



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**TESTING TOOLS FOR MOBILE X-RAY BATTERY**

This report is submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours.

by

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TAJUK: **TESTING TOOLS FOR MOBILE X-RAY BATTERY**

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## **DECLARATION**

I hereby, declared this report entitled “Testing Tools for Mobile X-Ray Battery” is the result of my own research expects as cited in the references.

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Date: 19 December 2015

## **APPROVAL**

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements of the degree of for the Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours. The member of the supervisory is as follows:

.....  
(IR. NIK AZRAN BIN AB. HADI)

## **ABSTRACT**

The PSM title for this project is the battery testing tools for mobile x-ray battery. My main objective for this project is to reduce the maintenance cost of mobile x-ray due to damage of the battery. Mobile x-ray is supplied with 10 batteries, each battery must supply 12 V. Failure of the each of the battery to supply 12 V may cause mobile X-ray fail to operate. Due to 10 battery need to check one by one to know which one battery is damaged it may take long time to do. So I come with my project to solve this problem. My project name is Battery Testing Tools for Mobile X-Ray Battery. Battery Testing Tools for Mobile X-Ray Battery is able to check up to four batteries simultaneously. This tester is to evaluate the performance of x-ray batteries using the discharging method with measuring the hold voltage. This tester is able to measure hold voltage after discharging process, by determining hold voltage it can know the condition of the battery either in good condition, weak condition or bad condition. Battery need to charge before use if the condition of the battery is in weak condition, while battery must to replace if a battery in bad condition.

## ABTRAK

Tajuk PSM untuk projek ini adalah alat pengujian bateri bagi sinar x mudah alih. Objektif utama saya untuk projek ini adalah untuk mengurangkan kos penyelenggaraan bagi sinar x mudah alih akibat kerosakan bateri. Sinar x mudah alih dibekalkan dengan 10 bateri, setiap bateri mestilah membekalkan 12 V. Kegagalan setiap bateri untuk membekalkan 12 V boleh menyebabkan x-ray mudah alih gagal untuk beroperasi. Oleh kerana 10 bateri perlu diperiksa satu demi satu untuk mengetahui yang mana satu bateri yang rosak, ia mungkin mengambil masa yang lama untuk selesai. Jadi saya datang dengan projek saya untuk menyelesaikan masalah ini. Nama projek saya ialah alat pengujian bateri bagi sinar x-ray mudah alih. Alat pengujian bateri bagi sinar x mudah alih dapat memeriksa sehingga empat bateri serentak. Alat pengujian ini digunakan untuk menilai prestasi bateri sinar x mudah alih dengan menggunakan kaedah nyahcas, kaedah nyahcas ialah kedah dimana bateri di nyahcas sebelum “hold voltage” diukur. Dengan mengukur ‘hold voltage” kita dapat mengetahui keadaan bateri sama ada dalam keadaan yang baik, keadaan lemah atau keadaan yang tidak baik. Bateri perlu dicas sebelum digunakan jika keadaan bateri berada dalam keadaan lemah, manakala bateri perlu diganti jika bateri dalam tidak baik.

## **DEDICATION**

Thanks god for giving sustenance and simplify all my affairs in preparing the my PSM report and PSM project A special feeling of gratitude to my loving parents, whose words of encouragement and push to finish my PSM report and next, finish my degree study. Next would like to say thanks to my supervisor Ir. Nik Azran Bin Ab. Hadi that a lot to teach me in order to prepare the project report and PSM. Also, not forget to my friends that help me and take care about me.

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## LIST ABBREVIATIONS, SYMBOLS AND NOMENCLATURES

V	Volt
kV	Kilovolt
A	Ampear
PbSO	Lead Sulfuric Acid
PB	Lead
SO	Sulfiruc Acid
$H_2O$	Water

# CHAPTER 1

## INTRODUCTION

### 1.0 Introduction

Currently, many circuits are using a battery to operate. The battery used either as a main supply or as a backup supply if the main supply fails to work. But use battery as power supply, users will be faced with several problems. One of the problem is how to determine the condition of battery after a long time operation. The battery has three main conditions, good condition, weak condition and bad condition. The good condition means the battery is in full charge. For weak condition is, the battery is in half charge. While, bad condition is, condition where the battery no longer can store charge, in this condition the battery must be replaced.

