

SECTION 2: MODEL ROCKETRY PROGRAM

Model rocketry is the designing, building, and flying of small rockets that are made of paper, plastic, balsa wood, or any other lightweight material. A model rocketry program can provide an exciting introduction for cadets to concepts of aerospace engineering and design and the basic concepts of flight and space. It can motivate cadets to attain a greater knowledge of aerospace studies and arouse interest in aerospace careers. This chapter details model rockets constructed in this manner are approved for use by AFJROTC cadets. Obtain approval of school authorities before establishing a program.

OPERATIONAL PERFORMANCE REQUIREMENTS (OPR)

OPR 1. Construct, launch, and evaluate at least one model suitable for the altitude competition described in the NAR United States Rocketry Sporting Code (NARUSRSC).

OPR 2. Construct, launch, and evaluate at least one model rocket suitable for the scale, plastic scale, or payload competition described in the NARUSRSC.

OPR 3. Construct, launch, and evaluate at least one model rocket suitable for the drag race, parachute duration, boost, or glide competition described in the NARUSRSC.

OPR 4. Construct, launch, and evaluate at least one model rocket suitable for the aerospace systems or research and development competition described in the NARUSRSC (Optional for advanced rocketry program only).

OPR 5. Prepare a diagram of a typical model rocket launch site. This diagram may be as elaborate as desired, but must include: launcher, model rocket, igniter, and land area requirements.

OPR 6. Submit for evaluation a journal of all activities completed in the model rocketry program. The journal must indicate completion of all OPRs.

LEADERSHIP PERFORMANCE REQUIREMENTS (LPR)

LPR 1. Demonstrate knowledge of the AFJROTC model rocketry program and its concepts and techniques by satisfactorily implementing, administering, supervising, and evaluating model rocketry activities.

LPR 2. Demonstrate a knowledge of the organization of AFJROTC model rocketry program

activities, including personnel required, skills necessary, and the job responsibilities of cadets and adult supervisors for rocketry activities.

LPR 3. Demonstrate knowledge of the physical facilities required for all model rocketry operational activities, to include facilities for storage, handling, and building static models, flying and safety precautions, and spectator protection.

LPR 4. Demonstrate the leadership skills necessary to conduct an individual test, group test, and NAR-sanctioned model rocketry competitive meet.

LPR 5. Serve successfully as the safety officer in addition to a minimum of three of the remaining positions listed in para 2.4.2.6.

LPR 6. Pass an oral examination covering the topics of model rocketry techniques, procedures, operations, and safety precautions.

PROGRAM GUIDANCE

1. Model Rocketry. Model rocketry is the designing, building, and flying of small rockets that are made of paper, plastic, balsa wood, or any other lightweight material. Model rockets constructed in this manner are approved for use by AFJROTC cadets. Model rocket engines are solid propellant engines made by commercial manufacturers intended for use in model rockets of the construction indicated. The manufacturer furnishes these "safe" engines ready for use; there is no need for the user to mix potentially dangerous chemical ingredients. Commercially produced engines are the only type approved for use by AFJROTC cadets. Obtain approval of school authorities before establishing a program. Reference WINGS for more details.

1.1. Units will develop a training plan for cadets desiring to qualify for the Model Rocketry badge. The plan will provide for the completion of the Operational Performance Requirements and the Leadership Performance Requirements.

1.2. If your unit participates in the Model Rocketry Program, you must ensure the school's liability policy covers accidents associated with launching rockets. If not, you will need to purchase separate coverage to cover the launchings. For more information, check www.modelaircraft.org.

1.3. Contact Holm Center/JROL for students who satisfactorily complete both sets of requirements for issue of the Model Rocketry badge.

2. Particular attention should be given to the selection of instructional personnel. Although desirable, it is not necessary that instructors be experts. Before a program has begun, units should

decide how many instructors are needed and provide enough time for them to become knowledgeable in the specialties they will teach.

3. Units will conduct the model rocketry program according to the provisions of this instruction and the following guidelines:

- National Association of Rocketry(NAR)
- United States Model Rocket Sporting Code
- NAR Model Rocket Safety Code
- Contest rules and safety regulations of the National Aeronautics Association (NAA) and the Federation Aeronautique Internationale (FAI)
- Federal Aviation Regulations, Part 101, Manned Balloons, Kits, and Unmanned Rockets.
- Federal Communications Commission, Part 95, Citizens Radio Service.
- State and local governments.

4. Cadets will keep a record of their rocket launchings to include aircraft flown on an individual, group, or competitive basis. Flight records will include duration of flight, fuel, repairs (if any), type of aircraft, and whether the operation is under supervision of a qualified flight instructor. Cadets should be prepared to provide flight information to the SASI.

