Session 5

Suction Pumps

COVID-19 Preparation for Biomedical Professionals
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ECHO Etiquette

• Foundation of love and respect - respond kindly rather than react if you disagree
• It is everybody’s responsibility to keep ECHO a safe space
• Test your equipment ahead of time
• **Mute your microphone** when not speaking
  • Bottom left corner of your screen
• Remember to **unmute before speaking**
• Introduce yourself before speaking
• Speak clearly, and stay close to your microphone
• IT issues? Send a message through chat/email.
  • AssistHTM@assistinternational.org
<table>
<thead>
<tr>
<th>Time Allotted</th>
<th>Topic</th>
<th>Presenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 minutes</td>
<td>Didactic – Suction Pumps</td>
<td>Dr. Masreshaw/Guna</td>
</tr>
<tr>
<td>15 minutes</td>
<td>Preventive Maintenance on Suction Machines</td>
<td>Benedicto</td>
</tr>
<tr>
<td>10 minutes</td>
<td>Discussion</td>
<td>All</td>
</tr>
</tbody>
</table>
What’s so dangerous about COVID-19?

The virus is stable for long periods of time on surfaces and in aerosols. According to a study from experts at the National Institute of Health, the Center for Disease Control, UCLA, and Princeton University the virus is detectable:

- In aerosols for up to 3 Hours
- On copper for up to 4 Hours
- On cardboard for up to 24 Hours
- On plastic and stainless steel for up to 3 Days

Session 1 Summary

How do we keep our hospitals and equipment virus-free?

PPEs needed include:

- Single use gloves
- Disposable or washable gowns
- Single use caps/hats
- Single use shoe covers
- N95 Respirators
- Eye goggles/face shields

High level disinfectants use products that include one of the following:

- 2% glutaraldehyde
- 6% hydrogen peroxide
- 0.2% peracetic acid
- 7% accelerated hydrogen peroxide
- 0.55% ortho-phthalaldehyde (OPA)

GLOVES AND PPEs DO NOT REPLACE HAND HYGEINE

1. **EVERYONE** should practice basic hygiene and social distancing.

2. In hospital settings, **CLINICIANS** and **BIOMEDICAL PROFESSIONALS** should adopt the following, in addition to standard procedures:
   - Increased frequency of basic hygiene like handwashing
   - Increased use of personal protective equipment to protect against droplet and airborne infections, such as respirators and face masks
   - Increased frequency of equipment disinfection

3. The virus can last up to three days on some surfaces, so be sure to use proper disinfectants (as recommended by the CDC or WHO) and to autoclave materials at high enough temperatures/for long enough.
Resources

• For more information about the specifications for equipment/PPE needed to manage cases of COVID 19, see the WHO Operational Support & Logistics Disease Commodity Packages, COVID-19 v4, Updated March 6, 2020

• On ventilators –
  • If you need guides or service manuals on ventilators, try visiting the Ventilator Training Alliance webpage.
Objectives

By the end of this refresher module, the participants will recollect:

• Fundamental background such as main parts/function and working principles
• How to perform preventive maintenance
• Basic troubleshooting and corrective maintenance for suction pumps

Clinical attachment yields better experience for trainees to train other BMETs in the future.
INTRODUCTION
**Suction;** the flow of a fluid into a partial vacuum, or region of low pressure.

- Sucking on a straw – we create a lower pressure inside our mouth, so the water is pushed in from outside.
- Vacuum cleaning – we create a lower pressure inside the vacuum cleaner, so the air from outside rushes in to the region of lower pressure – taking with it bits of dirt.
- Dust being "sucked" into a vacuum cleaner is actually being pushed in by the higher pressure air on the outside of the cleaner. The higher pressure of the surrounding fluid can push matter into a vacuum but a vacuum cannot attract matter.
Specifications from WHO

• Portable suction devices / aspiration pumps used to evacuate secretions and liquids from the nasal cavity or from high airways.
• Devices capable to resist high level disinfection procedures.
• Aspiration pumps are varied in vacuum level and flow capacity.
• Anti-bacterial filter and containers should be available, if applicable.

