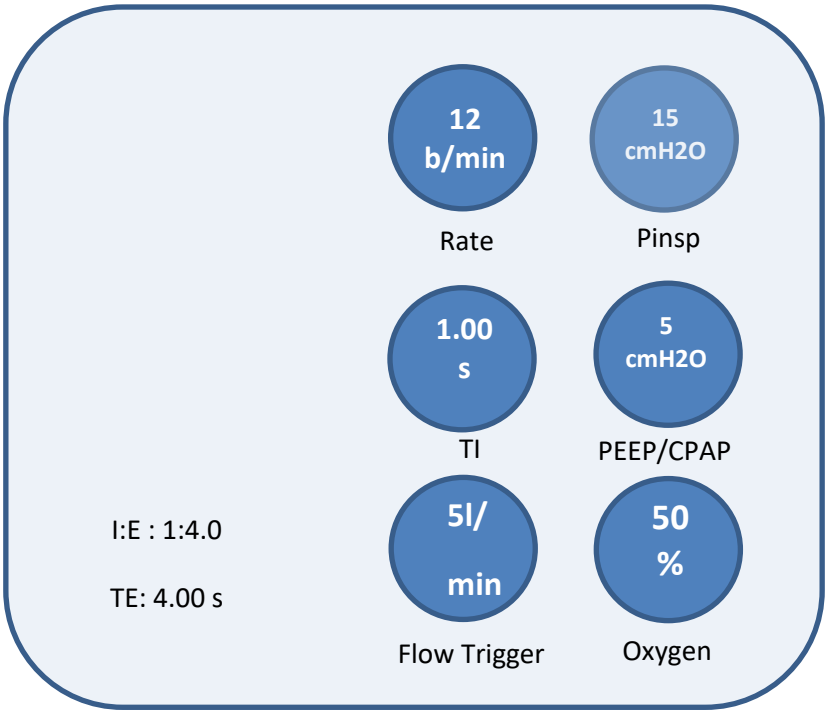
Provides pressure support to spontaneous breaths with additional CPAP. To use as a conventional CPAP system, set pressure support to 0cm H_2O. 'NIV' mode does not deliver mandatory breaths, but a back-up rate can be set. Adjustable options in NIV mode are shown below :-



NIV-Spontaneous/Timed ('NIV-ST') mode

Delivers pressure-controlled, time cycled mandatory breaths **and** pressure supported, flow-cycled spontaneous breaths. Combines elements of the PCV+ and NIV modes.

Adjustable options in NIV-ST mode are shown below



Troubleshooting leaks - Expiratory Trigger Sensitivity (ETS) and TI max

ETS and TI Max can be found under the 'More' tab in both NIV and NIV-ST mode. Their function is explained below :-

ETS is a percentage of the peak inspiratory flow. Once this value is reached, the ventilator stops delivering a breath and instead cycles into the expiratory phase. It is set by default at 25%.

When there is a significant leak, the volume of the gas leaked may be so high that the inspiratory flow never falls below the ETS – meaning that the ventilator will not 'know' to cycle in to the expiratory phase, resulting in endless inspiration. This can be overcome in one of two ways. Either

i) Increasing ETS above the default of 25%

ii) Adjusting TI max (maximum inspiratory time) – When inspiration lasts longer than TI max, the ventilator will automatically cycle in to expiration

Patient set-up for NIV and NIV –ST modes

Neonate / Infant (<10kg)

1.

The circuit set up for NIV and Invasive ventilation is the same.

HMEFs can be put onto the patient/mask end of the tubing. Alternatively, a single HMEF can be placed at the Inspiratory port of the ventilator.

Flow sensor and tightness tests (as shown on page 8) must be performed

2.

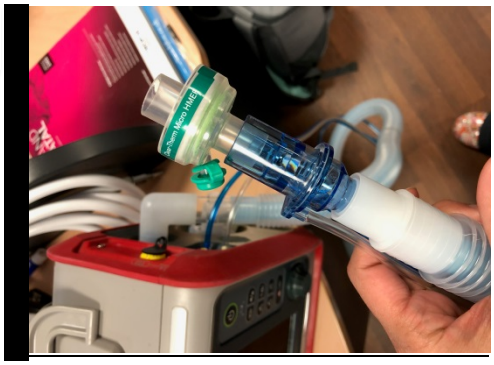
Attach an approriately sized facemask to the patient and secure using the blue straps as shown.

