The Republic of Uganda

Ministry of Health

HEALTH INFRASTRUCTURE DEPARTMENT

Operation Manual for Regional Medical Equipment Maintenance Workshops and Medical Equipment Maintenance Guidelines

Volume IIa

Standard Operating Procedures for carrying Planned Preventive Maintenance on Commonly used Medical Equipment and Hospital Plants in Health Facilities in Uganda

August 2020

LIST OF MEDICAL EQUIPMENT AND HOSPITAL PLANTS COVERED

FOREWORD

The mission of the Ministry of Health is "to provide the highest possible level of health services to all people in Uganda through delivery of promotive, preventive, curative, palliative and rehabilitative health services at all levels". In pursuit of the above mission, government ensures that healthcare services are delivered in an efficient, safe and cost-effective manner.

In the delivery of healthcare, medical equipment plays an important role in diagnosis of diseases and treatment of patients. To ensure that available medical equipment is safe and serves for a long time, it must be properly maintained to guarantee its reliability and the quality of healthcare delivered to patients.

In order to enhance patient safety and cost-effective management of medical equipment, the Ministry of Health has developed SOPs for carrying out preventive maintenance on medical equipment and hospital plants. The SOPs will enable standardization of maintenance procedures and enhance patient safety. Additionally, the SOPs for carrying out PPM on medical equipment will enable the Engineers and Technicians to maintain high level of consistency, equipment uptime and reliability.

The SOPs will be prepared in several volumes to enable the MoH cover more equipment as resources become available over time. Each volume will cover a specific number of equipment starting with the most commonly used equipment in our healthcare facilities across the country. Volume IIa covers 31 commonly used medical equipment and hospital plants.

Special recognition goes to Mr. Naoki Mimuro, Eng. Sitra Mulepo C.S and Eng. Owen Muhimbise for their dedication and effort to ensure that the first set of SOPs are prepared for 31 commonly used equipment in healthcare facilities in Uganda.

I equally extend my appreciation to the staff of the Health Infrastructure Department, Regional Medical Equipment Maintenance Workshops and Members of the National Advisory Committee on Medical Equipment (NACME) for their oversight role during the process of preparing the SOPs.

I am honoured to sign the Foreword for the first volume of the SOPs and implore the Engineers and Technicians to adhere to the requirements of the SOPs while carrying out preventive maintenance on the medical equipment and hospital plants.

Dr. Henry Mwebesa
Director General for Health Services

Important Definitions

For purposes of this document, the following terms shall have the following meaning:

Competent Personnel: This is an Engineering professional with Electromechanical Engineering knowledge, practical skills and biomedical engineering values to maintain medical equipment and hospital plants; and who has authorization to take corrective measures to eliminate equipment malfunction in a health facility.

Engineer: This is a professional with a Bachelor's Degree in any of the following Engineering Disciplines: *Electrical, Mechanical, Telecommunication or Biomedical/Hospital/Clinical Engineering.*

Health Infrastructure Department (HID): This is a Department of the Ministry of Health, with the mandate to oversee the development of health infrastructure (including medical equipment and hospital plants) and preparation of policy guidelines to ensure their proper operation and management (including their maintenance).

Job Card: This is a form used to prepare a summarized description of the maintenance work performed on a specified equipment or electromechanical system including the materials used and final status of the work.

Personal Protective Equipment (PPE): This is the collective term of wearable equipment and gear that is meant to protect engineers and technicians from occupational hazards.

Planned Preventive Maintenance (PPM): This refers to regular safety and performance inspection carried out on equipment to evaluate risk and reduce failure so as to enhance its performance, efficiency and reliability.

PPM Check sheet/list: This is a document that describes the tasks that have to be undertaken while carrying out PPM on a specific equipment**.**

Standard Operating Procedures (SOPs): This is a set of instructions compiled by HID/MoH to enable Engineers and Technicians carry out specific routine maintenance task on equipment. *SOPs* aim to achieve efficiency, quality output and uniformity in the performance of maintenance tasks on equipment.

Technician: A professional with a Diploma or Certificate in any of the following Engineering Disciplines: *Electrical, Mechanical (including Refrigeration and Air Conditioning, Plumbing, Metal Fabrication and Fitter Mechanics), Telecommunication or Biomedical/Hospital/Clinical Engineering.*

Objectives of Preparing Standard Operating Procedures

The specific objectives of having the SOPs for carrying out PPM on medical equipment are:

a) To ensure patient safety and equipment reliability through proper equipment maintenance.
b) To standardize preventive maintenance procedures and ensure high level of consistency in the implementation of preventive maintenance on medical equipment and hospital plants.
c) To enhance the safety of the maintenance Engineers and Technicians.

General Operation, Procedural and Safety Guidelines

During implementation of PPM activities, the RW Engineers and Technicians will adhere to the following general operational procedures:

1) Before commencing the PPM activity, inform and agree with the facility In-Charge and users about the scheduled PPM. Power supply to the equipment shall never be disconnected without the knowledge of the In-Charge and equipment user. This is aimed at minimizing disruption of services, wastages (of samples, reagents) and ensuring proper planning for alternative options where necessary. This is both an operational and safety procedure.
2) Before commencing any maintenance work on a medical equipment, the Engineer/Technician must wear appropriate PPE for the attendant work environment and risk factors. This is a safety procedure while executing PPM.
3) Equipment shall be disinfected before carrying out any maintenance on it. Appropriate disinfecting agents shall be used using the recommended dilution ratio/concentration by the manufacturer of the equipment. This is a safety procedure while executing PPM for all medical equipment.
4) Functional tests shall be carried out with the equipment user who will ascertain that equipment is fully functional before signing the Job card to confirm the work done and final equipment condition.
5) The SOP shall be revised every five years and whenever deemed very necessary to ensure quality assurance and safety for the patient, user and equipment itself.

STANDARD OPERATING PROCEDURE FOR CARRYING OUT PREVENTIVE MAINTENANCE ON A BLOOD PRESSURE MACHINE (MERCURY, ANEROID & DIGITAL)

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on a *Blood Pressure (BP) Machine* to keep it in a safe working condition.

2. Definitions/Acronyms

- BP: Blood pressure
- NiBP: Non-Invasive Blood Pressure
- SOP: Standard operating procedures
- PPM: Planned Preventive Maintenance

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on BP Machine. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on a *BP Machine*. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Manager is responsible for ensuring that competent personnel under her/him use and comply to this procedure to carry out PPM on a *BP Machine*. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and test results obtained to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools

1) Complete electromechanical toolkit
2) Multimeter

3) Secondary standard gauge or NiBP simulator
4) Brush

Supplies
1) Alcohol Pad with 70% Alcohol or 0.5% bleach
2) Liquid Soap
3) Gauze

Required Parts
1) Cuffs (all types)
2) Inflating bulbs (all sizes)
3) Control valves
4) Dry cells (recommended types)
5) Mercury
6) Mercury column

6. Procedure

This procedure is for the recommended PPM to be carried out on a *BP Machine* as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on a *BP Machine.*

6.1 Safety procedure
1) Wear necessary PPE
2) Disinfect equipment with 70% alcohol

6.2 PPM Procedure

1) Carry out physical inspection of different parts of the equipment
2) Check for air and/or mercury leakages
3) Check the mercury level where applicable
4) Zero the pointer and check its movement
5) Check the status of dry cells/battery where applicable

6.3 Functional test/Calibration

1) Inflate and deflate the BP machine at least three times and confirm that the pointer always comes back to Zero.
2) Connect the secondary standard pressure gauge or NiBP simulator to the BP machine under test and compare the readings after inflating. Tolerance limit is ± 3mmHg.

7. Maintenance Check sheet/List

PPM Check sheet for BP Machine			
Health Facility Name:			
Date:			
Description of procedure	**Pass**	**Fail**	**Remarks**
1.0 Physical inspection			
1.1 Check the BP Machine general cleanliness			
1.2 Check for the condition of the bulb			
1.3 Check for the condition of the cuff			
1.4 Check for the condition of the tubing			
1.5 Check for the condition of the pointer			
1.6 Check and clean the battery/cell terminals			
2.0 Planned Preventive Maintenance			
2.1 Clean any dust on the outside/inside of the equipment			
2.2 Tighten all loose parts			
2.3 Replace leaking bulb, cuff or tubing			
2.4 Balance/Zero the pointer			
3.0 Functionality Tests			
3.1 Confirm that the pointer always returns to zero after inflating and deflating the BP machine.			
3.2 Compare the BP machine reading with that given by the secondary standard pressure gauge or NiBP simulator.			
3.3 Check the cell voltage			
4.0 Documentation			
4.1 Prepare a job card			
4.2 Attach a service sticker			
PPM carried out by: Name: Contact: Sign:	Date:		
Verified By: Name: Contact: Sign:	Date:		

8. Revision History

Version Number	Version Date	Section and description of changes made	Name of Authorizing Authority
2020/04/1		First release	ACHS(BEMS)

9. References and Related Documents

- UNDP GEF Global Healthcare Waste Project: Guidance on Maintaining and Calibrating Non-Mercury Devices
- Jorge Emmanuel, PhD Chief Technical Advisor, with input from Peter Orris, MD, Megha Rathi, PhD, and Shanthi Mendis, MD UNDP GEF Project July 2013 *World Federation of Societies of Anaesthesiologists*
- Maintenance of a Mercury Sphygmomanometer by Mr. Mike Yeats Derriford Hospital, Plymouth, UK.

10. Acknowledgements

This SOP was developed by Engineers and Technicians from the MoH and RWs. The following persons were major contributors in the development of this SOP.

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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON A STETHOSCOPE

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on a **Stethoscope** to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: Standard operating procedures
- PPM: Planned Preventive Maintenance.
- PPE: Personal Protective Equipment
- HID: Health Infrastructure Department
- BME: Biomedical Engineer
- AEO: Assistant Engineering Officer
- STP: Stethoscope

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on a Stethoscope. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on a Stethoscope. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Manager is responsible for ensuring that competent personnel under her/him use and comply to this procedure to carry out PPM on a Stethoscope. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results to obtained to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools
1) Retractable Knife
2) Flexible wire of a smaller diameter

Supplies
1) Gauze
2) Mild soapy water
3) Clean water
4) Isopropyl alcohol 70%

Required parts
1) Ear pieces
2) Diaphragm

6. Procedure

This procedure is for the recommended full PPM to be carried out on a stethoscope as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on a stethoscope:

6.1 Safety Procedure

1) Notify and agree with facility in-charge about the PPM.
2) Wear appropriate PPE
3) Disinfect appropriate parts.

6.2 PPM Procedure

1) Perform a physical inspection on the external part.
2) Replace any worn-out parts (e.g. earpieces, tubing, and diaphragms)

6.3 Electrical Safety Test

Not applicable

6.4. Functional Test

1) Softly tap on the diaphragm with the earpiece on the ear to ascertain sound transmission and functionality.

7. Maintenance Check Sheet/List

PPM Check sheet for Stethoscope			
Health Facility Name:			
Date:			
Description of procedure	**Pass**	**Fail**	**Remarks**
1.0 Physical inspection			
1.1 Check for any physical damage on the stethoscope (i.e. earpieces, binaural spring, tubing, bell and diaphragm.)			
2.0 Planned Preventive Maintenance			
2.1 Clean any dirt from sound holes in the earpiece			
2.2 Replace any worn-out parts e.g. earpieces, tubing and diaphragms.			
3.0 Functionality Tests			
3.1 Put on the ears and tap softly on the diaphragm to ascertain the functionality			
4.0 Documentation			
4.1 Prepare a job card			
4.2 Attach a service sticker			
PPM carried out by: Name: Contact: Sign:	Date:		
Verified By: Name: Contact: Sign:	Date:		

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9. References and Related Documents

- MoH, Uganda, RWs Operational Manual and Maintenance Guidelines, 2013.

10. Acknowledgements

This SOP was developed by Engineers and Technicians from the MoH and Regional Medical Equipment Maintenance Workshops. The following persons were major contributors in the development of this SOP.

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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON REFRIGERATORS AND AIR CONDITIONERS

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on a Refrigerator and Air Conditioner to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: Standard operating procedures
- PPM: Planned Preventive Maintenance
- PPE: Personal Protective Equipment
- HID: Health Infrastructure Department
- BME: Biomedical Engineer
- MD: Managing Director
- AC: Air Conditioner

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM a Refrigerator and Air Conditioners (ACs). It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on a Refrigerator and Air conditioners. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Managers responsible for ensuring that competent personnel under her/him use and comply to this procedure to carry out PPM on a Refrigerator and Air conditioners. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results obtained to determine functionality of the equipment. This shall be in the form of a dully filled and signed Job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools

1) Refrigeration Tool kit (Pressure gauge, Gas leak detector, a set of screw drivers, a set of spanners, multimeter with temperature probe)
2) Blower
3) High pressure water pump
4) Electrical safety analyzer
5) Ladder
6) Extension cable
7) Brazing gun

Supplies

1) Cleaning materials (Condenser cleanser, soft brush, blower, hand gloves, liquid soap and gauze or cleaning cloths)
2) Alcohol 70%.
3) PPE
4) Lubricating and cleaning agents
5) Brazing rods

Required parts

1) Door gasket
2) Refrigerant gas
3) Filter dryer

6. Procedure

This procedure is for the recommended full PPM to be carried out on refrigerators and Air conditioners as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on Refrigerators and ACs.

6.1 Safety Procedures

1) Inform the facility in-charge about PPM on the equipment.
2) Wear appropriate PPE
3) Disconnect Refrigerator/AC from power.
4) Remove supplies from the Refrigerator where necessary.
5) Disinfect Refrigerator/AC using 70% alcohol or other recommended nonaggressive disinfecting agents.

6.2 PPM Procedure

1) Carry out physical inspection on equipment (door hinges, door gaskets, power cord, missing screws, nuts and body corrosion)
2) Clean the condenser, evaporator and fans using a soft brush, blower and condenser cleanser.
3) Clean condensate drainage pipe and its tray; and all internal parts of the fridge.

4) Check and clean door gaskets/seals using a recommended cleaning agent. Close the fridge door on a small piece of paper. If you can pull it out very easily, then the seal is not effective and should be replaced.
5) Check refrigerant level if possible.
6) Check any refrigerant leaks in the system and close them appropriately.
7) Check and tighten electrical terminals, screws and bolts.
8) Clean temperature probes with a gauze.
9) Replace internal cover as may be necessary.
10) Load the refrigerator with removed supplies.
11) Top up refrigerant gas if necessary.
12) Position the refrigerator with a clearance of not less than 8 cm from all sides.
13) Place a spirit level on top of the fridge to verify that the fridge is level both front-to-back and side-to-side. Where applicable, adjust the fridge feet to ensure proper door movement and icemaker operation.
14) Close the doors of the refrigerator and connect to power.

6.3 Electrical Safety Tests

1) Electrical current leakage test and recording the value.
2) Electrical current consumption test and recording the value.
3) Electrical resistance test.
4) Voltage test.

6.4 Functionality Tests

1) Check high and low temperature settings. Adjust and set the appropriate temperature as may be applicable. Monitor set temperature using a temperature probe over 2 hours.
2) Check defrost system functionality (timer and heaters).
3) Check cut-out and cut-in temperature difference.

7. Maintenance Check Sheet/List

PPM Check Sheet for Refrigerators and ACs.			
Health Facility Name:			
Date:	__/__/__		
Description of Procedure	**Pass**	**Fail**	**Remarks**
1.0 Physical inspection			
1.1 Check for any physical damage on the Refrigerator/AC			
1.2 Check for damage on electrical power cord			
1.3 Check for missing screw, nut, bolt, etc.			
1.4 Check for any damage on door gasket/seals.			

2.0 Planned Preventive Maintenance			
2.1 Disinfect Refrigerator/AC			
2.2 Blow or clean any dust on outside/inside Refrigerator/AC			
2.3 Clean condensate drainage pipe and its tray			
2.4 Clean the condenser, evaporator and fans			
2.5 Clean door gasket/seal			
2.6 Check refrigerant level and possible leaks			
2.7 Lubricate all moving parts – door hinges			
2.8 Tighten all loose parts – nuts, screws, bolts			
2.9 Top up refrigerant gas as necessary			
2.10 Clean temperature probes			
2.11 Clean internal cover			
3.0 Electrical Safety Tests			
3.1 Check leakage current			
3.2 Check electrical resistance			
3.3 Check electrical insulation resistance			
3.4 Check that the supply voltage is as per recommendation			
4.0 Functionality Tests			
4.1 Performing equipment function test- zero balancing			
4.2 Set operation temperature and verify using standard thermometer			
4.3 Check defrost system (timer and heaters)			
4.4 Check cut-out and cut-in temperature difference			
5.0 Documentation			
5.1 Prepare a job card			
5.2 Attach a service sticker			

PPM carried out by:		Date: ……
Name:		
Contact:		
Signature:		
Verified By:		Date: ……
Name:		
Contact:		
Signature:		

8. Revision History

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9. References and Related Documents

- Refrigeration: A practical manual for mechanics second Edition by G. H. REED, F. Inst. R, MD Buchan Refrigeration Company, Worthing, UK.

10. Acknowledgements

This SOP was developed by Engineers and Technicians from the MoH and Regional Medical Equipment Maintenance Workshops. The following persons were major contributors in the development of this SOP.

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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON A SUCTION MACHINE

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on a **Suction Machine** to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: Standard operating procedures
- PPM: Planned Preventive Maintenance
- HID: Health Infrastructure Department
- MOH: Ministry of Health

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on a Suction Machine. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on a Suction Machine. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Manager is responsible for ensuring that competent personnel under her/him use and comply to this procedure to carry out PPM on a Suction Machines. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results to obtained to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools

1) Electrical safety analyzer
2) Aspirator Test kit
3) MultiMate Meter
4) Set of tubings (8" & 72")
5) Service Manual

Supplies

1) 70% Alcohol, general purpose detergent for disinfection
2) Lubricants
3) Gauze or dry cloth, disposable gloves, disposable apron (PPE)
4) Hand towel

Required Parts

1) Antibacterial/hydrophobic filters
2) Fuse & cap kit 4amps, 250V

6. Procedure

This procedure is for the recommended full PPM to be carried out on Suction Machine as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on Suction Machine:

6.1. Safety procedures

1) Inform and agree with the facility in charge and users about the Infant Suction planned maintenance.
2) Wear PPE before carrying any activity on the equipment
3) Disconnect Suction machine from power.
4) Disinfect the equipment with 70% alcohol or other recommended non aggressive disinfecting agents.

6.2 PPM Procedure

1) Check the Power cord and Top plug for any cracks, wear and tear or twists. Replace if necessary
2) Check outer surface of the equipment for any damage or corrosion. Apply coat of paint if necessary.
3) Inspect the condition of the handle and fix loose screws, nuts and bolts.
4) Check for leakages on tubes, gaskets & seals. Replace as may be required.
5) Clean air vents.
6) Clean or change Hydrophobic filters if wet or discolored.
7) Clean brushes on motors as necessary (every 3 months).
8) Grease or lubricate all moving parts.
9) Drain fluid in the jar, tubings and clean appropriately.
10) Use non-aggressive washing agent, soft wash cloth to clean outer surfaces.

6.3 Electrical Safety Tests

1) Check mains power supply voltage
2) Carry out Current leakage test and power consumption and record the values obtained
3) Check Grounding resistance between chassis and ground pin. It should not exceed 0.5 ohms.