5. Conduct individual model rocketry program activities involving launchings or flying under the supervision of the range officer, safety officer, and first aid officer.

POSITIONS AND RESPONSIBILITIES

Minimum positions and responsibilities necessary to supervise an AFJROTC model rocket competitive meet include:

Range Officer or Contest Officer. The range or contest officer takes complete charge of the range or flying field, directs all action, gives all orders, makes all decisions, supervises all operations, and is normally positioned at the control center. For AFJROTC launches or meets sponsored by AFJROTC, the range officer will be an AFJROTC instructor.

Safety Officer. The safety officer is responsible for checking all critical points of the operation in advance to ensure safety regulations are followed. The safety officer conducts safety briefings prior to launches and instructs all personnel in safety procedures. No launching or flying will take place until the safety officer issues clearance to the range officer.

First Aid Officer. The first aid officer administers first aid to participants and spectators as required. The first aid officer will be an individual who qualifies for the job by completing a Red

Cross first aid course or similar training required by school officials.

Launch Supervisor, Flight Line Officer, or Contest Security Officer. Ensures established procedures are followed at the launch site/flying field, monitors launches and landings, and certifies a clear launch/flight area to the range officer before activity begins. This officer is responsible for ensuring the security of displayed static models.

Spectator Control Officer. The spectator control officer is responsible for clearing launch areas of all personnel not assigned to specific posts and ensuring spectators and personnel are at a safe distance before giving clearance for activity to the range officer.

Range Guards. Range guards are responsible for keeping passers-by out of the area, scanning the sky for aircraft, and certifying to the range officer that it is safe to launch rockets.

Observers and Trackers. Observers and trackers are responsible for tracking the path of the rocket and taking observations on the azimuth and angle of the elevation at the peak of the trajectory for plotting. They are also responsible for advising the range officer of in-flight emergencies and dead-stick landings, assisting in the safe recovery of downed aircraft, and reporting all pertinent data to the control center.

Public Affairs Officer. The public affairs officer arranges for advance publicity and provides for newspaper, radio, television, and magazine coverage of the activities, seeking favorable public relations. The public affairs officer is also responsible for maintaining lines of communication with supporting organizations, parent booster clubs, and school authorities as to the current activities of the program.

Units conducting model rocketry programs are encouraged to establish a NAR section or have interested cadets apply for membership in local NAR sections. AFJROTC units or cadets may then enter into competitive meets with other NAR units on section, area, regional, and national levels. Applications for membership or establishment of an NAR Model Rocketry Section may be obtained from the National Association of Rocketry.

SUGGESTED 6-WEEK PROGRAM OF INSTRUCTION FOR MODEL ROCKETS

Week #	Classroom/Period/Activities	Laboratory Period/Activities
1	<p>Introduce basic model rocketry glossary</p> <p>Discuss construction of body tubes, nose cones, and fins</p> <p>Explain construction of commercial model rocket engines and their principles of operation</p> <p>Present the Model Rocketry Safety Code</p>	<p>Demonstrate the tools and materials needed to construct a simple single- stage rocket</p> <p>Demonstrate types of engines available (borrow from model shops)</p> <p>Provide lists of tools and materials needed to construct a single-stage rocket; provide plans for a rocket</p>
2	<p>Explain techniques of constructing recovery devices</p> <p>Explain rocket aerodynamics</p>	<p>Begin construction of single-stage rocket (all cadets use same basic plan)</p>
3	<p>Explain rocket ignition techniques</p> <p>Explain paints and finishes suitable for rockets being constructed</p> <p>Explain launching devices suitable for launching rockets</p> <p>Decide which launching device</p>	<p>Continue construction of rockets</p> <p>Begin construction of a launching device from materials available; procure remainder of needed materials before next meeting</p>
4	<p>Explain basic techniques of altitude determination and the type of tracking device used at unit rocket launching activity</p> <p>Get volunteers to construct or obtain a suitable tracking device</p>	<p>Complete construction of rockets</p> <p>Continue construction of launching device</p>
5	<p>Plan rocket launching activity</p> <p>Make assignments (range officers, special details, etc.)</p> <p>Review safety code</p>	<p>Complete launching and tracking devices</p> <p>Inspect completed model rockets</p>
6.	<p>Unit model rocket launching</p>	

