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Royal Brompton & Harefield NHS
NHS Foundation Trust

Astral 150 Ventilator Information and User Guide for Home Care Workers

Children's Long-Term Ventilation Service
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Contents

Disclaimer: This user guide is designed for use by home care workers who have received appropriate training to use the ventilator for the home setting. It does not include guidance on setting and altering ventilation parameters. If this guidance is required by a qualified medical professional please see alternative user guide titled '*Astral Ventilator: Information and User Guide for Qualified Healthcare Professionals*'. Information was correct at the time of writing and will be updated at the next review date.

Description of Outside of Ventilator

Expiratory Port: Expired air coming back to the ventilator

Inspiratory Port: Air going to the patient.

Air inlet

Oxygen Connector

USB Connector
(to download monitoring data)

Power Inlet

Power Button

1. Touch Screen
2. Power source Indicator

Power source indicators

- AC (mains power supply)
- DC (external battery or car accessory adapter)
- Internal battery

3. Ventilation on/off indicator

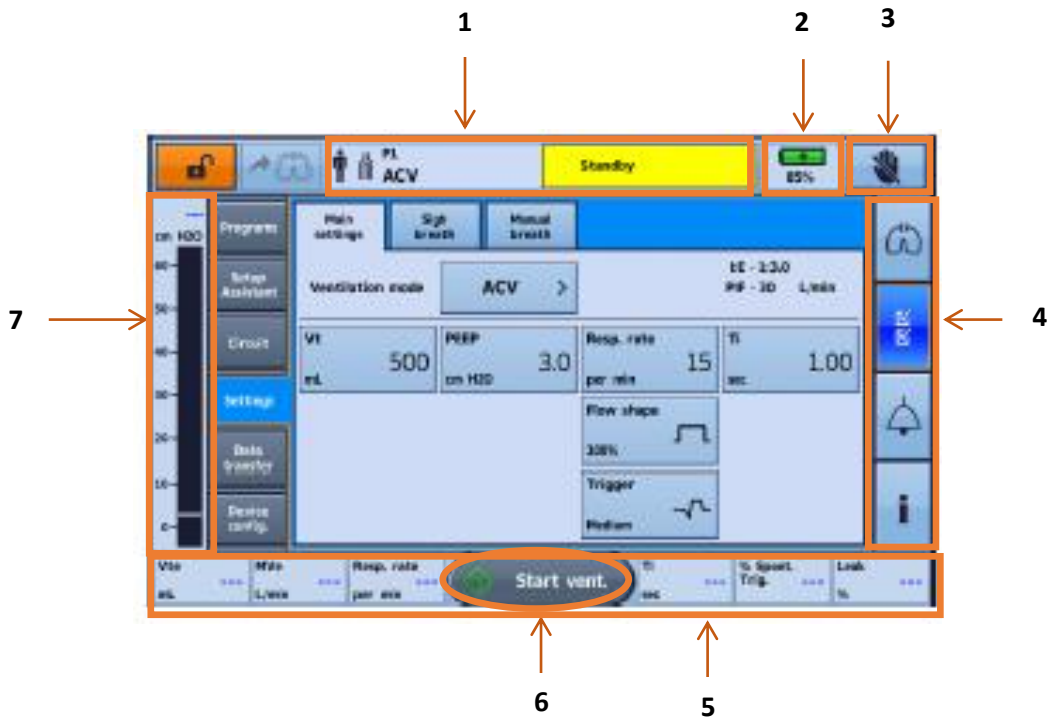
Device ready
Constant green display when the device is turned on but not ventilating.

Device ventilating
Flashes blue when the device is ventilating and the Ventilation LED setting is 'ON'. Otherwise is 'OFF'.

4. Alarm mute button
5. Alarm light

Flashing red	High priority alarm
Flashing yellow	Medium priority alarm
Constant yellow	Low priority alarm

Understanding the Screen



1. Information bar (see below for more information)
2. Battery power indicator
3. Lock touch screen button
4. Menu bar (see below for more information)
5. Bottom bar
6. Start ventilation button
7. Pressure bar (see below for more information)

Information Bar (1)

The Information bar is displayed at the top of the touch screen. The Information bar displays the operating status of the device, including patient type, current circuit configuration, programs, information messages, ventilation status, alarms and power status.

	Description
	Patient type – Adult
	Patient type – Pediatric
	Circuit type – Single limb with intentional leak
	Circuit type – Single limb with expiratory valve
	Circuit type – Double limb
P1 (A)CV	Program number and ventilation mode in use
	Multiple alarms are active simultaneously. The highest priority active alarm is displayed first.
Message window	Will display alarms or information. Image above shows device in Standby. (Displayed when the device is powered on but not ventilating). Date and time will be displayed when the device is ventilating and there are no active alarms. Information messages are displayed in blue text. If the device Alert tone setting is 'On', you will be alerted to new information messages by a single beep.

Menu Bar (4)

This provide access to the four main menus in the Astral Device.

Monitors menu

View real-time patient data in either waveform or monitoring formats including pressure, flow, leak, tidal volume, synchronisation and oximetry.

Setup menu

Configure and view ventilation therapy and device settings.

Alarms menu

Configure and view alarms including alarm volume.

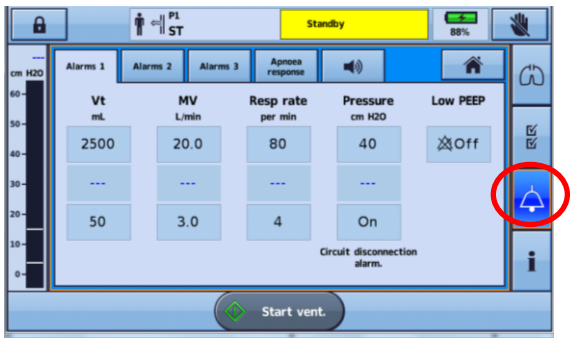
Information summary menu

View therapy statistics, used hours, events, reminder and device information.