6.4 Functionality Tests

1) Check functioning of the High and Low Suction pressure regulator.
2) Verify that the overflow valve (float valve) works properly when container is filled with water.

7 Maintenance Check sheet/List

PPM Check sheet for Suction Machine			
Health Facility Name:			
Date:			
Description of procedure	**Pass**	**Fail**	**Remarks**
1.0 Physical inspection			
1.1 Check for any physical damage on the equipment			
1.2 Check for damage on electrical power cord			
1.3 Check for missing screw, nut, bolt, etc.			
1.4 Check to see the filters are clean and replace whenever discoloration appears.			
1.5 Check for proper operation of the unit			
1.6 Check to see if suction pump is clean and clean whenever necessary.			
1.7 Check that the cap gasket is properly positioned inside the cap cover and that the gasket seals properly.			
1.8 Check that the float moves freely.			
1.9 Check to ensure suction catheter and tubing's are clean and free from damage.			
2.0 Planned Preventive Maintenance			
2.1 Clean any dust/dirt on the outside surface of the equipment and bottle covers.			
2.2 Lubrication of all moving parts, remove dirt from wheels.			
2.3 Tighten all loose parts and nuts.			
3.0 Electrical Safety Tests			
3.1 Check that there is no leakage current			
3.2 Check that the supply voltage is as per recommendation			
3.3 check the power code cable for insulation resistance.			
4.0 Functionality Tests			
4.1 Check that all the switches and vacuum control operates correctly			
4.2 Check functionality of the overflow valve (float valve) when container is filled with water			

5.0 Documentation			
5.1 Prepare a job card			
5.2 Attach a service sticker			
PPM carried out by: Name: Contact: Sign:		Date:	
Verified By: Name: Contact: Sign:		Date:	

8 **Revision History**

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9 **References and Related Documents**

- Allied Healthcare Products Inc.; Form No. S168-507-001 Rev. H
- Allied Healthcare Products Inc, Service Manual - F-30.doc Rev. 2 /12 APR 2006

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This SOP was developed by Engineers and Technicians from the MoH and Regional Medical Equipment Maintenance Workshops. The following persons were major contributors in the development of this SOP.

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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON AN ULTRASONIC NEBULIZER

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on an Ultrasonic Nebulizer to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: Standard operating procedures
- PPM: Planned Preventive Maintenance
- HID: Health Infrastructure Department

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on an Ultrasonic Nebulizer. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on an Ultrasonic Nebulizer. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Manager is responsible for ensuring that competent personnel under her/him use and comply to this procedure to carry out PPM on an Ultrasonic Nebulizer. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results obtained to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools
1) Complete Electro-Mechanical tool kit
2) Multimeter

Supplies
1) Neutral liquid cleanser
2) Nebulizer mask
3) Mouth piece

Required Parts
1) Fuses
3) Thermoplastic elastomers tube (100cm)
4) Error seal

6. Procedure

This procedure is for the recommended full PPM to be carried out on Ultrasonic Nebulizer as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on ultrasonic nebulizer:

6.1 Safety Procedures

1) Wear PPE when carrying out any activity on the Nebulizer.
2) Disconnect the Nebulizer from power.
3) Inspect the equipment for any visible cracks or damage.
4) Disinfect the Nebulizer with 70% alcohol or any recommended disinfectant.

6.2 PPM procedures

1) Clean the visible parts of the Nebulizer using moist gauze or cloth with water and soap.
2) Open the internal parts of the Nebulizer, clean the PC boards with a fine soft brush.
3) Assemble all internal parts and covers.
4) Clean the diaphragm.
5) Clean and disinfect the chamber.
6) Tighten the loose nuts.
7) Check and replace worn out tubes and seals.

6.3 Electrical safety procedures

1) Current leakage test
2) Supply voltage
3) Insulation resistance test

6.4 Functionality Tests

1) Check water level sensors.
2) Check pilot lamps.
3) Check that the fan is working without excessive noise.

7. Maintenance Check Sheet/List

PPM Check sheet for Ultrasonic Nebulizer			
Health Facility Name:			
Date:			
Description of procedure	**Pass**	**Fail**	**Remarks**
1.0 Physical Inspection			
1.1 Check for any physical damage on the equipment			
1.2 Check for damage on electrical power cord			
1.3 Check for missing screw, nut, bolt, etc.			
1.4 Check all parts are present and tightly fixed			

2.0 Planned Preventive Maintenance				
2.1 Blow or clean any dust on the outside/inside the equipment.				
2.2 Clean and disinfect the diaphragm, chamber and the other parts				
2.3 Tighten all loose parts.				
2.4 If chamber and tube seals are damaged, replace them				
3.0 Electrical Safety Tests				
3.1 There is no leakage current				
3.2 Supply voltage is as per recommendation				
3.3 Insulation resistance test				
4.0 Functionality Tests				
4.1 Check the whole system functions before use				
4.2 Check for water level sensors and pilot lamps				
4.3 Before next use, check that there is adequate nebulization				
4.4 Check that the fan is working without excessive noise.				
4.5 Check to see that the drain tube is held in the holder.				
5.0 Documentation				
5.1 Prepare a job card				
5.2 Attach a service sticker				

PPM carried out by:		Date:
Name:		
Contact:		
Sign:		
Verified By:		Date:
Name:		
Contact:		
Sign:		

8. Revision History

Version Number	Version Date	Section and description of changes made	Name of Authorizing Authority
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9. References and Related Documents

- MoH, Uganda, RWs Operational Manual and Maintenance Guidelines, 2013.

10. Acknowledgements:

This SOP was developed by Engineers and Technicians from the MoH and Regional Medical Equipment Maintenance Workshops. The following persons were major contributors in the development of this SOP.

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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON AN OXYGEN CONCENTRATOR

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on an Oxygen Concentrator to keep it in a safe working condition.

2. Definitions/Acronyms

- LPM: Litres Per Minute
- PPE: Personal Protective Equipment
- Psi/kPa: Pounds per Square Inch/ Kilo Pascals
- SOP: Standard operating procedures
- PPM: Planned Preventive Maintenance
- HID: Health Infrastructure Department

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on an Oxygen Concentrator. It is intended to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistencies while carrying out PPM on an Oxygen Concentrator. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Manager is responsible for ensuring that competent personnel under her/him use and comply with this procedure to carry out PPM on an Oxygen Concentrator. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and test results obtained to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools

1) Oxygen analyzer
2) Complete electromechanical tool kit (All tools must be FREE of oil and grease)

3) Multimeter
4) Cold air blower
5) Electrical Safety Analyser

Supplies
1) Soap/detergent solution.
2) Lint-free cotton cloth.
3) Appropriate PPE
4) 70% alcohol solution.

Required Parts
1) Gross particle filter
2) Bacterial filter

6. Procedure

This procedure is for the recommended full PPM to be carried out on Oxygen Concentrator as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on Oxygen Concentrator:

6.1 Safety Procedure

1) Disconnect machine from mains power.
2) Disinfect external surface using lint-free cotton cloth soaked in 70% alcohol solution.

6.2 PPM Procedure

1) Do visual inspection;
   - Check nameplate to confirm the class of equipment, power rating.
   - Check power cord for any damage.
   - Inspect the casing for any damage.
   - Check the switches and castor wheels.
   - Check for any missing nuts, screws and bolts.
2) Inspect the coarse particle filter. If it is dusty and the texture is still good, wash with water and allow it to dry before placing back. Replace if it is worn out.
3) Inspect the inlet filter, replace after every 6 months.
4) Wash the humidifier bottles with an anti-bacterial agent and refill with distilled or boiled water.
5) Open the cabinet and use a cold air blower to remove dust if any.
6) Check the compressor mounting bolts and springs; tighten if loose or replace if worn out.
7) Check for leakage at the humidifier bottle. A pop sound should be heard if the flow rate is set at 2.5 LPM.
8) Check the fan mounting screws, tighten if loose.
9) Check that the tubing on the air and oxygen circuits are firm.
10) Check the final bacterial filter, replace if dusty.

6.3 Electrical Safety Tests

1) Check that the mains voltage is within recommended range using a multimeter.
2) Check for Electric current leakage.
3) Check for Current consumption.
4) Check for Insulation resistance.

6.4 Functionality Tests

1) Test the power outage alarm by running the unit and unplug from the power socket, the alarm should come on. If it does not, check the alarm battery and replace if necessary.
2) Test the alarm battery, it should not be less than 8Volts, replace if less.
3) Set the oxygen concentrator to 5LPM and run for 5 minutes then check the concentration with an oxygen analyzer. Allow display to stabilize before taking a reading. The recommended concentration should be 90% and above.
4) Listen for the two sounds made by the cannisters to confirm pressurization and depressurization cycles.

7. Maintenance Check sheet/List

PPM Check sheet for Oxygen Concentrator			
Health Facility Name:			
Date:			
Description of procedure	**Pass**	**Fail**	**Remarks**
1.0 Physical inspection			
1.1 Check for any physical damage on the equipment			
1.2 Check for damage on electrical power cord			
1.3 Check for missing screw, nut, bolt, etc			
1.4 Check nameplate to confirm the class of equipment, power rating			
1.5 Check the switches, castor wheels, control knobs.			
1.6 Check the internal tubings for any damage/looseness/leakage.			
2.0 Planned Preventive Maintenance			
2.1 Blow or clean any dust on the exterior/interior of the equipment			
2.2 Clean the wheel castors to free them of any obstacles.			
2.3 Tighten all loose parts			
2.4 Clean or replace filters as recommended by the manufacturer			
2.5 Replace internal oxygen tubings where necessary.			
2.6 Wash humidifier bottles and refill with distilled water. Replace damaged humidifier bottles, where necessary.			
3.0 Electrical safety test			
3.1 Check that there is no chassis leakage current			
3.2 Check that the supply voltage is as per recommendation			

4.0 Functionality tests			
4.1 Trigger alarms to confirm that they work			
4.2 Confirm that O_2 concentration is above 90%			
4.3 Listen for pressure adsorption swing sounds			
5.0 Documentation			
5.1 Prepare a job card			
5.2 Attach a service sticker			

PPM carried out by:	Date:
Name:	
Contact:	
Sign:	
Verified By:	Date:
Name:	
Contact:	
Sign:	

8. Revision History

Version Number	Version Date	Section and description of changes made	Name of Authorizing Authority
2020/04/1		First Release	ACHS(BEMS)

9. References and Related Documents

- VSO Books; Care and Safe Use of Hospital Equipment by Muriel Skeet and David Frear, www.devilbisshealthcare.com www.precisionmedical.com
- https://www.researchgate.net/publication/229795840_Design_of_a_Two-Step_Pulsed_Pressure Swing_Adsorption Based_Oxygen_Concentrator

10. Acknowledgements

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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON THE OXYGEN THERAPY APPARATUS

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on the Oxygen Apparatus to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: Standard operating procedures
- PPM: Planned Preventive Maintenance
- HID: Health Infrastructure Department

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on the Oxygen Apparatus. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on the Oxygen Apparatus. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Managers responsible for ensuring that competent personnel under her/him use and comply to this procedure to carry out PPM on the Oxygen Apparatus. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results to obtained to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools

1) Adjustable spanner
2) Oxygen key

Supplies

1) Clean Cloth/Gauze
2) Detergent Solution and tooth brush

Required Parts

1) O-rings
2) Sealing Washers

6. Procedure

This procedure is for the recommended full PPM to be carried out on the Oxygen Apparatus as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on the Oxygen Apparatus:

6.1 Safety Procedures

Personal Safety

1) Oxygen cylinders should be carried on an oxygen cylinder carrier or make sure at least two people lift and carry large cylinders.
2) Wear good foot protection when moving a cylinder in case it is inadvertently dropped.
3) Do not smoke anywhere near the oxygen cylinders as oxygen promotes combustion
4) Do not carry a cylinder by its valve.
5) Do not use grease or oil anywhere on the equipment as this creates an explosion risk.
6) Do not direct pressurized oxygen to the skin.

Storage Safety

1) Keep cylinders in a dry, clean and well-ventilated area.
2) Keep cylinders away from flames, lighted cigarettes, inflammable liquids and combustible material.
3) Store cylinders in an upright position.
4) Use chains or other methods to prevent the cylinders falling over.
5) Keep empty cylinders separate from filled ones.
6) Do not store cylinders in direct sunlight as this cause the gas to expand and the cylinder pressure to increase excessively.

6.2 PPM Procedures

1) Clean the cylinder, humidifier bottles and regulators.
2) Test for leakages.
3) Paint the cylinders with the correct colors.

6.3 Functionality Tests

1) Check that the regulator has an intact and secure pin.
2) Check the expiry date on the cylinder.
3) Ensure regulator's needle responds to pressure differences by rotating.
4) Check for leakages at the cylinder connection.
5) Check that the flow meter works properly.

7. Maintenance Check Sheet/List

PPM Check sheet for Oxygen Apparatus			
Health Facility Name:			
Date:			
Description of procedure	**Pass**	**Fail**	**Remarks**
1.0 Physical inspection			
1.1 Check for any physical damage on the equipment			
1.2 Check the cylinder valves have their protective caps or seals in place.			
1.3 Check the cylinder valves have their threads and pin-indexes are in good order.			
1.4 Check the cylinders are colour coded according to the standard laid down by the governing authority			
1.5 Check the correct key or spanner is available for opening valves			
2.0 Planned Preventive Maintenance			
2.1 Check cylinders are in a dry, clean and well-ventilated area			
2.2 Check for wheeled cylinder trolley			
2.3 Check for a fire extinguisher is in place			
2.4 Check that all statutory labels and warning notices are in place and visible			
2.5 Check if the cylinder chains are in place			
3.0 Functionality Tests			
3.1 O-rings on bullnose regulators are fitted and are in good condition			
3.2 Bodok (Sealing Washer) washers are fitted to the pin-index regulators and are good condition			
3.3 Tighten the pipeline joints			
3.4 Blowout valves to remove dust			
3.5 Open and close all valves to make sure they are working			
4.0 Documentation			
4.1 Prepare a job card			
4.2 Attach a service sticker			
PPM carried out by: Name: Contact: Sign:	Date:		
Verified By: Name: Contact: Sign:	Date:		

8. Revision History

Version Number	Version Date	Section and description of changes made	Name of Authorizing Authority
2020/04/1		First Release	ACHS(BEMS)

9. References and Related Documents

- New South Wales Health, Australia Medical Safety Notice on Medical Gas Cylinders, Oct. 2016https://www.health.nsw.gov.au/sabs/Documents/2016-sn-010.pdf

10. Acknowledgements

This SOP was developed by Engineers and Technicians from the MoH and Regional Medical Equipment Maintenance Workshops. The following persons were major contributors in the development of this SOP.

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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON AN INFUSION PUMP

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on an Infusion Pump to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: Standard operating procedures
- VTBI: Volume to be infused
- CVI: Controlled Vacuum Infusion
- KVO: Keep Vein Open
- ET: Engineering Technician
- PPE: Personal Protective Equipment
- PPM: Planned Preventive Maintenance
- BME: Biomedical Engineer
- AEO: Assistant Engineering Officer
- HID: Health Infrastructure Department

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on an Infusion Pump. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on an Infusion Pump. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Manager is responsible for ensuring that competent personnel under her/him use and comply to this procedure to carry out PPM on an Infusion Pump. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.
It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results to obtained to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools

1) Complete Electro-Mechanical tool kit
2) Soft brush 1''
3) Multimeter
4) Electrical safety analyzer
5) Infusion device analyzer

Supplies

1) Clean water
2) Soft cloths
3) Detergent, non-corrosive

Required Parts

1) Batteries, as per manufacturer's recommendation

6. Procedure

This procedure is for the recommended full PPM to be carried out on Infusion Pump as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on Infusion Pump.

6.1 Safety procedures

1) Inform the user about the PPM of the infusion pump.
2) Wear PPE before carrying out any activity on the infusion pump.
3) Disconnect from the power.
4) Disinfect Infusion pump with 70% alcohol.
5) Physically inspect the infusion pump.

6.2 PPM Procedures

1) Clean the housing with a soft moist piece of cloth.
2) Gently wipe the sensor of the air detector with wet cotton swab and dry well.
3) Remove and clean the finger Cassette.
4) Remove the tube clamp and clean.
5) Clean the drip detector with a wet cotton swab
6) Clean the PC boards.

6.3 Electrical Safety Tests:

1) Electrical leakage current test.
2) Electrical consumption test.

3) Electrical resistance test.
4) Voltage test.

6.4 Functionality Tests:

1) Check the functionality of main unit and accessories.
2) Verify unit operates on battery.
3) Check accuracy of the flow rate, volume
4) Check occlusion detector and alarm function

7. Maintenance Check Sheet/List

PPM Check sheet for Infusion Pump				
Health Facility Name:				
Date:				
Description of procedure		**Pass**	**Fail**	**Remarks**
1.0 Physical Inspection				
1.1 Device is clean and disinfected				
1.2 No physical damage to case, display, mounts, cart, or components				
1.3 Check the functionality of switches and controls.				
1.4 Check the intensity of the display.				
1.5 Control numbers, labeling, and warnings present and legible				
1.6. Inlets and hoses				
1.7. Power cord, accessory cables and charger				
1.8. Filters and vents clean (where applicable)				
2.0 **Planned Preventive Maintenance**				
2.1. Blow or clean any dust on the outside				
2.2. Clean flow detector				
2.3. Tighten all loose parts				
2.4. Check and replace the battery as per manufacturer's recommendation				
3.0 Electrical Safety Test				
3.1 Ground wire resistance				
3.2 Chassis leakage				
3.3 Supply voltage				
4.0 Functionality Tests				
4.1 Verify unit operates on battery				
4.2 Pole clamp function				
4.3 Flow rate accuracy ± 10 %				

4.4 Volume accuracy ± 10 %			
4.5 Infusion complete/KVO			
4.6 Occlusion detection pressure			
4.7 Alarm function			
5.0 Documentation			
5.1 Prepare a job card			
5.2 Attach a service sticker			
PPM carried out by: Name: Contact: Sign:		Date:	
Verified By: Name: Contact: Sign:		Date:	

8. Revision History

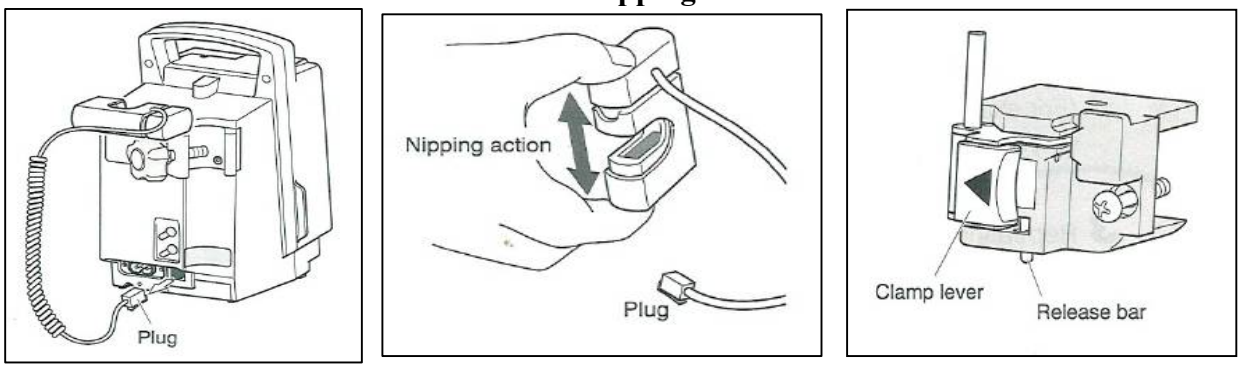
Version Number	Version Date	Section and description of changes made	Name of Authorizing Authority
2020/04/1		First Release	ACHS(BEMS)

9. References and Related Documents

- Infusions pump OT-701 Operators manual.

