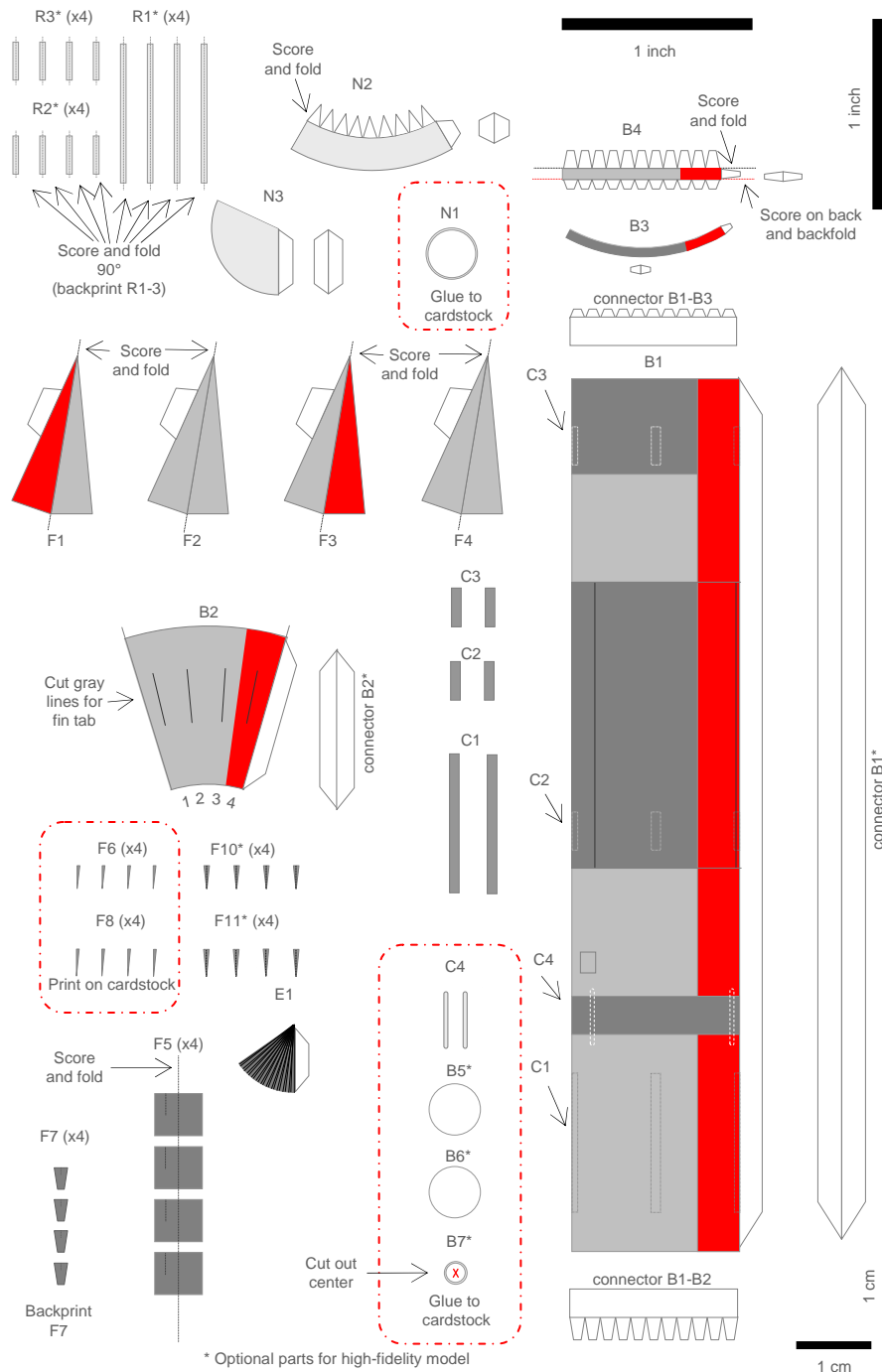


Robert Goddard's L-13 (1:32nd scale)