Another problem is, when the testing process is involved with a lot of batteries to tested, the testing process will take a long time because battery load tester that sell at the market just able to test a battery at one time. To solve this problem, testing tools for mobile x-ray battery is designed, this testing tool is able to make the testing process on one or more batteries simultaneously.

Besides that, by using the regular analog load tester, user will face accuracy problems during reading voltage value. To solve this problem the testing tools for mobile x-ray battery is designed with 7 segment display. It is to display the value of the voltage in a decimal number.



## **1.1 Problem Statement.**

There are a few problems during the battery testing process. Among them is, the process to test the battery takes a long time to do, because only one battery is tested at a time. So, the tools for a mobile x-ray battery tester is created, by using this tester, one or more batteries are able to test simultaneously. Also, the user will face with an accuracy problem during reading the value of voltage when an analog voltmeter is used. To solve this problem, the testing tools for mobile x-ray battery is created with 7 segment display to show the value of voltage in a decimal number. Another problem is, to design discharging coil, the watt of the discharging coil and the watt of the battery must be equal to able discharging process done properly. Another problem is, when three or more from the 9 batteries cannot longer store the charge, it may cause the mobile x-ray cannot operate, it's because the mobile x-ray not receive enough power to operate. Usually when three or more batteries cannot longer store a charge, all batteries will be replaced. It involves huge cost, so to reduce the cost, the testing tools for mobile x-ray battery is built. The testing tools for mobile x-ray battery tester may detect which one battery is damaged, so only damaged battery is replaced.

## **1.2 Objective.**

The objectives of the project are:

1. To carry out the discharging process of the battery.
2. To know the condition of the battery, whether in good, weak or bad condition.
3. To display the value of the voltage before the discharging process and after the discharging process.

### **1.3 Scope.**

To evaluate the performance of x-ray batteries using the discharging method with measuring the hold voltage

### **1.4 Project Significance**

This project is important because this project will be used to do testing process on hospital equipment. The testing tools for mobile x-ray battery project is used to test the condition of the battery that use in mobile X-ray. This mobile X-ray is using 9 batteries to operate. Usually when one or more batteries of mobile X-ray batteries are damaged, all 9 batteries are replaced, it involved with high cost. Also, by using battery load tester that sale on market, it takes long time to do testing process, it is because this tester only can doing the testing process on battery one by one on one time. So the possible solution for entire problem is, by creating the testing tools for mobile x-ray battery.

## **CHAPTER 2**

### **LITERATURE REVIEW**

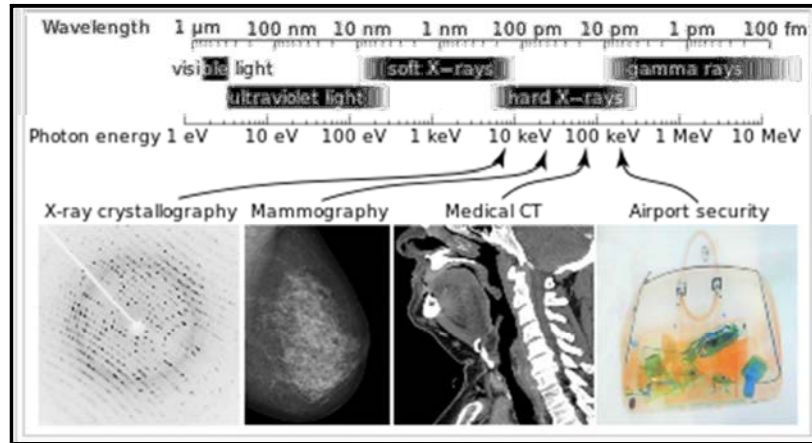
#### **2.0 Introduction.**

This chapter will provide an overview of what research that has been done in completing this project. In completing this project, there are several research that has been done to collect a suffice data that needed to develop this testing tools for mobile x-ray battery tester. The content of the research consists of the type of battery, method to know the condition if the battery and see back effect and other important materials needed.