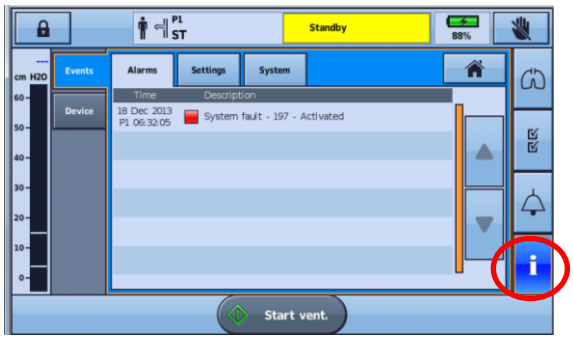
See Monitoring for more details about this button.

When you select the *'settings'* button, all the clinical parameters are displayed.

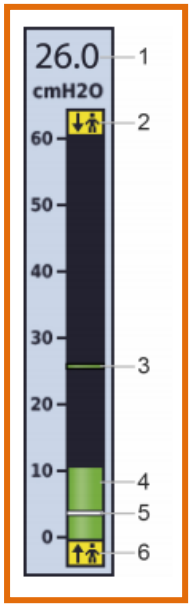
When in the '*alarm settings*', there are 5 tabs with various alarm settings at the top of the screen.



When the *'information'* is selected the ventilator will show you information about alarms that have activated and when settings have been changed.



Pressure Bar (7)



	Description
1	Peak inspiratory pressure (PIP) value
2	Spontaneous cycled breath marker—indicates patient-cycled breath
3	Peak inspiratory pressure marker
4	Current pressure
5	Positive end expiratory pressure (PEEP) setting
6	Spontaneous triggered breath marker—indicates patient-triggered breath

Power

The Astral runs on mains power and can be used with different power sources. These includes internal battery power, external battery power and car charger power source.

Removing the power lead

The power cord is equipped with a push-pull locking connector. To remove, grasp the power cord housing and gently pull the connector back- this will release the power cord. **NEVER twist its outer housing or pull on the cord and NEVER force the cord from the Astral as it will break the collar and it cannot be repaired.**	

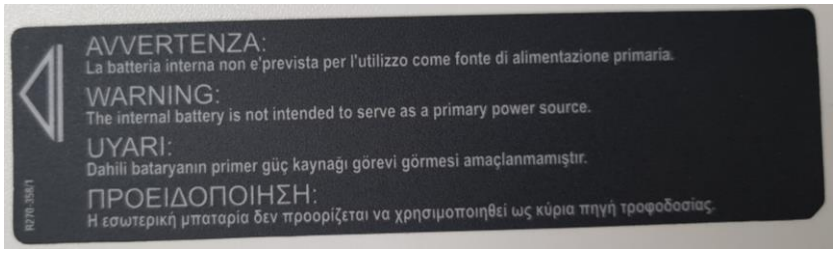
Internal Battery Power

The ventilator has an internal battery. Whilst the ventilator is connected to mains power the internal battery will charge. When the mains power is disconnected the ventilator will automatically switch to using the internal battery (assuming no external batttery is connected). There is no interuption to ventilation when this happens. The ventilator will notify you of this change by sounding an alarm. The internal battery life is approximately 8 hours. There will be slight variations in the battery life dependent on the individual child's ventilator parameters and the child's respiratory pattern. Please observe the internal battery indicator carefully.

Display	Description
 100%	When the internal battery is in use, but the device is not ventilating, the battery charge level is displayed.
 8h00	When the internal battery is in use during ventilation, the remaining usage is displayed as estimated by current operating conditions.
 70%	When the internal battery is charging, the charge battery symbol and percentage charged is displayed.

Warning:

- Please ensure to regularly check the internal battery.
- The internal battery should be replaced every two years, or when there is a noticeable reduction in usage time when fully charged.
- Following a Field Safety Notice 1706001, MHRA has released a for the Astral ventilator (July 2017) concerning the Astral power supply. Their current recommendations are that the internal battery is NOT intended to serve as a primary power source. It should only be used when other sources are not available or briefly when necessary; for example, when changing power sources. See image below.



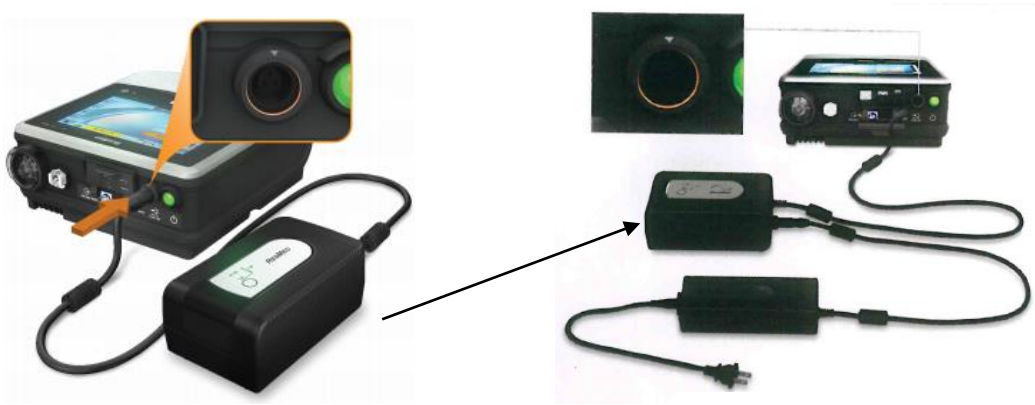
Please Note: When the ventilator is running on internal battery power in standby mode no alarms will sound, take care to observe the battery life indicator.

External Battery Power

The external battery will power the device for approximately 8 hours. A maximum of two external batteries can be connected to the Astral device.