10. Appendices

Procedure for Nipping



11. Acknowledgements

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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON A SYRINGE PUMP

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on a syringe Pump to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: Standard operating procedures
- VTBI: Volume to be infused
- CVI: Controlled Vacuum Infusion
- KVO: Keep Vein Open
- ET: Engineering Technician
- PPE: Personal Protective Equipment
- PPM: Planned Preventive Maintenance
- BME: Biomedical Engineer
- AEO: Assistant Engineering Officer
- HID: Health Infrastructure Department

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on a syringe Pump. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on a syringe Pump. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Manager is responsible for ensuring that competent personnel under her/him use and comply to this procedure to carry out PPM on a Syringe Pump. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.
It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results to obtained to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools

1) Complete Electro-Mechanical tool kit
2) Soft brush 1''
3) Multimeter
4) Electrical safety analyzer
5) Infusion device analyzer

Supplies

1) Clean water
2) Soft cloths
3) Detergent, non-corrosive
4) Grease

Required Parts

1) Batteries, as per manufacturer's recommendation

6. Procedure

This procedure is for the recommended full PPM to be carried out on Syringe Pump as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on Syringe Pump.

6.1 Safety procedures

1) Inform the user about the PPM of the syringe pump.
2) Wear PPE before carrying out any activity on the syringe pump.
3) Disconnect from the power.
4) Disinfect syringe pump with 70% alcohol.
5) Physically inspect the syringe pump.

6.2 PPM Procedures

1) Clean the housing with a soft moist piece of cloth.
2) Gently wipe the syringe guide screws and clamps with wet cotton swab and dry well.
3) Remove any debris on the lead screw and the guide rods.
4) Apply lubricant along the length of the lead screw and the guide rods.
5) Press the block-release button and slide the pusher block to the left edge.

6.3 Electrical Safety Tests:

1) Electrical leakage current test.
2) Electrical consumption test.
3) Electrical resistance test.
4) Voltage test.

6.4 Functionality Tests:

1) Run the pump end-to-end without a syringe to work the lubricant into the components.
2) Verify unit operates on battery.
3) Check accuracy of the flow rate, volume
4) Check alarm function

7. Maintenance Check sheet/List

PPM Check sheet for Syringe Pump				
Health Facility Name:				
Date:				
Description of procedure		**Pass**	**Fail**	**Remarks**
1.0 Physical inspection				
1.1 Device is clean and decontaminated				
1.2 No physical damage to case, display, mounts, cart, or components				
1.3 Check the functionality of switches and controls				
1.4 Check the intensity of the display.				
1.5 Control numbers, labeling, and warnings present and legible				
1.6. Power cord, accessory cables and charger				
2.0 Planned Preventive Maintenance				
2.1. Blow or clean any dust on the outside				
2.2. Clean syringe guide screws and clamps				
2.3. Tighten all loose parts				
2.4 Apply lubricant along the length of the lead screw and guide rods				
2.5. Check and replace the battery as per manufacturer's recommendation				
3.0 Electrical Safety Test				
3.1 Ground wire resistance				
3.2 Chassis leakage				
3.3 Supply voltage				
4.0 Functionality Tests				
4.1 Verify unit operates on battery				
4.2 Flow rate accuracy ± 10 %				
4.3 Volume accuracy ± 10 %				
4.4 Alarm function				
5.0 Documentation				
5.1 Prepare a job card				
5.2 Attach a service sticker				

PPM carried out by:		Date:
Name:		
Contact:		
Sign:		
Verified By:		Date:
Name:		
Contact:		
Sign:		

8. Revision History

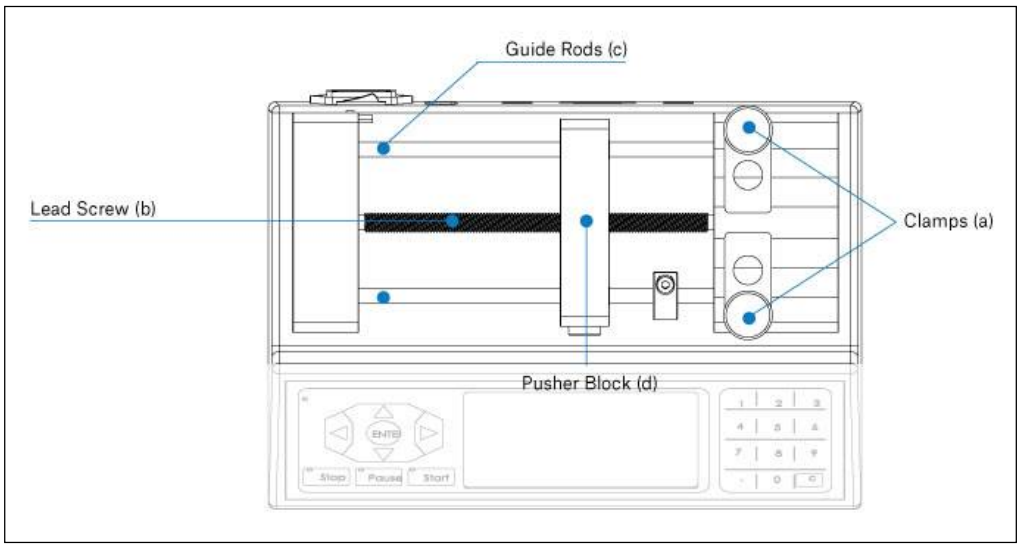
Version Number	Version Date	Section and description of changes made	Name of Authorizing Authority
2020/04/1		First Release	ACHS(BEMS)

9. References and Related Documents

- Syringe pump Operators manual.

10. Appendices

Typical block diagram of a syringe pump showing key parts for maintenance



11. Acknowledgements

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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON A DIAGNOSTIC ULTRASOUND MACHINE

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on a **Diagnostic Ultrasound Machine** to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: Standard operating procedures
- PPM: Planned Preventive Maintenance
- HID: Health Infrastructure Department
- PPE: Personnel Protective equipment

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on "Diagnostic Ultrasound Machine". It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on Diagnostic Ultrasound machine. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Manager is responsible for ensuring that competent personnel under her/him use and comply to this procedure to carry out PPM on Diagnostic Ultrasound Machine. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results to obtained to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools

1) Complete medical equipment tool box
2) Electrical safety analyzer
3) Digital Multimeter.

4) Ultrasound probe leakage detector
5) Plastic resin container

Supplies
1) Soft brush
2) Dry soft cloth
3) PPE
4) Disinfectant (70% Alcohol)
5) Mild soap solution

6. Procedure

This procedure is for the recommended full PPM to be carried out on the Ultrasound Machine as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on Ultrasound machine:

6.1 Safety Procedure

6) Inform and agree with the facility In-Charge and users about the PPM.
7) Wear appropriate PPE.
8) Disconnect the machine from power source
9) Ensure that the machine is on a firm surface and lock wheels, where applicable.

6.2 PPM Procedure

1) Disinfect and Clean the equipment
2) Carry out a physical inspection on probes, LCD display, printer, power cable, sockets and then take appropriate action.
3) Carefully clean any dirt on the probe.
4) Check the probe for any damage and/or exposed elements. Replace the probe if necessary.
5) Carry out inspection on all mechanical parts (e.g. castors, CD Driver) and clean appropriately.
6) Check thermal printer, gear system and thermal paper alignment. Clean any dirt and lubricate the gears.
7) Reconnect and charge the equipment while monitoring the percentage of charge, if the battery is incorporated.

6.3 Electrical Safety Test

1) Check power consumption
2) Check current leakage

6.4 Functionality test

1) Confirm functionality on inbuilt battery backup power source
2) Using a phantom check picture resolution and contrast.

7. Maintenance Check Sheet/List

PPM Check sheet for Diagnostic Ultrasound Machine			
Health Facility Name:			
Date:			
Description of procedure	**Pass**	**Fail**	**Remarks**
1.0 Physical inspection			
1.1 Inspect the probe for possible damage			
1.2 Inspect power plug and sockets for any cracks or damage			
1.3 Inspect keyboard keys and turning knobs. Clean as necessary			
1.4 Inspect the mechanical parts; castors, handle, lifting mechanism, control panel and support assembly.			
1.5 Inspect all other accessories and device enclose			
2.0 Planned Preventive Maintenance			
2.1 Clean monitor, trackball, control panel, probe and probe holder			
2.2 Clean the equipment interior using a blower			
2.3 Check battery charging and discharging behavior			
2.4 Clean the probe of any dirt deposits using a soft cloth			
2.5 Check the probe for any damage and/or exposed elements. Replace if necessary.			
3.0 Electrical safety test			
3.1 Check for earth leakage current			
3.2 Check for Mains on Applied Part Leakage current			
3.3 Check Protective earth resistance (Max. 0.2Ω)			
4.0 Functional check			
4.1 Check the different modes with assistance from the user			
4.2 Check functionality of Ultrasound scanner on battery power backup.			
4.3 Verify the functionality of the printer.			
5.0 Documentation			
5.1 Prepare a job card			
5.2 Attach a service sticker			

PPM carried out by:		Date:
Name:		
Contact:		
Sign:		
Verified By:		Date:
Name:		
Contact:		
Sign:		

8. Revision History

Version Number	Version Date	Section and description of changes made	Name of Authorizing Authority
2020/04/1		First Release	ACHS(BEMS)

9. References and Related Documents

1) Service manual Ultrasound Diagnostic Scanner EUB-5500
2) Service manual Samsung Medison Diagnostic Ultrasound system HS50A/HS60A
3) Service manual Mindray DC-70/DC-70T/DC-70 Pro/DC-70 Exp/DC-70S

10. Acknowledgements

This SOP was developed by Engineers and Technicians from the MoH and Regional Medical Equipment Maintenance Workshops. The following persons were major contributors in the development of this SOP.

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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON A HYDRAULIC DELIVERY BED & OPERATION TABLE

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on Delivery Bed and Operation (OP) Table to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: Standard operating procedures
- PPM: Planned Preventive Maintenance
- HID: Health Infrastructure Department
- OT: Operation Table

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on a Delivery Bed and OP Table. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on a Delivery Bed and OP Table. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Manager is responsible for ensuring that competent personnel under her/him use and comply with this procedure to carry out PPM on a Delivery Bed and OP Table. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results obtain to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools

1) Complete electromechanical toolkit.
2) Oil funnel

3) Oil can
4) Appropriate PPE

Supplies
1) Automatic Transmission Fluid (ATF)
2) Penetrating oil
3) Grease
4) Chrome spray
5) A non-corrosive detergent/soap
6) 70% alcohol
7) Glutaraldehyde-based solution
8) Cloth/gauze

6. Procedure

This procedure is for the recommended full PPM to be carried out on Delivery Bed and OP Table as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on Delivery Bed and OP Table.

6.1 Safety procedure

1) Wear appropriate PPE3+
2)
3) Disinfect the equipment with appropriate disinfectant.
4) Engage the brakes on the castors to fix the equipment in one position

6.2 PPM Procedure

1) Check for any physical damage and cracks on any part of the equipment
2) Check all mechanical movements of the machine and grease or lubricate all moving parts
3) Check hydraulic oil level and top up or replace as necessary
4) Check for corrosion of any part and clean appropriately. Apply coat of paint if necessary.

6.3 Functionality Tests

1) Check for maximum and minimum movement
2) Check the whole range of table movements.
3) Check the brake system and castors.

7. Maintenance Check Sheet/List

PPM Check Sheet for a Delivery Bed and OP Table			
Health Facility Name:			
Date:			
Description of procedure	**Pass**	**Fail**	**Remarks**
1.0 Physical inspection			
1.1 Check for damage and cracks on mackintosh, foot pedal, handles, arm-rest, leg-rest etc.			
1.2 Check all mechanical moving parts			
1.3 Check hydraulic oil level			
1.4 Check corroded parts and clean appropriately			
2.0 Planned Preventive Maintenance			
2.1 Inspect the pump, top up hydraulic oil/replace oil and O-ring as may be necessary			
2.2 Oil the casters and the brakes			
2.3 Check gearing system and grease or lubricate as necessary			
2.4 Tighten all loose parts – screws, nuts and bolts			
2.5 Apply coat of paint on corroded/rusted equipment parts			
2.6 Replace damaged castors as may be necessary			
3.0 Functionality Tests			
3.1 Check all movements of the Delivery bed or Operating Table			
3.2 Test compression pressure of hydraulic pump, if possible.			
4.0 Documentation			
4.1 Prepare a job card			
4.2 Attach a service sticker			
PPM carried out by: Name: Contact: Sign:			
Verified By: Name: Contact: Sign:	Date:		

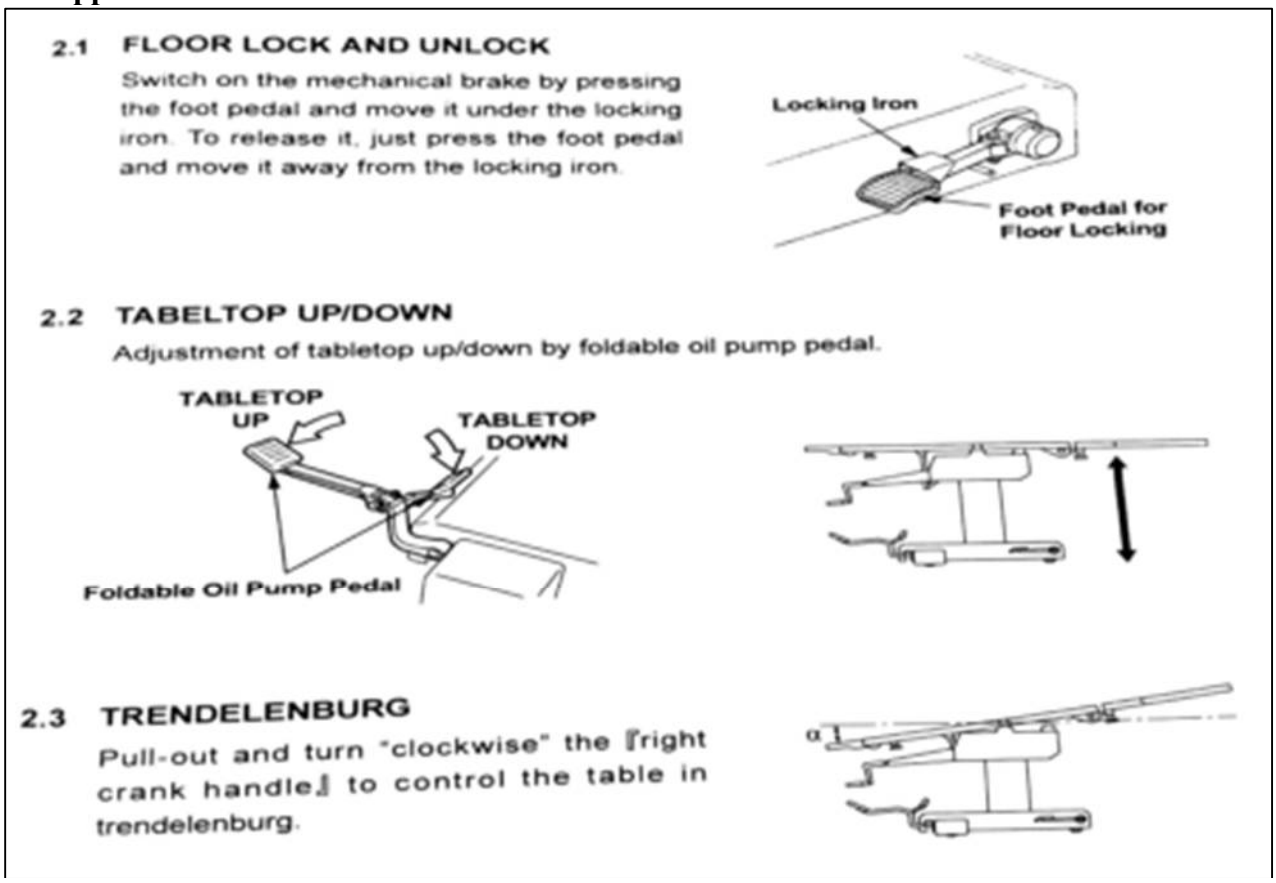
8. Revision History

Version Number	Version Date	Section and description of changes made	Name of Authorizing Authority
2020/04/1		First Release	ACHS(BEMS)

9. References and Related Documents

- Maintenance Manual for Operating table, Model OP 1700
- MoH, Uganda, RWs Operational Manual and Maintenance Guidelines, 2013.

10. Appendices



11. Acknowledgements

This SOP was developed by Engineers and Technicians from the MoH and Regional Medical Equipment Maintenance Workshops. The following persons were major contributors in the development of this SOP.

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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON OPERATING AND EXAMINATION LIGHTS

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on Operating and Examination Lights to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: Standard operating procedures
- PPM: Planned Preventive Maintenance
- HID: Health Infrastructure Department
- PPE: Personnel Protective Equipment

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on an Operating Light. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on Operating and Examination Lights. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Managers responsible for ensuring that competent personnel under her/him use and comply to this procedure to carry out PPM on Operating and Examination Lights. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results to obtained to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools

1) Complete electromechanical toolkit.
2) Blower

4) Multimeter
5) Soft brush

Supplies
1) Alcohol 70 %
2) Gauze
3) Liquid Soap
4) Penetrating oil.

Required parts (have on hand or in stock prior to starting PM)
1) Bulbs
2) Battery
3) Fuses

6. Procedure

This procedure is for the recommended full PPM to be carried out on Operating Lamp as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on Operating and Examination Lights.

6.1 Safety Procedure

1) Notify and agree with facility in-charge about the PPM
2) Wear appropriate PPE
3) Isolate the equipment from any power source
4) Disinfect appropriate parts.

6.2 PPM

1) Perform a physical Inspection on the Operating/Examination light, both Electrical and mechanical and take appropriate action where necessary.
2) Open and clean the inner parts using a blower and a soft brush.
3) Lubricate the casters wheels with penetrating oil where applicable.
4) Top up battery electrolyte for wet batteries and clean battery terminal and connectors. Grease the battery terminals.
5) Check functionality of all lights and replace faulty lights.

6.3 Electrical Safety Test

1) Insulation Resistance
2) Earth Leakage current
3) Supply Voltage

6.4 Functionality Test

1) Connect the machine to the mains and verify whether the machine is working.
2) Test functioning of the light on power back up source if available

7. Maintenance Check sheet/List

PPM Check sheet for an Operating Lamp			
Health Facility Name:			
Date:			
Description of procedure	**Pass**	**Fail**	**Remarks**
1.0 Physical Inspection			
1.1 Check for any physical damage on the equipment			
1.2 Check for damage on electrical power cord			
1.3 Check for loose/ missing screw, nut, bolt, etc.			
2.0 Planned Preventive Maintenance			
2.1 Clean any dust on the outside/inside of the equipment			
2.2 Lubricate all moving parts			
2.3 Tighten all loose parts			
3.4 Check functionality of all lights and replace faulty lights			
3.5 Check power back up battery status. Top up battery electrolyte for wet batteries and clean battery terminal and connectors			
3.0 Electrical Safety Tests			
3.1 Check leakage current			
3.2 Check the mains power supply and power back up voltage			
4.0 Functionality tests			
4.1 Verify whether the machine is working well			
5.0 Documentation			
5.1 Prepare a job card			
5.2 Attach a service sticker			
PPM carried out by: Name: Contact: Sign:			Date:
Verified By: Name: Contact: Sign:			Date:

8. Revision History

Version Number	Version Date	Section and description of changes made	Name of Authorizing Authority
2020/04/1		First Release	ACHS(BEMS)

9. References and Related Documents

- MoH, Uganda, RWs Operational Manual and Maintenance Guidelines, 2013.

