

THE MARS MEDICAL CHALLENGE

DESIGN GUIDELINES

Here are some guidelines to keep in mind when designing your Medical 3D print. Please know that you do not need a 3D printer to participate in this challenge, only a digital 3D model. We understand that making a 3D model is tough for beginners. We encourage participation first and foremost, so don't forget that a great idea is worth more points during judging than an expertly crafted 3D model. (But having both will score big!) You won't be disqualified if you submit a model that doesn't comply with every guideline below, so if you're a beginner don't fret if this seems overwhelming. Before you know it you'll be a pro!

GOOD LUCK!

MARS MEDICAL CHALLENGE DESIGN GUIDELINES OVERVIEW

- 3D Printable in a 6in x 6in x 6in printer volume
- Advances long-term human space exploration
- Specify your 3D printing material. Please use general terms if possible (avoid trade names).
- Designed for a Journey to Mars - which could be for:
A microgravity environment on the trip there and back
- OR -
A roughly 1/3 gravity environment on Mars' surface
-OR Both! -

DOES IT HAVE TO BE 100% 3D PRINTABLE OR JUST A PART OF IT?

Your medical object needs to be 100% 3D printable, but it can be a component of a larger assembly. If your design is part of a larger assembly then it needs to specify what component(s) are intended to be 3D printed and what parts will be used from elsewhere on the mission.

WHAT KIND OF 3D PRINTER?

Great question! The type of 3D printer to be taken to Mars hasn't been decided yet, but we've provided information about NASA's Fab Lab plans and In-Space Manufacturing goals. Your design does not have to comply with FDM printer guidelines (like the 3D printer on the ISS), but should be intended for a Mars-bound Fab Lab.

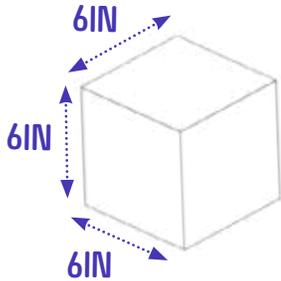
WHAT PRINT MATERIAL?

It's up to you! The first 3D printer on the ISS prints with ABS plastic, but part of NASA's In-Space Manufacturing research is to study what materials NASA may print with in the future - whether brought, recycled, or sourced locally on Mars. You may specify the material you think would be best for your medical print.



3D PRINTING GENERAL GUIDELINES

FOR MARS MEDICAL CHALLENGE



Maximum Medical Object 3D Print Dimensions are 6inches wide x 6inches long x 6inches tall. All entries will be judged as if they were scaled down to print and function in this volume.

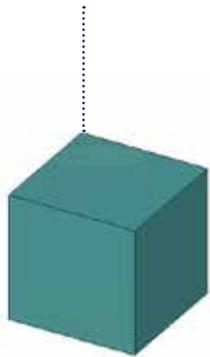


Multi-part assemblies are allowed. All parts must fit into ONE 3D print session - max 6in x 6in x 6in print volume.

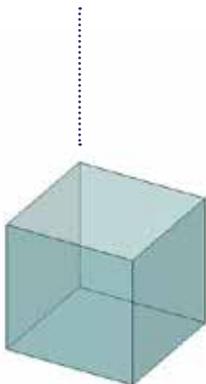


Assemblies that are created in print are allowed and welcome.

GOOD!

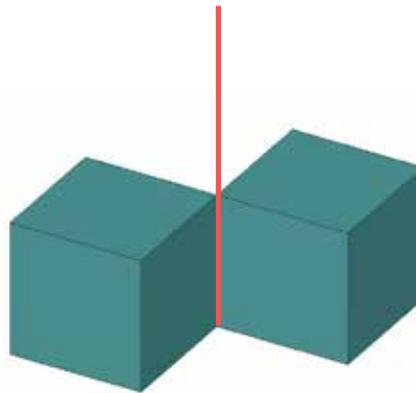


BAD!



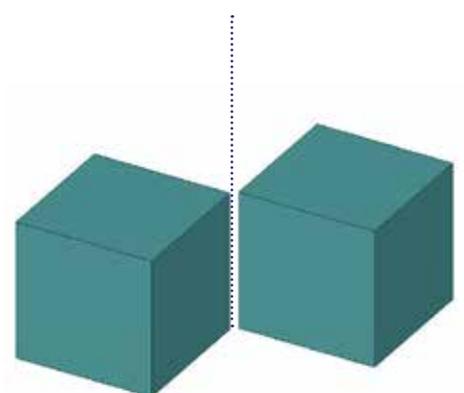
Your 3D model should be solid geometry. For example, the model on the right has no top surface and zero wall thickness. This is not a 3D printable model. If in doubt, upload your model to Meshmixer to analyze your STL file

BAD!



No shared single edges (lines) like above.

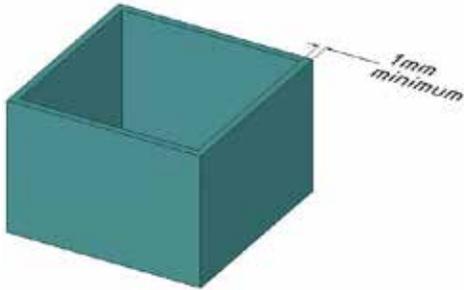
GOOD!



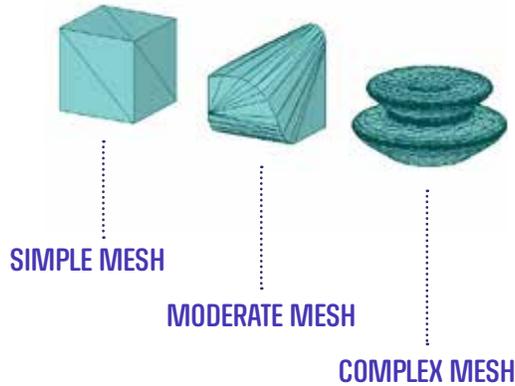
If you have multiple parts to print at the same time, make sure there is at least 1mm of spacing between the parts.

