*Instruction Sheet
for the PASCO
Model ME-6617*

ROCKET ENGINE TEST BRACKET
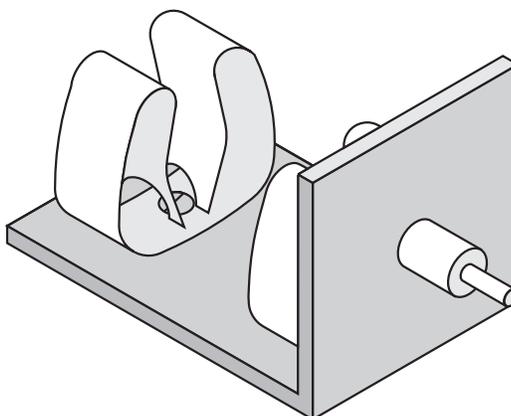
Introduction

The PASCO ME-6617 Rocket Engine Test Bracket is designed for use with the PASCO CI-6537 Force Sensor and a PASCO computer interface to determine the magnitude of impulse of Estes™ model rocket engines (series A – D). By permitting the measurement of the impulse of an Estes model rocket engine, the Rocket Engine Test Bracket can augment rocketry studies, such as those detailed in the Estes Educator™ Teacher Resources[1].

⚠ The Rocket Engine Test Bracket should be used only in a supervised class setting by personnel who are familiar with the National Association of Rocketry Safety Code and after complying with any state regulations for igniting rocket engines.[1]

[1]*For more information, contact Estes Industries, 1295 H. St., Penrose, CO 81240, 1-800-820-0202*

Equipment

Included:

• Rocket Engine Test Bracket

Additional Required:

• Estes™ Model Rocket Engine (series A, B, C, or D)
• Estes launch controller
• Large Rod Stand (ME-8735)
• 90 cm support rod (ME-8738)
• Force Sensor (CI-6537)
• *Science Workshop* and a PASCO computer interface (300, 500, or 700)
• computer

➤ *Note: Because of its remote data logging capability, the PASCO 500 Interface is the most practical computer interface to use with the Rocket Engine Test Bracket.*

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⚠️ **Important Safety Notes**

➤ Read all the warnings and follow the instructions provided with the Estes Model Rocket Engine and Igniter.

➤ Review the National Association of Rocketry (NAR) Safety Code prior to igniting a rocket engine. Point number 9 of the NAR Safety Code is of particular importance:

"The system I use to launch my model rocket will be remotely controlled and electrically operated. It will contain a launching switch that will return to "off" when released. The system will contain a removable safety interlock in series with the launch switch. All persons will remain *at least 15 feet (5 meters)* from the model rocket when I am igniting model rocket engines totalling 30 newton–seconds or less of total impulse . . . I will use only electrical igniters recommended by the engine manufacturer that will ignite model rocket engines within one second of actuation of the launching switch."

➤ Choose an asphalt or concrete launch area free of any combustible material, animals, or people.

➤ Use a remote electrical launching system that includes a safety key feature to ignite the model rocket engine. Remote electrical launching is the only safe and approved way to ignite model rocket engines.

➤ Install igniters only when you are outdoors and almost ready to launch.

➤ Wear safety glasses when installing the igniter and connecting the cables to the launch controller.

➤ Never put the safety key in the launch controller unless the exhaust area of the rocket engine is clear. Otherwise, accidental ignition causing injury may result.

➤ Before igniting the rocket engine, check to be sure there are no objects, people, or animals near the exhaust of the model rocket engine.

➤ Remove the safety key as soon as the rocket engine is ignited.

➤ **Do not** allow the igniter leads or alligator clips on the cables to touch each other.

➤ Wait 10 minutes after ignition of the rocket engine before touching the Rocket Engine Test Bracket—**it will be *hot.***

➤ Comply with any regulations from your state or country for igniting rocket engines.

➤ Use ony Series A–D Estes model rocket engines.

➤ In the event of a misfire, remove the safety key from the controller and wait 60 seconds before disconnecting the micro-clips. Then replace the igniter.

➤ Never store or transport model rocket engines with igniters installed.

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Setup

Set up the equipment

1. Remove the hook from the end of the Force Sensor. Use a small screwdriver to connect the Rocket Engine Test Bracket to the Force Sensor in place of the hook (Figure 1).
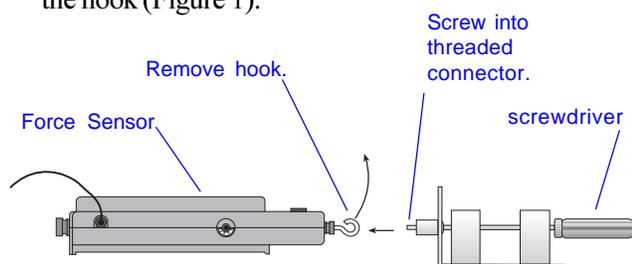
Figure 1
Attaching the Rocket Engine Test Bracket to the Force Sensor

2. Mount the Force Sensor on the support rod in one of two ways: horizontally (Figure 2a) or vertically (Figure 2b).
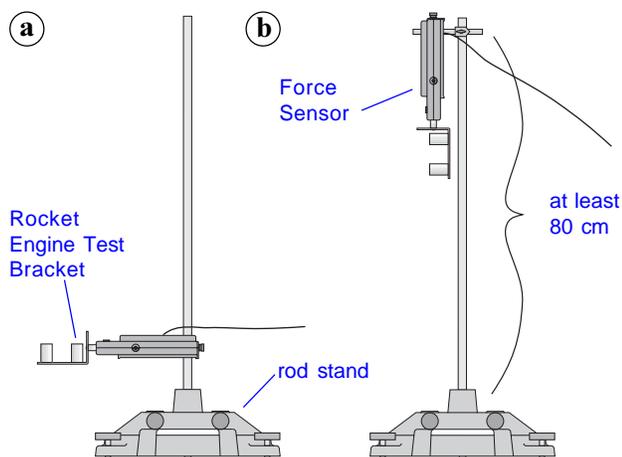
Figure 2
a) horizontal mount b) vertical mount

3. Insert the model rocket engine into the test stand with the engine's exhaust port pointing away from the Force Sensor.

