

**UNIVERSITI TEKNOLOGI MARA**

**DEVELOPMENT OF N-CLASS  
POTASSIUM NITRATE - SORBITOL  
SOLID PROPELLANT ROCKET  
MOTOR**

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## ABSTRACT

In the age of Internet of Things (IoT), satellite launching has become more common than for the past decades. To date, rocket system is the only means of bringing satellites into Earth's orbit. However, the technology is very localized, and Malaysia is still in an embryonic stage. In this thesis, the study of solid rocket motor (SRM) using sugar-based propellant is documented. The main motivation is to produce a reliable SRM using a relatively cheap and easily available resources since the commonly built high power rocket are made from expensive and hardly obtained materials. The propellant fabrication was studied using several casting methods with target of obtaining density ratio of more than 95 %, the study of SRM case was done using Ansys static structural analysis by first verifying the setup with exact mathematical solution and used the setup to obtain the maximum von-Mises stress to calculate the safety factor of the SRM case. The rocket motor was designed to produce a total impulse of N-class motor, which is mainly developed for sounding rocket. The focus of the study is on the propellant formulation, design and fabrication of the SRM case, and performance assessment of the SRM through static test. Results showed that there is three propellant casting method that produced a density ratio of more than the threshold value of 95 %. Furthermore, the analysis of SRM case structural integrity revealed maximum stress exceeding the targeted safety factor of 1.5 by 35 %. The static firing test performance was able to be recorded and plotted in a force against time graph with calculated total impulse of lower than design due to nozzle ejection event that occurs. However, the test has provided some insights into the SRM performance, although the combustion has prematurely ended due to nozzle ejection. A detail cause and effect analysis are presented for future improvement. In short, three casting methods was found to produce propellant with higher density ratio than the target of 95% and the SRM was assets to have higher than target safety factor of 1.5. The SRM performance also has been verify in term of force and total impulse produced.

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All the praises and thanks to Allah

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# TABLE OF CONTENTS

	<b>Page</b>
<b>CONFIRMATION BY PANEL OF EXAMINERS</b>	<b>ii</b>
<b>AUTHOR'S DECLARATION</b>	<b>iii</b>
<b>ABSTRACT</b>	<b>iv</b>
<b>ACKNOWLEDGEMENT</b>	<b>v</b>
<b>TABLE OF CONTENTS</b>	<b>vi</b>
<b>LIST OF TABLES</b>	<b>viii</b>
<b>LIST OF FIGURES</b>	<b>ix</b>
<b>LIST OF PLATES</b>	<b>xi</b>
<b>LIST OF SYMBOLS</b>	<b>xii</b>
<b>LIST OF ABBREVIATIONS</b>	<b>xvii</b>
<b>LIST OF NOMENCLATURE</b>	<b>xx</b>
<b>CHAPTER ONE INTRODUCTION</b>	<b>1</b>
1.1 Research Background	1
1.2 Problem Statement	3
1.3 Objectives	5
1.4 Scope of Study	5
<b>CHAPTER TWO LITERATURE REVIEW</b>	<b>6</b>
2.0 Introduction to Literature Review	6
2.1 Introduction to Rocket	6
2.2 Solid Rocket Motor	13
2.2.1 Solid Rocket Motor Propellant	13
2.2.2 Solid Rocket Motor Case	18
2.2.3 Solid Rocket Motor Nozzle	24
2.2.4 Propellant Evaluation Program (ProPEP) 3 Software	24
2.3 Solid Rocket Motor Performance and Static Test	28
2.3.1 Rocket Motor Classification	30
2.3.2 Theoretical Performance of Solid Rocket Motor	33

# CHAPTER ONE

## INTRODUCTION

### 1.1 Research Background

As with other types of vehicles, rockets are designed to transfer objects from one location to another. This is the same goal as other vehicles, which is to transport any object from one point to another. A rocket is considered to be one of the air transportation vehicles, each with its own function and set of objectives to achieve. Because of World War II, the early development of rocket technology was mostly focused on military applications. However, as time progressed, this technology assisted humanity in expanding their knowledge in a variety of sectors, particularly in the field of propulsion. We have gained knowledge and expertise in a variety of other sectors because of our research into rocket technology, including the strength of materials, communications, climate and weather monitoring, and space exploration. Furthermore, the National Aeronautics and Space Administration, NASA's research on this subject has resulted in approximately 2000 spin-off commercial items being developed through the NASA Technology Transfer Program, which was established in 1996 [1].

Rockets are vehicles that move by producing exhaust gas to be propelled via their nozzles. Normally, people associate rockets with military applications, but in reality, rockets have played an important role in a variety of civil applications, including sounding rockets that have been used to study lightning and fire extinguishers that have been used to extinguish fires in extremely tall buildings or difficult-to-reach locations. The type of rocket depends on the payloads attached to it. For instance, "missiles" is for the rocket's which payload is loaded with an explosive, while "launch vehicles" for the rocket that is loaded with a satellite or other payload and is launched into space. As a result, they are usually referred to as "launched vehicles" because their functions are comparable to those of a vehicle that travels on land and whose primary job is the transportation of a load from one location to another.

The rocket engine, often known as the rocket motor is the core of the rocket that propels it forward. There are three types of rocket motors that are regularly used: solid rocket motors (SRM), liquid rocket motors (LRM), and hybrid rocket motors (HRM). Solid rocket motors are the most popular type of rocket motor, followed by liquid rocket