10. Acknowledgements

This SOP was developed by Engineers and Technicians from the MoH and Regional Medical Equipment Maintenance Workshops. The following persons were major contributors in the development of this SOP.

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Segane Ashrea	Biomedical Engineering Technician, Kabale RRH
Ogen-Mungu Ronald	Biomedical Engineer, Fort Portal RRH
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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON AN ANAESTHESIA MACHINE

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on an **Anaesthesia Machine** to keep it in a safe working condition.

2. Definitions/Acronyms

- APL: Adjustable Pressure-Limiting
- SOP: Standard Operating Procedures
- PPM: Planned Preventive Maintenance
- HID: Health Infrastructure Department
- N_2O: Nitrous Oxide
- O_2 +: Oxygen Flush
- PEEP: Positive End-Expiratory Pressure
- SIMV: Synchronized Intermittent Positive Ventilation.

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on an Anaesthesia Machine. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on an Anaesthesia Machine. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Manager is responsible for ensuring that competent personnel under her/him use and comply to this procedure to carry out PPM on an Anaesthesia Machine. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results to obtained to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools

1) Manometer
2) Anaesthetic gas analyzer (if available)
3) Complete Service kit
4) Calibration Analyzer
5) Calibration Tool kit
6) Gas leakage detector
7) Service Manuals

Supplies

1) Disinfecting/cleaning reagents (70% ethyl alcohol, liquid soap)
2) Soda lime.
3) Service kit with bellow seals, O-rings, air circuit/patient tubing, etc
4) Oxygen sensor.

6. Procedures

This procedure is for the recommended full PPM to be carried out on an Anaesthesia Machine as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on an Anaesthesia Machine:

6.1. Safety procedures

1) Inform and agree with the facility in-charge and users about the anaesthesia machine planned maintenance.
2) Wear appropriate PPE before carrying any activity on the equipment
3) Disconnect anaesthesia machine from power.
4) Disinfect the anaesthesia machine with 70% alcohol or other recommended non aggressive disinfecting agents.

6.2 PPM Procedure

1) Inspect exterior of equipment for damage or missing hardware
2) Inspect the power cord and strain relief for any signs of damage
3) Turn unit off, open user-accessible covers and inspect interior for damage
4) Clean unit interior components and exterior with vacuum or compressed air
5) Inspect interior for signs of corrosion.
6) Inspect electrical components for signs of excessive heat or deterioration.
7) Inspect condition of all tubing, replace if necessary.
8) Open and clean inspiratory and expiratory flow valves
9) Perform a thorough leak test (detailed in the appendix).
10) Verify operation of gas scavenger systems.
11) Check vaporizer O-ring and scale movement

.

6.3 Electrical Safety Tests

1) Check power supply voltage
2) Test Earth Continuity
3) Carry out Insulation Resistance test
4) Carry out Earth Leakage test
5) Carry out Enclosure Leakage test

6.4 Functionality Tests

1) Check the hypoxia-guard mechanism.
2) Check the flow meter ball movement.
3) Verify correct operation of ventilator (rate, volume and flow)
4) Check functionality of the APL valve & manometer.
5) Verify correct operation of all buttons, controls, displays and/or indicators.
6) Verify operation of unit in all functional modalities (using breathing circuit, airbag, vent/bag switch) and check for any leaks in the system[1].
7) Verify the performance of Oxygen sensor. Re-calibrate if necessary.

7. Maintenance Check Sheet/ List

PPM Check sheet for an Anaesthesia Machine			
Health Facility Name:			
Date:	__/__/__		
Description of Procedure	**Pass**	**Fail**	**Remarks**
1.0 Physical inspection			
1.1 Check for any physical damage			
1.2 Check for damage on electrical power cord			
1.3 Clean for damage on the user-accessible interior parts			
1.4 Check for any damage on the tubing			
1.5 Check Pressure gauges for damage			
1.6 Check Flowmeter operation			
1.7 Check Pipeline hoses for damage			
1.8 Check the integrity of Oxygen Flush system			
1.9 Check the control monitor battery			
1.10 Check the integrity of medical gas flow controls			
1.11 Check the integrity of low-pressure system			
1.12 Check the integrity of intermediate pressure system			
2.0 Planned Preventive Maintenance			
2.1 Disinfect the equipment			
2.2 Clean any dust on the equipment exterior and interior with vacuum or compressed air			
2.3 Lubricate all moving parts			

[1] Use the procedure described in the Appendices to carry out a leak test on the Anaesthesia machine.

2.4 Tighten all loose bolts, nuts and screws, or replace as necessary			
2.5 Check condition of all tubing, replace if necessary			
2.6 Check the condition of the O-rings, replace if worn out			
2.7 Check the vaporizers whether they are freely moving or not			
2.8 Open and clean inspiratory and expiratory valves			
2.9 Check condition of soda lime and replace where necessary.			
3.0 Electrical Safety Tests			
3.1 Check that the supply voltage is as per recommendation			
3.2 Check Earth Continuity (Max 0.2 Ω) at 1 A or less			
3.3 Check Insulation Resistance (not less than 20 MΩ) at 340- 500Vdc			
3.4 Check Earth Leakage (Max 500 µA)			
3.5 Check Enclosure Leakage (Max 100 µA)			
4.0 Functionality Tests			
4.1 Check the hypoxia-guard mechanism			
4.2 Check the flow meter ball movement			
4.3 Verify correct operation of ventilator (rate, tidal volume and flow)			
4.4 Check functionality of the APL valve & manometer			
4.5 Verify correct operation of all buttons, controls, displays and/or indicators			
4.6 Verify operation of unit in all functional modalities (using breathing circuit, airbag, vent/bag switch etc.)			
4.7 Calibrate the Oxygen sensor at 21% and 100%, replace if necessary			
5.0 Documentation			
5.1 Prepare a job card			
5.2 Attach a service sticker			

PPM carried out by:		Date: ……
Name:		
Contact:		
Signature:		
Verified By:		Date: ……
Name:		
Contact:		
Signature:		

8. Revision History

Version Number	Version Date	Section and description of changes made	Name of Authorizing Authority
2020/04/1		First Release	ACHS(BEMS)

9. References and Related Documents

Related documents and references that we referred to and used:

- General Electrics (GE) Healthcare, Datex-Ohmeda 9100c Anaesthesia Machine Technical Reference Manual
- GE Healthcare Datex-Ohmeda 9100c Users Reference Manual
- Service Engineer's Checklist for Penlon IM 500 Anaesthesia Machine, model Basic & Mech AHD

10. Appendices

Procedure for conducting a leak test on an Anaesthetic Machine

1) Close APL (Scavenging /Adjustable Pressure Limiting) valve by turning the knob clockwise.
2) Place thumb over patient connection of a new breathing circuit Y (No assumption that the new Circuit has no leakage).
3) Remove breathing bag and cover bag port opening. (Use the palm of hand that is covering Y)
4) With oxygen (50-55 psi or 3.4-3.8 bar) supplied to anaesthesia machine, slowly open flowmeter to register 30cm H_20 on anaesthesia machine pressure gauge.
5) Turn off flowmeter when pressure reaches 30cm H_2O. If pressure holds steady, the system is leak-free but if pressure drops, proceed to step 6.
6) Slowly open flowmeter until pressure stabilizes at 30cm H_2O setting. This determines the magnitude of the leak. If the Leak is more than 300ml/minute, consult **CW or Local Vendor** of the manufacturer. If leak rate is not greater than 300ml/min, that's OK. Proceed to step 7.
7) Replace reservoir bag. Repeat step (2) and steps (4) through (6). This will determine the integrity of breathing bag. If there is a leak beyond 300ml/min. Replace the bag.

11. Acknowledgements

This SOP was developed by Engineers and Technicians from the MoH and Regional Medical Equipment Maintenance Workshops. The following persons were major contributors in the development of this SOP.

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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON AN INFANT INCUBATOR

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on an Infant Incubator to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: Standard operating procedures
- Planned Preventive Maintenance (PPM):
- HID: Health Infrastructure Department

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on Infant Incubator. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on an Infant Incubator. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Manager is responsible for ensuring that competent personnel under her/him use and comply with this procedure to carry out PPM on an Infant Incubator. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results obtain to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools

1) Complete electromechanical toolkit
2) Blower and Soft brush
3) Multi meter
4) Electrical safety analyzer
5) Thermometer
6) Baby incubator/infant wormer analyzer

Supplies

1) Distilled water
2) Soft cloths
3) Detergent [Non corrosive]
4) Penetrating oil spray

6. Procedure

This procedure is for the recommended full PPM to be carried out on Infant Incubator as recommended by the manufacturer.

6.1 Safety procedure

1) Inform and agree with the facility in charge and users about the Infant Incubator planned maintenance.
2) Wear appropriate PPE before carrying any activity on the equipment.
3) Disconnect Infant Incubator from power.
4) Disinfect the Incubator with 70% alcohol or other recommended non aggressive disinfecting agents.
5) Carry out physical inspection.

6.2 PPM Procedure

1) Clean entire surface of the equipment
2) Clean skin sensor probe
3) Check operation of circulation fan and clean it
4) Clean air filter
5) Clean the humidity tray
6) Clean air/oxygen flow vents and baby tray

6.3 Electrical Safety Tests

1) Carry out Leakage current test
2) Carry out Insulation Resistance test
3) Check Power Consumption
4) Check Grounding

6.4 Functionality Tests

1) Using a calibrated thermometer, check functionality of cut-in and cut-out temperature difference. Reset if necessary.
2) Check functionality of Audio Alarm system.
3) Check air circulation and/or oxygen flow where applicable.
4) Check the Hygrometer where applicable.

7. Maintenance Check sheet/List

PPM Check sheet for Infant Incubator				
Health Facility Name:				
Date:				
Description of procedure		**Pass**	**Fail**	**Remarks**
1.0 Physical inspection				
1.1 Check for any physical damage to case, mattress, displays, mounts, cart and missing screws/nuts and bolts				
1.2 Check supply cable, switches and control panel buttons for any damages				
1.3 Check condition of the access port gasket				
2.0 Planned Preventive Maintenance				
2.1 Blow or clean any dust on the outside of the equipment				
2.2 Clean the humidifier chamber and tray				
2.3 Tighten all loose parts and replace missing screws/nuts and bolts				
2.4 Clean the skin temperature probe				
2.5 Clean air filters and vents. Replace filters if necessary.				
2.6 Clean baby tray with non-aggressive disinfectant				
3.0 Electrical safety test				
3.1 Check Ground wire resistance				
3.2 Check Chassis leakage				
3.3 Check Patient leakage current				
3.4. Check Patient lead leakage current – isolation test (mains on patient applied part)				
3.5 Carry out Insulation test (optional) at 500 V				
4.0 Functionality Tests				
4.1 Verify unit operates on battery if applicable				
4.2 Confirm that the Alarm system functions				
5.0 Documentation				
5.1 Prepare a job card				
5.2 Attach a service sticker				
PPM carried out by: Name: Contact: Sign:		Date:		
Verified By: Name: Contact: Sign:		Date:		

8. Revision History

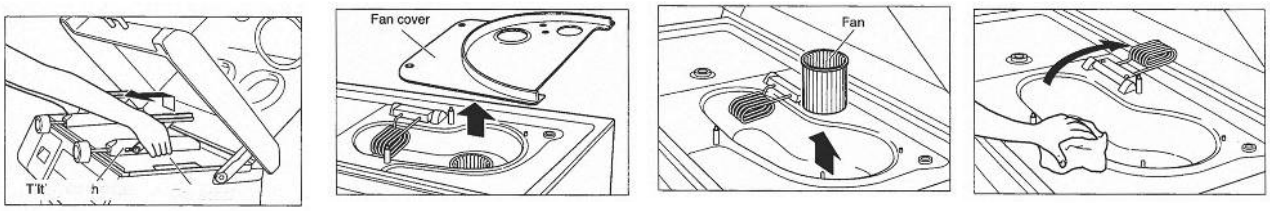
Version Number	Version Date	Section and description of changes made	Name of Authorizing Authority
2020/04/1		First Release	ACHS(BEMS)

9. References and Related Documents

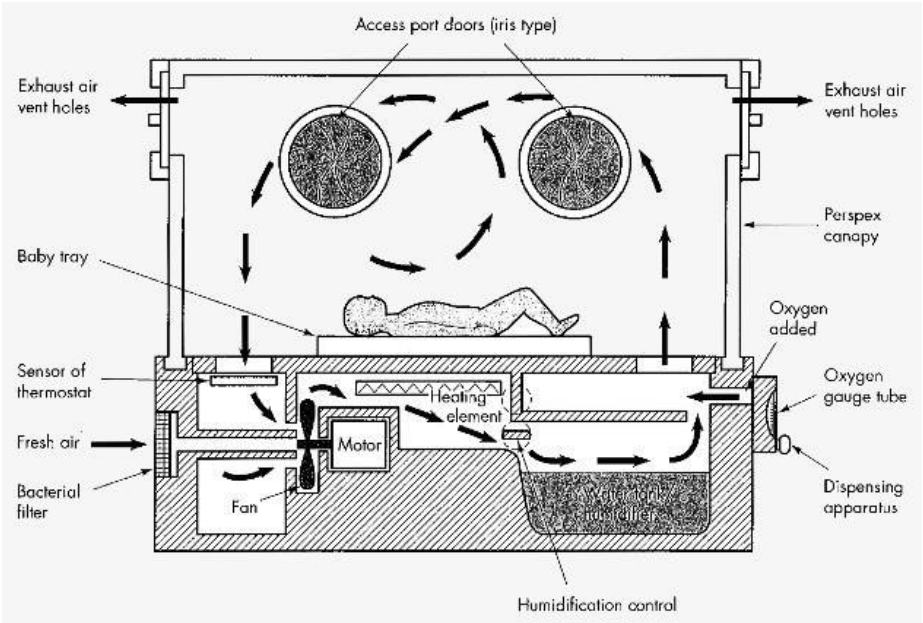
- Atom Infant Incubator Model Operators Manual.
- MoH, Uganda, RWs Operational Manual and Maintenance Guidelines, 2013.

10. Appendices

Procedure for removing the fan



Incubator parts



11. Acknowledgements

This SOP was developed by Engineers and Technicians from the MoH and Regional Medical Equipment Maintenance Workshops. The following persons were major contributors in the development of this SOP.

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Absolom Emudu	Assistant Engineering Officer, Gulu RRH
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Ken Kalungi	Engineering Technician, Electrical, China-Uganda Friendship Hospital, Naguru

STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON AN INFANT WARMER

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on **Infant Warmer** to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: Standard operating procedures
- PPM: Planned Preventive Maintenance
- HID: Health Infrastructure Department

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on Infant Warmer. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on an Infant Warmer. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Manager is responsible for ensuring that competent personnel under her/him use and comply with this procedure to carry out PPM on an Infant Warmer. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results obtain to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools

1) Complete electromechanical toolkit.
2) Infant warmer analyzer
3) Electrical safety analyzer
4) Blower and Soft brush
5) Multi meter
6) Soft cloths

Supplies

1) Distilled water
2) Detergent (Non corrosive)

6. Procedure

This procedure is for the recommended full PPM to be carried out on Infant Warmer as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on Infant Warmer.

6.1. Safety Procedures

1) Inform and agree with the facility in-charge and users about the planned Infant warmer.
2) Be sure to turn off, remove the power plug from mains.
3) Ware appropriate PPE
4) Disinfect the unit
5) Clean the equipment and the accessories appropriately

6.2 PPM Procedures

1) Clean and decontaminate the equipment
2) Clean the entire equipment inside and out side
3) Clean the skin temperature probe
4) Tighten all loose parts
5) Verify the operation of the control panel

6.3 Electrical Safety Tests

1) Carry out electrical safety tests
2) Carryout earth leakage test
3) Carryout ground resistance test

6.4 Functionality Tests

1) Using a calibrated thermometer, check functionality of cut-in and cut-out temperature difference.
2) Check functioning of Audio Alarm system.
3) Check the functionality of Skin Temperature sensors.
4) Check functionality of thermostat

7. Maintenance Check Sheet/List

PPM Check sheet for Infant Warmer				
Health Facility Name:				
Date:				
Description of procedure		**Pass**	**Fail**	**Remarks**
1.0 Physical inspection				
1.1 Check for any physical damage to case, display, mounts, cart, castors				
1.2 Check mains supply cable, switches, control panel buttons for any damage				
1.3 Check mattress for any damage				
2.0 Planned Preventive Maintenance				
2.1 Blow or clean any dust on the outside of the equipment				
2.2 Clean the skin temperature probe				
2.3 Tighten all loose parts and replace missing screws/nut and bolts				
2.4 Clean the mattress with non-aggressive disinfectants				
2.5 Check and adjust locking mechanisms where applicable				
3.0 Electrical Safety Tests				
3.1 Check Ground wire resistance (< 0.3 Ω)				
3.2 Check Chassis leakage (< 100µA, < 500µA SFC)				
3.3 Check Electrical Power Consumption.				
3.4 Check Patient leakage current (<100 µA, B and BF) (< 10 µA, CF)				
3.5 Check Patient lead leakage current – isolation test (< 100µA BF)				
(mains on patient applied part, < 10 µA CF)				
3.6. Carry out Insulation test (optional) 500V, < 2 MΩ				
4.0 Functionality Tests				
4.1 Verify the operation of the control panel				
4.2 Check functionality of the Alarm system				
4.3 Check the operation of the phototherapy warning light lamp.				
5.0 Documentation				
5.1 Prepare a job card				
5.2 Attach a service sticker				
PPM carried out by: Name: Contact: Sign:		Date:		
Verified By: Name: Contact: Sign:		Date:		

8. Revision History

Version Number	Version Date	Section and description of changes made	Name of Authorizing Authority
2020/04/1		First Release	ACHS(BEMS)

9. References and Related Documents

- Atom Infant warmer model Operators manual.
- MoH, Uganda, RWs Operational Manual and Maintenance Guidelines, 2013.

10. Acknowledgements

This SOP was developed by Engineers and Technicians from the MoH and Regional Medical Equipment Maintenance Workshops. The following persons were major contributors in the development of this SOP.

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Barungi Valet	Assistant Engineering Officer, Mechanical, Arua RRH
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Absolom Emudu	Assistant Engineering Officer, Gulu RRH
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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON A PHOTOTHERAPY UNIT

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personal on a phototherapy unit to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: standard operating procedures
- ESA: Electrical Safety Analyser
- PPM: planned preventive maintenance
- HID: Health Infrastructure Department.
- CP: Competent person

3. Scope

The MoH Engineers and Technicians are to conduct PPM on phototherapy unit. It is designed to ensure consistent execution of PPM by Engineer /Engineering Technicians and mitigate the risk of inconsistence while carrying out PPM on Phototherapy unit. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The regional Workshop manager is responsible for ensuring that competent personnel under her/him use and comply to this procedure to carry out PPM on phototherapy unit.
MoH Engineers and Technicians shall use and adhere to the equipment of this SOP and the manufacturer's recommended service schedules. It is the responsibility of the Engineers/Engineering Technicians to prepare documented evidence of the maintenance activities carried out and test results to obtain to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet/list.