Applications

• Removing fluid from a patient
• Assisting patients with internal bleeding
• Removing excess fluid during dentistry
• Removing excess fluid during surgery
Suction Pumps

MAIN PARTS & THEIR FUNCTION
Main components

1. Antibacterial filter
2. Silicone tubes 8 x 14 mm
3. LED indicator (if present)
4. Pressure Gauge (Vacuum meter)
5. On/off switch
6. 1000 cc Jar
7. Adjustment knob
The Suction System

From the Patient

To the Collection bottle

Through a vacuum regulator

To the suction device
Examples of Typical Suction Systems
Seven Types of Suction Pumps

1. Diaphragm Pumps
2. Piston Pumps
3. Peristaltic Pumps
4. Rotary Vane Suction Pumps
5. Thermotic Drain
6. Centrifugal Suction Pump
7. Venturi Suction
1. Diaphragm Pump

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Cylinder Head</td>
</tr>
<tr>
<td>B</td>
<td>Valve Flapper</td>
</tr>
<tr>
<td>C</td>
<td>Diaphragm</td>
</tr>
<tr>
<td>D</td>
<td>Connecting Rod Assembly</td>
</tr>
<tr>
<td>E</td>
<td>Pump Bearing</td>
</tr>
</tbody>
</table>
1. Diaphragm Pump

1) Diaphragm
2) Head cover
3) Housing
4) Connecting rod
5) Suction chamber
6) Valves
1. Diaphragm Pump: Check Valves

- A lot of suction devices do not produce suction continuously. They may only produce suction for half of their cycle.
- To ensure that the suction produced is not lost during the other half of the cycle, check valves are used.
- A check valve – also known as a non-return valve or one-way valve - allows fluid to flow in only one direction.
- The symbol for a check valve is as follows:
1. Diaphragm Pump: Check Valves

- Check valves come in many different types – but they are usually small, simple and inexpensive, and hence usually quite reliable.
- Our heart uses check valves to ensure that the pumped blood doesn’t flow backwards through the heart.
- Here are some types of check valves:
1. Diaphragm Pump

• A **Flapper Valve** opens and shuts from one hinged side.
• These are commonly used in diaphragm suction pumps because of their relatively small size.
• The movement of the air is what makes the valves operate.
1. Diaphragm Pumps

• There are different types of diaphragms that can be used, as shown in the figure to the right.
2. Piston Pumps

- A piston is used to generate suction
- The suction is sustained by the use of check valves
3. Peristaltic Pumps

- These pumps use the same method that we use for swallowing food.
- This type of pump can be used for liquids as well as sludge – the pump mechanism never comes in contact with the material being pumped.
3. Peristaltic Pumps

• A shaft with lobes rotates and squeezes a tube – which then moves the fluid along the tube.
3. Peristaltic Pumps

• A shaft with lobes rotates and squeezes a tube – which then moves the fluid along the tube.
4. Rotary Vane Suction Pump

• This is also a very common type of suction device found in hospitals.
• It uses an electric motor to turn an off-center rotor which is fitted with vanes that move to suit the cavity.
4. Rotary Vane Suction Pump

- The rotor is mounted off-center so that when it rotates, the vanes produce different sized cavities
- This creates low pressure parts and high pressure parts
- The low pressure produces suction, which is then pushed out through the outlet
- By design they do not require check valves
4. Rotary Vane Suction Pump

CAUTION:

• In typical medical applications, this pump is vulnerable to unwanted intake of fluid.
  • For example, this can happen if someone hooks up the collection bottle backwards.

• If fluid goes in to the pump then it will seize – either damaging the motor or blowing a fuse.
  • If the fuse blows – it can be simple to repair.
  • If the motor burns out – then it is more costly and difficult.
5. Thermotic Drain

• These are relatively common for wards that perform gastric procedures.
• GOMCO is the most common brand
• These have no moving parts – can be very reliable
• Caution – the device can be damaged if fluid enters chamber
6. Centrifugal Suction Pump

• Uses a motor to spin a rotor, which provides areas of low pressure and high pressure.
• Not so common in hospitals
7. Venturi Suction

• Venturi suction pumps make use of the Venturi Effect to generate suction.

