ROYAL CANADIAN AIR CADETS

PROFICIENCY LEVEL FOUR

INSTRUCTIONAL GUIDE

SECTION 4

EO C440.02 – LAUNCH A SMALL MODEL ROCKET

Total Time: 90 min

PREPARATION

PRE-LESSON INSTRUCTIONS

Resources needed for the delivery of this lesson are listed in the lesson specification located in A-CR-CCP-804/PG-001, *Proficiency Level Four Qualification Standard and Plan*, Chapter 4. Specific uses for said resources are identified throughout the instructional guide within the TP for which they are required.

Review the lesson content and become familiar with the material prior to delivering the lesson.

Locate a proposed launch site IAW the Launch Site Set-Up located at Attachment A.

Ensure that permission to launch a small model rocket has been received from airport authorities.

Ensure that written permission to use the launch location has been received from the property owner.

Perform a risk assessment of the launch location.

Practice rocket engine and igniter installation.

Assemble the rocket launch controllers and launch towers.

PRE-LESSON ASSIGNMENT

Nil.

APPROACH

A practical activity was chosen for this lesson as it is an interactive way to introduce the cadets to constructing and launching model rockets in a safe, controlled environment.

INTRODUCTION

REVIEW

Nil.

OBJECTIVES

By the end of this lesson, the cadet shall have launched a small model rocket.

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IMPORTANCE

It is important for cadets to experience the thrill of launching a model rocket, as it will stimulate an interest in aerospace, model rocketry and the Air Cadet Program. Launching a small model rocket that they built themselves will also develop in cadets a sense of pride and accomplishment.

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Teaching point 1 **Demonstrate and have the cadets assemble a model rocket.**

Time: 25 min Method: Practical Activity

ACTIVITY

OBJECTIVE

The objective of this activity is to have the cadets assemble a model rocket.

RESOURCES

- No. 11 hobby knives,
- Cement for plastic models,
- Scissors,
- Pencil, and
- Model rocket kit that utilizes an A-series engine.

ACTIVITY LAYOUT

Nil.

ACTIVITY INSTRUCTIONS

1. Familiarize the cadets with the parts of the rocket.
2. Distribute one model rocket kit to each cadet.
3. Demonstrate and have the cadets, in pairs, complete the steps in building a model rocket.

SAFETY

- Caution is required when using sharp tools.
- Provide adequate ventilation when using solvent-based glues.

CONFIRMATION OF TEACHING POINT 1

The cadets' participation in the activity will be the confirmation of this TP.

Teaching point 2 **Have the cadets assist in the set-up of the rocket launch site.**

Time: 20 min Method: Practical Activity



Have the cadets assist in the set-up of the rocket launch site IAW Attachment A.

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CONFIRMATION OF TEACHING POINT 2

The cadets' participation in the activity will serve as the confirmation of this TP.

Teaching point 3 **Have the cadet launch a small model rocket.**

Time: 35 min Method: Practical Activity

ACTIVITY

OBJECTIVE

The objective of this activity is to have the cadets launch the small model rockets assembled in TP 1.

RESOURCES

- Preassembled model rockets from TP 1,
- Rocket launch site setup drawing located at Attachment A,
- Model rocket launching procedure located at Attachment B,
- Model rocket launch tower,
- Model rocket launch controller,
- 80 m of safety tape,
- 18 modular tent pegs or a suitable substitute,
- Safety glasses,
- Voltmeter,
- Pliers,
- Screwdriver, and
- Electrical tape.

ACTIVITY LAYOUT

The rocket launch site will be set up IAW Attachment A.

ACTIVITY INSTRUCTIONS

1. Follow the model rocket launching procedure located at Attachment B.
2. Have the cadets install the igniters in the rocket engines.
3. Have the cadets install the rocket engines in the rockets.
4. Have the cadets place the rockets on the launch pads.
5. Have the cadets press the launch buttons and launch their rockets.
6. Have the cadets track the rockets through its flight.
7. After the rockets have landed, have the cadets recover them.

