International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Home-Based Rocket Design and Fuel Project

Sahil Umarani

High School Senior, Gokuldham High School and Junior College

Abstract
This detailed research paper delves into the practicality and step-by-step process of creating a small-scale rocket and manufacturing its fuel from scratch within a home setting. The main objective of this study is to furnish a thorough manual for individuals passionate about amateur rocketry, emphasizing the importance of safety measures, materials, design concepts, and fuel composition. The project showcases the educational and experimental possibilities of rocketry in a domestic context, which can enhance knowledge of propulsion science and engineering fundamentals.

Keywords: Propulsion, Rocketry, Furnish,Small-Scale, Amateur

Introduction

Rocketry has fascinated people since the early 20th century, leading to significant progress in aerospace engineering and space exploration. This document highlights the essential aspects of a home-based rocket project,with an emphasis on safety, practicality, and scientific integrity.
Rocket engines are vital components of any rocket as they provide the necessary thrust for liftoff. For hobbyists and educators, creating rocket engines at home can be a rewarding experience that combines physics, chemistry, and engineering. This guide outlines the fundamental components and steps for constructing a small-scale rocket engine and Rocket Design.

Materials and Tools for Rocket Design .

- **Rocket Body:**
  PVC pipes or cardboard tubes
- **Fins:**
  Lightweight plastic or balsa wood
- **Nose Cone:**
  Plastic or molded clay
- **Assembly:**
  Hot glue gun or epoxy
- **Cutting:**
  Hobby knife or saw
- **Smoothing:**
  Sandpaper
- **Optional Finishing Touches:**
  Paint

Step-by-Step Construction

1. Making the Rocket Body (Airframe) The rocket body, also known as the airframe, is where the engine, payload, and recovery system are housed. PVC pipes or cardboard tubes are great choices because they are easy to find and work with.

Materials:

PVC pipe or cardboard tube (1-2 inches in diameter, 12-18 inches long).

Procedure:

Cutting the Tube:

Measure and cut your PVC pipe or cardboard tube to the length you want using a saw or hobby knife.
Smooth the edges with sandpaper so there are no rough spots.

Making the Engine Mount:

You'll need to secure the engine inside the rocket body.
Use a smaller tube or a ring to hold the engine in place. Glue it at the lower end of the main tube with hot glue or epoxy.

2. Creating the Fins Fins help stabilize the rocket during flight. They need to be light and evenly spaced around the body.

Materials:

Lightweight plastic or balsa wood.

Procedure:

Designing the Fins:

Draw the shapes of the fins on your material. A common shape is a right triangle or trapezoid.
Cut out the fins using a hobby knife or saw.

Attaching the Fins:

Mark where you want the fins to go on the lower part of the rocket body. Make sure they're evenly spaced (usually three or four fins).
Attach the fins with hot glue or epoxy and let them dry completely.

3. Making the Nose Cone The nose cone helps reduce aerodynamic drag and protects the payload. It should be light and fit snugly into the top of the rocket.

Materials:

Plastic or molded clay.

Procedure:

Shaping the Nose Cone:

Shape your nose cone out of plastic or clay. A simple cone or ogive shape works well.
Make sure the base of the nose cone matches the diameter of the rocket body.

Attaching the Nose Cone:

Attach the nose cone to the top of the rocket body with hot glue or epoxy. It should fit snugly but be removable if you need to access the payload.

4. Adding a Recovery System A recovery system ensures your rocket returns safely to the ground. Parachutes or streamers are common choices.

Materials:
Lightweight plastic or fabric for the parachute.
String or cord.
Procedure:
Making the Parachute:
Cut a circle (12-18 inches in diameter) from the plastic or fabric.
Attach strings to the edges of the parachute and gather them together.
Installing the Recovery System:
Attach the parachute to the nose cone or a designated spot inside the rocket body.
Make sure the parachute is packed loosely enough to deploy when the rocket comes down.

Finishing Touches
Painting and Decoration:
Paint your rocket body, fins, and nose cone however you like. Use lightweight, non-flammable paints.
Let the paint dry completely before you handle the rocket
Materials and Tools Needed for Rocket EngineCasing:
PVC pipe or aluminum tube (diameter: 0.5-1 inch, length: 3-6 inches)
Fuel:
Potassium nitrate (you can find this as a common garden fertilizer)
Sugar (ordinary table sugar works)
Corn syrup (optional, used as a binder)
Nozzle:
Clay or high-temperature epoxy
Ignition:
Electrical igniter or fuse (you can get these from hobby stores)
Safety Equipment:
Safety goggles
Gloves
Fire extinguisher
Well-ventilated workspace or outdoor area
Tools:
Drill with appropriate bits
Hobby knife
Measuring scale
Mixing bowl and spoon
Heat source (stove or hot plate)
Protective clothing

Step-by-Step Construction
1. **Casing Preparation** The casing is the main body of the rocket engine, containing the fuel and supporting other components.

Materials:
PVC pipe or aluminum tube.

