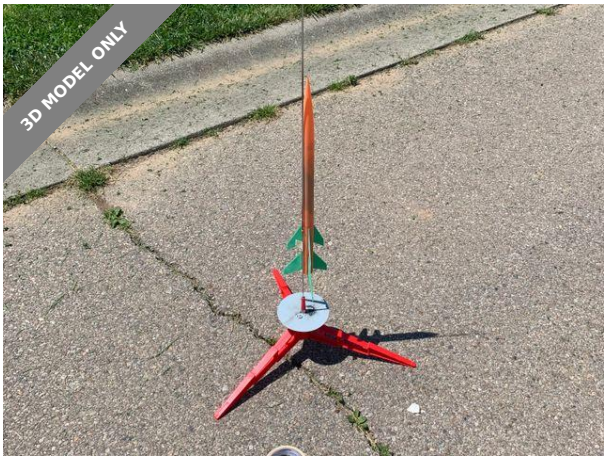

2 Stage Model Rocket - "The Carrot"

LyricPants

VIEW IN BROWSER

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Summary

A simple 2 stage Model Rocket designed to be printable on a Prusa Mk3s, and put together with basic rocketry supplies.

Toys & Games > Vehicles

Tags: rocket rocketry modelrocket

Background Info

I designed this rocket for a school project. I wanted to learn and better understand how rockets work and improve my abilities with CAD design. This design was made using Fusion 360 and OpenRocket.

The Design

As mentioned earlier, I used Fusion 360 and OpenRocket to design the rocket. I settled upon a two-stage rocket because I realized that it wouldn't be too much harder to design and make but would be much more fun to launch.

The Fins and Nosecone were both computer optimized by Open Rocket for altitude while still having a fair amount of stability. The rocket was also

designed with the ability to carry an Arduino Altimeter(also my design); however, its use is completely optional.

The stage separation is straightforward. Two rocket engines are taped together. When the first stage is done burning, flaming material shoots out the other end immediately. It lights the second engine(this is important because any delay could cause the rocket to point the wrong way and make its subsequent trajectory dangerous). The second engine lights and burns off the tape, ejecting the first stage. Due to its lightness, it will safely tumble down to earth. Meanwhile, the second stage continues. A couple of seconds after fuel expenditure, an ejection charge is shot out the other end of the engine. This mix of hot gas and particles ejects the cone, the parachute, and the protective recovery wadding. From here, the rocket will safely float back down. For a better explanation with pictures, go here.

Printing and Outside Parts

Printing the design is simple. So to keep it simple, here is a parts list:

3D Print:

- 1x Nose Cone
- 1x Bodytube*
- 1x Stage 2 fincan**
- 3x Stage 2 fins (small fins)***
- 1x Stage 1 fincan**
- 3x Stage 1 fins (big fins)***

*Print in Vase Mode with one layer walls, at 0.45mm

**10% infill

***100% infill

ABS or ASA is recommended, however, the use of other materials is OK.

Outside:

NOTE: DO NOT purchase anything here only because I link it. These are only general guidelines. Please do your research as to what is appropriate for you.

- Sandpaper (optional, but highly recommended)
- Spray paint (optional, but cooler looking rocket = cooler launch)
- Superglue
- Cellophane tape

- Shock Cord
    - 2 feet or more
- Parachute
- Launch System
    - EXAMPLE: Complete Sky Launch System by Apogee Components
- 18mm Booster stage Engines (Estes Purple Label)
    - EXAMPLE: B6-0
- 18mm Upper stage Engines (Estes Red Label)
    - EXAMPLE: B6-6

For engines, see the below image. Realistically, any 18mm purple and red engine will work, however, anything past a C engine is too much for a rocket of this size and weight.

ENGINE CHART

- Delays have a tolerance of plus or minus 10% or 1 second, whichever is greater.
- All Estes engines come complete with igniters and patented igniter plugs (Pat. No. 5,410,966 and 5,509,354). The Estes Igniter Plug makes engine ignition extremely reliable.
- Do not fly a rocket/engine combination whose liftoff weight exceeds the recommended maximum liftoff weight.