3.

Attach the ventilator circuit, including the flow sensor and an angle piece

Infant / Paediatric (>10kg

1.



HMEF can be attached to the patient end of the circuit as per invasive ventilation.

Use the appropriate size HMEF according to Vt.

Flow sensor and tightness tests (as shown on page 8) must be performed

2.

Attach an approriately sized facemask to the patient and secure using the blue straps as shown.

3.

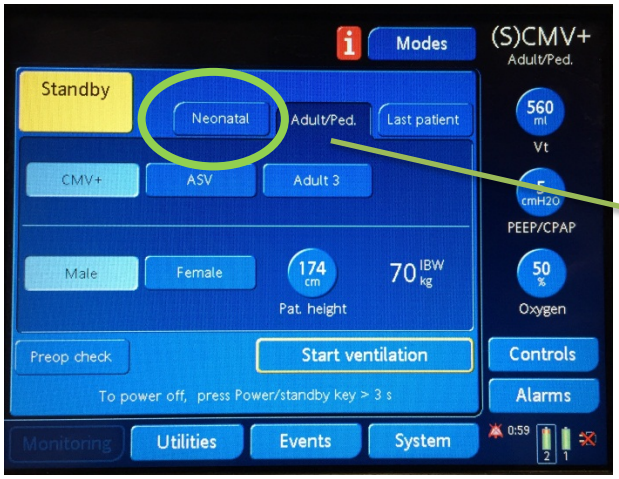
Attach the ventilator circuit, including the flow sensor and an angle piece

NEO-NATAL NASAL CPAP

Nasal Continuous Positive Airway Pressure (nCPAP)

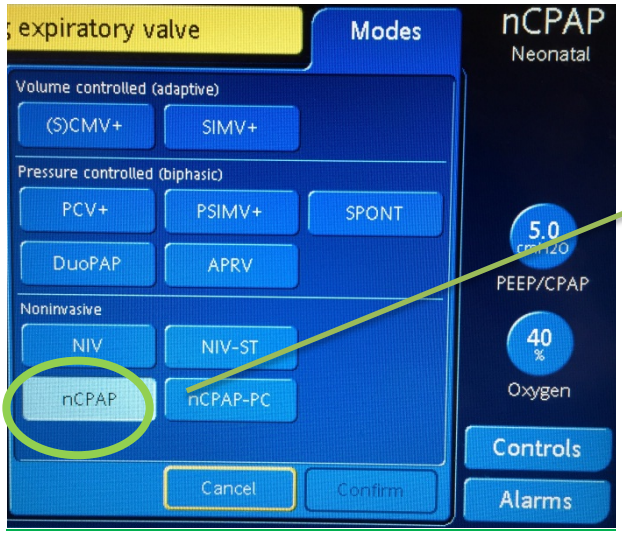
Applies CPAP over a nasal interface (masks or prongs). Adjustable parameters include FiO2 and PEEP. To enter nCPAP mode…

1.



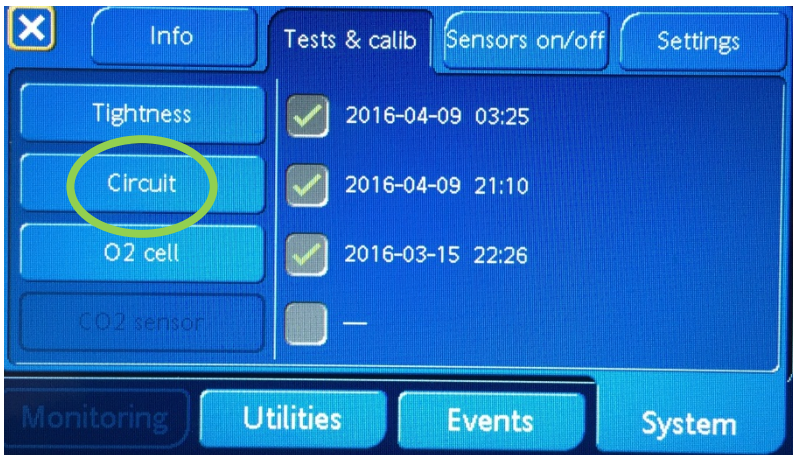
…select the Neonatal option from the home screen

2.