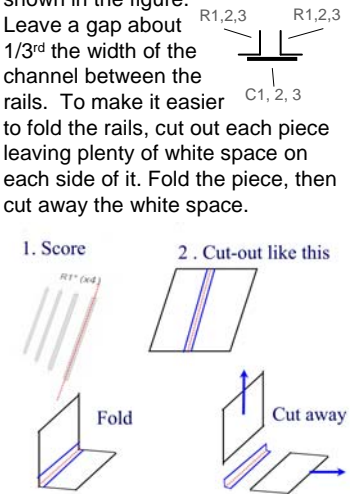
Launched on March 26, 1937, L-13 flew higher than any of the other 35 liquid fueled rockets flown by Robert Goddard. From its launch pad at Roswell N. M. it achieved an altitude of an estimated 1.7 miles (2.7 km).

The rocket used a gyroscope to control the air and blast vanes at the bottom of the fins, to keep it vertical during flight. It burned gasoline and liquid oxygen. Overall length was 200-3/8 inches (5.089 m) with a tube diameter of 9 inches (0.229 m). One quadrant of the steel and aluminum missile was painted red, as were the sides of the two fins parallel to the quadrant.



Assembly instructions

1. Roll main body (B1) into a cylinder and glue. (if desired, cut off tab on B1 and use optional connector for a flush tube.)
2. Score tabs on connector B1-B3. Roll and glue inside of B1.
3. Slide B5 inside B1 and glue to bottom of connector B1-B3.
4. Slide B6 approx 1/2" (12 mm) up the bottom of the main body tube. Use a pencil or rod to keep it perpendicular to the tube.
5. Score the tabs on connector B1-B2, roll, and glue inside the bottom of the main tube,
6. Form part B3 into a cone, and glue.
7. Score the tabs on bottom and top of B4. Form B4 into a cylinder.
8. Glue B1 to B3, then glue B4 to the top of the assembly
9. Cut slits for the fins into the lower body (B2), then roll B2 into a cone, and glue.
10. Roll the engine (E1) into a cone with the color inside, and glue. Slide inside B2 and glue flush with bottom. (Or skip this step and use step 11).
11. Optional: Cut out the bottom of the body (B7) – including the center – and glue to the bottom of B2. Glue the bottom of the engine to the inside of B7.
12. Glue the bottom of the body to the main body. Keep the seams aligned.
13. Cut out the launch rail channels. If desired (for higher accuracy) cut out the launch rails and form into a 90° "L" along their length. Then glue them on to the channels as shown in the figure. Leave a gap about 1/3rd the width of the channel between the rails. To make it easier to fold the rails, cut out each piece leaving plenty of white space on each side of it. Fold the piece, then cut away the white space.



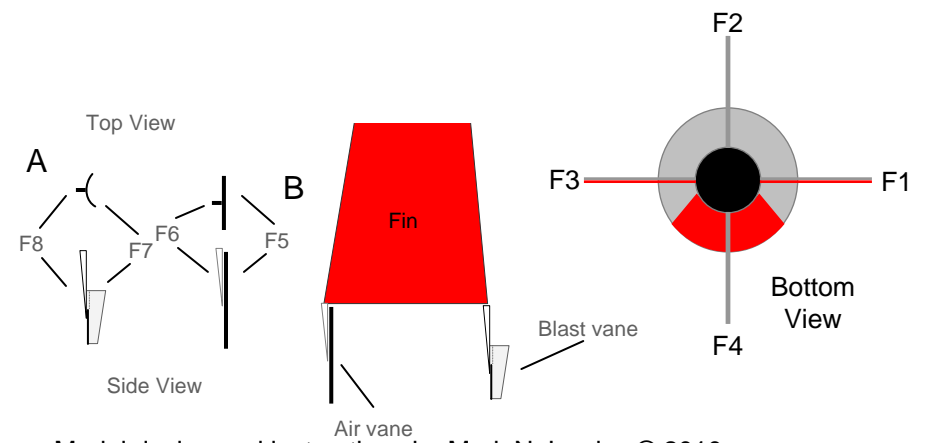
(continued on other side)