• In a Venturi Pump, fluid (liquid or gas) flows through a tube which then narrows. When the tube narrows, the fluid's speed increases, and because of the Venturi Effect, its pressure decreases. Vacuum is taken from this point.
7. Venturi Suction

- Can be used in a hospital setting when compressed air is available
Recap: Seven Types of Suction

• Most require electric motors, including:
  • Diaphragm,
  • Piston,
  • Peristaltic,
  • Rotary Vane and
  • Centrifugal

• Some have no moving parts, except for valves. These are:
  • Thermotic and Venturi

• Venturi needs compressed air but requires no electricity

If maintained properly, most of the suction devices can work for many years.

Most maintenance involves inspection, cleaning and lubrication.
Suction Pumps

WORKING PRINCIPLES
Some Useful Conversions

• 1 inch = 25 mm; therefore,

\[
\begin{array}{cccccccccccc}
\text{kPa} & \text{bar} & \text{psi} & \text{kgf} / \text{cm}^2 & \text{mmH}_2\text{O} & \text{inH}_2\text{O} & \text{ftH}_2\text{O} & \text{mmHg} & \text{inHg} & \text{torr} \\
\hline
\text{kPa} & \text{bar} & \text{psi} & \text{kgf} / \text{cm}^2 & \text{mmH}_2\text{O} & \text{inH}_2\text{O} & \text{ftH}_2\text{O} & \text{mmHg} & \text{inHg} & \text{torr} \\
100,000 & 14,5039 & 1.01972 & 101.972 & 4.01463 & 0.33455 & 7.50064 & 0.29360 & 7.50064 \\
6.89476 & 0.06895 & 0.07031 & 703.070 & 27.6799 & 2.30666 & 51.7151 & 2.03602 & 51.7151 \\
98,0665 & 0.98067 & 14.2233 & 10000.0 & 393.701 & 32.6084 & 735.561 & 28.8590 & 735.561 \\
0.00981 & 0.00010 & 0.00142 & 0.00010 & 0.03937 & 0.00328 & 0.07356 & 0.00290 & 0.07356 \\
0.24909 & 0.00249 & 0.03613 & 0.02654 & 25.0000 & 0.08333 & 1.66833 & 0.07356 & 1.66833 \\
2.98907 & 0.02989 & 0.43353 & 0.03048 & 304.600 & 12.0000 & 22.4199 & 0.88267 & 22.4199 \\
0.13332 & 0.00133 & 0.01934 & 0.00136 & 13.5951 & 0.53524 & 0.04460 & 0.03937 & 1.00000 \\
3.38639 & 0.03386 & 0.49115 & 0.03453 & 345.316 & 13.5951 & 1.13292 & 24.4001 & 25.4001 \\
0.13332 & 0.00133 & 0.01934 & 0.00136 & 13.5951 & 0.53524 & 0.04460 & 0.03937 & 1.00000 \\
\end{array}
\]
Suction Circuits

• Suction is equal at all points in the circuit where the fluid is able to travel freely
  • Ex: If a tube has a leak at one point, then the suction will be less everywhere in the circuit, not just where the leak is
  • This is a key principle when troubleshooting suction equipment
  • Once suction is generated, it will remain until fluid is allowed to move – either through a tube, or valve or a leak
Suction Pumps

KEY CLINICAL USER ERROR
Key Clinical User Error - Overflow

• Once the suction pump is running, it will start to take liquid from the patient (blood, water, lymphatic fluids etc...) through the system; this can cause a number of problems including:
  • Transfer of disease,
  • Blockages
  • Damage to the pump
  • Overflow

• For this reason, it is necessary to keep all suction devices separated from the patient fluids

How do we do this?
Collection Bottles

How do we prevent overflow and keep our suction pump separate from patient fluids?

• We use a collection bottle, such as the one pictured to the right.

This contains fluids safely, and has protections against many of the problems associated with the process of removing liquids from a patient - contamination, blockages, and overflow.
Collection Bottles

• Collection bottles may be disposable, or re-usable. Re-usable will typically be glass or good quality plastic. This is because they need to be able to withstand the high temperatures and/or chemicals used during sterilization.

