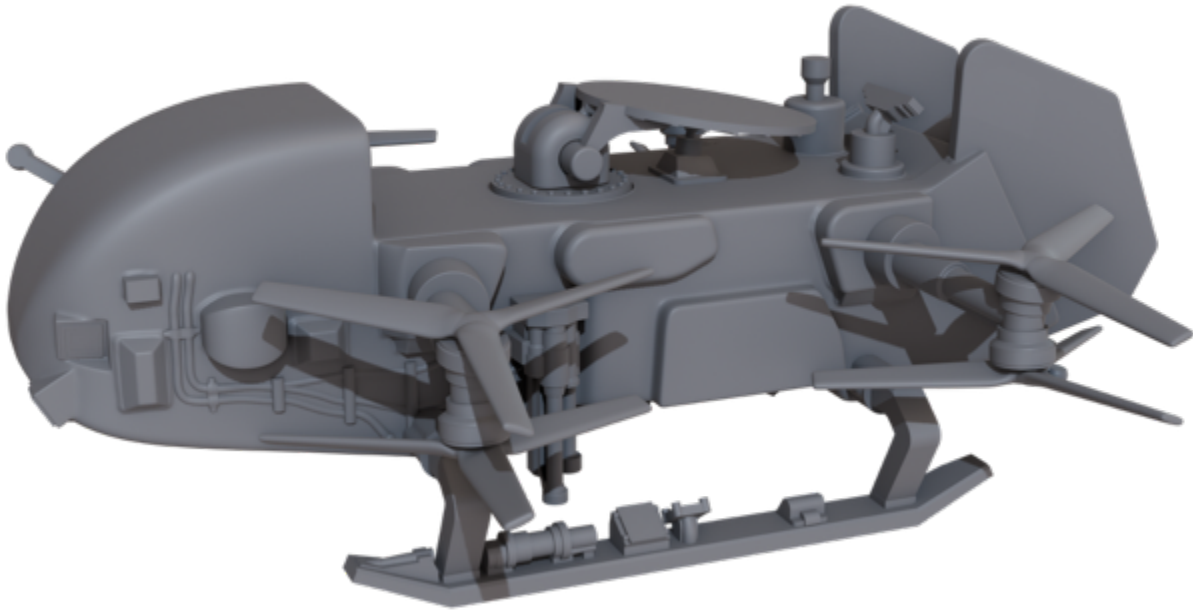


Dragonfly 'LV' (Lightweight Version) Printing Guide

1:23.5 Scale FDM Printable Model of Dragonfly Rotorcraft for Titan Exploration



Experience Required: General understanding of how to use your 3D printer including: adding .STL files to a build plate, editing settings for support and infill

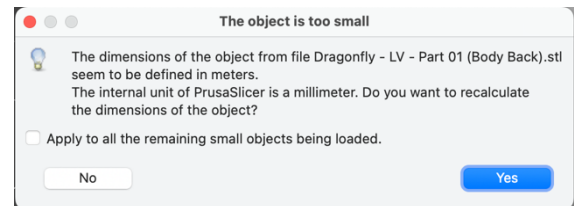
Software Required: Slicing software compatible with your printer such as Bambu Studio, Orca, Prusa Slicer, Cura, etc.

Description: The Lightweight Version (LV) of the Dragonfly lander was designed to print on one 7"x7" 3D printer bed, with minimal assembly to make as accessible as possible. The print time depends on your individual printer and the layer height chosen and can range from 6 hours to overnight. We chose to optimize this model for Fused Deposition Modeling (FDM) over resin printing techniques due to the easier entry point, safety of students, and the popularity of FDM printers in schools, libraries, and museum settings.

If you have a printer other than the selected slicing software (and printer models) that have been tested, then you may have to work directly with the .STL files. (Note: Even if you have a different printer, you may be able to easily use the .3MF project file for Prusa Slicer or Orca and simply select your printer model.)