Please Note:

- There will be slight variations in the battery life dependent on the individual child's ventilator parameters and the child's respiratory pattern. Please observe the internal battery indicator carefully.
- The external battery cannot be charged from your main power. This can be used and recharged while connected to the Astral device.



External battery with charging device – charging both external and internal batteries

⚠ WARNING

Do not attempt to connect more than two external batteries. Battery specific messages and alarms on the Astral device will not operate for any additional units.

Previous External Battery

This may still be seen in the community giving 8 hours of power during typical use.

Please Note: When using this battery, the internal battery will not be charged. Do not use this battery with the new external battery seen above. This is charge using an adapter connected to main power.

Using a car Charger

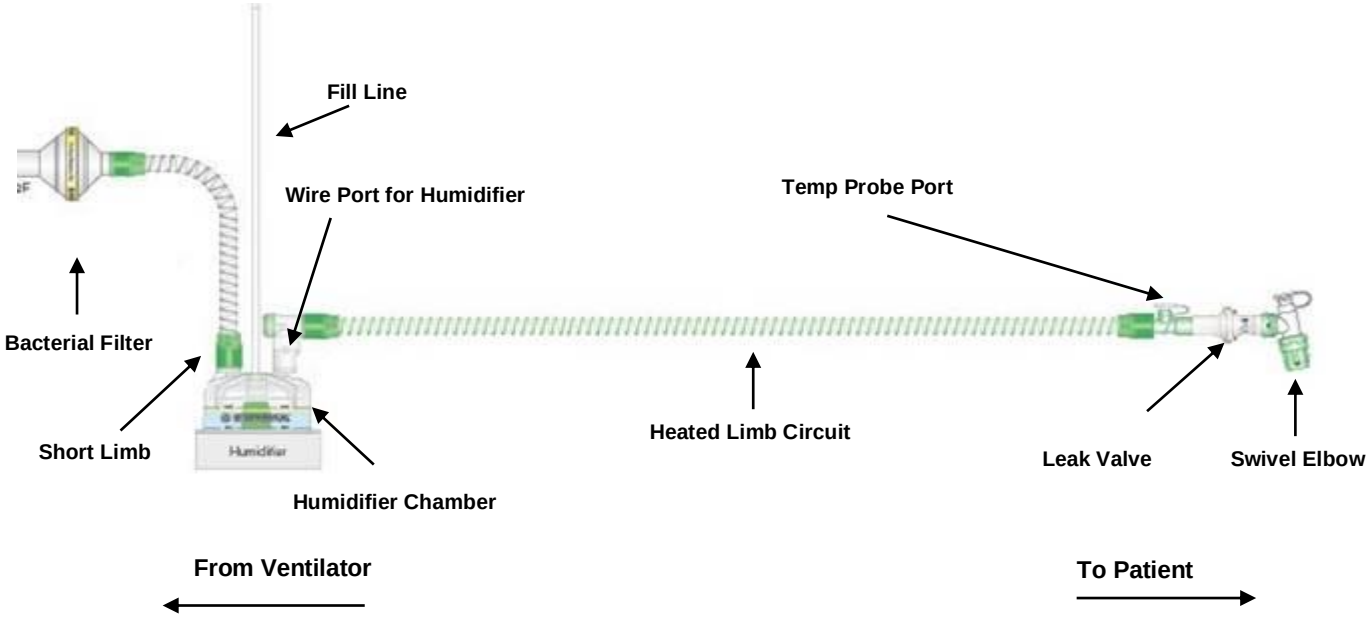
When using a car adapter, start the car before connecting the adapter. If the power source drops the ventilator will switch automatically to internal battery power.

Types of Ventilation Circuits

Single Leaked Circuit (wet)

The whole circuit should be changed weekly at home (i.e. once every 7 days). See local hospital guideline for antibacterial filter.

Order code: 7073800 MR7LEAK15 from ResMed for circuit, 24988 from Resmed for leak valves (15 mm circuit). *See equipment list for other order code.* **Please note that the circuits and leak valves come separately from April 2020 so please check stock.**

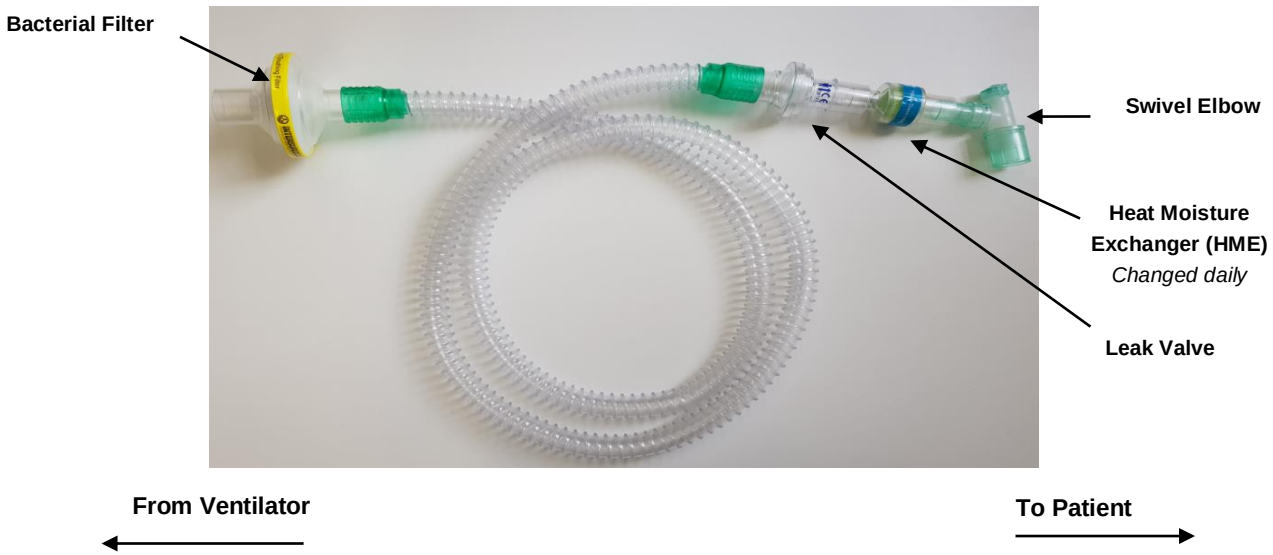


Single Leaked Circuit (dry)

The whole circuit should be changed every 7 days at home including antibacterial filter. See local hospital guideline for antibacterial filter.