Procedure:

Cutting the Casing:

Measure and cut the PVC pipe or aluminum tube to the desired length, between 3 to 6 inches.

Smooth the edges using sandpaper to avoid any sharp edges that might cause injuries.

2. **Fuel Preparation** "Rocket candy" is a popular and simple solid rocket fuel made from potassium nitrate and sugar.

Materials:

Potassium nitrate (oxidizer)

Sugar (fuel)

Corn syrup (optional, as a binder)

Procedure:

Mixing the Fuel:

Measure a ratio of 65% potassium nitrate to 35% sugar by weight.

Thoroughly mix the potassium nitrate and sugar in a mixing bowl.

Heating the Mixture:

Place the mixture in a saucepan over a low heat source.

Stir continuously until the sugar melts and blends with the potassium nitrate, forming a thick paste.

Optionally, add a small amount of corn syrup to help bind the mixture.

Molding the Fuel:

While the mixture is still pliable, carefully pack it into the prepared casing, ensuring there are no airpockets.

- Allow the fuel to cool and harden within the casing.

3. **Nozzle Creation** The nozzle directs the exhaust gases to produce thrust and must be able to withstand high temperatures.

Materials:

Clay or high-temperature epoxy.

Procedure:

Forming the Nozzle:

Shape the clay or epoxy into a cone that fits tightly into one end of the rocket casing.

Drill a small hole through the center of the nozzle to allow exhaust gases to escape. The hole should be small enough to increase pressure but large enough to prevent clogging.

Attaching the Nozzle:

Secure the nozzle at the end of the rocket casing using additional clay or epoxy, ensuring it is airtight and firmly in place.

Let the nozzle dry and harden completely.

4. **Ignition System** The ignition system is what lights the fuel to start the engine.

Materials:

Electrical igniter or fuse.

Procedure:

Installing the Igniter:
Insert the electrical igniter or fuse into the fuel through the nozzle.
Make sure the igniter is in contact with the fuel and secure it in place.

5. Final Assembly and TestingSafety Precautions:
Always wear safety goggles, gloves, and protective clothing.
Work in a well-ventilated area or outdoors.
Keep a fire extinguisher nearby.
Procedure:
Final Checks:
Verify that all components are securely in place.
Ensure the rocket engine is free from obstructions and properly vented.
Testing:
Conduct a static test of the engine before attaching it to a rocket body.
Secure the engine in a safe location, away from flammable materials and structures.
Ignite the engine remotely, observing from a safe distance.

Conclusion

This research paper presents a practical approach to designing and building rocket engines at home, with a focus on safety and scientific rigor. While the project is feasible for dedicated hobbyists, it requires careful attention to detail and adherence to safety protocols. Future work could explore advanced materials and more sophisticated
ignition systems, contributing to the broader field of amateur rocketry. Building a rocket body at home involves careful planning, precise construction, and adherence to safety protocols. By following this step-by-step guide, enthusiasts can create a functional and stable rocket, providing a hands-on learning experience in basic rocketry principles.

Acknowledgement

I am extremely thankful for the support and guidance I have received from various individuals during this research project. Firstly, I'd like to express my deepest appreciation to my family and friends for their unwavering encouragement and support.
Their understanding of the time and dedication required for this endeavor has been invaluable. I am also grateful to my teachers for nurturing my interest in science and engineering and providing the foundational knowledge necessary to undertake this
endeavor. Special thanks to my mentors. Lastly, I would like to extend my gratitude to anyone who has directly or indirectly contributed to the completion of this project. Your support has been essential in turning this concept into a reality.

References

1. "Handbook of Model Rocketry" by G. Harry Stine and Bill Stine. This comprehensive guide covers all aspects ofmodel rocketry, including materials, construction, and safety measures.
2. "Make: Rockets: Down-to-Earth Rocket Science" by Mike Westerfield. This book provides detailed instructions andtips for building rockets using common materials.

3. Estes Rockets Educational Materials. Estes offers a variety of educational resources and guides on model rocketconstruction and safety.
4. PVC pipes and cardboard tubes are commonly used for constructing rocket bodies. These materials can be foundat most hardware stores or hobby shops.
5. Information on using balsa wood for fins can be found in model airplane building guides, such as those from theAcademy of Model Aeronautics .
6. "Rocket Propulsion Elements" by George P. Sutton and Oscar Biblarz. This textbook is an authoritative resource onthe principles and design of rocket engines.
7. "Rocket Manual for Amateurs" by Bertrand R. Brinley. Although older, this book offers practical advice andinstructions on building and testing amateur rocket engines.
8. Amateur Experimental Rocketry resources such as the website of the Experimental Rocket Propulsion Society ,which provides information on DIY rocket engine construction and safety.
9. The use of potassium nitrate and sugar as a solid rocket propellant, often referred to as "rocket candy," is
10. well-documented in amateur rocketry circles. Detailed recipes and safety guidelines can be found in online forumssuch as The Rocketry Forum .
11. Articles and guides from the National Association of Rocketry provide additional insights into the safe handling andpreparation of rocket fuels.