Backprint side

This model can be copied and used for non-commercial purposes

14. Cut out the cable tunnels (C4). Glue the launch rail channels and the cable tunnels to the rocket body as shown.
15. Cut out nose cone pieces N1, N2, and N3. Form N2 and N3 into cones and glue.
16. Glue N3 into the top of N2, using the tabs from N2.
17. Glue N1 to the bottom of the nose cone, keeping the colored side visible (on the bottom). Set aside for now.
18. Score the fins (F1-F4) as shown. Cut out the pieces. Double each fin over and glue together. Press the pieces flat.
19. Slide each fin into the appropriate slot on the lower body (B2), and glue into place. The fins are numbered, and the corresponding numbers are shown under B2. Note that the fin that goes in the red quadrant is bare aluminum on both sides. The red sides on the fins should be visible when viewed from the red quadrant.
20. Cut out the air vane (F5), and air vane shaft (F6). Double over the air vane pieces, and glue together. Glue the two pieces together as shown in Figure A. Make four sets. (Alternatively, if you cannot back-print cardstock, substitute F10 for F6, scoring the piece on the dashed line. Double over the piece, glue, and glue to F5.)
21. Cut out the blast vane (F7), and air vane shaft (F8). Curve the blast vane as shown in Figure A, and glue the vane to the shaft. Make four sets. (Or substitute F11 for F8, doubling over the halves and glue together.)
22. Glue one blast vane assembly and one air vane assembly to the bottom of each fin as shown in Figure B. The air vane goes on the outside corner and the blast vane on the inside corner. (The model will sit on these vanes.)
23. Fold the tabs on B4 perpendicular, and glue the nose cone to the body. The colored ring on the nose cone should be visible.

