How to build your own miniature REXUS rocket

WARNING: Science content!

YOU MUST READ THE SAFETY INSTRUCTIONS AND LEGAL DISCLAIMER CAREFULLY BEFORE STARTING TO SET UP THE EXPERIMENT!!!

SAFETY INSTRUCTIONS:

Be aware that you are doing experiments with explosive propellants which can cause harmful accidents!

So DO NOT conduct the experiment at all, if you don't understand this tutorial in every single point!

DO NOT conduct the experiment, if you don't have some basic knowledge about flight dynamics and aerodynamics!

DO NOT let children conduct the experiment without attendance! Make sure that in the impact area nobody and nothing could be harmed! So:

- DO NOT launch INDOORS!
- DO NOT launch in DRY AREAS (e.g. dry forests, straw fields etc.)
- DO ONLY launch with PERFECT WEATHER CONDITIONS (NO wind, NO rain/snow, NO fog)!
- KEEP DISTANCE to people, houses, trees, cars and any other flammable objects!
- DO only launch in complete vertical position!

DO also regard the safety instructions of your rocketry motor / propellant!

LEGAL DISCLAIMER:

Please note, that we only provide this short tutorial, but do not overtake any responsibilities or warranty of correctness. So no charges for any damage of any kind can be claimed from us. You agree, that you perform the experiment for your own risk. So you are ultimately responsible for your experiment and all its consequences to anybody for yourself.

But now let's start and have fun =)

First, you need a few things:

- Scissor
- Pen
- Sheets of paper
- Paper cardboard (= rigid paper)
- Scotch tape or sellotape
- Hot glue gun or other liquid adhesive
- One rocketry motor (can be bought legally, e.g. a manufacturer is ESTES)

First, we have to roll a large sheet of paper (e.g. calendar) around our rocket motor and tape it to avoid unrolling. Cut of the end and it should look like this:



Then, make your nose cone out of paper and stick it to the rockets body.



After that, one important step you'll have to do: Mark the centre of gravity. It's the balance point – find it by balancing the rocket on one finger.



To guarantee a stable flight, we have to calculate two very important points. The first point is the centre of gravity of your rocket. In the following it's named as the CG-point, which we already marked.

The other point is called centroid of an area, named as CA-point.

The CA-point has to be two and half diameter of the rockets "main pipe" from the CG-point away.

Orientation of the two points:



How to calculate the CA-point:



Regarding the 2D-projection of your model the blue area has to be the same as the orange – that's what the CA-point indicates.

TIP: To calculate the area of the 2D-projection, you can imagine that you calculate the shadow of the rocket when you put the model against the sun.

If you know the area of the orange part, you can calculate how big your fins should be. So one fin's area would be:

 $A_{fin} = (A_{orange, total} - A_{main pipe, blue})/2$

Example calculation:

Flachenschworpunkt 29 an 2.29= 58 an2 4,5.1 = 4,5 cm² apsount: 65,5 cm2 => Die Flache des roten Abschnitts muss mit der Flügelflache addiert exakt 65,5 cm² ergeben ? Flache einer Flosse: (65,5an² - 10an²) = 24,45an Es missen 4 Flossen mit den ausgerechneten Maken avsgschnitten werden?

Then cut out the fins of your cardboard. You need four fins, each same size (calculated as above).



Stick the fins to the main body with hot glue.



Note: You can use your own design and sizes but your rocket must have four fins, with the calculated size so that the CA-Point is wellplaced 2.5 diameters under the CG-Point!

Now, it's done! Have fun!