5. Tools and supplies required to undertake PPM

Tools

1) Electrical Safety Analyser.
2) Complete electromechanical toolkit.
3) Multimeter
4) Blower
5) Phototherapy light intensity meter (must measure light only within 430-490 nm range)

Supplies

1) Personal Protective Equipment
2) Decontaminating solution (70% alcohol solution)
3) Lint free cotton cloth

Required Parts

1) Appropriate type of lamps
2) Fuses

6. Procedure

This procedure is for the recommended full PPM to be carried out on phototherapy unit as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on phototherapy unit.

6.1 Safety Procedure

1) Disconnect from the mains systematically
2) Prepare the working environment to work safely.
3) Put on the appropriate PPE.
4) Disinfect the phototherapy unit with proper disinfectant (70% Alcohol).

6.2 PPM Procedure

1) Carry out visual inspection on the phototherapy unit for any damage.
   - Check the casing of the machine for any damage
   - Check controls and switches
   - Check condition of the power cord
2) Clean dust and dirt from the phototherapy unit.
3) Tighten all loose parts, nuts and screws.
4) Replace burnt light source, where necessary.

6.3 Electrical Safety Tests

1) Check the voltage from the mains using a multimeter to confirm that it falls within the recommended range.
2) Connect the safety analyser into the mains and then connect the phototherapy machine into the analyser.
3) Carry out electric current leakage test
4) Carry out the current consumption test.
5) Carry out insulation resistance test.

6.4 Functionality Tests

1) Check the functionality of the phototherapy unit with a light intensity meter. The spectral irradiance should be at least above 30µW/cm^2/nm (at place where infant is placed) for intensive phototherapy.

7. Maintenance Check Sheet/List

PPM check list for Phototherapy Unit				
Health Facility:				
Date:				
Description of procedure		**Pass**	**Fail**	**Remarks**
1.0 Physical inspection				
1.1 Check for any damage				
1.2 Check for damage on power code				
1.3 Check the phototherapy unit status				
1.4 Check on and off button.				
1.5 Check nameplate and warning labels on the machine				
2.0 Planned Preventive Maintenance				
2.1 Clean the interior and exterior of the machine				
2.2 Tighten all loose parts				
2.3 Replace light sources, if necessary				
2.4 Ensure proper assembling				
3.0 Electrical Safety Tests				
3.1 Supply Voltage	V			
3.2 Insulation resistance	Ω			
3.3 Chassis leakage current	A			
4.0 Functionality Tests				
4.1 Ensure its powering well				
4.2 Use the phototherapy light meter to measure intensity (must be above 30 µW/cm^2/nm)				
5.0 Documentation				
5.1 Prepare a job card				
5.2 Attach a service sticker				

PPM carried by: Name: Contact: Sign:		Date:	
Verified By: Name: Contact: Sign:		Date:	

8. Revision History

Version Number	Version Date	Section and description of changes made	Name of Authorizing Authority
2020/04/1		First Release	ACHS(BEMS)

9. References and Related Documents

- Medical Equipment User Training Manual for National and Regional Trainers, Ministry of Health, Uganda, December 2020

10. Acknowledgements

This SOP was developed by Engineers and Technicians from the MoH and Regional Medical Equipment Maintenance Workshops. The following persons were major contributors in the development of this SOP.

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<table>
<tr><td rowspan="2">THE REPUBLIC OF UGANDA
MINISTRY OF HEALTH
Health Infrastructure Department</td><td colspan="2">Version Number:

MOH/SOP/BME/AUTOCLAVE/2020/04/1</td><td>Page: 1 of 4</td></tr>
<tr><td>Version Date: ___/___/ 2020</td><td colspan="2">Effectiveness: Date: ___/___/ 2020</td></tr>
<tr><td>Document Name:</td><td colspan="2">Standard Operating Procedure (SOP) for carrying out Planned Preventive Maintenance on Autoclaves.</td><td>Reviewed and Approved by: ACHS(BEMS)</td></tr>
<tr><td>Authorizing Signature</td><td colspan="3"></td></tr>
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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON AUTOCLAVES

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on an *Autoclave* to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: Standard operating procedures
- PPM: Planned Preventive Maintenance
- HID: Health Infrastructure Department
- PPE: Personnel Protective Equipment

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on Autoclaves. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on an *Autoclave*. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Manager is responsible for ensuring that competent personnel under her/him use and comply to this procedure to carry out PPM on an Autoclave. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results to obtained to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools

1) Complete electromechanical tool kit
2) Blowing Machine
3) Soft cloth
4) Digital Multimeter.
5) Service Manual

Supplies

1) Sterilization tape/strip
2) De-scaler
3) Service kit of commonly wearing parts (e.g. lid gasket, safety valves, etc.)

6. Procedure

This procedure is for the recommended full PPM to be carried out on an Autoclave as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on Autoclave:

1.3 Safety Procedure

1) Notify and agree with facility in-charge about the PPM.
2) Wear appropriate PPE.
3) Isolate the equipment from any power source.
4) Disinfect appropriate parts.
5) Ensure that the chamber is not pressurized.

6.2 PPM Procedure

1) Carry out a physical inspection on the entire machine and take appropriate action where necessary.
2) Clean all the necessary parts (e.g. Internal chamber, lid gasket, cobweb, inside the housing, heating element etc.)
3) De-scale the chamber and the heating element where necessary.

6.3 Electrical Safety Testing

1) Carry out Earth leakage test
2) Check power consumption

6.4 Functionality tests

1) Run a complete cycle with a load of medical supplies and sterilization tape/strip. Confirm that sterilization is achieved using the colour of the sterilization tape/strip.
2) Run a complete cycle and ascertain the functionality of safety valves, temperature and pressure gauge; and that the lid gasket is not leaking.

7. Maintenance Check sheet/List

PPM Check sheet for Autoclave (Steam Sterilizer)			
Health Facility Name:			
Date:			
Description of procedure	**Pass**	**Fail**	**Remarks**
1.0 Physical Inspection			
1.1 Inspect switches, buttons and other controls			
1.2 Check condition of power cord and other electrical accessories.			
1.3 Check door locking mechanism.			
1.4 Check the integrity of the gasket.			
2.0 Planned Preventive Maintenance			
2.1 Replace the air filter, where applicable.			
2.2 Clean the water strainer.			
2.3 Clean the fan grid and the electronic control unit with a vacuum cleaner			
2.4 Inspect and Clean door gasket with a soft cloth			
2.5 Lubricate the door pins and door tightening bolts with oil.			
2.6 Descale sterilising chamber using a recommended agent.			
2.7 Check autoclave levelling			
3.0 Electrical Safety Tests			
3.1 Check for Earth leakage current			
3.2 Check the power consumption			
4.0 Functionality Tests			
4.1 Ascertain functionality of safety valves, temperature and pressure gauge; and that the lid gasket is not leaking			
4.2 Run a complete cycle with a load of medical supplies and sterilization tape. Confirm that sterilization is achieved using the colour of the sterilization tape, in the presence of the user.			
5.0 Documentation			
5.1 Prepare a job card			
5.2 Attach a service sticker			
PPM carried out by: Name: Contact: Sign:	Date:		
Verified By: Name: Contact: Sign:	Date:		

8. Revision History

Version Number	Version Date	Section and description of changes made	Name of Authorizing Authority
2020/04/1		First Release	ACHS(BEMS)

9. References and Related Documents

1) Tuttnauer Autoclave logbook
2) Autoclave Environmental and safety guidelines University of Washington
3) Eschmann Autoclave testing

10. Acknowledgements

This SOP was developed by Engineers and Technicians from the MoH and Regional Medical Equipment Maintenance Workshops. The following persons were major contributors in the development of this SOP.

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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON A HOT AIR OVEN.

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personal on a Hot Air Oven to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: standard operating procedures
- PPE: Personal Protective Equipment
- PPM: planned preventive maintenance
- HID: Health Infrastructure Department

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on Hot Air Oven. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on a Hot Air Oven. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The regional Workshop manager is responsible for ensuring that competent personnel under her/him use and comply to this procedure so as to carry out PPM. MoH Engineers and Technicians shall use and adhere to the equipment of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineers/Engineering Technicians to prepare documented evidence of the maintenance activities carried out and test results to obtain to determine functionality of the equipment, this shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools

1) Electrical/ electronic tool kit
2) Multimeter
3) Thermometer
4) Electric blower
5) Electrical safety analyzer

Supplies
1) PPE
2) Decontaminating solution (70% alcohol)
3) Lint free cotton cloth

Required Parts
1) Gasket/ Rubber Seals

6. Procedure

This procedure is for the recommended full PPM to be carried out on Hot Air Oven as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on a Hot Air Oven.

6.1 Safety Procedure

1) Disconnect the hot air oven from power. Allow equipment to cool if the temperature is high.
2) Put on hand glove safely to avoid infection.
3) Clean the internal surface and the trays with proper disinfectant (70% Alcohol)

6.2 PPM procedure

1) Carry out visual inspection on hot air oven;
   - Check the outside of hot air oven for any damage
   - Check controls and switches
   - Check condition of the power cord
   - Check door movement, gasket, vents for air circulation
2) Clean the exterior and interior surfaces with lint-free moist cotton cloth
3) Tighten all loose parts, nuts and screws.

6.3 Electrical Safety Tests

1) Check voltage from the mains using a multimeter
2) Carry out Electric current leakage test
3) Carry out Insulation resistance test

6.4 Functionality Tests

1) Check if the circuit system is well connected.(if ground insulation is intact and reliable)
2) Check if the fan is running normally(if abnormal sound,immediatly shut down the machine)
3) Check if the vents of the hot air circulation oven are blocked(clean up the dust in time)
4) Check if the temperature controller is accurate at regular intervals
5) Check if the heating pipe is not damaged

7. Maintenance Check Sheet/List

PPM Check sheet for Boiler				
Health Facility Name				
Date				
Description of procedure		Pass	Fail	Remarks
1.0 Physical inspection				
1.1 Check for physical damage				
1.2 Check for damage on the electrical power code				
1.3 Check all screws, connectors and parts are tightly fitted				
1.4 Check all moving parts move freely, all holes are unblocked				
2.0 Planned Preventive Maintenance				
2.1 Carry out visual inspection				
2.2 Clean the exterior and interior surfaces				
2.3 Tighten all loose parts, nuts and screws				
3.0 Electrical Safety Tests				
3.1 Electric current leakage test				
3.2 Power consumption test				
3.3 Insulation resistance test				
4.0 Functionality Tests				
4.1 Check if the circuit system is well connected				
4.2 Check if the fan is running normally				
4.3 Check if the vents of the hot air circulation oven are blocked				
4.4 Check if the temperature controller is accurate				
4.5 Check if the heating pipe is not damaged				
5.0 Documentation				
5.1 Prepare a job card				
5.2 Attach a service sticker				
PPM carried out by:		Date		
Name:				
Contact:				
Sign:				
Verified By:		Date		
Name:				
Contact:				
Sign:				

8. Revision History

Version Number	Version Date	Section and description of changes made	Name of Authorizing Authority
2020/04/1		First Release	ACHS(BEMS)

9. References and Related Documents

- MoH, Uganda, RWs Operational Manual and Maintenance Guidelines, 2013.

10. Acknowledgements

This SOP was developed by Engineers and Technicians from the MoH and Regional Medical Equipment Maintenance Workshops. The following persons were major contributors in the development of this SOP.

Sitra Mulepo C. S	Senior Engineer (Mechanical), MoH
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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON A BOILER

11. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personal on a Boiler to keep it in a safe working condition.

12. Definitions/Acronyms

- SOP: standard operating procedures
- PPE: Personal Protective Equipment
- PPM: planned preventive maintenance
- HID: Health Infrastructure Department

13. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on Boiler. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on a Boiler. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

14. Roles and responsibilities

The regional Workshop manager is responsible for ensuring that competent personnel under her/him use and comply to this procedure so as to carry out PPM.

MoH Engineers and Technicians shall use and adhere to the equipment of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineers/Engineering Technicians to prepare documented evidence of the maintenance activities carried out and test results to obtain to determine functionality of the equipment, this shall be in the form of a dully filled and signed job card and a maintenance check sheet.

15. Tools and supplies required to undertake PPM

Tools

1) Electrical/ electronic tool kit
2) Multimeter

Supplies
1) PPE
2) Decontaminating solution (70% alcohol)
3) Lint free cotton cloth
4) Descaling agent

Required Parts
1) Heating element
2) Gasket/ Rubber Seals
3) Top plug

16. Procedure

This procedure is for the recommended full PPM to be carried out on Boiler as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on a Boiler.

6.1 Safety Procedure

1) Disconnect the boiler from power.
2) Put on hand glove safely to avoid infection.
3) Disinfect the medical equipment boiler with proper disinfectant (70% Alcohol)
4) Prepare the working environment to work safely.

6.2 PPM procedure

1) Carry out visual inspection on the medical equipment boiler;
   - Check the casing of the machine for any damage
   - Check controls and switches
   - Check condition of the power cord
4) Clean the exterior and interior surfaces with lint-free moist cotton cloth
5) Using a multimeter, check the integrity of the heating element.
6) Use descaling agent (preferably *chamberbright*) to remove any scale deposits.
7) Tighten all loose parts, nuts and screws.

6.3 Electrical Safety Tests

1) Check voltage from the mains using a multimeter
4) Carry out Electric current leakage test
5) Check power consumption
6) Carry out Insulation resistance test

6.4 Functionality Tests

1) Check the thermostat operation, if applicable
2) Check for any pressure leakage

17. Maintenance Check Sheet/List

PPM Check sheet for Boiler				
Health Facility Name				
Date				
Description of procedure		Pass	Fail	Remarks
1.0 Physical inspection				
1.1 Check for physical damage				
1.2 Check for damage on the electrical power code				
1.3 Check all screws, connectors and parts are tightly fitted				
1.4 Check all moving parts move freely, all holes are unblocked				
2.0 Planned Preventive Maintenance				
2.1 Use multimeter to check the heating element integrity				
2.2 Descale the heating element and chamber				
2.3 Clean the interior and exterior of the boiler with a damp cotton cloth				
3.0 Electrical Safety Tests				
3.1 Electric current leakage test				
3.2 Power consumption test				
3.3 Insulation resistance test				
4.0 Functionality Tests				
4.1 Run a cycle and confirm that it boils and thermostat operates				
4.2 Check for any pressure leakage				
5.0 Documentation				
5.1 Prepare a job card				
5.2 Attach a service sticker				
PPM carried out by:		Date		
Name:				
Contact:				
Sign:				
Verified By:		Date		
Name:				
Contact:				
Sign:				

18. Revision History

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19. References and Related Documents

- MoH, Uganda, RWs Operational Manual and Maintenance Guidelines, 2013.

20. Acknowledgements

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Owen Muhimbise	Biomedical Engineer, MoH
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Owen Muhimbise	Biomedical Engineer, MoH

STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON AN ECG MACHINE

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on an ECG Machine to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: Standard operating procedures
- PPM: Planned Preventive Maintenance
- HID: Health Infrastructure Department
- ECG: Electrocardiogram

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on ECG Machine. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on an ECG machine. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Managers responsible for ensuring that competent personnel under her/him use and comply to this procedure to carry out PPM on an ECG Machine. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results to obtained to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools

1) Multimeter
2) Electrical Safety Analyser, Fluke
3) Blower
4) Complete Electro-Mechanical tool kit

5) Soft brush 1''
6) User/service manual

Supplies
1) 70% alcohol
2) Mild detergent and water
3) Gauze or a clean cloth

Required Parts
1) Battery as per manufacturer's recommendation

6. Procedure

This procedure is for the recommended full PPM to be carried out on an ECG Machine as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on an ECG Machine.

6.1 Safety procedures

1) Wear PPE when carrying out any activity on the ECG machine
2) Inspect the equipment for any visible cracks or damage.
3) Disinfect the patient monitor with 70% alcohol or any recommended disinfectant.

6.2 PPM procedures

1) Clean the visible parts of the ECG machine using moist gauze or cloth with water and soap
2) Open the internal parts of the ECG machine clean the PC boards with a fine soft brush.
3) Assemble all internal parts and covers.
4) Verify that the electrodes and clips that attach to the ECG lead wires are clean and not expired.
5) Replace the batteries basing on the status of the battery.
6) Clean the ECG electrodes with 70% alcohol
7) Clean the thermal printer

6.3 Electrical Safety Tests

1) Electrical current leakage test.
2) Electrical current consumption test.
3) Electrical resistance test.

6.4 Functionality Tests

1) Check functioning of the warning alarms and controls
2) Check the general function of ECG Machine
3) Simulate ECG wave forms using the electrical safety analyser

7. Maintenance Check Sheet/List

PPM Check sheet for ECG Machine				
Health Facility Name:				
Date:				
Description of procedure		**Pass**	**Fail**	**Remarks**
1.0 Physical Inspection				
1.1 Check for any physical damage on the equipment				
1.2 Check for damage on electrical power cord				
1.3 Check for missing screw, nut, bolt, etc.				
1.4 physical inspection of the ECG accessories for any damage				
1.5 If thermal printer equipped, check the labeling on the control buttons				
2.0 Planned Preventive Maintenance				
2.1 Blow or clean any dust on the outside/inside the equipment				
2.2 Clean the thermal printer				
2.3 Tighten all loose parts, including electrodes and clips				
2.4 Replace the batteries, if necessary				
2.5 Open and clean the PC board				
3.0 Electrical safety test				
3.1 There is no leakage current				
3.2 Supply voltage is as per recommendation				
3.3 Electrical resistance test				
4.0 Functionality Tests				
4.1 Check functionality of warning alarms and controls				
4.2 Check the general function of the machine				
4.3 Simulate ECG wave forms using the electrical safety analyser				
5.0 Documentation				
5.1 Prepare a job card				
5.2 Attach a service sticker				
PPM carried out by: Name: Contact: Sign:		Date:		
Verified By: Name: Contact: Sign:		Date:		

8. Revision History

Version Number	Version Date	Section and description of changes made	Name of Authorizing Authority
2020/04/1		First Release	ACHS(BEMS)

9. References and Related Documents

10. Acknowledgements

This SOP was developed by Engineers and Technicians from the MoH and Regional Medical Equipment Maintenance Workshops. The following persons were major contributors in the development of this SOP.

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Reuben Mwesigye	Engineering Technician, Electrical, Fort Portal RRH
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Kato Hussein Ssebuliba	Biomedical Engineer, MoH
Franco Omaset	Biomedical Engineering Technician, Hoima RRH
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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PLANNED PREVENTIVE MAINTENANCE ON A PATIENT MONITOR

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on a Patient Monitor to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: Standard operating procedures
- PPM: Planned Preventive Maintenance
- HID: Health Infrastructure Department
- SpO_2: Saturation of Percutaneous Oxygen
- NiBP: Non-invasive Blood Pressure
- ECG: Electrocardiogram

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on Patient Monitor. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on a Patient Monitor. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Managers responsible for ensuring that competent personnel under her/him use and comply to this procedure to carry out PPM on a Patient Monitor. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results to obtained to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools

1) Multimeter
2) Electrical Safety Analyser.
3) Complete Electro-Mechanical tool kit

4) Blower and Soft brush
5) Vital signs simulator

Supplies
1) 70% alcohol
2) Mild detergent and water
3) Gauze or a clean cloth

6. Procedure

This procedure is for the recommended full PPM to be carried out on a Patient Monitor as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure.