Prod. No.	Engine Type	Total Impulse	Time Delay	Max. Lift Wt.		Max. Thrust		Thrust Duration	Initial Weight		Propellant Weight	
		N-sec	Sec.	Oz.	g	Newtons	Lbs.	Sec.	Oz.	g	Oz.	g
SINGLE STAGE ENGINES (GREEN LABEL)												
1502	1/4A3-3T	0.625	3	1.0	28	4.9	1.1	0.25	0.20	5.6	0.03	0.85
1503	1/2A3-2T	1.25	2	2.0	57	8.3	1.9	0.3	0.20	5.6	0.06	1.75
1507	A3-4T	2.50	4	2.0	57	6.8	1.5	0.6	0.27	7.6	0.12	3.50
1511	A10-3T	2.50	3	3.0	85	13.0	2.9	0.8	0.28	7.9	0.13	3.78
1593	1/2A6-2	1.25	2	2.0	57	8.9	2.0	0.3	0.53	15.0	0.06	1.56
1598	A8-3	2.50	3	3.0	85	10.7	2.4	0.5	0.57	16.2	0.11	3.12
1601	B4-2	5.00	2	4.0	113	13.2	3.0	1.1	0.70	19.8	0.29	8.33
1602	B4-4	5.00	4	3.5	99	13.2	3.0	1.1	0.74	21.0	0.29	8.33
1605	B6-2	5.00	2	4.5	127	12.1	2.7	0.8	0.68	19.3	0.22	6.24
1606	B6-4	5.00	4	4.0	113	12.1	2.7	0.8	0.71	20.1	0.22	6.24
1613	C6-3	10.00	3	4.0	113	15.3	3.4	1.6	0.88	24.9	0.44	12.48
1614	C6-5	10.00	5	4.0	113	15.3	3.4	1.6	0.91	25.8	0.44	12.48
1622	C11-3	10.00	3	6.0	170	22.1	4.9	0.8	1.14	32.2	0.39	11.00
1666	D12-3	20.00	3	14.0	396	32.9	7.4	1.6	1.49	42.2	0.88	24.93
1667	D12-5	20.00	5	10.0	283	32.9	7.4	1.6	1.52	43.1	0.88	24.93
1673	E9-4	30.00	4	15.0	425	25.0	5.6	2.8	2.00	56.7	1.27	35.80
1674	E9-6	30.00	6	12.0	340	25.0	5.6	2.8	2.00	56.7	1.27	35.80
UPPER STAGE ENGINES (PURPLE LABEL)												
1504	1/2A3-4T	1.25	4	1.0	28	8.3	1.9	0.3	0.21	6.0	0.06	1.75
1599	A8-5	2.50	5	2.0	57	13.3	3.0	0.5	0.62	17.6	0.11	3.12
1607	B6-6	5.00	6	2.5	71	12.1	2.7	0.8	0.78	22.1	0.22	6.24
1615	C6-7	10.00	7	2.5	71	15.3	3.4	1.6	0.95	26.9	0.44	12.48
1668	D12-7	20.00	7	8.0	226	32.9	7.4	1.6	1.55	44.0	0.88	24.93
1675	E9-8	30.00	8	10.0	283	25.0	5.6	2.8	2.00	56.7	1.2	35.80
BOOSTER STAGE ENGINES (RED LABEL)												
1608	B6-0	5.00	None	4.0	113	12.1	2.7	0.8	0.58	16.4	0.22	6.24
1616	C6-0	10.00	None	4.0	113	15.3	3.4	1.6	0.80	22.7	0.44	12.48
1665	D12-0	20.00	None	14.0	396	32.9	7.4	1.6	1.44	40.9	0.88	24.93
PLUGGED ENGINES - FOR USE WITH ROCKET POWERED RACERS & R/C ROCKET GLIDERS (BLUE LABEL)												
1505	A10-PT	2.50	None	3.0	85	13.0	2.9	0.8	0.26	7.4	0.13	3.78
1669	D11-P	20.00	None	16.0	453	27.6	6.2	1.8	1.55	44.0	0.88	24.93

The data listed above is from randomly chosen production samples.
NOTE: The "T" designates a mini engine.

*** There are 4 mini engines per package. All other engines are 3 per package.**

Putting everything together

Step 1: Sand all of the parts. Be careful not to break the stage 2 launch rings

Step 2: Tie one end of your shock cord to the stage 2 fincan through the hole.

Step 2: Superglue the body to the stage 2 fincan, making sure that the shock cord goes inside of the body, and comes out the other side

Step 3: Superglue the fins to their corresponding fincan. They can only be oriented one way, so you can't place them upside down.

Step 4: Tie the other end of the shock cord to the hole in the cone. Make an Alpine Butterfly Loop Knot between the end of the body and the cone, attaching your parachute to this knot.

Assembly is complete!

Launch

Launch is similar to most other model rockets, so online guides on how to do a generic launch will be useful.

Step 1: now you need to tape your engines together. Place the upper stage engine(purple) on top of your booster stage engine(red), both having their nozzles facing down. Tape them together using ONLY 1 layer of cellophane tape. This tape will be burnt through on stage separation.

Step 2: Slide your double engine inside of the fin cans. If they slide freely, layer tape on each engine until the fin-cans are firm. Make sure that the securing tape only contacts one fincan, you do not want to friction fit the two fincans together, only the engines to the fincans.

Step 3: Load 3 pieces of crumpled-up recovery wadding into the body tube, lightly pushing it all the way down.

Step 3.5: tie your altimeter to the same Alpine Butterfly Loop Knot for easy recovery.

Step 4: Fold your parachute and insert it into the body, along with your shock cord. Make sure any accessories are below the parachute. Place your cone on top of it, making sure everything is securely inside.

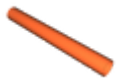
Step 5: Follow your engines setup instructions. You only need to insert the igniter into the lower engine(its the only one you have access to anyways).

Step 6: Place your rocket on its launch pad, and press the launch button!

Model files

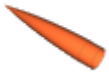
Stage 2

4 files



bodytube.stl

Print in Vase mode



cone.stl

No supports

stage2fincan.stl

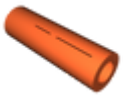
supports only for interior overhang and hooks.

stage2fin.stl

Use ironing for better finish

Stage 1

2 files



stage1fincan.stl

No supports

stage1fin.stl

Use ironing for better finish

Other files

print-settings.ini

In Prusaslicer, CTRL + L, and select this file.

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