#### **2.1 X-ray.**

X-ray is comprised of electromagnetic radiation. The wavelength the x-ray is from 0.01 to 10 nanometers, it means the wavelength of the x-ray is longer than gamma ray and shorter than UV rays. While, the frequency of the x-ray is between 30 petahertz to 30 exahertz ( $3 \times 10^{16}Hz$  to  $3 \times 10^{19}Hz$ ). The energies are in the ranges 100 eV to 100 keV.

The x-rays are classed by two types, hard x-ray and soft x-ray, it classes based on photon energies that generates. X-ray with photon energies above 5 keV to 100 keV are in hard x-ray class while photon energies between 100 eV to 10 keV is in soft x-ray class. The hard x-ray that energy range between 5 keV to 10 keV are widely used to image inside of the objects. It duly is penetrating ability. For example, they are used in medical radiography and the airport security.



**Figure 2. 1: Wavelength of X-ray**

## 2.2 X-ray machine.

The X ray machine is the unit for medical diagnosis. It uses to shoot an x-ray beam that energies range between 5 keV to 10 keV through the patient and having the beam impinge on a photographic film. When a patient is to be imaged, a patient is placed between beam path emitter and the receptor.

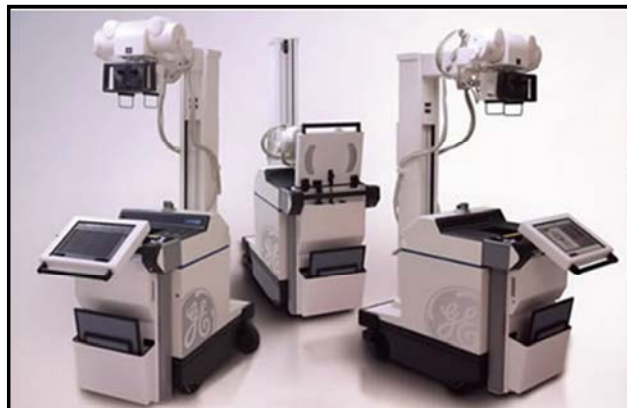
The source of the x ray is called as an x-ray tube. X-ray beam is produced when high speed electrons from cathode hit the metal target. The energy of the electron beam only produced one percent of the photons, the rest is converted to heat. The x-ray tube is a vacuum tube, it causes the temperature of the tube hard to rid of it. The temperature of the anode that hits by electron start increases, in long time an anode may melt. To prevent the anode from melting, the anode is rotated. A new surface continually hits by the electron. By time the anode rotated 360 degrees it may cool down

### 2.3 GE AMX-4.

GE AMX-4 X-ray unit is completely supplied by batteries. It operates from rechargeable battery pack. The AMX-4 is a mobile radiography system, its mobility and ease of use makes the AMX-4 suitable for all radiography procedures either at emergency and operating rooms, pediatrics, neonatal, orthopedics and clinics.

Power for this x-ray units are supplied by 9 units lead acid batteries with expected life is five years. Batteries for AMX-4 will not leak even if damaged because the battery is using minimal liquid. All 9 units of batteries are capable to supply 110 V and no need extra part to charge the battery except wall plug. To prevent from deep discharge and permanent damage, the AMX-4 battery is controlled by automatic battery voltage sensors. Basically the AMX-4 use Genesis G12V26Ah 10EP sealed lead acid battery, this battery able to supply 12 V and 26 Ah.

The x-ray tube is required voltage between 50 kV to 125 kV to emit the x-ray beam. The voltage is proportional with current between range 0.4 mA to 200 mA. Selection of voltage and current is based on an area of the body that need to emitted by x-ray beam. The step up transformer with ratio 1 : 1102 is used to increase the voltage up to 125 kV.



**Figure 2. 2: GE AMX-4**

## 2.4 Lead acid battery.

Basically has two types of lead acid battery, starting (cranking) and deep cycled. The starting battery is designed to deliver energize for starting engines. While, the deep cycled battery is designed to generate a long time energy delivery, but his battery didn't have instance energy. The starting battery not recommended used at deep cycle application because the thinner plates are more prone to warping and petting when discharged.