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SAFETY

- Ensure control of the entire rocket site at all times.
- Only the instructor and the cadets launching the rockets will be in the launch control area.
- Spectators will remain at least 20 m from the launch tower.
- Engines should be kept in a steel box and only distributed when the rockets are ready to be launched.
- Horseplay will not be tolerated at any time during the launching of model rockets.
- Recovery should be done quickly as delay may prevent the launching of all the rockets.

CONFIRMATION OF TEACHING POINT 3

The cadets' participation in the activity will serve as the confirmation of this TP.

END OF LESSON CONFIRMATION

The cadets' participation in the small model rocket launch will serve as the confirmation of this lesson.

CONCLUSION

HOMEWORK / READING / PRACTICE

Nil.

METHOD OF EVALUATION

Nil.

CLOSING STATEMENT

A model rocket is subject to the same forces and laws of nature as a space-program launch vehicle. Experience with model rockets will give the hobbyist useful space program insights.

INSTRUCTOR NOTES / REMARKS

EO C440.01 (Describe Model Rocketry) must also be selected and delivered prior to this lesson.

Cadets who are qualified Advanced Aerospace may assist with this instruction.

REFERENCES

C3-162 Beach, T. (1993). *Model rocketry technical manual*. Retrieved October 10, 2007, from http://www.estesrockets.com/assets/downloads/roecketrytechniques.pdf

C3-163 Cannon, R. L. (1999). *A learning guide for model rocket launch systems*. Retrieved October 10, 2007, from http://www.estesrockets.com/assets/downloads/launchsystemguide.pdf

C3-259 ISBN 978-0-471-47242-1 Stine, G. H. (2004). *Handbook of model rocketry*. Toronto, ON: John Wiley & Sons.

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LAUNCH SITE SET-UP

1. A safety briefing will be held before the launch site is set up, covering the following points:

   a. The Launch Control Officer (LCO) is the only person permitted to activate the launch control panel.

   b. All launch systems will be placed in "safe" mode between each flight.

   c. When a rocket is descending out of control, launch site personnel will point at the rocket and repeat the phrase "heads up" until the rocket has landed.

   d. No horseplay will be tolerated.

   e. A safe rendezvous point will be clearly indicated and in the event of an emergency, launch site staff will move all cadets and staff to this point.

   f. The area required for launching model rockets should be at least 100 m square. It should not have any tall buildings, trees, power lines or other tall objects close by. The cadets and spectators should be located in an area at least 20 m from the launch towers. Bleachers at a baseball field or soccer field are suitable.

   g. If the site is within 9 km (5.6 miles) from an aerodrome, the aerodrome must be advised of the date and time the rockets will be launched. The rocket can reach a height of 200–400 feet at apogee and can be flown safely from the suggested field size.

2. Wind will play an important factor in the rocket's recovery. The descending rocket will drift with the wind and if descending too slowly will land far from the launch site. Rockets should not be launched in winds stronger than 35 km / h (28 miles per hour).



If the first rockets launched descend too slowly resulting in the rockets landing far from the launch site, a hole can be cut in the centre of the parachute to speed up the rockets descent.

3. Layout the rocket launch site as per Figure A-1. Wind direction should be accounted for by placing the towers closer to the windward side of the field.

4. Using modular tent pegs or a suitable substitute as posts, cordon off a 10 m by 10 m security tape border around the launch towers and a 10 m by 10 m security tape border around the launch control site leaving a 1 m opening for access.