*__Note:__ Heat Moisture Exchanger should be changed daily (i.e. once every 24hours)

Order code: 7077399 7LEAK15 from Resmed for circuit (15mm circuit), 1850 from Intersurgical for HME, 24988 from Resmed for leak valves. *See equipment list for other order code.* **Please note that the circuits and leak valves come separately from April 2020 so please check stock.**



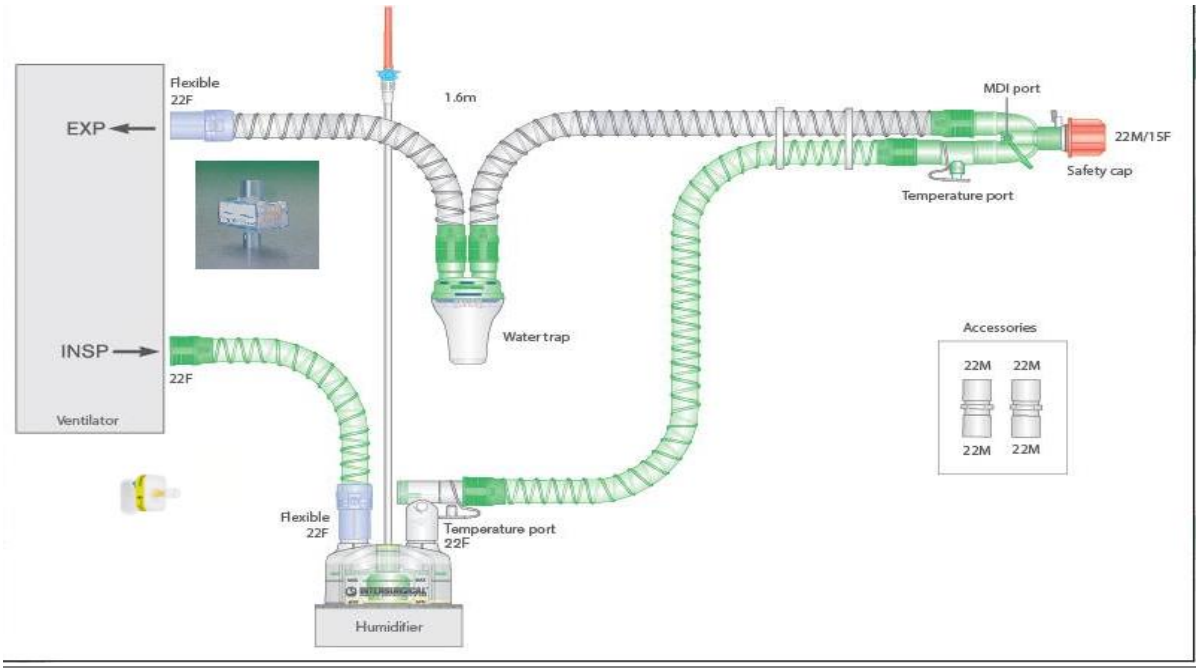
Other Circuit that may be seen:

Double Limb Circuit (wet)

The whole circuit should be changed weekly at home including antibacterial filter. See local hospital guideline for antibacterial filter. **Order code: 5504810 from Intersurgical for circuit, 1644 from Intersurgical for filter.**

Note: The grey PALL Filter should be changed minimum daily (i.e. once every 24hrs)

Order code: 70386 from Resmed or BB50TE Pall Medical.



Double Circuit (dry)

The whole circuit should be changed every 7 days at home including antibacterial filter. See local hospital guideline for antibacterial filter.

Oder code: 5500 from Intersurgical

Note: Heat Moisture Exchanger should be changed daily (i.e. once every 24hours).

Order code: 1644 from Intersurgical for filter.

Antibacterial Filter
(connects to inspiratory limb) *Changed weekly*

Insert Heat Moisture Exchanger here
Changed daily

Turning On/Off

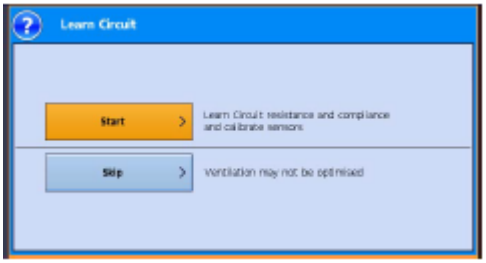
To turn the machine on and off, press the green button on the rear of the machine. The ventilator can only be powered off once the ventilation has been stopped.

Learn Circuit

The ventilator will require a 'learn circuit' to be completed as part of troubleshooting and for any additional different circuit type that may be used i.e. a separate 'learn circuit' is required for a wet circuit and then a dry circuit. The 'learn circuit' does not need to be completed at each scheduled circuit change but a good practice to do once monthly.

From the Setup Menu, select the Circuit sub-menu. Press start and follow the on-screen prompts.

If '*skip*' is selected, the device will revert to default factory settings.