• Need to be careful - they may look the same! But try putting a disposable one in the steriliser and it could melt or catch fire.
Protections in Collection Bottles

- What happens if the collection bottle fills up?
- Collection bottles have a method for protecting the suction device.
- **Before we see a real one - have a try yourself at designing a protection method...**
Measuring Suction

• There are various types of gauges for measuring suction
  • Most will show suction in mmHg. (can also be measured in PSI, Inches of Hg or kPa)
  • This refers to how far up a tube that the suction will pull mercury (Hg)
2.6
PREVENTATIVE MAINTENANCE
Preventive Maintenance

Preventive Maintenance is necessary to:

• Reduce the risk of injury (to patient, staff or visitors) or the risk of significant adverse impact on patient care.
• Decrease equipment life-cycle costs.
• Avoid operational difficulties.
• Comply with codes, standards and regulations.
Test tools & Cleaning materials

• Safety analyzer
• Digital pressure meter or pressure gauge
• Multimeter
Preventive Maintenance

The PPM (planned preventive maintenance) procedure can be divided into the following tasks:

• **Qualitative Task/Physical Inspection**
  • Visible test and Cleaning

• **Electrical Safety Test**
  • Verify the electrical safety of the system

• **Performance Verification Test**
  • Verify that it performs as per its design parameters.
Visible Test

• Ensure that the electrical plug and cord are in good condition.
• Check the collection bottle/jar for cracks, chips, and other damage.
• Check that the float valve moves freely.
• Insure that anti-static tubing is used.
Cleaning

For collection bottles and tubing:

- Clean the outer surface of equipment using a soft cloth dampened with a nonabrasive cleaner.

- Remove the collection bottle to check if it is single use:
  - If it IS **single use** – dispose of them properly, according to your facilities procedure
  - If it is **re-useable**, clean using proper disinfectants and sterilize in an autoclave them according to manufacturer recommendation
Cleaning

• Clean air intake filters.
• Use a solution of water, detergent, and disinfectant to sterilize jars, tubing, and other components that come into contact with patient fluids.
• Change bacteria filter if wet or discolored. Make sure there is a sufficient supply of bacterial filters.
• Clean brushes on motors as necessary.
Electrical safety test

Electrical safety test for suction pumps:

• Some suction devices are Class I device some are class II. This depends on the manufacture’s design.

Grounding resistance between chassis and ground pin should not exceed 0.3 ohms.
Maximum chassis leakage current with ground wire disconnected should not exceed 300 microamps.
## EST checklist

<table>
<thead>
<tr>
<th>Description</th>
<th>UOM</th>
<th>Set values</th>
<th>Measured values</th>
<th>Limit/Tolerance</th>
<th>Pass</th>
<th>Fail</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Voltage L-N</td>
<td>Vac</td>
<td>-</td>
<td></td>
<td>10%</td>
<td></td>
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<tr>
<td>Device Current</td>
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<td>-</td>
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<tr>
<td>Earth/Ground wire resistance</td>
<td>Ω</td>
<td>-</td>
<td></td>
<td>&lt;0.3Ω</td>
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<td></td>
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<tr>
<td>Insulation test (optional)</td>
<td>MΩ</td>
<td></td>
<td></td>
<td>&gt;2MΩ</td>
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<tr>
<td><strong>Earth Leakage Current</strong></td>
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<tr>
<td>1. Normal Condition</td>
<td>uA</td>
<td></td>
<td></td>
<td>&lt;500 uA</td>
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<tr>
<td>2. Open Neutral</td>
<td>uA</td>
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<td></td>
<td>&lt;1000 uA</td>
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<tr>
<td>3. Open Neutral- Reversed Mains</td>
<td>uA</td>
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<td>&lt;1000 uA</td>
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<tr>
<td>4. Normal Condition- Reversed Mains</td>
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<td>&lt;500 uA</td>
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<tr>
<td><strong>Enclosure Leakage Current</strong></td>
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<td>1. Normal Condition</td>
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<td>&lt;100 uA</td>
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<tr>
<td>2. Open Earth</td>
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<td>&lt;500 uA</td>
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<tr>
<td>3. Open Neutral</td>
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<td>&lt;500 uA</td>
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<tr>
<td>4. Open Neutral- Reversed Mains</td>
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<td>&lt;500 uA</td>
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<tr>
<td>5. Normal Condition- Reversed Mains</td>
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<td></td>
<td>&lt;100 uA</td>
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<tr>
<td>6. Open Earth- Reversed Mains</td>
<td>uA</td>
<td></td>
<td></td>
<td>&lt;500 uA</td>
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</table>
Performance Verification Test

• Test the suction pump’s performance using the **digital pressure meter** or negative pressure gauge.