A. Adding the parts and orientation to the print bed:

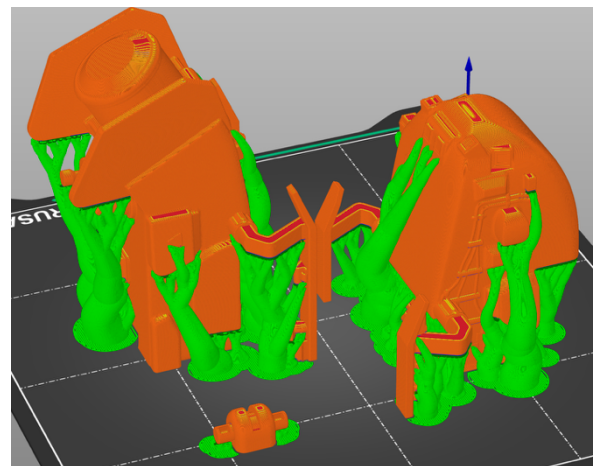
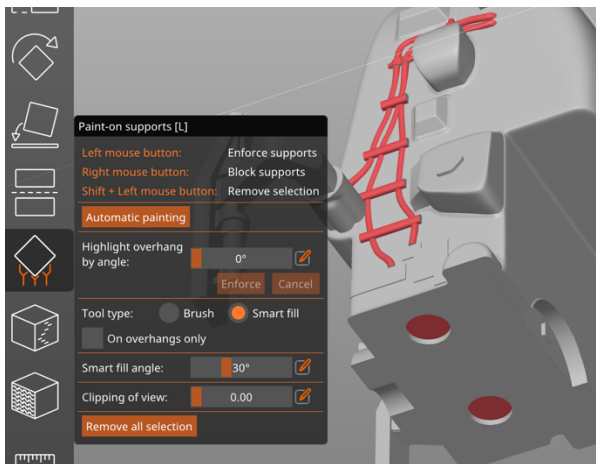
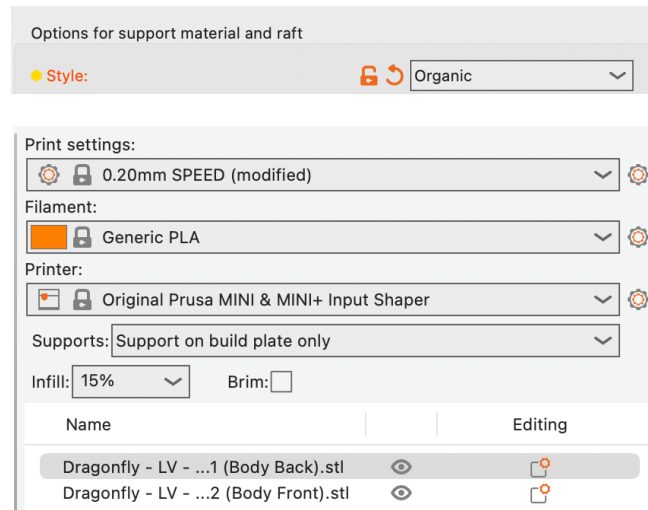
When a part is selected, you will most likely get a warning that the parts don't have a unit chosen. Select millimeters (mm) and choose Yes, or Yes for all if importing multiple parts at once. All the parts were designed with a flat surface that was intended to be against the print bed. Please refer to the diagram for both orientation and part numbering.



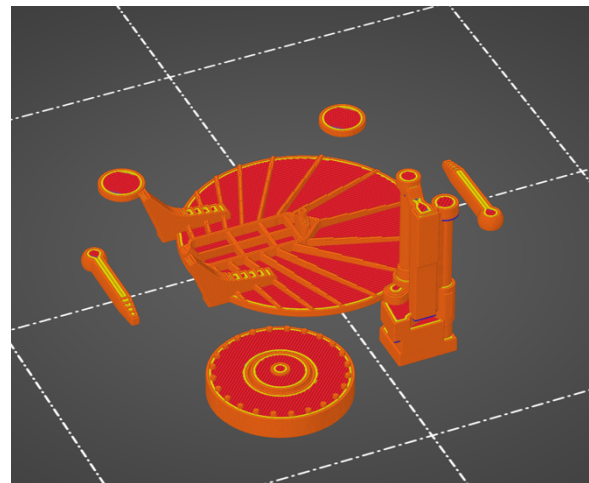
B. Selecting Infill and Support:

NOTE: While you can print all the parts at once in a single project, for this guide, we broke the model into three prints to simplify the unique settings which vary by part.