The battery are consists with 6 pair of lead plates. A positive plate is covered with a paste while the negative plate is made by sponge lead, these two are separated by insulating material. Each pair of plate is able to supply 2 V. The plates are enclosed in the battery case. In battery case also are filled with electrolyte that construing with 65 % with water and 35 % of acid sulfuric. The capacity of the battery is 125 Ah and the voltage supply is 12 V.

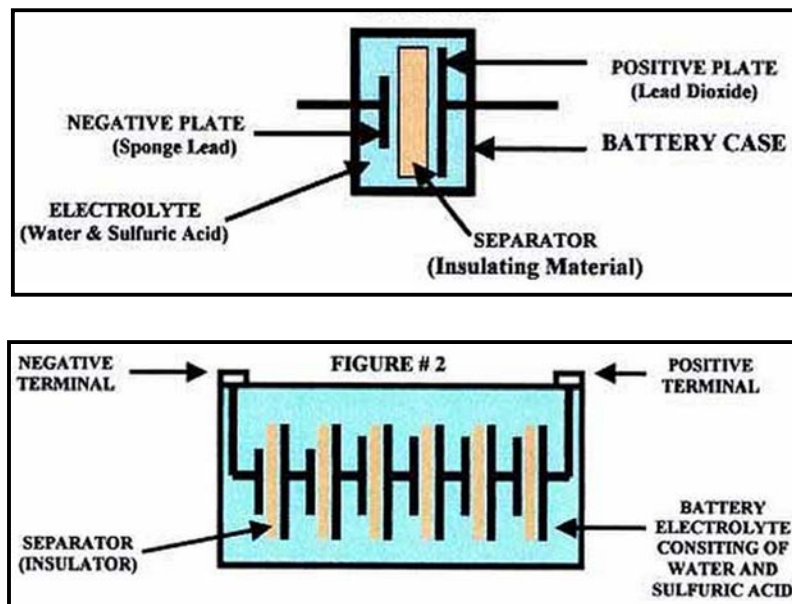


Figure 2. 3: Basic Constructions of Lead Acid Battery

## **2.4.1 Contractions Type of Lead Acid Battery.**

### **2.4.1.1 AGM (The Absorbed Glass Matt).**

In theory, this battery is more efficient in the charging and the discharging because this battery is designed to allow the electrolyte to be suspended in close with the plates active material. The AGM battery commonly cost twice, then premium wet cell. However, this battery is best in store and do not tend to sulfate or degrade as easily as wet cell. Those have a litter change to explosion or corrosion during using this battery. Commonly application that uses this battery type is a high performance engine starting, deep cycle solar and power sports. Typically the AGM is best in deep cycle. To make this battery deliver better performance, the battery must be recharged before the battery droop 50 % discharging rate. This battery is good to operate equipment that not use in daily.



**Figure 2. 4: AGM (The Absorbed Glass Matt)**

### **2.4.1.2 Gel Cell.**

The electrolyte of this battery is suspended, similar to AGM battery, but the AGM battery still uses water so it can consider as wet cell. The electrolyte in Gel cell contains silica additive, it makes the electrolyte in Gel cell easily to stiffen. This battery is best for equipment that operates on a very deep cycle. Like the AGM

battery, the Gel cell cost twice, then premium wet cell. However, they are best in store and do not tend to sulfate or degrade as easily as wet cell. Those have a litter change to explosion or corrosion during using this battery.



**Figure 2. 5: Gel Cell**

## **2.4.2 Discharging and Charging of Lead Acid Battery.**

### **2.4.2.1 Discharging.**

1. A chemical reaction between sulfuric acid and the lead plates produces the electricity.
2. This chemical reaction also started coats both positive and negative plates with a substance called lead sulfate also known as sulfation. (Show as a yellow buildup on plates).
3. The discharging process of the battery is continuing, more and more lead-sulfate coats covered in plates. Then voltage of the battery started decreasing from full stage of 12.6 V.
4. Lead sulfate is the soft material which it can convert back to lead and sulfuric acid by charging the battery immediately. The battery must immediately charge if not the soft lead sulfate will change into a hard crystal form. This hard crystal only able to convert back by standard fixed voltage (13.6 V).