• Compare reading between digital pressure meter and pressure gauge on suction pump.

• Sometimes the pressure gauge on the suction device will fail, but this will help to verify actual output from the test
Performance Verification Test

• Ensure that the vacuum works over the full range of suction pressures if there is a control/knob. Measure and record vacuum.
• Verify that overflow valve (float valve) works properly when container is filled with water.
• Check for unusual noises or vibration in motor/pump.
• Check for evidence of fluid spills. Clean any spills as necessary.
Testing with a DPM
## Suction Pump Checklist

Tick (V) where appropriate

<table>
<thead>
<tr>
<th>Description</th>
<th>UOM</th>
<th>Set values</th>
<th>Measured values</th>
<th>Gauge Reading</th>
<th>Limit/Tolerance</th>
<th>Pass</th>
<th>Fail</th>
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<tbody>
<tr>
<td>1. Suction output</td>
<td>mmHg</td>
<td>Max</td>
<td></td>
<td></td>
<td>&gt;500mmHg</td>
<td>(</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Low setting suction</td>
<td>mmHg</td>
<td>Min</td>
<td></td>
<td></td>
<td></td>
<td>(</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Suction Pressure can Adjust</td>
<td></td>
<td></td>
<td>N/A</td>
<td></td>
<td>Tick if yes</td>
<td>(</td>
<td></td>
<td></td>
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</tbody>
</table>
2.7 TROUBLESHOOTING & MAINTENANCE
Common Problems

- Leakage in the circuit
- Pump isn’t creating enough negative pressure
- Collection bottle overflows to the pump (float valve)
- Pump fails to work
- Pump is working but not producing pressure (no leakage)
- Unable to turn the unit on
Common Problems

Most common: Clogs, Leaks, Motor Failure

- Leaks:
  - Tube leak
  - Jar/lid leak (bad O-ring, possibly)
- Tube blockage or kink
- Missing/damaged parts:
  - Bad motor
  - Bad power supply
  - Missing/damaged collection bottle
  - Missing/damaged filter
  - Clogged bacterial filter
Common Problems

• Float valve closes air pathway with full collection jar
• Insufficient pressure/suction
• Ventilation grill obstructed
• Suction control knob is set to a low setting
• Diaphragm needs cleaning or replacing
• Brushes need cleaning
• Motor needs lubrication
Common Problems

Overflow:
Protection device prevents fluid from getting into this tubing.

Protection Device:
Motor with pump
Vacuum Gauge

Bodily Fluids... yuck!
Common Problems

- Blown fuse
- Transformer failure
  - Solution: rewind the transformer and replace the fuse and test.
Inside parts

- Motor
- Air intake from collection container
- Vacuum gauge
- Vacuum regulator
- Electrical input receptacle
- Air intake to pump
- Air exhaust from Pump
- Grounding ribbon
- Grounding plate
Power Supply

- Power Distribution Board
- Power Supply
- Battery
The following are procedures should be taken during planned preventive maintenance (PPM) of suction machine:

- Physical inspection
- Electrical Safety Check
- Performance check
Physical inspection

Physical inspection involves checking of all physical conditions of the unit, such as:

- Unit housing or casing
- Power cord
- Change filters
- Bottle
- Tubes
- Cleanness
- etc.
PM Physical Inspection
Planned Preventive Maintenance (PPM) Checklist
Planned Preventive Maintenance Work