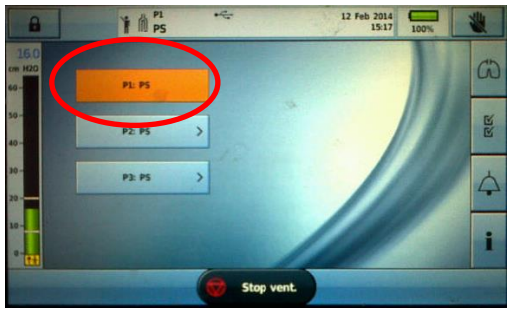
Follow the on-screen prompts to attach and test the circuit. A test result is displayed if any of the tests fail, otherwise the Learn Circuit function has been successfully completed and you will be returned to the main settings page.

See *'Troubleshooting Common Problems'* Section if the Learn Circuit fails for more guidance.

Note: It is acceptable to use a circuit that gives a caution message as the Astral device will compensate for circuit resistance and compliance.

Changing between Programmes

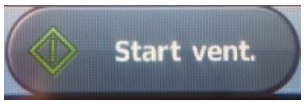
It is possible to set up more than one ventilation programme. For example, some children may have a programme of ventilation set to use when they are well and another for when they are unwell or for use with a wet ventilation circuit and a dry ventilation circuit. If more than one ventilation programme is set, the screen will appear as below:



To activate the correct programme press on the appropriate icon so that it turns orange.

Press '*confirm*'

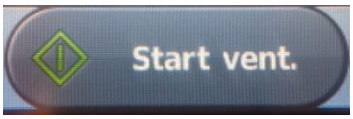
Then press start ventilation



Note: The ventilation should be started with the cap on the end of the circuit and removed once ready to attach to the tracheostomy tube

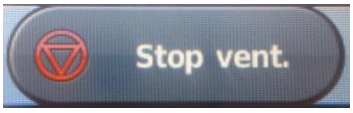
Starting/Stopping Ventilation

To start ventilation press the '*start ventilation*' icon



Note: The ventilation should be started with the cap on the end of the circuit and removed once ready to attach to the tracheostomy tube

To stop the ventilation, press and hold the '*stop ventilation*' icon for 3 seconds. Release when prompted and then select 'confirm'.



Entraining Oxygen

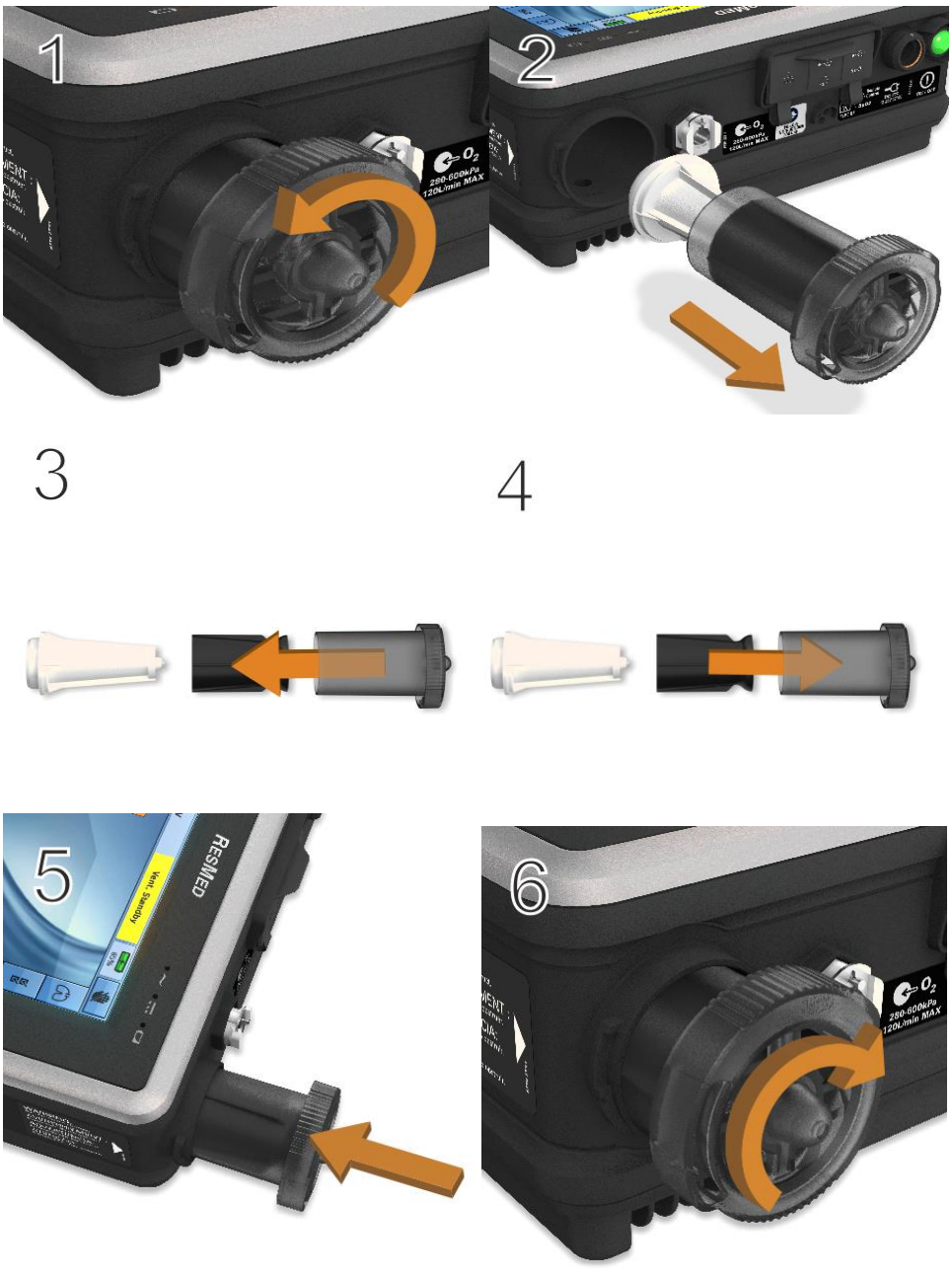
Oxygen is entrained via the oxygen nozzle on the back of the machine.
Note: When the machine is not in use oxygen should be turned off and when oxygen is not required the oxygen nozzle should be removed.

