PEAK OF FLIGHT NEWSLETTER

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https://www.apogeerockets.com/Rocket-Kits/Skill-Level-5-Model-Rocket-Kits/Saturn-V-1-70th-Scale

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PEAK OF FLIGHT

Modifying a Saturn V to Fly on a 38mm Motor

By Ken Horst

When I first saw Apogee's Saturn V kit in 2001, I had to buy it! I graduated from high school in 1969, when the Saturn V was the most famous, most powerful moon rocket ever. Model rocketry has three aspects that I enjoy: design and building, computer simulation, and actually flying the model. Could I make this Saturn V kit just as it is? No, I could not. I wanted to use a more powerful motor than the one the kit was designed for, so that would require changes to several parts of the model. This article explains how I modified it and what I would improve if I could do it again. I was a high school physics teacher for many years, and am only an amateur engineer. I enjoy finding solutions to problems as I build and enjoy the challenge of using creativity to solve construction issues.

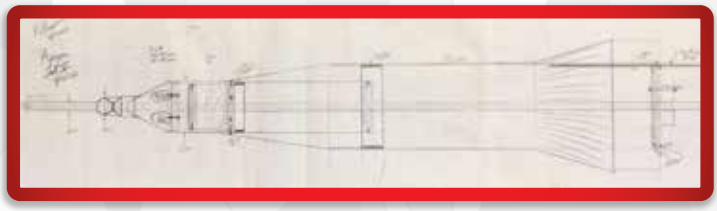

FIGURE 1 - PLAN FOR THE MODIFICATIONS

Lower section of the rocket

The stock kit has a 29 mm motor mount, and most 29 mm motors are short burn motors. The actual Saturn V rocket, of course, has a very long burn first stage, and I wanted this model to echo the original. So I set out to redesign the kit to use a 38 mm Ellis Mountain I-134-10 (Figure

FIGURE 2 - 38 MM ELLIS MOUNTAIN I-134-10

2), which has a five-second burn (Figure 3). I purchased the motor early in the design/build phase of the project, so I was committed to making the modifications work.

FIGURE 3

The first step was to adapt the stock cardboard centering rings to fit a 38 mm motor mount tube (MMT). I wanted to keep the aft end of the rocket as light as possible and keep most of the weight near the Apollo capsule so the Center of Gravity (CG) would remain as far forward as possible. I was hoping that wood glue, cardboard, and some 1/16 inch plywood glued to balsa wood would be strong enough to withstand the acceleration of the larger motor. It was.

The launch lugs (LL) were chosen so that an 80/20 or 1010 one inch square aluminum rail could be used. The polystyrene wraps on the body tube (BT) were carefully cut to the shape of the LL, a pin was used to poke 6 or 8 holes into the cardboard BT, and JB Weld 5 minute epoxy was used to fasten the aluminum lugs to the BT (Figure 4). The

FIGURE 4

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FIGURE 5

FIGURE 6

two LL were carefully aligned using a plumb bob on a string (Figure 5). The ten-foot rail was carefully cleaned before flight and worked well.

The motor retention system was three pieces of #6 threaded rod epoxied to the MMT (Figure 6). The thrust surface was about six wraps of quarter inch masking tape

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FIGURE 7

around the base of the motor. The shock cord attachment was a 4-foot loop of 1/8 inch Kevlar rope anchored to the MMT (Figure 7). At the forward end of the two-foot-long MMT and bulkhead, the body tube wall was strengthened with thin wood lath glued to the cardboard BT (Figure 8). A ring of quarter inch wide cardboard BT was glued to the inside of the rocket wall in position to support the upper portion of the rocket. This was done so that the upper section of the rocket, which was carrying 675 grams of lead, would not slide down into the lower section of the rocket during strong acceleration.

FIGURE 8

Fins

I left the fins stock as they came with the kit, making sure they were solidly epoxied to the body tube, which was supported by the internal motor mount structure. Since my finished project was only marginally stable during flight, I think I would recommend building larger fins to move the center of pressure further aft. So my first challenge for you is to design and build larger fins in the spirit of the Saturn V style.

Upper section of the rocket

The first thing I noticed in the upper section of the rocket is that the launch escape tower (LES) was not very sturdy in the original kit. Fortunately, a quarter inch wood

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FIGURE 9

dowel rod just fit inside the LES engine space (Figure 9). I used a long enough dowel rod to extend through the entire upper section of the rocket. This was designed to hold the whole upper part of the rocket together (Figure 10). The polystyrene LES tower structure was carefully cut

FIGURE 10

to allow the dowel to pass through into the Apollo capsule (the astronauts had to adjust their seating locations a bit). One-quarter inch holes were drilled in the various bulkheads to allow the rod to easily pass through (Figure 11). The bulkheads were loosely fit to the rod so the top section

FIGURE 11

could be opened and closed until the right amount of mass (lead) was added. The dowel rod was secured with blocks of wood and screws at the aft end of the upper section (Figure 12), although apparently not securely enough, as

FIGURE 12

is explained later. RockSim software was used to make the decision to add the 675 grams of lead. The lead was positioned as shown in the diagram (Figure 13). It was purchased at a sporting store.

