ISSUE 33

APOGEE PEAK OF FLIGHT NEWSLETTER

What's the Maximum Weight a Motor Can Lift? Part 1 of 2

By Tim Van Milligan

A reader writes:

> Is there any place that gives a general chart that tells the
> amount of weight a rocket engine can lift? I would like to
> do some scratch building of rockets and would like to get a
> general idea.
>
> Thank You
> Pat Riepl

Hi Pat,

The quick answer is that there isn't a general chart that is useful in all situations.

The amount of weight a rocket can safely lift is dependent on a lot of things. I'll try to explain some of the factors.

The two most important factors are the size of the rocket (it's diameter), and its drag coefficient. These two parameters directly affect the overall "DRAG" force acting on the rocket. As the rocket gets bigger, or it has lots of extra garbage hanging off it, it gets draggy, and doesn't fly as high.

Besides weight, the Drag force acting on the model determines how high the rocket flies. But if the model does fly high enough and the delay time is right, the recovery device will deploy to bring the model safely to the ground.

There are still some other factors that will determine how high the rockets flies. One of them is the wind at liftoff. Some rockets will weathercock into the wind more than others. A rocket that weathercocks (turns into the wind), will not fly as high as if there were no wind -- all other things being equal.

Weathercocking is affected by the strength of the wind, and the speed of the rocket as it leaves the launch pad. A rocket that travels faster is less effected by wind than one that travels slower. To a lessor extent, the moment of inertia of the rocket also plays a roll in how the rocket responds to the wind. This is difficult to explain, but the moment of inertia is dependent on the shape of the rocket, and its distribution of mass along the length of the model. A rocket with a high moment of inertia is harder for the wind to deflect than a rocket with a low moment of inertia.

Another factor is the length of the launch rod. This will determine how fast the rocket leaves the launch pad. If the rocket is traveling faster when it leaves the launcher, it will be less affected by the wind.

Basically, what we're asking here is what is the maximum weight the motor can lift (given the drag and wind forces acting on the rocket) and still fly high enough for the recovery system to safely deploy?

To get back to your original question, you can probably see why there are no charts that cover all the various conditions that might occur. You'd need a chart for each: diameter rocket, drag coefficient, launch rod length, wind speed, and moment of inertia.

Fortunately there is a better way to determine the maximum lift weight for each motor/rocket combination. That is with a program like RockSim. You can download the free demo version from our web site at: http://www.apogeerockets.com/rocksim.asp

In RockSim, what you'll do is: design the rocket, place a motor in it, and select a delay. After defining the launch conditions (elevation, wind speed, etc.), you'll launch it, and see how it flies. If you want to know if the rocket can accept more weight (such as a heavy payload), you can quickly put a "mass object" into the design. Then fly the simulation again.

This is the best way to determine the best motor for your rocket. It is far more accurate and therefore "safer" than any engine chart.

In part 2 of this article I'll try to define some conditions on what is generally considered a safe flights. Once you define that, you can find the maximum liftoff weight for your

APOGEE COMPONENTS
1130 Elkton Drive, Suite A
Colorado Springs, CO 80907 USA
www.ApogeeRockets.com
orders @ApogeeRockets.com
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rocket/motor combination.

About the Author:

Tim Van Milligan is the owner of Apogee Components (http://www.apogeerockets.com) and the curator of the rocketry education web site: http://www.apogeerockets.com/education. He is also the author of the books: "*Model Rocket Design and Construction*," "*69 Simple Science Fair Projects with Model Rockets: Aeronautics*" and publisher of the FREE e-zine newsletter about model rockets. You can subscribe to the e-zine at the Apogee Components web site, or sending an email to: ezine@apogeerockets.com with "SUBSCRIBE" as the subject line of the message.

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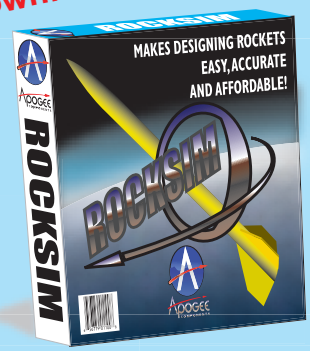

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