Replacing the air filter

The condition of the air filter should be inspected and checked weekly to see if it is blocked by dust or dirt. If it the filter is deemed in good condition is should be changed monthly. If on a weekly inspection it is found to be blocked that is advisable to change the filter even if the filter is less than 4 weeks old. NB. The filter is not reusable and cannot be washed.

Before replacing the air filter, turn off the device and remove mains power and/or external battery.
1. Unlock the air filter cover by turning in an anti-clockwise direction.
2. Pull the air filter cover from the device.
3. Pull the air filter from the cover and discard.
4. Insert a new filter into the cover.
5. Insert the air filter and cover back into the device.
6. Turn in a clockwise direction to secure in place.

Order code: 27939 for pack of 4 filters.

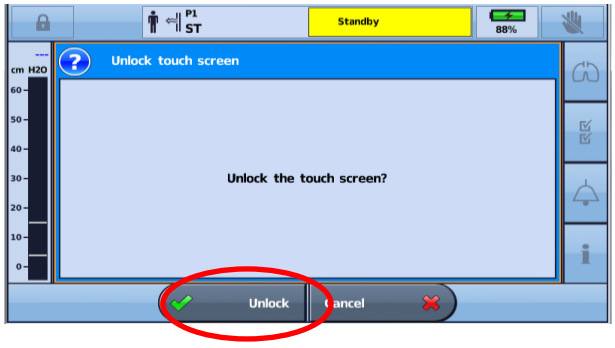


Screen Locking/Unlocking

Regardless of whether the ventilator is in use (ventilating the patient) or in standby (not ventilating the patient, but turned on) the screen display will lock (see below) after 30 seconds of inactivity. The screen will go to sleep (go black) after 60 seconds. Press anywhere on the screen to wake it up.

You can see it's locked as the hand in the top right will appear orange

When the screen is touched, '*unlock the touch screen*' will appear (see below). This does not unlock the '*clinical mode*', it simply enables you to view the parameters and alarms in the '*patient mode*'. To confirm you wish the screen to be unlocked, press '*unlock*' (circled below).



Monitoring

The monitoring menu allows you to see real time ventilation data that comprised of waveforms, monitoring and trends. To enter the monitoring menu, click on the menu on the right. Then select the monitoring menu icon from the right hand side of the screen.

Waveforms – displays the last 15 seconds of patient airway pressure and flow in graph

Monitoring – displays all measured parameters in numerical form

Trends – displays 30 days data in graph

Activated Alarms

When an alarm is activated the ventilator will provide both audible and visual alerts. A message is also displayed detailing the nature of the alarm.

1. **Alarm Display**. Shows the alarm message for either the highest priority alarm or the last active alarm not yet reset.
2. **Active Alarms Screen**. Displays all the active alarms. Alarms will disappear from this list as they are resolved.
3. **Information MENU**. To see a history of all activated alarms press the '**I**' icon.
4. **Alarm Mute/Reset Button**. This button allows you to mute an active alarm or reset the alarm display if no current alarm. When an alarm is muted this will last for 2 minutes. During this period the mute botton will flash. To cancel the mute simply press the button again.
5. **Alarm Priority**. Alarms are classified into high, medium and low priority according to the urgency that the alarm needs to be dealt with.

Alarm priority		Alarm bar	Audible alert
High		Red flashing light	10 beeps every 5 seconds
Medium		Yellow flashing light	3 beeps every 15 seconds
Low		Yellow steady	2 beeps every 25 seconds

IMPORTANT: All alarms should be responded to no matter what the priority. The priority indicator aims to guide the urgency in which the situation needs to be resolved.

Testing Alarms

Alarms Checks - Must be carried out at the beginning of each shift. A good time to do this would be when the patient requires suctioning. It would be useful for two people to do this in order to check the alarms.

- When tubing is first disconnected check that low pressure, disconnection ***or*** low tidal volume alarms are triggered

- Occlude the vent circuit whilst running and check the high pressure ***or*** low tidal volume alarms are triggered.

Understanding Alarms

<table>
<tr><td colspan="4">Low VTE/Low MVE</td></tr>
<tr><td colspan="2">Disconnection/leak/High MVe/High Vte</td><td colspan="2"></td></tr>
<tr><td>1 Assess child
Accidental decannulation
(i.e. tracheostomy has come out)</td><td>Action
Immediately insert tracheostomy
If difficulty follow emergency algorithm</td><td>1 Assess child
Possible causes include:
Blocked tracheostomy</td><td>Action
Emergency algorithm:
1. Suction
2. Emergency tracheostomy change</td></tr>
<tr><td>2 Assess equipment
Disconnection within circuit
(follow circuit from child through to ventilator and ensure everything is connected – NB humidifier connectors etc may be slightly loose)</td><td>Cause
- some leak may be tolerated and may be due to position of child – discuss with community ± medical teams, who can consider need for cuffed trache or upsize</td><td>2 Assess child
Retained secretions/ increased pulmonary resistance etc</td><td>Action
• suction, consider need for nebulisers, physiotherapy
• refer to advanced treatment plan
• discuss with community or medical team</td></tr>
<tr><td>3 Assess child
Possible causes include:
Leak around tracheostomy
(particularly when asleep)</td><td>Action
• Reconnect any loose connections
• Re-assess</td><td>3 Assess equipment
Circuit blockage
(Follow circuit from child through to ventilator and ensure it is not kinked or obstructed)</td><td>1 Assess child
• Correct fault
• Re-assess</td></tr>
<tr><td>Is the alarm set appropriately
(i.e. as previously recorded and checked at start of shift)</td><td>• Check alarm settings are as prescribed and re-set if any discrepancies</td><td>Is the alarm set appropriately
(i.e. as previously recorded and checked at start of shift)</td><td>• Check alarm settings are as prescribed and re-set if any discrepancies</td></tr>
<tr><td colspan="4">NV Mask (Non-Vented) Mask Alarm
Check exhalation value is not blocked or covered and within circuit. NB: If Jetstream nebuliser is running in circuit this alarm is frequently triggered.</td></tr>
</table>

Troubleshooting Common Problems

Machine Failure
• Hand-ventilate immediately and change ventilator. Organise a new ventilator. Children ventilated >12 hours should have a backup machine.

