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# Ventilator Preventive Maintenance

11-14 minutes

[Ventilators or respirators](#) are devices used to assist patients in ventilating their lungs. There are many things to be done for a ventilator during a Preventive Maintenance check-up. Most manufacturers recommend that a PPM be applied every 3 months of use. During which you will be prompted to do some or all of the following:



760 series Ventilators

- Inspect for any physical damage that might indicate mechanical damage.

- Run a full performance check, where you will check all modes of operation of the ventilator
- Change the air intake filter.
- Verify that all audible and visual alarms are working properly.
- Inspect labels.
- If there is a cooling fan filter then it is recommended to be inspected and cleaned every month. If you are in a dusty area you might want to clean it more often.
- Some ventilators have an option to self-calibrate their oxygen sensor. This needs to be done often, daily or as needed.
- If the ventilator has a collector vial then it needs to be cleaned and disinfected. In most cases, the collector vial can be sent to the autoclave to disinfect it, daily or as needed.
- Inspiratory and expiratory bacteria filters. If the filters are reusable then they should be autoclaved if they are disposable they should be replaced after every patient. If the same patient stays connected to a ventilator for a long period of time usually more than 15 days. The filters should be autoclaved or replaced whichever case is applicable or after a circuit change. You can check filter resistance in many types of ventilators. By referring to the operation manual you will get instructions on what to do when the filter resistance increases above a certain level?
- Check if the battery is charging and that it is fully charged

after long charge times. Usually, it is recommended to change a ventilator battery every year. You can refer to the user/service manual of your ventilator to follow manufacturer recommendations.

- Check battery life by operating the ventilator on battery mode by disconnecting the AC supply line. Then turning the ventilator ON, you can also check both audible and visible alarms indicating that a ventilator is using its battery power. Then start the operation of the ventilator and commence your PPM check. In some cases, a battery cable might be loosely connected. Do not operate in battery mode for longer periods than recommended by the operation manual of the manufacturer
- Some ventilator manufacturers allow for some parts to be chemically cleaned or treated.

**CAUTION:** Never send sensors of the ventilator for autoclave, usually flow sensors that are mounted on a ventilator hose. (Allowing the sensors to more accurately measure air pressure, but are "mistakenly" sent for an autoclave. Most manufacturers allow autoclave temperatures 135 degrees Celsius max. (i.e. 275 Fahrenheit).



Proper Tools are an integral part of a proper PPM!

## Diagnostic Functions in Ventilators

Some Ventilators have self-test options, applying it the ventilator initiates a self-diagnostic checkup. This checkup can aid in maintaining the machine. As it will either give an error code number related to a defective part in the machine or it will tell you what to do to resolve some minor problems.

The self-test procedure varies from a manufacturer to another and the procedure to apply such a check is usually provided in the user manual of the ventilator. Most ventilators with self-test options have 2 self-check modes where one is a short self-test (SST) the other is extended self-test (EST).

### Short Self Test Mode

This test procedure needs to be done:

1. Between patients to make sure that critical ventilator components are not damaged,
2. Every 15 days,

### 3. Or when the breathing circuit is changed.

This mode will quickly test safety valves, flow sensors, solenoids, leak rate in the breathing circuit and measure circuit compliance. There are fixed procedures to be done to be able to run the SST. One way is by having the patient circuit already connected to the ventilator. You may wish to see the operation/user manual for the ventilator before starting an SST.

### **Extended Self Test mode**

This test mode will inspect the operational integrity of the ventilator with testing both electronics and pneumatic circuits of the ventilator. The application of an EST is usually done if:

1. The ventilator needs servicing,
2. Or during a Preventive Maintenance performance verification
3. Or following a long idle period by which the ventilator was stored away.

For both self-test modes, it is highly recommended to follow the manufacturer's procedures that are provided in the operation/user manual.

In case a ventilator fails a self-test then it should NOT be used on a patient until it is serviced properly.

During self-tests, if there are some problems in the

ventilator, an error code number is usually displayed. These error code numbers are very important pieces of information that need to be used while maintaining the ventilator. If you are not the person who is going to service the ventilator then it is highly recommended that you send these error codes to the qualified person who is going to service it. This will reduce the downtime of the machine and allow for better machine diagnosis.

## **What needs to be changed During a Routine PPM in a Ventilator?**

As the ventilator is in service some parts might need to be changed. The interval by which parts that need to be changed is usually variable and might not be needed to be done every 6 months. For 6 months are usually the PPM interval by which a ventilator needs to be checked.