From the 'Modes' option, select nCPAP

3.

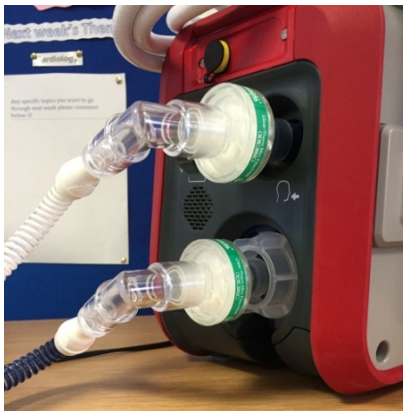


The 'Cicrcuit' calibration test may be required.

To perform this quick test, set up the circuit (see below) and disconnect both limbs from the CPAP extension when prompted

Circuit set-up for neonatal CPAP

1.



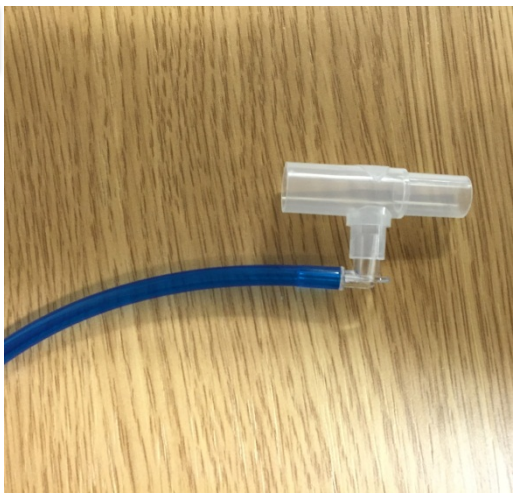
Place a **paediatric** HME filter onto the inspiratory and port of the ventilator, then attach the <10kg circuit by pushing firmly in to place

2.

Each new <10kg circuit comes with nasal CPAP flow senor tubing as shown

Attach the free end of the tubing to the blue flow senor port on the ventilator (as shown on page 4)

3.



Also in the packet is a ‘T’ shaped adapter

Attach the elbow on the other end of the flow sensor tubing to this adapter

4.

Place this adapter with the connected flow senor tubing on the inspiratory limb of the ventilator circuit

5.

Attach this to the Hamilton CPAP extension (shown)

5.

Attach the expiratory circuit to the expiratory valve of the ventilator. Attach the other end to the CPAP extension

5.

The correct cicruit set up once completed is shown here

6.

Attach a nasal CPAP mask or nasal CPAP prongs to the end of the extension and secure in place with the the CPAP hat and straps as shown

Alarms and the T1 Ventilator

To open the alarms menu, select the alarms option

A new window will be displayed as shown

Alarm limits can then be set for the following parameters:

i) Peak Pressure
ii) Expired Minute Volume (low & high)
iii) fTotal (low and High) = Total respiratory rate (inc spontaneous and mandatory breaths)
iv) Tidal Volume
v) Apnoea time

Use of 'Auto'

- This feature (circled in red on the image above) automatically sets all alarm limits around the current monitoring parameter values (with the exception of tidal volume and apnoea time).
- For example, if the ventilator is alarming for a peak pressure of 35 – pressing 'Auto' will default the upper peak pressure alarm limit to greater than 35 *from then on*, which may not necessarily be appropriate.
- **'AUTO' SHOULD THEREFORE BE USED WITH CAUTION.** If pressed, the clinician should take time to re-assess the alarm limit values once the patient has been stabilised, to ensure that they are safe and appropriate.