Learn Circuit Failure
• May be due to
a. Any leaks in the circuit e.g. heater wire loose in the humidifier. **b.** Any leak from the end of the circuit when occluding on the final stage-use cap if possible to occlude end or firmly place against palm of hand.
c. Any leak in the circuit-check integrity and replace if needed
d. Leak valve/HME has been left on circuit-needs to be removed
e. If ventilator has been in use and is warm this can sometimes cause the learn circuit to fail-switch to another ventilator if possible and allow ventilator to cool then retest.
f. Internal switch getting stuck-correct this by performing the learn circuit with the ventilator being held with the front of the ventilator facing the floor.

Humidification Problems
• Humidifier will alarm if temperature is too high or too low.
a. Heater wire: life spam approximately 8 months
b. Temperature gauges: one at humidifier and one at patient
c. Water in humidifier chamber: if low, temperature will go up if too much H_20, temperature will go down
d. Frequent disconnections: increase in cold air entry will increase heater activity so beware of increased heat on reconnection

Ventilator Alarming Low Pressure
• Could be caused by disconnection/leak in the circuit. Check circuit for splits, check for disconnection at the tracheostomy, of the humidifier wires and at the machine.

Ventilator Alarming High Pressure
• May be due to
a. Tracheostomy partially or completely blocked
b. Kink in the ventilator circuit
c. Expiratory valve covered therefore blocked.

Ventilator Alarming Low Volume (VTE or MVe)
• May be due to
g. Pressure control set to low **h.** Tracheostomy partially or completely blocked
i. Patient in need of airway clearance
j. Patient developing lung pathology

k.	Obstruction in circuit, check along circuit
l.	Patient upset, uncomfortable or experiencing abdominal expansion due to feeds therefore shallow breathing

Ventilator Alarming High Volume (VTE or MVe)	
•	May be due to
a.	Could be caused by disconnection/leak in the circuit. Check circuit for splits, check for disconnection at the tracheostomy, of the humidifier wires and at the machine.
b.	Patient upset, uncomfortable or excited.
c.	Patient is moving or being moved.

Ventilator Alarming Low Pressure
• Could be caused by disconnection/leak in the circuit. Check circuit for splits, check for disconnection at the tracheostomy, of the humidifier wires and at the machine.

Ventilator Alarming High/Low Respiratory Rate	
•	May be due to
a.	Respiratory limits set too low or high
b.	Patient upset, uncomfortable or excited.
c.	Patient very active in movement and machine ventilator misreads movement as a breath.

Low PEEP	
•	May be due to
a.	Blockage or leak in the circuit or expiratory valve or tracheostomy leak
b.	Disconnection

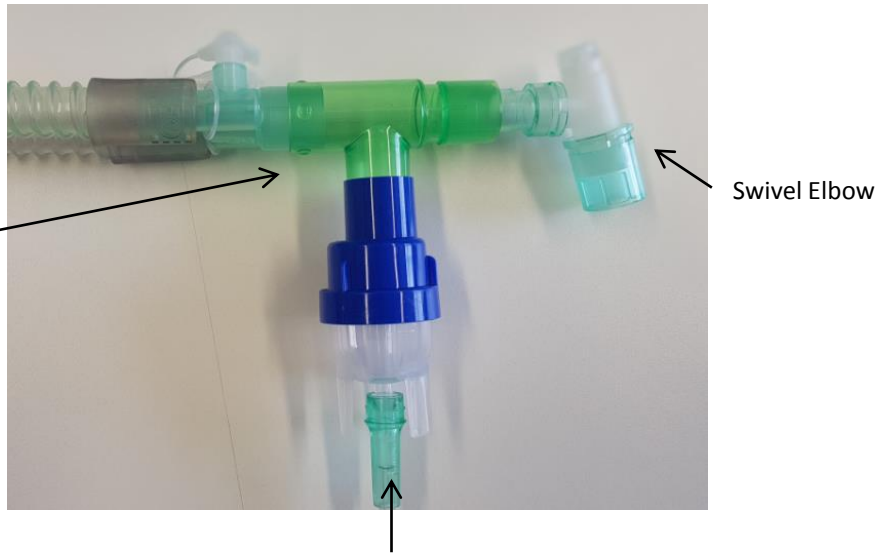
Ventilator Alarming NV Mask.	
•	Is normally caused by a blockage in the ventilator. This may be due to:
a.	Covering of the leak valve
b.	Blockage of the leak valve by condensation and/or secretions.
c.	Addition of supplemental oxygen/air into the circuit when using jetsream nebulisers for example.
d.	Coughing.