Accessories & Consumables

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Description</th>
<th>Pass/Fail</th>
<th>Not Available</th>
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<tbody>
<tr>
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<td>Check/func</td>
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<td></td>
</tr>
<tr>
<td>2</td>
<td>Misfit/leak</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Caster/brake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>AC plug</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Line cord</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Stein relief</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Fuse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Cable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Fitting/connector</td>
<td></td>
<td></td>
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<tr>
<td>10</td>
<td>Pump</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Control/switch</td>
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<tr>
<td>12</td>
<td>Indicator/display</td>
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<tr>
<td>13</td>
<td>Alarm</td>
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<tr>
<td>14</td>
<td>Label</td>
<td></td>
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<tr>
<td>15</td>
<td>Cleanliness</td>
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<td>16</td>
<td>Lubricate</td>
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<td>17</td>
<td>Safety</td>
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<tr>
<td>18</td>
<td>Lubricate</td>
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<tr>
<td>19</td>
<td>Battery</td>
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<td>20</td>
<td>Safety &amp; performance</td>
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<tr>
<td>21</td>
<td>Electrical safety test</td>
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<tr>
<td>22</td>
<td>Performance</td>
<td></td>
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</tr>
</tbody>
</table>

Planned Preventive Maintenance (PPM) Results:
- [ ] Safety relevant defects
- [ ] Defects which require repair and removed from service
- [ ] Defects corrected immediately
- [ ] Significant defects, this unit beyond feasible repair.

Remarks:
- [ ] Physical Inspection
- [ ] Passed

Evidence Attachment: (Physical Defect, if needed for exception incident)

Note:

Name of Technician/Engineer: [Signature]
Maintenance Date: 26/11/2019.
# PM Physical Inspection

## Planned Preventive Maintenance (PPM) Checklist

Planned Preventive Maintenance work:

<table>
<thead>
<tr>
<th></th>
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<td>Equipment/Instrumentation Description:</td>
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<td></td>
<td>26/11/2019 623</td>
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<tr>
<td>4</td>
<td>Department/Location:</td>
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</table>

Tick (✓) where appropriate:

## Planned Preventive Maintenance (PPM) Checklist

### Physically Inspection

<table>
<thead>
<tr>
<th></th>
<th>Pass</th>
<th>Fall</th>
<th>Not Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Chassis/Housing</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Mount/Fastener</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Caster/Brakes</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. AC plug</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Line Cord</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Strain relief</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Fuse</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Cables</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Fitting/Connectors</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Pump</td>
<td>✓</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>11. Control/Switches</td>
<td>Examine for controls and switches physical condition and free movement.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Indicator/Display</td>
<td>Examine for indicator/Display operational</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Alarm</td>
<td>Check audible alarm for indicator/Display operational</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Label</td>
<td>Check label legibility</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Internal Inspection</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Cleanliness</td>
<td>Clean interior and exterior of the equipment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Lubricate</td>
<td>Lubricate paper drive and recorder mechanism.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Battery</td>
<td>Check internal battery (Replace according manufacture requirement)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Performance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. Lubricate</td>
<td>Lubricate paper drive and recorder mechanism.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Battery</td>
<td>Check main external battery (Replace if required)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Safety Test &amp; Performance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20. Electrical Safety Test</td>
<td>Perform EST as stated and required in IEC 60601.01 (refer to EST report).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21 Performance</td>
<td>Test according to Hospital Engineering Planned Preventive Maintenance (HEPPM) recommendation specification.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Planned Preventive Maintenance (PPM) Results:**

- [ ] No safety relevant defects
- [ ] Defects corrected immediately
- [ ] Effect which require repair and removed from service.
- [ ] Significant defects, this unit beyond feasible repair.
PM Physical Inspection (3/3)

Planned Preventive Maintenance (PPM) Results:
☐ No safety relevant defects
☐ Defects corrected immediately
☐ Defect which require repair and removed from service.
☐ Significant defects, this unit beyond feasible repair.

Remarks/ Status: (Physical Inspection) Notes:
Physical Inspection Passed

Evidence Attachment: (Physical Defect) If needed for exception of incident.

Notes:

Name of Technician/ Engineer: Gladys N Pete
Signature: [Signature]
Maintenance Date: 26/11/2019
Electrical safety
Electrical safety is the main important condition in Suction machine due to the hazards that can be caused by electric current.