3D PRINTING GENERAL GUIDELINES

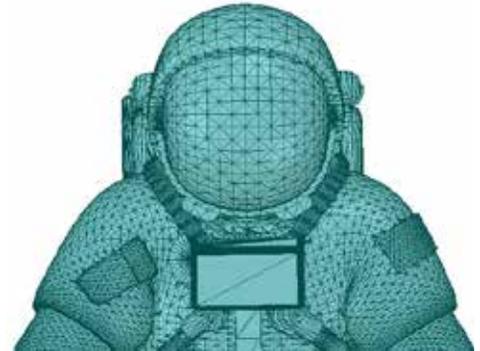
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Minimum recommended wall thickness is 1mm.

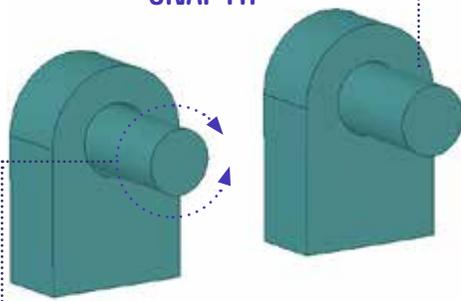


Maximum STL File size is 20MB. STL files are mesh geometry (triangles). A simple box may be a few KB, whereas a complex model that requires a mesh with more triangles will be a larger file. We encourage advanced designs and have given you a large file size limit!



For example, this mesh is complex, but is under 20MB if exported properly. Chord Tolerance or Angular Control can be modified in some 3D software packages to change the resolution of your STL file export. Otherwise, in Meshmixer you can upload your STL file and re-export it using the **STL Binary Format** to reduce file size.

SNAP FIT

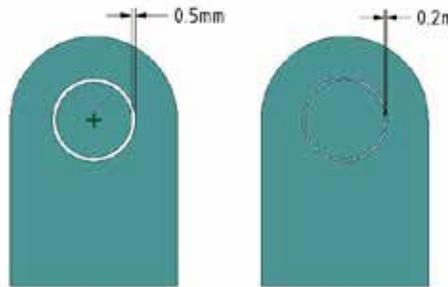


SLIP FIT =

A part that is designed to rotate or slide within another part.

SNAP FIT =

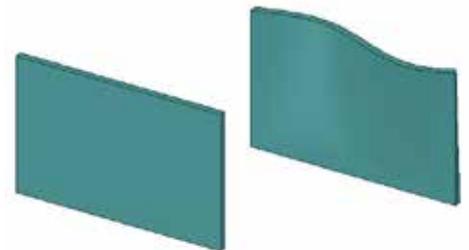
A part that is designed to press or snap into another part and does not move.



SLIP FIT

Slip fit guidelines are: .5mm on every side. (1 mm diameter difference if an axle) Snap fit guidelines are: .2mm on every side (.4mm diameter difference if an axle).

SNAP FIT



Avoid big, thin flats because they may tend to warp.

SUMMARY OF NASA ISM

FOR MARS MEDICAL CHALLENGE

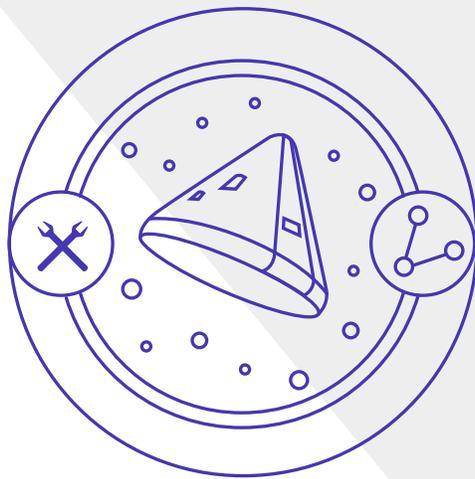
NASA In-Space Manufacturing or ISM is responsible for developing the manufacturing capabilities that will provide on-demand, sustainable operations during NASA Exploration Missions (in-transit via space vehicles and on-surfaces such as the Moon or Mars). This includes testing and advancing the desired technologies, as well as establishing the required skills and processes (such as certification and characterization).

The key capabilities being developed in ISM to support this “make it, don’t take it” approach include developing a 3D printing Fabrication Laboratory (Fab Lab) which can manufacture parts in space using multiple materials, as well as the ability to embed printed electronics, in-space recycling of printed parts and other materials such as packaging in order to reduce mass and waste, and manufacturing structures externally in space. In 2015, the ISM project sent the first 3D printer to the ISS and manufactured the first parts in space.

This was a critical step in demonstrating additive manufacturing in microgravity.

These new 3-D printing technologies will provide the capability to produce hardware on-demand, directly lowering cost and decreasing risk by having the exact part or tool needed in the time it takes to print. This capability will also provide a much-needed solution to the cost, volume, and up-mass constraints that prohibit launching everything needed for long-duration or long-distance missions from Earth, including spare parts and replacement systems. This project is the first step towards realizing a “machine shop” in space, which is a critical component of any deep space exploration mission. The ISM Project is under the NASA Human Exploration and Operations Mission Directorate (HEOMD) Office of Advanced Exploration Systems (AES) and is led out of NASA’s Marshall Space Flight Center (MSFC).





Just a reminder that we reserve the right to tweak, edit, or re-create all submissions for our program needs - i.e. make sure its perfect to print in space or here on Earth. It's in our Official Rules, but we wanted to say it again!

WE CAN'T WAIT TO SEE YOUR MEDICAL OBJECTS!