6.1 Safety procedures

1) Wear appropriate PPE.
2) Inspect the equipment for any visible cracks or damage.
3) Disinfect the patient monitor with 70% alcohol or any recommended disinfectant.

6.2 PPM Procedure

1) Clean the visible parts of the patient monitor.
2) Open and clean the internal parts of the patient monitor
3) Assemble all internal parts and covers.
4) Test the pulse oximeter probe for signal loss and false readings and this will help you find a replacement pulse oximeter probe, if necessary.
5) Test blood pressure cuffs and tubing for leaks.
6) Inspect temperature probe for cracks and confirm functionality.
7) Verify that the electrodes and clips that attach to the ECG lead wires are clean and not expired.
8) Replace the batteries basing on the expiry date on the battery which varies from manufacturer to manufacturer.

6.3 Electrical Safety Tests

1) Electrical current leakage test on the patient monitor including the applied parts.
2) Electrical current consumption test.
3) Electrical resistance test.

6.4 Functional tests

1) Simulate ECG waveform and NIBP using the ECG simulator/electrical safety analyser and NIBP simulator respectively.
2) Check the functionality of SpO_2 probe, NIBP cuff and temperature probe

7. Maintenance Check Sheet/List

PPM Check sheet for Patient Monitor				
Health Facility Name:				
Date:				
Description of procedure		**Pass**	**Fail**	**Remarks**
1.0 Physical Inspection				
1.1 Check for any physical damage on the equipment				
1.2 Check for damage on electrical power cord				
1.3 Check for missing screw, nut, bolt, etc.				
1.4 Inspect patient cable, leads & probes.				
1.5 Examine all cable connectors				
2.0. Planned Preventive Maintenance				
2.1 Blow or clean any dust on the outside/inside the equipment				
2.2 Tighten all loose parts				
2.3 Verify proper operation and illumination of the display/indicators				
2.4 Verify visual and audio alarms				
2.5 Verify high and low alarm delay				
2.6 Verify asystole alarm delay				
2.7 Check the 1mv step				
3.0 Electrical Safety Tests				
3.1 Ground resistance(<0.5Ω)				
3.2 Chassis leakage(<300μA)				
3.3 Lead leakage				
3.4 Inter-lead leakage				
3.5 Supply voltage is as per recommendation				
4.0 Functionality Tests				
4.1 Test for leaks on the NIBP cuff				
4.2 Check the functionality of the ECG leads and electrodes				
4.3 Check functionality of SPO_2 and temperature probe				
4.4 Simulate ECG wave form				
5.0 Documentation				
5.1 Prepare a job card				
5.2 Attach a service sticker				
PPM carried out by: Name: Contact: Sign:		Date:		
Verified By: Name: Contact: Sign:		Date:		

8. Revision History

Version Number	Version Date	Section and description of changes made	Name of Authorizing Authority
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9. References and Related Documents

10. Acknowledgements

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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON SLIT LAMPS

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on **Slit lamps** to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: Standard operating procedures
- PPM: Planned Preventive Maintenance
- HID: Health Infrastructure Department

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on Slit lamps. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistencies while carrying out PPM on Slit lamps. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Manager is responsible for ensuring that competent personnel under her/him use and comply with this procedure to carry out PPM on Slit lamps. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and test results obtained to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools

1) Complete electromechanical toolkit.
2) Electrical safety analyzer
3) Soft optical dust brush
4) Q-tips
5) Cleaner foam can

6) Blower or compressed air can
7) Service manual

Supplies
1) Lens cleaning fluids, water, mild detergent and alcohol
2) Silicon grease
3) Medical cotton swabs

6. Procedure

This procedure is for the recommended full PPM to be carried out on Slit lamps as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on Slit lamps:

6.1. Safety procedures

1) Inform and agree with the facility in charge and users about the Slit lamp planned maintenance.
2) Wear appropriate PPE before carrying any activity on the equipment.
3) Disconnect Slit lamp from power.
4) Disinfect the Slit lamp with 70% alcohol or other recommended non aggressive disinfecting agents.
5) Carry out physical inspection on the Slit lamp.

6.2 PPM Procedures

1) Clean the entire equipment.
2) Clean all the optical.
3) Lubricate all the moving parts.

6.3 Electrical Safety Tests

1) Supply voltage
2) Earth leakage test
3) Ground resistance test

6.4 Functionality Tests

1) Check the functionality of the light source
2) Check the functionality of all moving parts

7. Maintenance Check Sheet/List

PPM Check sheet for Slit lamp			
Health Facility Name:			
Date:			
Description of procedure	**Pass**	**Fail**	**Remarks**
1.0 Physical inspection			
1.1 Check for any physical damage on the equipment			
1.2 Check for damage on electrical power cord			
1.3 Check for missing screw, nut, bolt, etc.			
2.0 Planned Preventive Maintenance			
2.1 Blow or clean any dust on the outside/inside			
2.2 Lubrication of all moving parts			
2.3 Tighten all loose parts			
3.0 Electrical safety test			
3.1 Check that there is no leakage current			
3.2 Check that the supply voltage is as per recommendation			
4.0 Functionality tests –			
4.1 Check the light source			
4.2 Check all moving parts			
4.3 Calibrate the equipment using applanation Tonometer (at 0,20,and 60)mmHg			
5.0 Documentation			
5.1 Prepare a job card			
5.2 Attach a service sticker			
PPM carried out by: Name: Contact: Sign:	Date:		
Verified By: Name: Contact: Sign:	Date:		

8. Revision History

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9. References and Related Documents

- Orbis International. www.orbis.org Orbis Biomed Educational Kit Version 1.0
- National Center for Biotechnology Information USA, www.ncbi.nlm.nih.slitlamp/maintenance

10. Acknowledgements

This SOP was developed by Engineers and Technicians from the MoH and Regional Medical Equipment Maintenance Workshops. The following persons were major contributors in the development of this SOP.

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<table>
<tr><td rowspan="2">THE REPUBLIC OF UGANDA
MINISTRY OF HEALTH
Health Infrastructure Department</td><td colspan="2">Version Number:

MOH/SOP/BME/Centrifuge/2020/04/1</td><td>Page: 1 of 4</td></tr>
<tr><td>Version Date: ____/___/ 2020</td><td colspan="2">Effectiveness: Date: ____/___/ 2020</td></tr>
<tr><td>Document Name:</td><td colspan="2">Standard Operating Procedure (SOP) for carrying out Planned Preventive Maintenance on a Centrifuge</td><td>Reviewed and Approved by: ACHS(BEMS)</td></tr>
<tr><td>Authorizing Signature</td><td colspan="3"></td></tr>
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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON A CENTRIFUGE

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on a Centrifuge to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: Standard operating procedures.
- RPM: Revolutions Per Minute
- DUT: Device Under Test
- PPE: Personal Protective Equipment
- ESA: Electrical Safety Analyser
- PM: Planned Preventive Maintenance
- HID: Health Infrastructure Department

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on Centrifuge. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on a Centrifuge. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Manager is responsible for ensuring that competent personnel under her/him use and comply to this procedure to carry out PPM on Centrifuge. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results to obtained to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools

1) Electrical Safety Analyzer
2) Blower
3) Tachometer

4) Stop clock
5) Reflector
6) Multimeter
7) Standard electrical tool kit
8) Blower & brush
9) Spirit level

Supplies
1) Alcohol 70%
2) Liquid Soap
3) Penetrating oil.
4) Grease
5) Personal Protective Equipment

Required parts (have on hand or in stock prior to starting PPM)
1) Carbon brush
2) Fuses

6. Procedure

This procedure is for the recommended full PPM to be carried out on Centrifuge as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on Centrifuge.

6.1 Safety Procedures

1) Wear PPE equipment.
2) Disconnect centrifuge from power
3) Wipe centrifuge's internal and external surfaces with lint-free cloth dipped in 70% Alcohol

6.2 PPM Procedure

1) Perform visual Inspection on the Centrifuge, power cable, buckets, rotor, carbon brush, timer and electrical components
2) Clean the mechanical parts of the Centrifuge with damp cloth.
3) Clean and remove any debris from the centrifuge chamber.
4) Blow inside the centrifuge with blower.
5) Lubricate the rotors with grease.
6) Check the centrifuge speed with Tachometer
7) Replace any parts if necessary.

6.3 Electrical Safety Tests

1) Carry out the electrical current leakage test and record the value.
2) Carry out electrical current consumption test and record the value.
3) Carry out the electrical resistance test.
4) Carry out voltage test.

6.4 Functionality Tests

1) Verify the speed of the centrifuge.
2) Verify the functionality of the timer
3) Verify the functionality of the alarms

7. Maintenance Check Sheet/List

PPM Check sheet for Centrifuge				
Health Facility Name:				
Date:				
Description of procedure		**Pass**	**Fail**	**Remarks**
1.0 Physical inspection				
1.1 Check for any physical damage on the equipment				
1.2 Check for damage on electrical power cord				
1.3 Check for missing screw, nut, bolt, etc.				
1.4 Check the rotor for any defects				
1.5 Check the control knobs for any defects				
1.6 Check the door hinges and door lock				
2.0 PPM Procedure				
2.1 Clean all parts of the centrifuge with 70% alcohol				
2.2 Use blower to remove debris				
2.3 Verify the rotor speed using a tachometer				
2.4 Replace carbon brushes if necessary				
2.5 Lubricate moving parts(shaft and rotor hinges) with grease.				
3.0 Electrical Safety Tests				
3.1 Check for leakage current (<500µA)				
3.2 Check that supply voltage is as per recommendation				
3.3 Check ground resistance. (< 0.4 Ω)				
3.4 Check electrical insulation resistance (>20M Ω)				
4.0 Functionality Tests				
4.1 Use a tachometer to measure the speed of the centrifuge (record set speed on DUT and actual speed)				
4.2 Verify that the alarms are responsive				
4.3 Verify that the timer is working				
5.0 Documentation				
5.1 Prepare a job card				
5.2 Attach a service sticker				

PPM carried out by:		Date:
Name:		
Contact:		
Sign:		
Verified By:		Date:
Name:		
Contact:		
Sign:		

8. Revision History

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9. References and Related Documents

- MoH, Uganda, RWs Operational Manual and Maintenance Guidelines, 2013.

10. Acknowledgements

This SOP was developed by Engineers and Technicians from the MoH and Regional Medical Equipment Maintenance Workshops. The following persons were major contributors in the development of this SOP.

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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON MICROSCOPES

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on a Microscope to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: Standard operating procedures
- PPM: Planned Preventive Maintenance
- PPE: Personal Protective Equipment.
- HID: Health Infrastructure Department
- HD: Hospital Director
- BME: Biomedical Engineer
- AEO: Assistant Engineering Officer
- ET: Engineering Technician

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on Microscopes. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on Microscopes. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Managers responsible for ensuring that competent personnel under her/him use and comply to this procedure to carry out PPM on Microscopes. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results obtained to determine functionality of the equipment. This shall be in the form of a dully filled and signed Job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM for microscopes

Tools

1) Complete Electro-Mechanical Tool kit.
2) Multimeter.

Supplies

1) Alcohol 70%.
2) PPE
3) Cleaning materials (soft brush, hand gloves, liquid soap and gauze/cleaning cloths, lint-free Q tips, lens cleaner)
4) Penetrating oil.
5) Grease
6) Bulbs

6. Procedure

This procedure is for the recommended full PPM to be carried out on Microscopes as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on Microscopes.

6.1 Safety Procedures

1) Wear appropriate PPE.
2) Disconnect microscope from power.
3) Disinfect microscope with 70% alcohol or any other recommended disinfectant.

6.2 PPM Procedure

1) Carry out physical inspection on equipment (Body, table, slide clip, Eye piece, lenses, light source)
2) Clean visible parts of the microscope using moist gauze or cloth with water and soap.
3) Clean the PC board with fine soft brush and the reflector with soft cloth/Q tip.
4) Clean coarse and fine adjustment gears with penetrating oil and grease them.
5) Assemble all internal parts and cover the microscope.
6) Disconnect all optics from the microscope one by one (ocular lenses/ eyepieces, objective lenses, illuminator, condenser and light filter) clean them using lens cleaner and Q tips. Cleaning is in circular motion from center going out.
7) Clean the mechanical stage with soap, water and gauze and use penetrating oil to clean stage bearings.
8) Lubricate stage coordinates and grease stage bearings.
9) Assemble back all optics and mechanical stage accordingly.
10) Document work done.

6.3 Electrical Safety Tests

1) Carry out the electrical current leakage test and record the value.
2) Carry out power consumption test and record the value.

3) Carry out the electrical resistance test.
4) Carry out voltage test.

6.4 Functionality Tests

1) Confirm functionality of objective and eye piece(s) with the user
2) Check quality of the image at different magnifications.

7. Maintenance Check Sheet/List

PPM Check sheet for Microscopes				
Health Facility Name:				
Date:	__/__/__			
Description of Procedure		**Pass**	**Fail**	**Remarks**
1.0 Physical Inspection				
1.1 Check for any physical damage.				
1.2 Check for damage on electrical power cord				
1.3 Check for missing screw, nut, bolt, etc.				
1.4 Check diaphragm for any defect.				
1.5 Check the condenser				
1.6 Check the illuminator or light source				
1.7 Check the revolving nose-piece				
1.8 Check the color filter				
1.9 Check the variable light intensity switch				
1.10 Check ON/OFF switch.				
1.11 Check the mechanical stage functionality (coarse & fine adjustment)				
1.12 Check the brightness of the bulb by adjusting the light intensity knob				
2.0 Planned Preventive Maintenance				
2.1 Clean the microscope				
2.2 Clean the eyepieces and objectives with Q tips.				
2.3 Clean and lubricate mechanical stage and stage coordinates.				
2.4 Clean the illuminator/light source				
2.5 Clean condenser and diaphragm				
2.6 Clean light reflecting mirror				
2.7 Tighten all loose parts – nuts, screws, bolts				
3.0 Electrical Safety Inspection				
3.1Check Leakage current (<500µA)				
3.2 Check power consumption				
3.3 Check Ground resistance. (< 0.4 Ω)				
3.4 Check electrical insulation resistance (>20M Ω)				

3.5 Check that the supply voltage is as per recommendation				
4.0 Functionality tests				
4.1 Confirm functionality of objective and eye piece(s) with the user.				
4.2 Check quality of the image at different magnifications.				
5.0 Documentation				
5.1 Prepare a job card				
5.2 Attach a service sticker				
PPM carried out by:		Date: ……		
Name:				
Contact:				
Signature:				
Verified By:		Date: ……		
Name:				
Contact:				
Signature:				

8. Revision History

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9. References and Related Documents

- Olympus CX21 Maintenance Manual for maintenance engineer

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STANDARD OPERATING PROCEDURE FOR CARRYING OUT PREVENTIVE MAINTENANCE ON THE GENEXPERT MACHINE

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on GeneXpert to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: Standard operating procedures
- PPM: Planned Preventive Maintenance
- HID: Health Infrastructure Department
- TB: Tuberculosis
- HIV: Human Immune Virus
- MDR: Multiple Drug Resistance
- ESA: Electrical Safety Analyzer

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on GeneXpert. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on GeneXpert. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Manager is responsible for ensuring that competent personnel under her/him use and comply to this procedure to carry out PPM on GeneXpert MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.
It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results to obtain to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools
1) Complete electromechanical toolkit.
2) Blower
3) Multimeter
4) Electrical Safety Analyzer
5) Brushes
6) Appropriate PPE

Supplies
1) Glutaraldehyde-based disinfectant
2) 70% ethanol solution
3) Lint-free wipes / non-cotton swabs
4) Distilled water
5) Liquid soap

Required Parts
1) Replacement fan filters
2) Cartridges

6. Procedure

This procedure is for the recommended full PPM to be carried out on GeneXpert as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on the GeneXpert machine.

6.1 Safety procedure

1) Wear appropriate PPE.
2) Disconnect equipment from the mains power supply.
3) Disinfect the machine.

6.2 PPM Procedure

6.2.1 Cleaning the Surface

1) Thoroughly moisten a lint-free wipe or paper towel with the 70% ethanol solution and wipe all surfaces outside the instrument. Change lint-free wipes or paper towels frequently.
2) Move the GeneXpert instrument and wipe the table surfaces underneath and around the instrument. Change lint-free wipes or paper towels frequently while wiping.
3) Discard used wipes or paper towels according to your standard laboratory procedure.

6.2.2 In Case of Spill

Clean affected exterior instrument surfaces in the event of a spill as follows;

1) Thoroughly moisten a lint-free wipe or paper towel with the 1:10 bleach solution
2) Wipe affected surfaces on the instrument. Change wipes or paper towels frequently while wiping.
3) Allow the bleach solution to remain on the surfaces for at least two minutes but no longer than five minutes.
4) Repeat Step 1 through Step 3 two more times for a total of three times.
5) Thoroughly moisten a lint-free wipe or paper towel with the 70% ethanol solution.
6) Wipe affected surfaces on the instrument. Change wipes or paper towels frequently while wiping.
7) Discard used wipes or paper towels according to your standard laboratory procedure.

6.2.3 Cleaning the Cartridge Bays

1) Moisten a lint free wipe with 1:10 solution of chlorine bleach.
2) Wipe the inside of the cartridge bay, inside of the door and the top lip of the door. **Wait for 2 minutes.**
3) Moisten a lint free wipe with 70% ethanol solution (**this is done once.)**
4) Wipe the inside parts described above with the ethanol solution.
5) Change lint free wipes frequently while wiping.

6.2.4 Plunger rods cleaning procedure

1) Moisten a lint free wipe with 1: 10 solution of house hold chlorine bleach
2) After the plunger rods are lowered, gently wipe the plunger rods. Wait for 2 minutes
3) Moisten a lint free wipe with 70% ethanol solution **this is done once**
4) Wipe the plunger rods with ethanol solution
5) Change lint free wipes frequently while wiping.