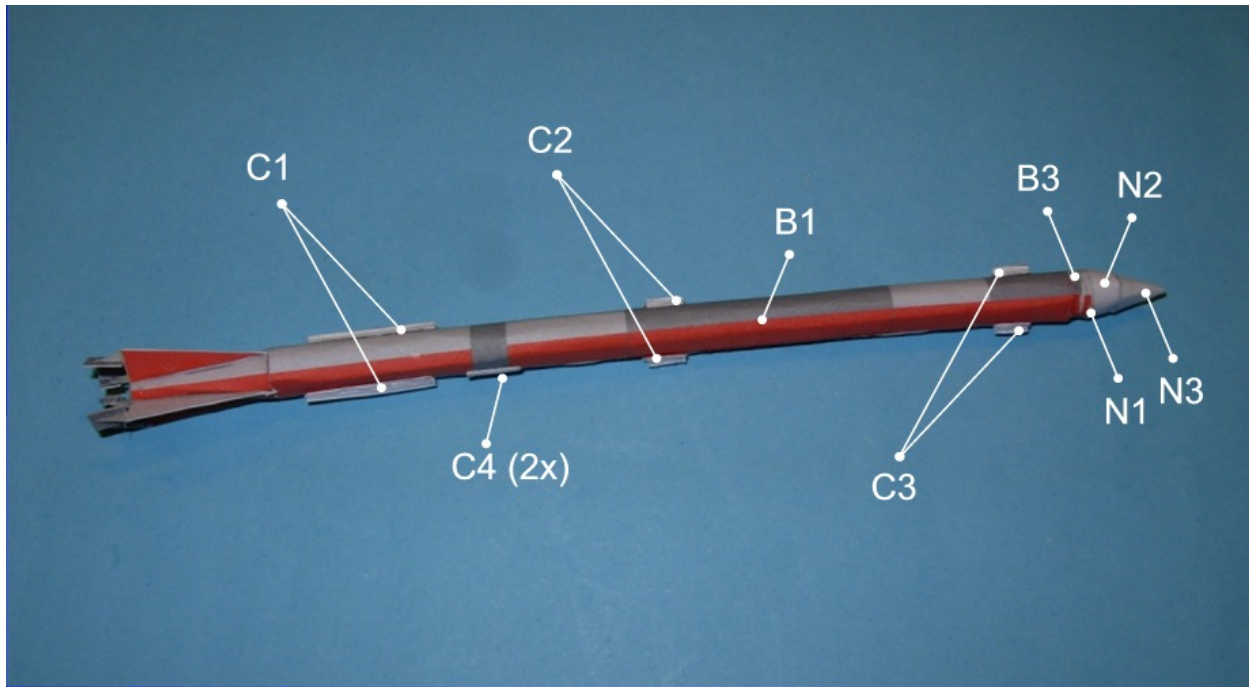
You should be done



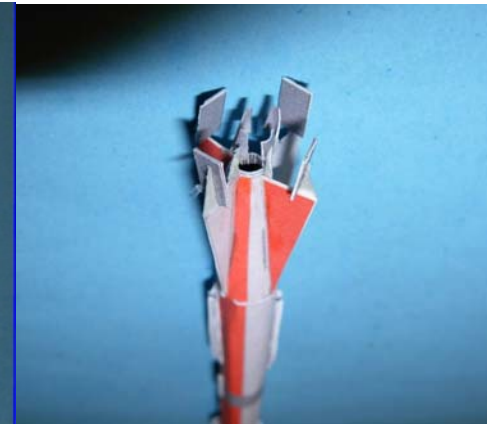
Model design and instructions by Mark N. Lardas © 2010

Plans for the L-13 are at: http://www.clarku.edu/research/archives/goddard/diagram_L13.cfm

Finished L-13 Model, with pieces labeled.



Close-up of vanes



Images courtesy Niels Knudsen, and used with his permission

B3-4



Want to make this model at a different scale?

I chose 1:32nd scale for this model because it fits with several other models of early rockets, including Ralph Currell's V-2 and Niels Knudsen's Hermes. (Besides, it is a traditional aircraft scale.) But 1/32nd is at the limit of what many modelers can make. It is easier to make at larger scales, rescaling the kit.

If you want to make a 1:24th scale model, print the sheets at 133% scaling. To print it at 1:16th scale, use a 200% scaling. For 1:8th scale, use a 400% scaling.

If you do this, you can only print part of the page on a standard-sized sheet (8.5x11 USA or A4 in Europe). With a .pdf file use the following procedure:

1. Scale the PDF window so that it shows the part of the page you wish to print.
2. Click on the print button.
3. When the "Print" menu appears, choose the following options:
 - Set "Print Range" to "Current View"
 - Set "Page Scaling:" to "None"
 - Turn "Auto-Rotate and Center" off and "Choose paper size by PDF page size."
4. Click on the "Properties" button for the printer. Find the scaling option for your printer. On some printers this is on one of the menu tabs. On others, there is a button that takes you to a menu with the option.
5. Set the scaling -- print at 133% for 1:24, 200% for 1:16, 400% for 1:8.
6. Print page.

Move the window around until all the pieces get printed

What about smaller scales?

First, look up "masochist" in a dictionary.

If that does not discourage you, use the following scaling values:

1:48	– 67%
1:72	– 44%
1:96	– 33%

Turn "Auto-Rotate and Center" on when you print.

In building the kit, omit the rails (R1, R2, R3). And just use half of the wind vanes, cutting at the dashed line (they are back-printed). Use wire for the vane shafts (or leave them off).

Substitute piece B3-4 (above) for pieces B3 and B4. Omit the connector B1 to B3, and slide the white part of B3-4 into B1, instead.

(I actually did build this in 1:72 scale to have a model that would go with the rest of my collection. It was an exercise in masochism.)