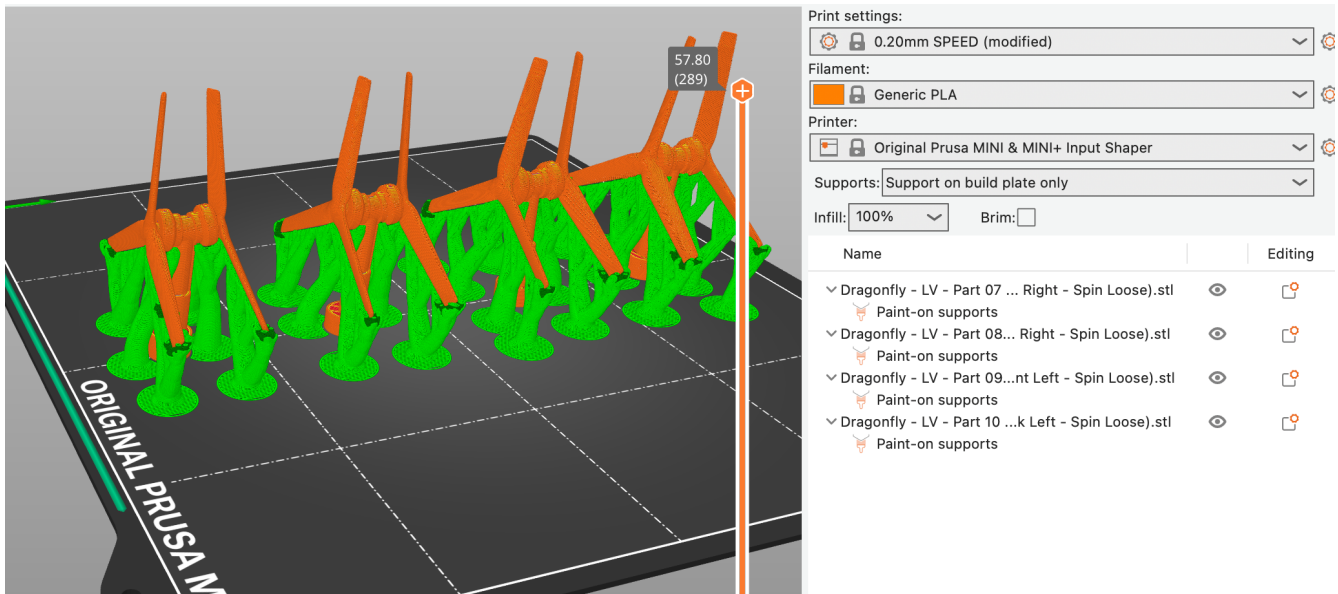
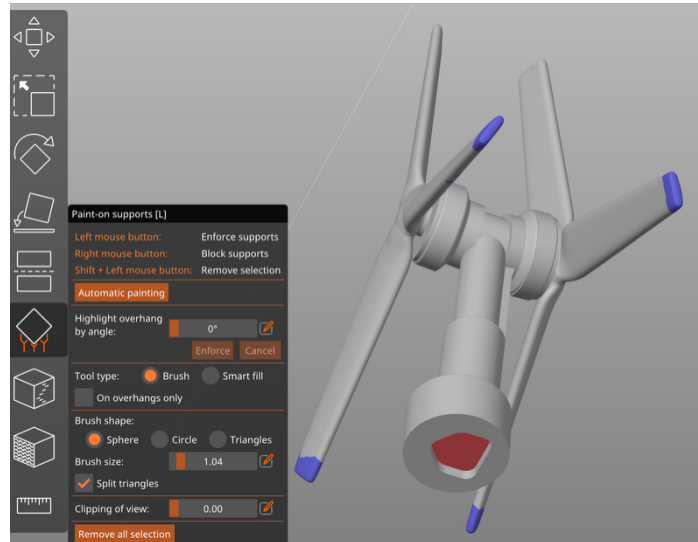
1. **Body and HGA Mount:** Print the two body halves (parts 1, 2) and the HGA Mount (part 4) with standard (15%) infill, "organic" or "tree" supports (Figure 1.) that originate "from the build plate". We tested the models at .20 mm layer height but you can either decrease this for a slower and smoother print, or increase that setting for a somewhat faster but less-detailed print. By using the Paint On Supports feature, you should BLOCK support from the alignment disc receivers, and on the piping along the front left side of the model.



2. **HGA, DrACO, and EFIELD Probes:** Print the High Gain Antenna (HGA) dish and rotating base (parts 3 & 5), DrACO (part 6) the DraGMet EFIELD probes (parts 11, 12), the alignment discs (parts 13, 14), with standard (15%) infill. No support is needed for any of these parts.



- Arms and Rotors:** The four arms and rotor assemblies require the most preparation in the slicer to get reliable prints. For this 3rd build plate, add the four rotors (parts 7, 8, 9,10) at 100% infill, with organic or "tree" supports from the build plate, but you will need to add supports to the tips of all blades that point down toward the build pate, and we recommend removing or blocking supports from the inset alignment pattern on the base of the arms.



Credits:

The Johns Hopkins Applied Physics Laboratory (APL) in Laurel, Maryland, leads the Dragonfly mission for NASA in collaboration with several NASA centers, industry partners, academic institutions and international space agencies. This model was developed using only publicly available imagery through the Open-Source Blender program. The Blender and .STL files, along with animations and documentation, were provided to Fairmont State University by designer Gary Allen Backus under the Dragonfly outreach program.