6.2.5 Cleaning module PCR slot

1) Remove cartridge from the module
2) Make sure that all the brittles are fully inserted
3) Brush the inside of the slot with up and down movement
4) Rotate the brush for approximately 180 degree and back, then repeat the previous step 2 times
5) Clean each module for at least 30 seconds

6.2.6 Cleaning the fan filter

1) Turn off the system and remove the four screws on the rear grey panel
2) Tilt back the panel
3) Unclip the 4 clips one by one and remove the sponge
4) Wash the filter with water and soap
5) Dry it between two paper towels.
6) Ensure that the filter is completely dry before putting it back

6.3 Electrical Safety Tests

1) Carry out the Earth leakage test
2) Check the Insulation resistance

6.4 Functionality Tests

1) Confirm that all modules are functioning well

7. Maintenance Check Sheet/List

PPM Check sheet for GeneXpert Machine			
Health Facility Name:			
Date:			
Description of procedure	**Pass**	**Fail**	**Remarks**
1.0 Physical inspection			
1.1 Check for any physical damage to case, display, mounts, cartridge bays			
1.2 Check the switches			
1.3 Check power cord, accessory cables, charger, barcode scanner			
1.4 Check the condition of module doors, filters and vents.			
2.0 Planned Preventive Maintenance			
2.1 Clean instrument surface			
2.2 Clean cartridge bay			
2.3 Clean plunger rods			
2.4 Clean module PCR tube slots			
2.5 Clean fan filter			
2.6 Tighten all loose parts			
3.0 Electrical safety Tests			
3.1 Carry out earth leakage/ground wire resistance test			
3.2 Carry out the Insulation test (optional) 500Vdc			
4.0 Functionality Tests			
4.1 Check the functionality of all modules			
5.0 Documentation			
5.1 Prepare a job card			
5.2 Attach a service sticker			
PPM carried out by: Name: Contact: Sign:	Date:		
Verified By: Name: Contact: Sign:	Date:		

8. Revision History

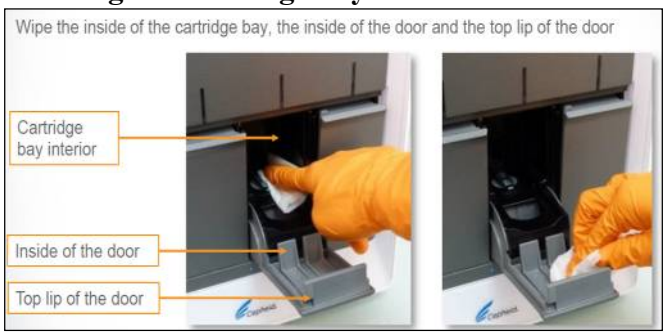
Version Number	Version Date	Section and description of changes made	Name of Authorizing Authority
2020/04/1		First Release	ACHS(BEMS)

9. References and Related Documents

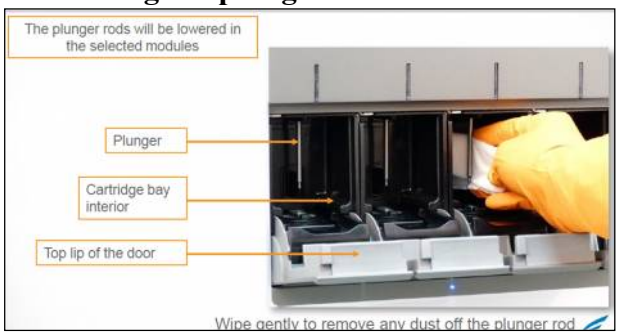
- Cepheid HBDC training session Hand book

10. Appendices

Cleaning the cartridge bay

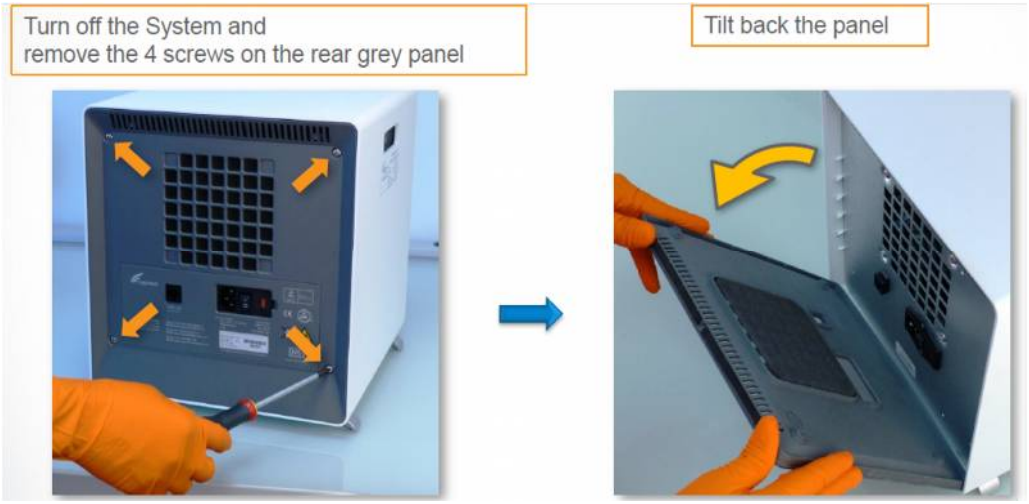


Cleaning the plunger rods



Cleaning module PCR slot

Cleaning the fan filters



11. Acknowledgements

This SOP was developed by Engineers and Technicians from the MoH and RWs. The following persons were major contributors in the development of this SOP.

Sitra Mulepo C. S	Senior Engineer (Mechanical), MoH
Ogen-Mungu Ronald	Biomedical Engineer, Fort Portal RRH
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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON THE PIMA CD4 ANALYZER

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on the PIMA CD4 Analyzer to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: Standard operating procedures
- Planned Preventive Maintenance (PPM):
- HID: Health Infrastructure Department
- CD4: Cluster of Differentiation 4, immune cells.
- USB: Universal Serial Bus.

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on the PIMA CD4 Analyzer. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on the PIMA CD4 Analyzer. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Managers responsible for ensuring that competent personnel under her/him use and comply to this procedure to carry out PPM on the PIMA CD4 Analyzer. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results to obtained to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools
1) Electrical Safety Analyzer
2) Electromechanical toolkit
3) Soft Cloth

Supplies
1) Alcohol 70 %
2) Gauze
3) Liquid Soap
4) Bead Standard (Low and High)

6. Procedure

This procedure is for the recommended full PPM to be carried out on PIMA CD4 Analyzer as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on PIMA CD4 Analyzer.

6.1 Safety Procedure

1) Notify and agree with facility in-charge about the PPM.
2) Wear appropriate PPE.
3) Isolate the equipment from the mains power source.
4) Disinfect appropriate parts.

6.2 PPM

1) Perform a physical inspection on all the external parts.
2) Clean the body and the printer with a damp cloth.
3) Check the battery status. Clean the battery terminals and apply grease.
4) Check the inbuilt thermal printer, lubricate the gears and align the thermal paper.
5) Check the cartridge and replace if necessary.

6.3 Electrical Safety Test

1) Carry out Insulation Resistance test
2) Check Earth leakage current
3) Check power consumption

6.4 Functionality Test

1) Inspect the integrity of the USB ports.
2) Run the beads standard quality control.

7. Maintenance Check sheet/List

PPM Check sheet for the PIMA CD4 Analyzer				
Health Facility Name:				
Date:				
Description of procedure		**Pass**	**Fail**	**Remarks**
1.0 Physical Inspection				
1.1 Check for any physical damage on the equipment				
1.2 Check for damage on electrical power cord				
1.3 Check for missing screws, nuts, bolts, etc.				
2.0 Planned Preventive Maintenance				
2.1 Clean any dust on the outside/ the equipment				
2.2 Tighten all loose screws, nuts and bolts				
2.3 Check battery status. Clean battery terminals and connectors and apply grease.				
2.4 Check the cartridge and replace if necessary.				
2.5 Check thermal printer gear system, paper alignment and lubricate.				
3.0 Electrical Safety Tests				
3.1 Check Insulation Resistance				
3.2 Check main supply voltage				
3.3 Check Earth leakage current				
3.4 Check power consumption				
4.0 Functionality Tests				
4.1 Inspect the integrity of the USB ports				
4.2 Run the bead Standard quality control				
5.0 Documentation				
5.1 Prepare a job card				
5.2 Attach a service sticker				
PPM carried out by: Name: Contact: Sign:		Date:		
Verified By: Name: Contact: Sign:		Date:		

8. Revision History

Version Number	Version Date	Section and description of changes made	Name of Authorizing Authority
2020/04/1		First Release	ACHS(BEMS)

9. References and Related Documents

- Alere Pima CD4, End User Training Manual Version 2 (18/06/2014)

10. Acknowledgements

This SOP was developed by Engineers and Technicians from the MoH and Regional Medical Equipment Maintenance Workshops. The following persons were major contributors in the development of this SOP.

Sitra Mulepo C. S	Senior Engineer (Mechanical), MoH
Segane Ashrea	Biomedical Engineering Technician, Kabale RRH
Ogen-Mungu Ronald	Biomedical Engineer, Fort Portal RRH
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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING PREVENTIVE MAINTENANCE ON A DENTAL UNIT AND DENTAL CHAIR

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on a *Dental Unit and Dental Chair* to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: Standard operating procedures
- PPM: Planned Preventive Maintenance
- HID: Health Infrastructure Department
- PPE: Personal Protective Equipment.

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on a Dental Unit and Dental Chair. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on a *Dental Unit and Dental Chair*. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Manager is responsible for ensuring that competent personnel under her/him use and comply to this procedure to carry out PPM on a *Dental Unit and Dental Chair*. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results to obtained to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools

1) Multi-meter
2) Complete electromechanical toolkit
3) Electrical Safety Analyser
4) Blower

5) Brush
6) Appropriate PPE

Supplies
1) Hydraulic oil
2) Grease
3) 70% Alcohol Gauze
4) Liquid soap
5) Glutaraldehyde-based disinfectant.

Required Parts
1) Assorted O-rings

6. Procedure

This procedure is for the recommended full PPM to be carried out on a Dental Unit and Dental Chair as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on a Dental Unit and Dental Chair:

6.1 Safety procedure

1) Wear appropriate PPE
2) Switch off water and electricity supply, and the machine including air compressor
3) Disinfect the machine

6.2 PMM Procedure

1) Physical inspection for any possible damage and cracks on the dental unit and its accessories
2) Check hydraulic level
3) Check water supply and drainage system
4) Check electrical terminals
5) Check for any leaks
6) Drain the compressor condensate water

6.3 Electrical safety Tests

1) Current leakage
2) Insulation resistance

6.4 Functionality Tests

1) Check the pneumatic system e.g. functionality of hand pieces
2) Check mechanical system e.g. hydraulic system and its movement
3) Check electrical system e.g. bulbs and switches
4) Check functionality of pressure switch
5) Check water supply to the dental unit

7. Maintenance Check Sheet/List

PPM Check sheet for Dental Unit and Dental Chair			
Health Facility Name:			
Date:			
Chair Serial No:			
Description of procedure	**Pass**	**Fail**	**Remarks**
1.0 Physical inspection and PPM			
1.1 Check for any damage and cracks on the dental chair, compressor, power cable			
1.2 Check water supply and drainage system			
1.3 Check electrical system			
1.4 Check for any leaks in pneumatic and hydraulic systems			
1.5 Drain the compressor condensate water			
1.6 Check Dental unit and Chair movements			
1.7 Grease and lubricate all moving parts			
1.8 Top up or replace hydraulic oil as necessary			
2.0 Electrical safety Tests			
2.1 Carry out current leakage test			
2.2 Carry out Insulation resistance test			
3.0 Functionality Tests			
3.1 Pneumatic system (hand pieces, air turbine, pressure valve etc.)			
3.2 Mechanical system (hydraulic system and its movement)			
3.3 Electrical system (light source and switches)			
3.4 Functionality of pressure switches			
3.5 Water supply to the dental unit			
4.0 Documentation			
4.1 Prepare a job card			
4.2 Attach a service sticker			
PPM carried out by: Name: Contact: Sign:			
Verified By: Name: Contact: Sign:	Date:		

8. Revision History

Version Number	Version Date	Section and description of changes made	Name of Authorizing Authority
2020/04/1		First Release	ACHS(BEMS)

9. References and Related Documents

- A-Dec Dental Service Course Training Material
- MoH, Uganda, RWs Operational Manual and Maintenance Guidelines, 2013.

10. Acknowledgements

This SOP was developed by Engineers and Technicians from the MoH and Regional Medical Equipment Maintenance Workshops. The following persons were major contributors in the development of this SOP.

Stephen Onyolo	Assistant Engineering Officer, Mechanical, Gulu RRH
Ecomu Thomas	Assistant Engineering Officer, Electrical Hoima RRH
Martin Engulu	Engineering Technician, Mechanical, Hoima RRH
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John Kateera	Assistant Engineering Officer, Mechanical Central Workshop, Wabigalo

STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON SOLAR PHOTOVOLTAIC SYSTEMS

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on Solar Photovoltaic (PV) systems to keep it in a safe working condition.

2. Definitions/Acronyms

SOP:	Standard Operating Procedures
PPM:	Planned Preventive Maintenance
PPE:	Personal Protective Equipment
HID:	Health Infrastructure Department
PV	Photovoltaic
LED	Light Emitting Diode

3. Scope

This SOP is for MOH Engineers and Technicians to conduct PPM on Solar PV Systems. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on Solar PV Systems. It is not designed for PPM activities carried out by the user of Solar PV Systems on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Manager is responsibility for ensuring that competent personnel under her/him use and comply to this procedure to carry out PPM on Solar PV Systems. MoH Engineers and Engineering Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results obtained to determine functionality of the equipment. This shall be in the form of a dully filled and signed Job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools

1) Multimeter
2) Hydrometer
3) Electromechanical tool kit

4) Blower
5) Megger
6) Wire management clips and zip-ties
7) Ladder
8) Brush
9) Plastic funnel
10) PPE (Lather or insulated gloves, Safety goggles, hard hat)
11) Bucket

Supplies
1) Grease
2) Rag for cleaning
3) Water
4) Battery electrolyte

Required Parts
1) Bulbs/lamps
2) Fuses, switches, bulb holders and sockets
3) Battery

6. Procedure

This procedure is for the recommended full PPM to be carried out on a solar PV system as recommended by the manufacturer. The following sequential steps shall be followed to carry out PPM procedure on a Solar PV system.

6.1 Safety Procedures

1) Inform and agree with the facility In-Charge and users about the planned Solar PV system shutdown.
2) Wear appropriate PPE.
3) Isolate solar PV array.

6.2 PPM Procedure

1) Inspect the solar PV system for any damage and take corrective action.
2) Remove any obstructions causing shading on the solar array.
3) Blow/clean dust/dirt on the outside/inside of the charge regulator, inverter and electrical control box.
4) Check the firmness of all electrical and mechanical connections. Tighten all loose screws, nuts and bolts.
5) Check the battery electrolyte levels where applicable and top up as necessary. Replace faulty batteries when necessary.
6) Clean battery terminals and connectors and apply grease. Tighten loose battery terminals and connectors.

6.3 Electrical Safety Test

1) Check effectiveness of the earthing system.
2) Check inverter output voltage

6.4 Functionality Test

1) Measure solar array output voltage before the DC disconnect and compare it with voltages at the charge controller terminals.
2) Check functionality of the changeover switch (where available) and circuit breakers.
3) Test inverter load detection by switching on recommended lowest detectable load by the inverter under test (if equipped).

7. Maintenance Check Sheet/List

PPM Check sheet for Solar PV Systems			
Health Facility Name:			
Date:			
Description of Procedure	**Pass**	**Fail**	**Remarks**
1.0 Physical Inspection			
1.1 Check and confirm the following components are intact and functioning well			
1) Solar PV Modules			
2) Charge regulators			
3) Inverters			
4) Switch gears			
1.2 Check cables to the junction boxes for any damage, looseness and fix as appropriate.			
2.0 Planned Preventive Maintenance			
2.1 Clean any dust, dirt/debris and trapped insects inside the charge regulator, inverter, light fittings/fixtures and switch gears.			
2.2 Check and confirm that all junction boxes and breaker boxes are clean and firmly fixed on the support structure with no missing screws/bolts/nuts, not clogged with insects/dirt and not water logged.			
2.3 Clean the solar PV modules and inspect solar modules for any cracks on the glass plate. Replace modules with damaged glass plate.			
2.4 Check and Clean the battery and battery box of any dust/dirt and rodent deposits.			
2.5 Clean any corrosion on the battery terminals and apply grease on the terminals. Tighten loose battery cables, clamps and connectors if necessary.			

3.0 Electrical Safety Tests				
3.1 Check the effectiveness of the earthing system				
3.2 Check inverter output voltage				
4.0 Functionality Tests				
4.1 Measure voltage before and after the DC disconnect.				
4.2 Check the functionality of changeover switch.				
4.3 Carry out inverter load detection test				
5.0 Documentation				
5.1 Prepare a job card				
5.2 Attach a service sticker				
PPM carried out by:			Date: …… ……	
Name:				
Contact:				
Signature:				
Verified By:			Date: …… ……	
Name:				
Contact:				
Signature:				

8. Revision History

Version Number	Version Date	Section and description of changes made	Name of Authorizing Authority
2020/04/1		First Release	ACHS(BEMS)

9. References and Related Documents

- A Practical Guide to Solar Photovoltaic Systems for Technicians, by Jean – Paul Louineau.
- Energy for Rural Transformation Programme, Health Component, Solar PV Energy Packages User's Manual, October 2018, Health Infrastructure Department, MoH

10. Acknowledgements

This SOP was developed by Engineers and Technicians from the MoH and Regional Medical Equipment Maintenance Workshops. The following persons were major contributors in the development of this SOP.

Sitra Mulepo C. S	Senior Engineer (Mechanical), MoH
Segane Ashrea	Biomedical Engineering Technician, Kabale RRH
Ogen-Mungu Ronald	Biomedical Engineer, Fort Portal RRH
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MINISTRY OF HEALTH
Health Infrastructure Department</td><td colspan="2">Version Number:

MOH/SOP/BME/GENERATOR/2020/04/1</td><td>Page: 1 of 6</td></tr>
<tr><td>Version Date: / / 2020</td><td colspan="2">Effectiveness: Date: ____/___/ 2020</td></tr>
<tr><td>Document Name:</td><td colspan="2">Standard Operating Procedure (SOP) for carrying out Planned Preventive Maintenance on a Diesel/Petrol Generator Set</td><td>Reviewed and Approved by: ACHS(BEMS)</td></tr>
<tr><td>Authorizing Signature</td><td colspan="3"></td></tr>
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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON A DIESEL/PETROL GENERATOR SET

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on a Diesel/Petrol Generator Set to keep it in a safe working condition.

2. Definitions/Acronyms

SOP:	Standard operating procedures
PPM:	Planned Preventive Maintenance
PPE:	Personal Protective Equipment
HID:	Health Infrastructure Department

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on Diesel/Petrol Generator Set. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on a Diesel/Petrol Generator Set. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Manager is responsible for ensuring that competent personnel under her/him use and comply to this procedure to carry out PPM on a Diesel/Petrol Generator Set. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results obtained to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools

1) Mechanics/Electricians tool kit
2) Filter spanner
3) Spark plugs
4) Plug spanner
5) Toque wrench

6) Tachometer
7) Hydrometer
8) Insulation tester
9) Infrared measurement meter
10) Vibration measuring equipment
11) Funnel
12) Ladder
13) Coolant sampling collection bottles
14) Oil sampling collection bottle
15) Used oil collection container
16) Appropriate PPE

Supplies
1) Engine oil (Diesel/Petrol)
2) Distilled water
3) Cleaning materials (Cotton waste, Detergent OMO)
4) Plastic bags for storage of used oil filters

Required Parts
1) Functional battery
2) Oil filters
3) Air filters
4) Fuel filters

6. Procedure

This procedure is for the recommended full PPM to be carried out on a Diesel/Petrol Generator Set as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on a Diesel/Petrol Generator Set:

6.1 Safety Procedures

1) Inform and agree with the operator and users about the planned generator shutdown.
2) Use proper PPE when handling hazardous materials – fuels, battery electrolyte and lubricants.
3) De-energize, tag and lock out circuits and all powered equipment. Disable automatic starting circuits and confirm that all supplied circuits are dead before starting work.
4) Ensure ready access to working fire extinguishers.
5) Make sure there is no open flame or smoking in the generator room.
6) Use safety type fuel cans only
7) Remove the radiator pressure relief cap with care. Steam may spray outward under high pressure.