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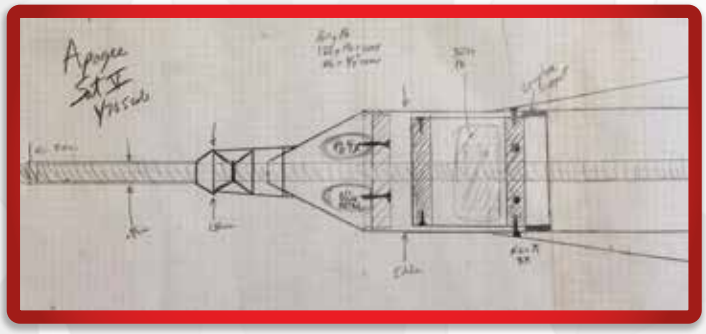

FIGURE 13

Flight

The thrust portion of the flight was an awesome five-second burn (Figure 14)! I like that I-134. I used the

FIGURE 14

SmartLaunch app on my iPad to predict a flight altitude of about 1200-1400 feet (Figure 15). There was no onboard altimeter. Deployment of the parachutes initially looked good, with a large 'chute on the lower section and a separate smaller 'chute on the upper section. The two 'chutes descended at about the same rate and landed close together. However, at parachute deployment, the smaller 'chute snapped open and the heavy Apollo capsule's inertia

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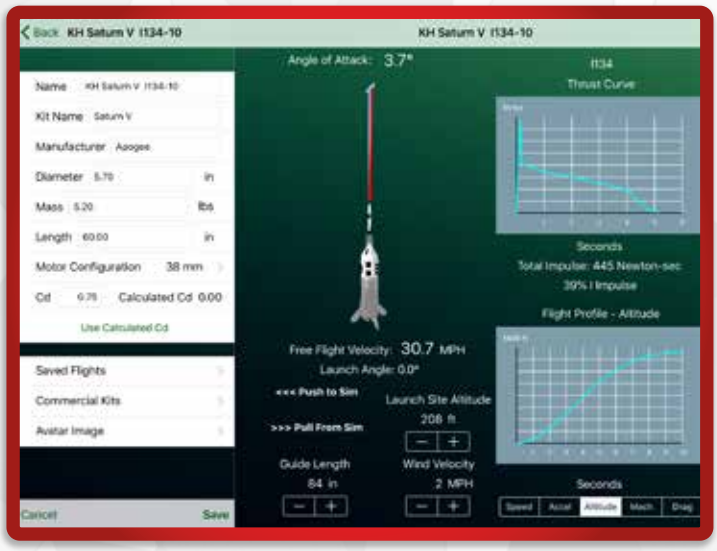


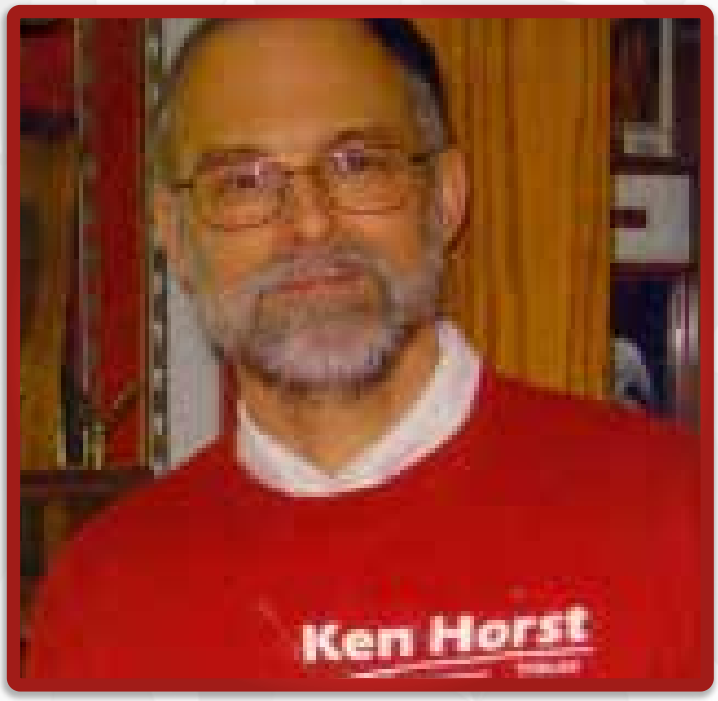
FIGURE 15

tore two of the shroud lines. Since the aft end of the upper section dowel rod was not adequately fastened, the dowel rod, the lead and the Apollo capsule section went for a ballistic ride and were lost. There was no damage to the larger lower section of the rocket.

In retrospect, I wish I had tested the strength of the dowel rod's attachment to the wood blocks in the base of the upper section. You can use what I learned in this project to modify your own Saturn V kit, perhaps for an even larger motor. My second challenge to you is to redesign and build this model to fly on a 9 second burn 54mm K250. Let us know how your project works out.

References:

Newsletters #284 (https://www.apogeerockets.com/education/downloads/Newsletter284.pdf), #300 (https://www.apogeerockets.com/education/downloads/Newsletter300.pdf), and #302 (https://www.apogeerockets.com/education/downloads/Newsletter302.pdf)



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