Using Nebulisers

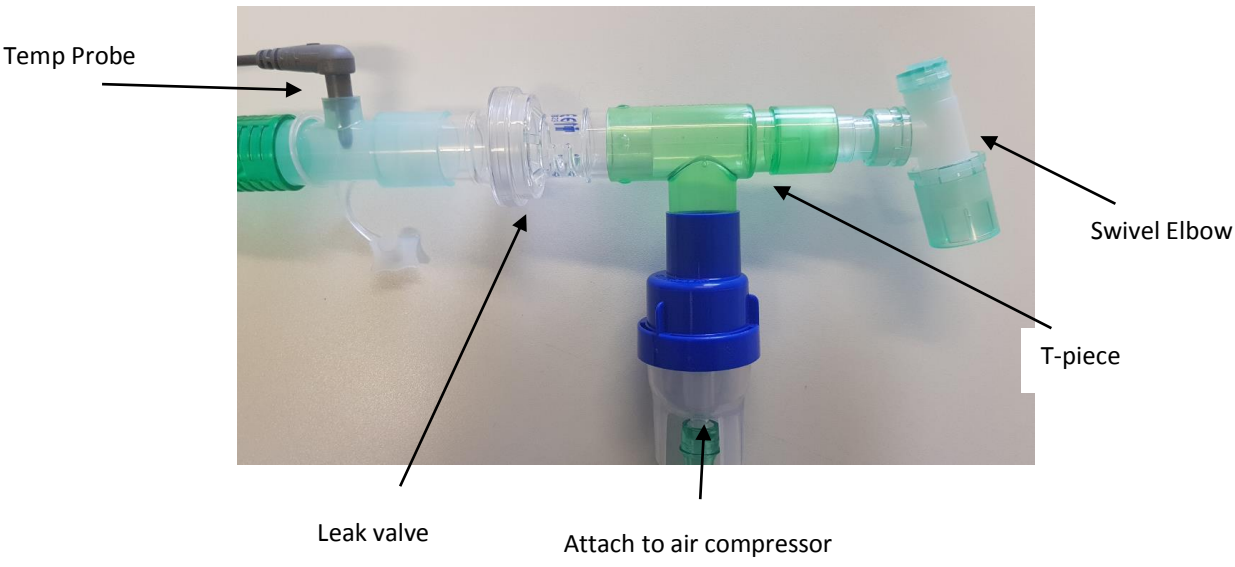
Nebulisers are attached to the ventilator circuit as shown below. The nebuliser is powered by an air compressor.

Using a Nebuliser in a Double Limb Circuit

The Double limb circuit is a closed system therefore particles will remain within the system.

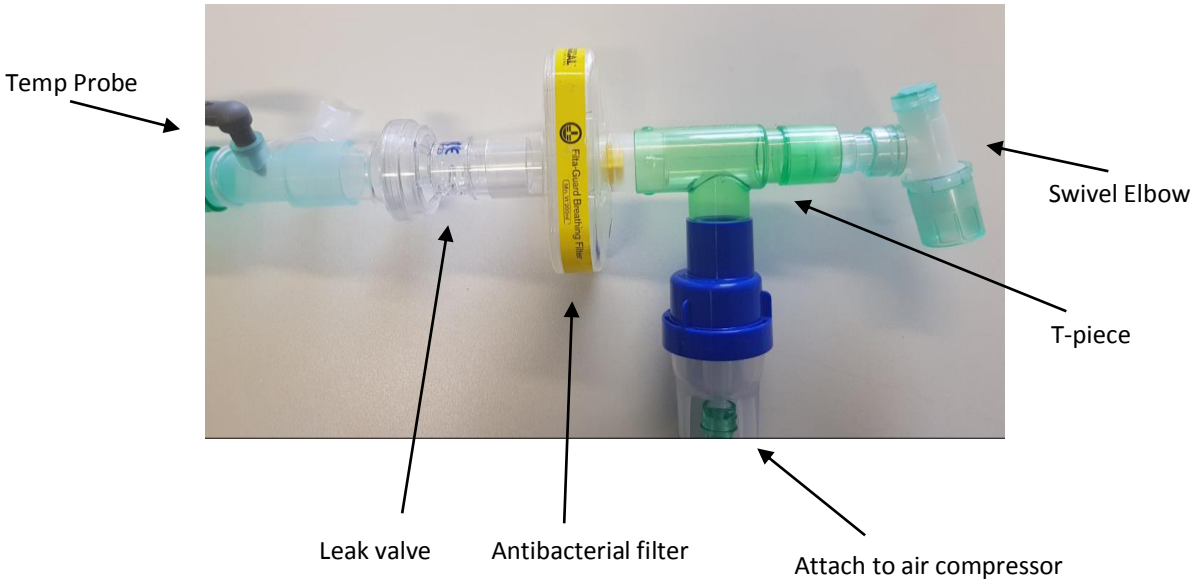


Using a Nebuliser in a Single Leaked Circuit



Note: For dry circuit, HME may be removed during nebulisation

For **nebulising antibiotics in a single leaked circuit,** an antibacterial filter must be used in between the nebuliser chamber and expiratory leak to prevent particles escaping into the atmosphere. (**Please check your local policy on whether antibiotic nebulisers require filtering)**



Please note: the correct filter to use is shown in the picture above – order code: 1644 (intersurgical)

Consumables:

- Antibacterial filter should be changed weekly at home – see local policy for hospital setting
- Air filter at the back of the ventilator should be checked weekly and changed monthly. Changed sooner if needed.
- Breathing circuit should be changed weekly

NOTE: Please see equipment list for ordering information

Ventilator Tips:

- Allow a period for a ventilator to do it self test prior to connecting to the child
- Check the alarms prior to connecting the child to the ventilator.
- Good practice to perform the Learn Circuit within the last month.
- Ensure that you are in the correct programme as per individualize patient's plan.
- If 24-hour ventilation is required, the patient should have a back-up ventilator ensuring equal usage to both ventilators.
- Machine is locked and on the appropriate settings

Useful Contact Information

For further advice on the ResMed Astral 150 ventilator machine on the phone during week working hours:

ResMed (UK)
Registered address: 8 Wimpole Street, London, United Kingdom, W1G 9SP
Customer Services: 01235862997

Check your service agreement for your options.