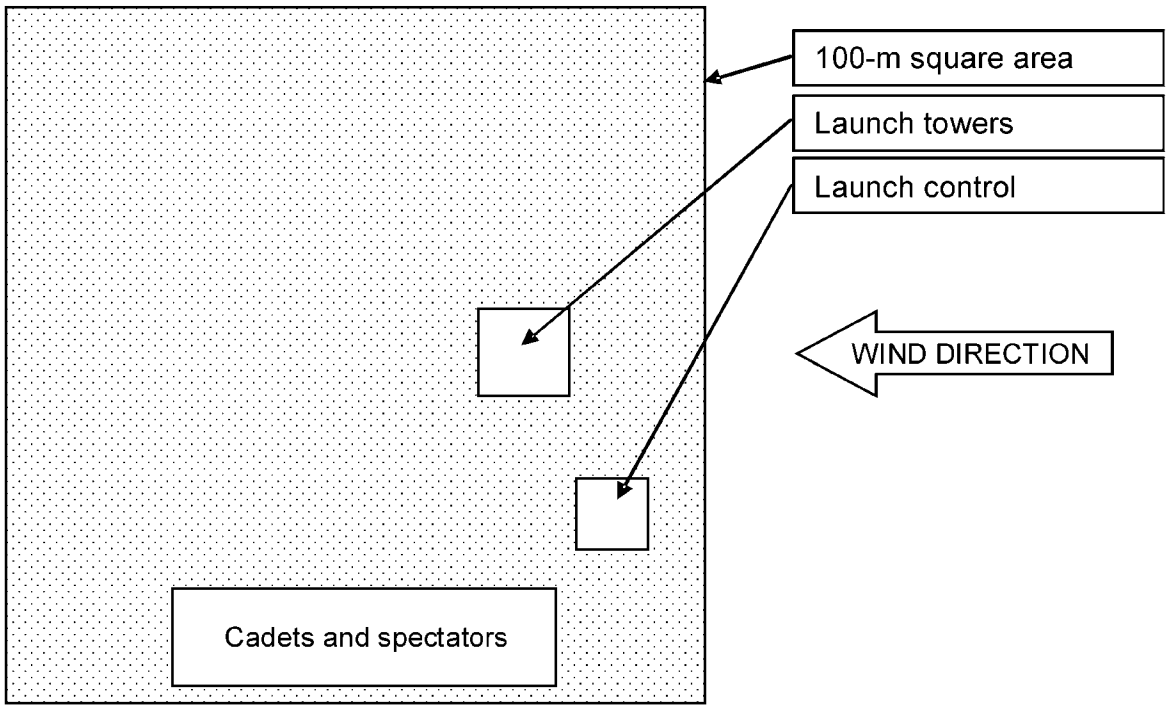
5. Assemble the launch towers as per directions included with the towers. Place the launch towers in a line perpendicular to the wind. The launch rods should point slightly into the wind.

6. Place the launch control panels on the launch control tables and run the wire from each of the launch control boxes to the launch towers ensuring the wires are not tangled and in good working order.

7. All rockets will be brought to the rocket holding area before the launch begins.

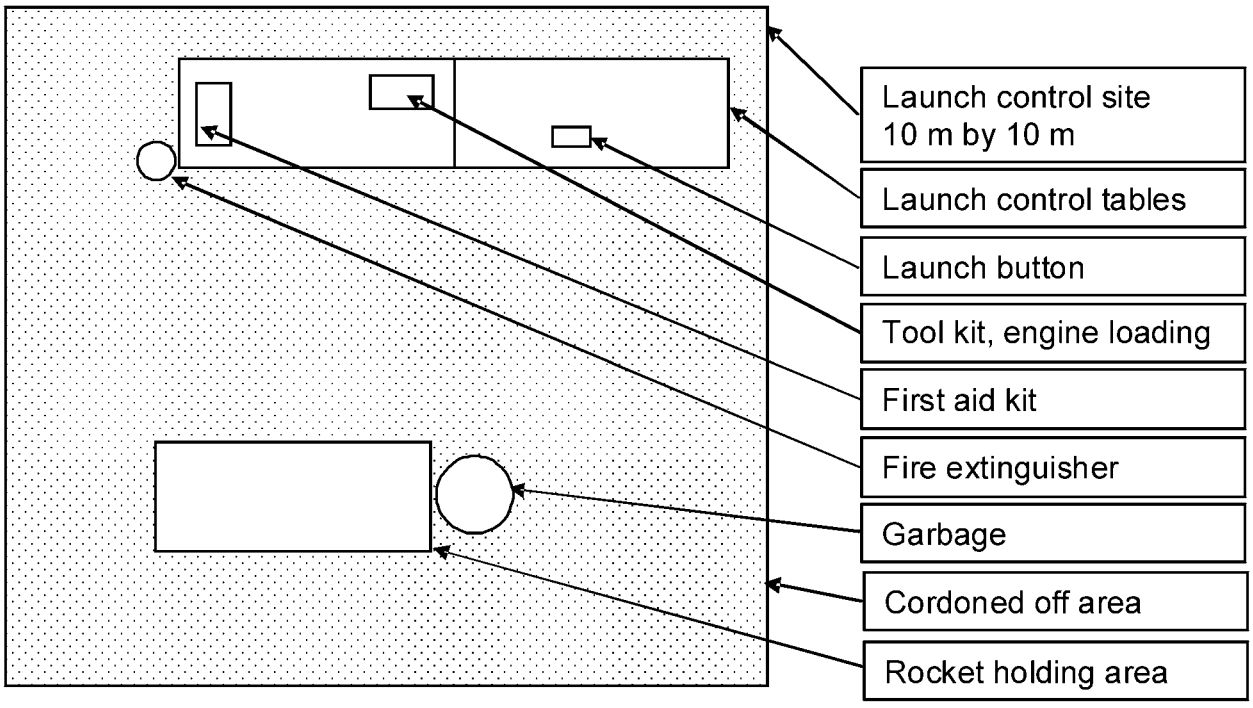
8. Make sure all the connections are clean and tight.