Electrical Safety Analyzer is used to check the electrical safety of Suction machine.
Why are some fields blank?

This is a general checklist meant to cover most devices.

Since there are no patient leads, these fields are not applicable.
**Title: Planned Preventive Maintenance Performance Record**

**Protocol – Planned preventive Maintenance (PPM) Testing Checklist**

Planned Preventive Maintenance work.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
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<tr>
<td>1</td>
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<tr>
<td>2</td>
<td>Service Report No:</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Card No:</td>
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</tr>
<tr>
<td>3</td>
<td>Equipment/ Instrumentation Description:</td>
<td>Suction Machine</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Department/ Location:</td>
<td>OT</td>
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<td>5</td>
<td>Maintenance Date:</td>
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</tr>
<tr>
<td>6</td>
<td>Serial No:</td>
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<tr>
<td>7</td>
<td>Model:</td>
<td>0560</td>
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<td>8</td>
<td>Manufacturer:</td>
<td>SUGOBO</td>
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</tr>
</tbody>
</table>

---

### Quantitative Tasks

**Tick (v) where appropriate**

<table>
<thead>
<tr>
<th>Description</th>
<th>UOM</th>
<th>Set values</th>
<th>Measured values</th>
<th>Limit/Tolerance</th>
<th>Pass</th>
<th>Fail</th>
<th>N/A</th>
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<tbody>
<tr>
<td>Main Voltage L-N</td>
<td>V</td>
<td>-</td>
<td>280Vac</td>
<td>±10%</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
</tr>
<tr>
<td>Device Current</td>
<td>A</td>
<td>-</td>
<td>0.84A</td>
<td>-</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
</tr>
<tr>
<td>Earth/Ground wire resistance</td>
<td>Ω</td>
<td>-</td>
<td>&lt;0.3Ω</td>
<td>-</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
</tr>
<tr>
<td>Insulation test (optional)</td>
<td>MD</td>
<td>-</td>
<td>&gt;2MΩ</td>
<td>-</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
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<tr>
<td>500V/250VDC Earth Leakage Current</td>
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<td></td>
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<tr>
<td>1. Normal Condition</td>
<td>uA</td>
<td>-</td>
<td>13μA</td>
<td>&lt;5000 uA</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
</tr>
<tr>
<td>2. Open Neutral</td>
<td>uA</td>
<td>-</td>
<td>29μA</td>
<td>&lt;10000 uA</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
</tr>
<tr>
<td>3. Open Neutral - Reversed Mains</td>
<td>uA</td>
<td>-</td>
<td>08μA</td>
<td>&lt;10000 uA</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
</tr>
<tr>
<td>4. Normal Condition - Reversed Mains</td>
<td>uA</td>
<td>-</td>
<td>14μA</td>
<td>&lt;5000 uA</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
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<td>Enclosure Leakage Current</td>
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<tr>
<td>1. Normal Condition</td>
<td>uA</td>
<td>-</td>
<td>00</td>
<td>&lt;100 uA</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
</tr>
<tr>
<td>2. Open Earth</td>
<td>uA</td>
<td>-</td>
<td>00</td>
<td>&lt;500 uA</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
</tr>
<tr>
<td>3. Open Neutral</td>
<td>uA</td>
<td>-</td>
<td>00</td>
<td>&lt;500 uA</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
</tr>
<tr>
<td>4. Open Neutral - Reversed Mains</td>
<td>uA</td>
<td>-</td>
<td>00</td>
<td>&lt;500 uA</td>
<td>( )</td>
<td>( )</td>
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<tr>
<td>5. Normal Condition - Reversed Mains</td>
<td>uA</td>
<td>-</td>
<td>00</td>
<td>&lt;100 uA</td>
<td>( )</td>
<td>( )</td>
<td>( )</td>
</tr>
<tr>
<td>6. Open Earth - Reversed Mains</td>
<td>uA</td>
<td>-</td>
<td>00</td>
<td>&lt;500 uA</td>
<td>( )</td>
<td>( )</td>
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<tr>
<td>Patient Leakage Current (AP)</td>
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</table>
Performance test

Digital pressure meter is used to check the performance of suction machine. We use DPM4 which is used to measure air pressure to the equipments that is associated with pressure like suction and Oxygen Concentrator machines. It measures negative and positive pressure.