### **Ventilator Internal Battery**

Every 6 months the battery performance must be checked. This is done by having the ventilator work using the battery after it has been fully charged and monitor its performance. Usually, the period at which the ventilator can work fully dependant on the battery is mentioned in the user/service manual.

As a rule of thumb if the battery performance test passes then no need to change the battery. Some manufacturers might recommend changing the battery every 1-2 years depending on the interval of battery operation.

## **Ventilator Reusable Patient Breathing Circuit**

The reusable patient breathing circuit will not last forever! And based on manufacturer recommendations it has to be changed after a certain number of autoclave cycles. This is mostly the task of the staff using the ventilator, not the biomedical team. But Biomed has to make sure that the staff is following the manufacturer's recommendations on the number of autoclave cycles. After which the breathing circuit has to be changed. Make sure also that changing the breathing circuit is not too frequent. In this case, the hospital or clinic is losing money that could be used more wisely.

Whereas if the breathing circuit is not changed at all or beyond the recommended cycles. Then this might lead to other problems, the simplest of which is that there would be leakage from a small crack in the circuit leading to a flow test error. Or have other errors that can have the staff think that the ventilator is not working properly! This would have the staff think that the ventilator needs to be checked and serviced. This might become a major time waste for the biomedical technician. As he will be looking for a problem that is non-existent in the ventilator hardware and software.

## **Ventilator Oxygen Sensor**

Usually, it has to be replaced after 1-2 years based on the manufacturer's recommendation. It is very important to make sure the Oxygen sensors are replaced during the recommended period. As the sensor will start to be not reliable and would lead to some error messages that can be

prevented.

## **Preventive Maintenance Kit**

Most ventilator manufactures have a PPM kit that includes various parts that need to be changed in a certain interval of time. Some manufacturers have various kits for various periods of time.

Usually, these parts kits have to be changed either periodically every 6 months, 1 year or 2 years. Not based on the number of hours the ventilator has been working.

The biomedical department should be aware of the kits that need to be replaced based on the working hours. Usually, these are overlooked if the technician is not aware of them.

## **Fans and Fan Filters in the Respirator/Ventilator**

Fans are vital for any electronic device as they are responsible solely for keeping the heat generated by various electronics parts away. Thus making sure that such electronic parts are not defected due to overheating.

So making sure that the fans are working is a very important preventive measure. That can prevent the defect or failure of usually expensive electronic boards.

Moreover, some filters are used especially to fans that are placed at the sides or rear parts of the ventilator. These fans get air from the outside surroundings to the inside of the machine to cool the internal electronics of the ventilator. These fans have an added filter that handles filtering dust



particles from entering the ventilator.

These filters, over time, accumulate dust to a certain extent that they are not allowing proper airflow. So such a filter needs to be either cleaned or replaced based on the condition of that filter. Surely if you find a tear in the filter then a replacement is needed. usually, these filters are standard for most ventilators and even the fans are standard as well, so replacing them would not be a problem.

### **Exterior Cleaning of the Artificial Ventilator**

This step can be performed by the staff using the ventilator and not the biomedical technician. But you, as a Biomed, need to make sure that the cleaning procedure that is recommended by the manufacturer is being applied. And that if there is any standard procedure that the hospital or clinic recommends to be applied as well.

### **Inspiratory Manifold and Exhalation Valve and Sensor in the Respiratory Machine**

In the case that a ventilator operator has forgotten to connect the bacterial filter or viral filter. Then these parts need to be removed cleaned sterilized and then be returned back to the ventilator. This process is time-consuming! So making surer that best practices are applied saves effort and money while maintaining the best patient safety standards.

The steps of removing, cleaning, sterilizing and reinstalling these parts vary between models. Thus it is best to follow

the manufacturer service manual to ensure best practices.

## Fuses in the Ventilator

Any electronic device has fuses that mounted to protect sensitive electronic boards from electrical surges that might lead to defective parts. Fuses don't need to be replaced unless they are blown or damaged. Sometimes there is an accumulation of carbonation at the sides of the fuse. In this case, you can clean the carbonation and apply an electric contact grease that will enhance electric transmission and prevent future carbonation on the fuse.

## Software Updates



Software Update!

Software updates are an important part of the PPM. Often times software updates resolve some bugs and reduce hardware problems as well! Always make sure that your ventilator is working on the newest version of the software released by the manufacturer.

We can't stress this enough! In many cases, there are

added features in the new software. In other cases, the hardware performance improves with software updates.

Always look for software updates as usually, the newer software resolved some of the problems discovered in the older software.

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