Set up *Science Workshop*

1. Set up the Force Sensor in *Science Workshop* on analog channel A.

2. Adjust the sampling rate for the Force Sensor to 500 Hz.

➤ *Note: Refer to the User's Guide to* Science Workshop *("Sampling Options") for details on adjusting the sampling rate.*

3. Open a Graph display.

➤ *Note: If you are using a 500 computer interface, prepare it for remote data logging (refer to the* **User's Guide to Science Workshop** *("Remote Data Measurement with the* Science Workshop *500 Interface").*

Prepare for Ignition

1. Move the equipment to the launch site.

2. Insert the igniter into the rocket engine and spread the wires apart, leaving the paper separator in place (Figure 3).
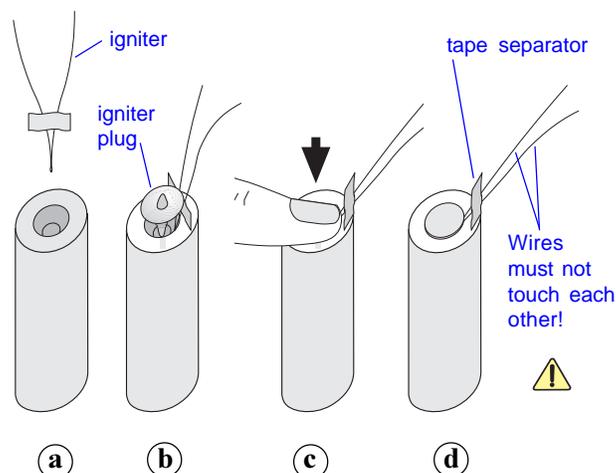
Figure 3
Inserting the igniter into the model rocket engine

➤ *Note: Carefully follow the instructions that accompany the rocket engine and igniter.*

3. Clip the alligator clips of the cables from the launch controller to the igniter wires.

⚠ *Note: Do not allow the igniter wires or alligator clips to touch each other. Be certain that the safety key is not in the launch controller. Insure that the cables are well away from the exhaust area (Figure 4) and the computer interface is as far away from the exhaust area as possible.*

4. Plug the Force Sensor's DIN connector into analog channel A.
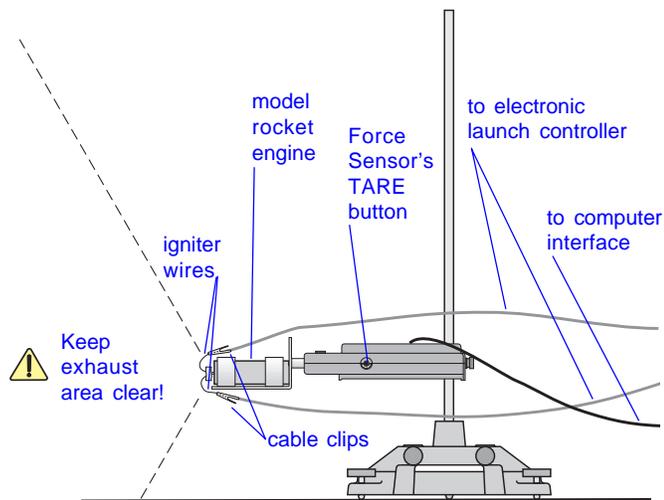
Figure 4
Completed experimental setup

5. Press the TARE button on the Force Sensor (Figure 4).

➤ *Note: For the 500 interface in remote mode, press the TARE button after the "log" button has been pressed and the LED has flashed 10 times.*

6. Check the exhaust area to ensure it is clear of any combustible material, people, or animals.

Data Collection

1. Insert the safety key into the launch controller.

2. Begin recording data and move to 15 feet (5 meters) away from the Rocket Engine Test Bracket.

3. Ignite the rocket.

4. After the burn, stop recording data.

Data Analysis

1. In *Science Workshop*, click the statistics button and select **Integration** from the pop-up menu, and click the Autoscale button to resize the graph.

2. Select the area under the curve and record the integrated value (impulse of the rocket engine).

3. Use the smart cursor to determine the time to the ejection charge.

4. Compare your recorded values with the expected values for the type of you are using.

The exclamation point within an equilateral triangle is intended to alert the user of important operating and safety instructions that will help prevent damage to the equipment or injury to the user.
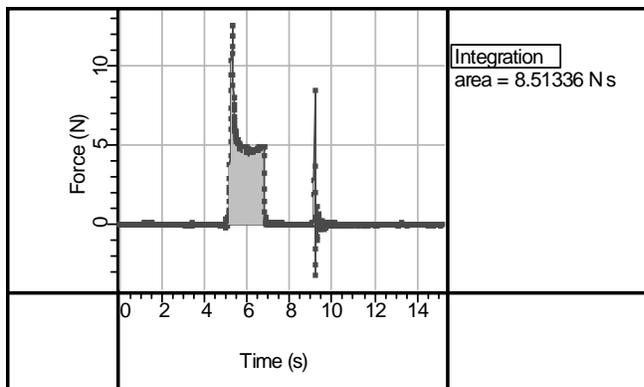
Figure 5
Graph of typical experimental results of a test of an Estes C6-3 model rocket engine

Suggested Activity

Calculate the expected height of a rocket propelled with an identical rocket engine from the force and mass data, and compare with the actual height attained in a flight test.

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