NATIONAL ASSOCIATION OF ROCKETRY MODEL ROCKET SAFETY CODE

- 1. Materials.** I will use only lightweight, non-metal parts for the nose, body, and fins of my rocket.
- 2. Motors.** I will use only certified, commercially-made model rocket motors, and will not tamper with these motors or use them for any purposes except those recommended by the manufacturer.
- 3. Ignition System.** I will launch my rockets with an electrical launch system and electrical motor igniters. My launch system will have a safety interlock in series with the launch switch, and will use a launch switch that returns to the "off" position when released.
- 4. Misfires.** If my rocket does not launch when I press the button of my electrical launch system,
I will remove the launcher's safety interlock or disconnect its battery, and will wait 60 seconds after the last launch attempt before allowing anyone to approach the rocket.
- 5. Launch Safety.** I will use a countdown before launch, and will ensure that everyone is paying attention and is a safe distance of at least 15 feet away when I launch rockets with D motors or smaller, and 30 feet when I launch larger rockets. If I am uncertain about the safety or stability of an untested rocket, I will check the stability before flight and will fly it only after warning spectators and clearing them away to a safe distance.
- 6. Launcher.** I will launch my rocket from a launch rod, tower, or rail that is pointed to within 30 degrees of the vertical to ensure that the rocket flies nearly straight up, and I will use a blast deflector to prevent the motor's exhaust from hitting the ground. To prevent accidental eye injury, I will place launchers so that the end of the launch rod is above eye level or will cap the end of the rod when it is not in use.
- 7. Size.** My model rocket will not weigh more than 1,500 grams (53 ounces) at liftoff and will not contain more than 125 grams (4.4 ounces) of propellant 320 N-sec (71.9 pound- seconds) of total impulse.
- 8. Flight Safety.** I will not launch my rocket at targets, into clouds, or near airplanes, and will not put any flammable or explosive payload in my rocket.
- 9. Launch Site.** I will launch my rocket outdoors, in an open area at least as large as shown in the accompanying table, and in safe weather conditions with wind speeds no greater than 20 miles per hour. I will ensure that there is no dry grass close to the launch pad, and that the launch site does not present risk of grass fires.

10. Recovery System. I will use a recovery system such as a streamer or parachute in my rocket so that it returns safely and undamaged and can be flown again, and I will use only flame-resistant or fireproof recovery system wadding in my rocket.

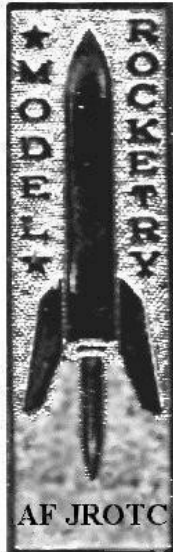
11. Recovery Safety. I will not attempt to recover my rocket from power lines, tall trees, or other dangerous places.

LAUNCH SITE DIMENSIONS		
Total Impulse (N- sec)	Motor Type	Site Dimensions (ft.)
0.00--1.25	1/4A, 1/2A	50
1.26--2.50	A	100
2.51--5.00	B	200
5.01--10.00	C	400
10.01--20.00	D	500
20.01--40.00	E	1,000
40.01--80.00	F	1,000
80.01--160.00	G	1,000
160.01--320.00	Two Gs	1,500

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MODEL ROCKETRY BADGE

The Model Rocketry Badge is awarded to cadets who have fulfilled model rocketry program requirements listed in this handbook. OPR: Holm Center/JROL.



ADDITIONAL SOURCES OF INFORMATION

1. NASA's Beginner's Guide to Rockets: <http://exploration.grc.nasa.gov/education/rocket/bgmr.html>
2. National Association of Rocketry's "Successful Rocketry for Scouting, 4-H, and Other Youth Groups" <http://www.nar.org/pdf/youthprogs.pdf>
3. NASA's Adventures in Rocket Science Educator Guide
http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Adventures_in_Rocket_Science.html
4. National Association of Rocketry Certified Motors: <http://www.nar.org/SandT/NARenglist.shtml>
5. National Association of Rocketry United States Model Rocketry Sporting Code:
<http://www.nar.org/pdf/pinkbook.pdf>
6. Most control of model rocketry is on the state and/or local level. 48 states adhere to a common code of regulation for model rocketry known as [National Fire Protection Association \(NFPA\) Code 1122](#). This code defines the power, weight, and other limits to which a rocket must comply in order to be classified as a (relatively unregulated) "model rocket." <http://www.nfpa.org/index.asp?cookie%5Ftest=1>
7. Forty Years of Model Rocketry A Safety Report Prepared for the National Association of Rocketry by G. Harry Stine: <http://www.nar.org/pdf/40years.pdf>