6.2 PPM Procedure

1) Perform a walk around inspection of generator and carry out checks on the following: Engine, Alternator, Fuel System, Voltage Regulator, Cooling & Exhaust System, Switch gear, Lubrication System, Battery and battery Charger & Control Panel. Record any equipment damage or malfunction.
2) Wipe down and clean the generator of any dust and oil deposits.
3) Check for any exhaust, oil, coolant, or fuel leakage. Rectify as appropriate.
4) Check electrical connections and switch gear for any loose connections and electric arcing/overheating. Tighten loose nuts/bolts/screws or replace as necessary.
5) Measure the specific gravity of battery electrolyte. Add distilled water if necessary.
6) Clean the battery terminals and connectors of any sulphate deposits and apply grease.
7) Check engine oil level and top up or change as necessary.
8) Check coolant level and top up or change as necessary.
9) Check radiator hose/pipe for wear and cracks. Replacement hose/pipe and clear blockages if necessary.
10) Clean the engine air pre-cleaner.
11) Check condition of fan belts and change if necessary.
12) Check the condition indicators for the air and fuel filters. Clean or change the filter as maybe necessary
13) Check and record fuel level. Never leave the generator without fuel.
14) Drain water and sediment from the fuel tank. Clean fuel strainer or replace as necessary.
15) Drain the exhaust condensate trap and clean any deposit soot in the exhaust pipe.
16) Reconnect circuits and loads and put generator back to service.

6.3 Electrical Safety and Functionality Tests

1) Perform a one-hour system operational test under full load conditions and record generator speed in R.P.M., voltage, amperes, frequency, power factor, engine temperatures, engine oil pressure, hour meter readings.
2) Inspect the annunciator panel for proper operation.
3) Test safety shut-off switch.
4) Check functionality of the condition indicators for the air and fuel filters.

7. Maintenance Check sheet/List

PPM Checklist for a Diesel/Petrol Generator			
Health Facility Name:			
Date:			
Description of Procedure	**Pass**	**Fail**	**Remarks**
1.0 Physical Inspection			
1.1 Check and confirm that the following generator components and accessories are intact – Engine, Radiator, alternator, Turbocharger, fuel system, voltage regulator, cooling & exhaust system, switch gear, lubrication system, battery and battery charger & control panel.			
1.2 Check radiator hoses for wear and cracks. Replacement if necessary.			
1.3 Check for damage to any generator component or accessory.			
1.4 Check for any loose electrical connections, nuts/bolts/screws and switch gears and signs of overheating/arcing.			
1.5 Check condition of fan belts, battery terminals, cables and connectors.			
2.0 Electrical Safety and Functionality Tests			
2.1 Check that there is no leakage current			
2.2 Perform a one-hour system operational test under full load conditions and record generator engine speed in R.P.M., voltage, Ampere, frequency, power factor, engine temperatures, engine oil pressure, hour meter readings			
2.3 Check charging system for proper operation			
2.4 Inspect the central control panel and confirm that all warning lights and alarms are operating properly			
2.5 Test safety shut-off control devices – changeover switch, emergency stop switch.			
3.0 Planned Preventive Maintenance			
3.1 Wipe down and clean the generator of any dust and oil deposits			
3.2 Firmly fixed electrical connections, switch gears and tighten loose nuts/bolts/screws.			
3.3 Check battery terminal for sulphate deposits or corrosion. Clean battery terminals and smear with grease.			
3.4 Check battery electrolyte condition (i.e. specific gravity). Top up battery electrolyte with distilled water; or drain and replace battery electrolyte if required.			
3.5 Check engine oil level and top up or change as necessary.			
3.6 Check coolant level and top up or change as necessary.			
3.7 Check and clean the engine air pre-cleaner.			

3.8 Check the condition of indicator lights/LEDs for the air and fuel filters. Clean or change the filter as maybe necessary.				
3.9 Check and drain water and sediments from the fuel tank. Clean fuel strainer or replace as necessary.				
3.10 Drain the exhaust condensate trap and clean any deposit soot in the exhaust pipe.				
3.11 Check and record fuel level. Never leave the generator without fuel				
3.12 Measure and record stator winding temperature (^{0}C)				
3.13 Measure and record bearing temperature (^{0}C)				
3.14 Test for vibration at various loads on the load bank (Hz)				
3.15 Check charging system for proper operation.				
3.16 Check for any exhaust, oil, coolant, or fuel leakage.				
3.17 Check Radiator fins for any clogging				
4.0 Documentation				
4.1 Prepare a job card				
4.2 Attach a service sticker				

PPM carried out by:		Date: ……
Name:		
Contact:		
Signature:		
Verified By:		Date:
Name:		
Contact:		
Signature:		

8. Revision History

Version Number	Version Date	Section and description of changes made	Name of Authorizing Authority
2020/04/1		First Release	ACHS(BEMS)

9. References and Related Documents

- Caterpillar Generator Preventive Maintenance Checklist, Document Code: GN43SA, April 2017
- Cummins Northwest Generator System Preventive Maintenance and Contingency Planning Manual, 2012

10. Acknowledgements

This SOP was developed by Engineers and Technicians from the MoH and Regional Medical Equipment Maintenance Workshops. The following persons were major contributors in the development of this SOP.

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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON AN OXYGEN PLANT

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on an Oxygen Plant to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: Standard operating procedures
- PPM: Planned Preventive Maintenance
- PPE: Personal Protective Equipment
- HID: Health Infrastructure Department

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on Oxygen Plant. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on an Oxygen Plant. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Manager is responsible for ensuring that competent personnel under her/him use and comply to this procedure to carry out PPM on an Oxygen Plant. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results obtained to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools

1) Oxygen plant tool kit (Ring spanners, Fix spanners, Adjustable spanners, Filter spanner, Star screw drivers, Flat/ Minus screw drivers etc.)
2) Multimeter
3) Clamp meter
4) Portable oxygen analyzer

5) Blower
6) Ladder
7) Oil Funnel
8) Used oil collection container
9) Air Oil separator
10) Motor belts

Supplies
1) Air compressor oil filter
2) Air compressor Standard or Synthetic nondetergent oil SAE 30/40
3) Appropriate PPE
4) Cleaning materials

6. Procedure

This procedure is for the recommended full PPM to be carried out on an Oxygen Plant as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on an Oxygen Plant.

6.1 Safety Procedures

1) Inform and agree with the operator and users about the planned oxygen plant shutdown.
2) Wear appropriate PPE and follow site safety procedures.
3) Switch off the mains power supply.
4) Shutdown air compressor and push the emergency stop button before starting any maintenance work on the air compressor.
5) Ensure ready access to working fire extinguishers.
6) Make sure there is no open flame or smoking in the oxygen plant room.
7) Obtain and review manufacturer maintenance instructions.

6.2 PPM Procedure

1) Perform a walk around inspection of oxygen plant and carry out checks on valves, horse pipes, pressure gauges and v-belts for damage or malfunction. Record any equipment damage or malfunction.
2) Using pressurized air, blow dust off the oxygen plant equipment and wipe the outer surfaces of the equipment with a dump cloth to clean dust and other Debris. Do not use aggressive cleaning agents.
3) Check electrical connections and switch gear for any loose connections and electric arcing/overheating. Tighten loose nuts/bolts/screws or replace as necessary.
4) Remove compressor cover using the keys provided by manufacturer. Clean/blow air to remove dust and oil.
5) Remove the air compressor coarse filter and washed off any accumulated dust/dirt trapped in it. Replace after cleaning and drying
6) Open the air compressor pressure release valve and check the pressure gauge is at “0 Bar” where applicable

7) Drain the air compressor oil as per the manufacturer's instructions. Check oil seals/O-rings, gaskets before replacement.
8) Fill air compressor with appropriate air compressor oil. Wipe any spilled oil with soft cloth.
9) Replace the oil filter cartridge. Confirm that it is firmly fixed.
10) Replace the oil separator.
11) Replace the air filter cartridge.
12) Tighten all screws, cables and control panel switches.
13) Replace damaged or malfunctioning pressure gauges, valves, horse pipes and v-belts. Adjust and tighten loose pulleys/belts to give them the right torque and alignment.
14) Clean the coarse filters.
15) Check the service status of all line filters between the air compressor and Air storage tank. Replace if pointer is in RED Zone. Check functionality of the drain on the filters.
16) Check the drain on the air compressor.
17) Check motor fans and bearings.
18) Test functionality of the air compressor alarm system/lights for; motor thermal protection, oil thermal protection, low oil pressure.
19) Clean or blow accumulated dust and dirt on the condenser coil for the refrigerated air dryer.
20) Check air dryer separator element and replace. This should be done whenever the pressure drop across the dryer is excessive.
21) Check the air dryer automatic drain and confirm that the condensate is being discharged. Drain the air separator if necessary.
22) Check the pressure gauges on the medical air and oxygen storage tanks for functionality and any pressure leaks. (where applicable).
23) Check the inlet and outlet valves on the medical air and oxygen storage tanks for any blockages and clean appropriately. (where applicable).
24) Test functionality of pressure relief valves on the medical air and oxygen storage tanks. Replace if necessary.
25) Check the water drain plug/valve at the bottom of the medical air and oxygen storage tanks; and drain any water condensate in the tank.
26) Check the filling station compressor for any air leaks and replace the seals if necessary.
27) Clean or blow dust or dirt trapped on the filling station compressor motor and other parts.
28) Check the filling station compressor fan. Clean any accumulated dust or dirt.
29) Check the inlet and outlet valves of the filling station compressor for any blockages and clean appropriately.
30) Check the filling station manifold system copper pipes, filling pipe Adaptors and outlet valves for any damage or leaks. Replace damaged pipes or pipe adaptors.
31) Reconnect circuits and restart air compressor.
32) Inspect the control panel for proper operation, LCD display, oxygen concentration, CO_2, etc.

7. Maintenance Check Sheet/List

PPM Checklist for an Oxygen Plant				
Health Facility Name:				
Date:				
Description of Procedure		**Pass**	**Fail**	**Remarks**
1.0 Physical Inspection				
1.1 Check and confirm that the following oxygen plant equipment and accessories are intact – air compressor, refrigerated air dryer, medical air tank, oxygen generator, oxygen storage tank, cylinder filling compressor, filling manifold ramp, line filters, and control panel.				
1.2 Check for any damage or malfunctioning of any oxygen plant component or accessory.				
1.3 Check horse pipes for wear and crack. Replace if necessary.				
1.4 Check for any loose electrical connections, nuts/bolts/screws and switch gears and signs of electrical arcing.				
1.5 Check the status of line filters and replace all those with pointers in the RED Zone.				
1.6 Check functionality of all drain lines.				
1.7 Check functioning of pressure gauges.				
2.0 Electrical Safety Tests and Functionality Tests				
2.1 Check that there is no leakage current.				
2.2 Perform a plant operational test while filing some cylinders.				
2.2.1Oxygen concentration as read from the integrated oxygen plant LCD monitor (%)				
2.2.2 Oxygen concentration of a sample taken from a filled oxygen cylinder using a portable oxygen analyzer (%)				
2.2.3Carbon monoxide level as read from the integrated oxygen plant LCD monitor (ppm)				
2.2.4 Line 1 Voltage (V)				
2.2.5 Line 2 Voltage (V)				
2.2.6 Line 3 Voltage (V)				
2.2.7 PSA pressure (Bar)				
2.2.8 Air compressor hour meter reading (Hrs.)				
2.2.9 Filling compressor hour meter reading (Hrs.)				
2.2.10 Inspect the central control panel and confirm that all warning lights and alarms are operating properly				
2.2.11Test functionality of emergency stop button/switch.				

3.0 Planned Preventive Maintenance			
3.1 Check valves, horse pipes, pressure gauges and v-belts for damage or malfunction.			
3.2 Clean dust/dirt and debris on outer surfaces of the equipment with a dump cloth.			
3.3 Check electrical connections and switch gear for any loose connections and electrical arcing.			
3.4 Remove compressor cover blow compressed air to remove accumulated dust in the inside of the compressor.			
3.5 Remove the air compressor coarse filter and washed off any accumulated dust/dirt trapped in it.			
3.6 Drain and fill air compressor with new oil if necessary. Check oil seals/O-rings, gaskets and grease them before replacement.			
3.7 Replace the oil filter cartridge. Confirm that it is firmly fixed.			
3.8 Replace the oil separator filter cartridge.			
3.9 Replace the air filter cartridge.			
3.10 Replace damaged or malfunctioning pressure gauges, valves, horse pipes and v-belts.			
3.11 Adjust and tighten loose pulleys/belts to give them the right torque and alignment.			
3.12 Clean the air/oil radiator.			
3.13 Clean the dust-removal pre-filter and housing			
3.14 Check the hydraulic seals for any leaks. Replace seals if necessary.			
3.15 Check the service status of all line filters between the air compressor and Air storage tanks. Replace if pointer is in RED Zone			
3.16 Check motor fans and bearings. Grease if necessary.			
3.17 Check functionality of the drains on the filters, air compressor and air dryer.			
3.18 Test functionality of the air compressor alarm system/lights for; motor thermal protection, oil thermal protection, low oil pressure.			
3.19 Check air dryer separator element and replace if necessary.			
3.20 Check the pressure gauges on the medical air and oxygen storage tanks for functionality and any pressure leaks.			
3.21 Check the inlet and outlet valves on the medical air and oxygen storage tanks for any blockages and clean appropriately.			
3.22 Test functionality of pressure relief valves on the medical air and oxygen storage tanks.			
3.23 Check the water drain plug/valve at the bottom of the medical air and oxygen storage tanks; and drain any water condensate in the tank.			
3.24 Check the filling station compressor for any air leaks and replace the seals if necessary			
3.25 Clean or blow dust or dirt trapped on the motor and other parts of the filling station compressor.			
3.26 Check the filling station compressor fan			

3.27 Check the inlet and outlet valves of the filling station compressor for any blockages and clean appropriately.			
3.28 Check the filling station manifold system copper pipes, filling pipe Adaptors and outlet valves for any damage or leaks.			
5.0 Documentation			
5.1 Prepare a job card			
5.2 Attach a service sticker			

PPM carried out by:		Date: ……
Name:		
Contact:		
Signature:		
Verified By:		Date:
Name:		
Contact:		
Signature:		

8. Revision History

Version Number	Version Date	Section and description of changes made	Name of Authorizing Authority
2020/04/1		First Release	ACHS(BEMS)

9. References and Related Documents

- GB Use and Maintenance Manual
- Ozcan Kardesler, Document No. AO2390, 17/07/2007; Medical Oxygen Plant Service and User Manual

10. Acknowledgements

This SOP was developed by Engineers and Technicians from the MoH and Regional Medical Equipment Maintenance Workshops. The following persons were major contributors in the development of this SOP.

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STANDARD OPERATING PROCEDURE (SOP) FOR CARRYING OUT PREVENTIVE MAINTENANCE ON A WATER PUMP

1. Purpose

The purpose of this document is to describe the criteria for carrying out planned preventive maintenance (PPM) by competent personnel on a Water Pump to keep it in a safe working condition.

2. Definitions/Acronyms

- SOP: Standard operating procedures
- PPM: Planned Preventive Maintenance
- HID: Health Infrastructure Department
- LPM: Litres per minutes

3. Scope

This SOP is for MoH Engineers and Technicians to conduct PPM on Water Pumps. It is designed to ensure consistent execution of PPM by Engineers/Engineering Technicians and mitigate the risk of inconsistences while carrying out PPM on a Water Pump. It is not designed for PPM activities carried out by the user of the equipment on daily or weekly basis.

4. Roles and responsibilities

The Regional Workshop Manager is responsible for ensuring that competent personnel under her/him use and comply to this procedure to carry out PPM on a Water Pump. MoH Engineers and Technicians shall use and adhere to the requirements of this SOP and the manufacturer's recommended service schedules.

It is the responsibility of the Engineer/Engineering Technician to prepare documented evidence of the maintenance activities carried out and tests results to obtained to determine functionality of the equipment. This shall be in the form of a dully filled and signed job card and a maintenance check sheet.

5. Tools and supplies required to undertake PPM

Tools

1) Complete electro-mechanical tool kit
2) Blower
3) Soft and wire brush
4) Multimeter/clamp meter
5) Tachometer

Supplies

1) Gauze
2) Thread seal tape
3) Penetrating oil
4) Grease
5) PPE
6) Soap/detergent

6. Procedure

This procedure is for the recommended full PPM to be carried out on a Water Pump as recommended by the manufacturer. The following sequential steps shall be followed to carry out a PPM procedure on a Water Pump.

6.1 Safety Procedure

1) Wear PPE
2) Isolate water pump from power supply and water circuits.

6.2 PPM Procedure

1) Perform visual inspection on the water pump, power cable, impeller, stator, seals, rotor unit, lower and upper bearings, terminal board, stator housing and electrical components.
2) Check the water pressure gauge
3) Check and clean any inlet water strainers/filters. Replace strainer/filters as may be necessary.
4) Clean the mechanical parts of the water pump
5) Grease or lubricate all the moving parts of the pump
6) Check the electrical components like contactors, relays and other controls for arcing
7) Replace any defective parts if necessary
8) Clean inside the water pump with a brush

6.3 Electrical Safety Tests

1) Check mains input supply voltage
2) Carry out Insulation resistance test
3) Carry out Current leakage test

6.4 Functionality Tests

1) Check the motor speed with a tachometer
2) Check operation of the water level sensor/float switch

7. Maintenance Check sheet/List

PPM Check sheet for Water Pump				
Health Facility Name:				
Date:	**/ /20**			
Description of procedure		**Pass**	**Fail**	**Remarks**
1.0 Physical inspection				
1.1 Check for any physical damage on the equipment (water pump, power cable, impeller, stator, seals, rotor unit, lower and upper bearings, terminal board, stator housing and electrical components)				
1.2 Check water pressure gauge				
1.3 Check for missing screw, nut, bolt, etc.				
1.4. Inspect electrical connections				
2.0 Planned Preventive Maintenance				
2.1 Clean any dust on the outside/inside the water pump				
2.2 Lubricate all moving parts				
2.3 Tighten all loose parts				
2.4 Check operation of the motor thermal protection control system (if equipped).				
2.5 Check condition of upper and lower shaft seals (inspect condition of motor / stator housing, if applicable).				
2.6 Check for water leakage and condition of bearings				
2.7 Clean or replace inlet & outlet filters/strainers.				
2.8 Check condition of impeller or propeller. Clean or replace as needed.				
2.9 Check for correct shaft rotation				
2.10 Test the pump / mixer operating cycle, under load (if water level in the station permits)				
2.11 Clean, reset and test run pump for at least 15 minutes				
3.0 Electrical Safety Tests				
3.1 Check Insulation resistance				
3.2 Check mains supply voltage				
3.3 Carry out Current leakage test				
4.0 Functionality Tests				
4.1 Perform draw down test on the pump to establish LPM being produced (when possible)				
4.2 Perform shut off head test on pump to establish pressure being produced (when possible)				
4.3 Check operation of valves and associated equipment				
4.4 For submersible pumps, test functionality of the water level float switch				
5.0 Documentation				
5.1 Prepare a job card				
5.2 Attach a service sticker				

PPM carried out by: Name: Contact: Sign:	Date:
Verified By: Name: Contact: Sign:	Date:

8. Revision History

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9. References and Related Documents

- MoH, Uganda, RWs Operational Manual and Maintenance Guidelines, 2013

10. Acknowledgements

This SOP was developed by Engineers and Technicians from the MoH and Regional Medical Equipment Maintenance Workshops. The following persons were major contributors in the development of this SOP.

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