Suction output

High setting suction  
\[ > -500 \text{mmHg} \]

Low setting suction  
\[ < -50 \text{mmHg} \]
### Title: Planned Preventive Maintenance Performance Record

**Protocol – Planned preventive Maintenance (PPM) Testing Checklist**

**Planned Preventive Maintenance work.**

<table>
<thead>
<tr>
<th>1</th>
<th>Asset Code No:</th>
<th>5</th>
<th>Maintenance Date:</th>
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<tbody>
<tr>
<td>2</td>
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<td>Model:</td>
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<td>Suction Pump</td>
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<td>4400</td>
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<td>4</td>
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<td>8</td>
<td>Manufacturer:</td>
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<td>OPERATING THEATER</td>
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<td>SUGOBO</td>
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#### Quantitative Tests

<table>
<thead>
<tr>
<th>Test (H) where appropriate</th>
<th>Description</th>
<th>UOM</th>
<th>Min Value</th>
<th>Max Value</th>
<th>Units/Reference</th>
<th>Pass</th>
<th>Fail</th>
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<tr>
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<td>Suction output</td>
<td>mGpH</td>
<td>12</td>
<td>12</td>
<td>50</td>
<td>10</td>
<td>1</td>
<td>1</td>
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<tr>
<td>2</td>
<td>Line suction suction</td>
<td>mGpH</td>
<td>6</td>
<td>6</td>
<td>50</td>
<td>1</td>
<td>1</td>
<td>1</td>
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<tr>
<td>3</td>
<td>Section Pressure on Adjust</td>
<td>mGpH</td>
<td>12</td>
<td>12</td>
<td>50</td>
<td>10</td>
<td>1</td>
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</table>

#### Unit of Measurement

**Remarks/Status: (Performance report)**

**Performance Test Pass.**

**Test Equipment Used**

**Test Device:**

**Model:**

**Serial No:**

**Test Device:** DPN4 (Digital Pressure Meter)

### Signature

**Emmanuel C. Francis**

**Signature**

**Maintenance Date:** 26/11/2019
<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>UOM</th>
<th>Set values</th>
<th>Measured values</th>
<th>Limit/Tolerance</th>
<th>Pass</th>
<th>Fail</th>
<th>N/A</th>
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<tbody>
<tr>
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<td>Suction output</td>
<td>mmHg</td>
<td>Max</td>
<td>506 mmHg</td>
<td>&gt;500 mmHg</td>
<td>✓</td>
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<tr>
<td>2</td>
<td>Low setting suction</td>
<td>mmHg</td>
<td>Min</td>
<td>5 mmHg</td>
<td></td>
<td>✓</td>
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<tr>
<td>3</td>
<td>Suction Pressure can Adjust</td>
<td>N/A</td>
<td>Tick if yes</td>
<td>✓</td>
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<td>UOM = UNIT OF MEASUREMENT</td>
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<td>Performance Test Passo.</td>
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<tr>
<td>Name of Technician/ Engineer</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Emmanuel C Francis</td>
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<td>Signature</td>
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<td>Maintenance Date</td>
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<td>26/11/2019</td>
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</tr>
</tbody>
</table>
COMMON PROBLEMS ASSOCIATED WITH SUCTION MACHINE

- **Machine doesn’t turn on**
  - No power at socket outlet
  - Power cord is broken or damaged
  - Issue with on/off switch
    - Faulty Switch
    - Disconnected wires
  - PC Board
    - Damaged
    - Loose Connector
Low or No Suction output
This problem can be caused by;

- Filters may be blocked and need replacement
  - Check fluid Filter
- Suction bottle leakage
- Pump failure
- Disconnection /misconnection of tubes
Poor handling
Poor handling may cause;
- Suction bottle breakage
- Power cables breakage
- Tires breakage

User error
User error can be caused by;
- Lack of training
- Over confidence
THANK YOU!

FIGHT AGAINST COVID-19
Discussion

Feel free to speak up or use the chat function so that our moderators can speak for you!