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Note. Created by Director Cadets 3, 2008, Ottawa, ON: Department of National Defence.

Figure A-1 Layout for a Rocket Launch Site



Note. Created by Director Cadets 3, 2008, Ottawa, ON: Department of National Defence.

Figure A-2 Layout for a Launch Control

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MODEL ROCKET LAUNCH PROCEDURE

1. Place the launch control switches in the safe position.

2. Collect the rockets from the cadets and prepare them for launch by following the directions included with the model rocket, launch control and launch towers.



The igniters should be handled with care, as damaged igniters are the cause of most misfires.

3. Following the launch tower directions, install one rocket on each launch tower.

4. Verify the launch control switches are in the safe position.

5. Connect the two alligator clips from each launch controller to the igniter leads on each of the rockets.

6. Make sure everyone stands back from the launch towers and have the cadets start a countdown from ten, backwards to zero.

7. Place the safe switches in the launch position.

8. Have the cadets press the launch buttons and launch their rockets.



If the rocket does not lift off the pad, wait at least one minute before approaching the pad. See Attachment C for troubleshooting the launch system.

9. Have the cadets track the rockets through their flights.

10. After the rockets have landed, allow the cadets to recover them.



After each flight, the alligator clips at the launch towers should be cleaned with 280-grit sandpaper and replaced when they can no longer be cleaned effectively.

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IF THE ROCKET ENGINE DOES NOT IGNITE

1. Place the launch control button in the safe mode.

2. Wait one minute before approaching the launch tower. This will ensure the engine is no longer able to ignite.

3. Undo the alligator clips from the igniter and remove the rocket from the launch tower.

4. At the launch tower, test the power with a voltmeter to ensure there is voltage present by setting the voltmeter to "V" and placing the tower's alligator clips on the leads of the voltmeter, red to red and black to black.

5. With all the wires connected and the launch button pressed, the launch control lights should be on and the voltmeter should read approximately the voltage of the combined batteries (eg, three batteries at 1.5 volts each equals 4.5 volts).

6. If the lights on the launch control do not light or the voltmeter registers low voltage or no voltage at all, the batteries are weak or dead, one of the wires is broken, or there is a loose connection at the launch control or the launch pad.

7. To trace the problem, start at the launch control and ensure there are fresh batteries. If the batteries are fresh and correctly installed, proceed to the launch tower and verify if there is voltage at the launch tower. Repair any breaks in the wire or loose connections.

8. Verify that the igniter leads are not touching each other and that the igniter tip is not broken. If the igniter appears to be unserviceable, install a new igniter and restart the launch process.

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