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3D printing – Making Detailed Parts

In my previous letter I discussed my first experience with 3D printing for the scale model boating hobby. I finally settled down on the process from creating the 3D model through ordering parts and finishing them for my model boats.

I will concentrate on the software and the printing company I used to make these models. My experience with products and services with other companies resulted in deciding which to use. This includes cost, performance, easy of use, and time.

The following is placed in the order on would use in following the process from need to having a part in had ready to install on your model.

Step 1 – Get Information About the Part You Need

I will start this process (and follow through) with an item I created and had printed: A 40mm Bofors ammunition box for the PT-61 gunboat I am building.

In the final part of finishing the PT-61 I decided to have some 40mm ammo boxes on the deck. I searched the internet and found photos of a box on one of the sites selling old military items. This was a good hit as it had photos taken of the top and sides, which included lettering on the box. The accompanying paragraph described the size of the box allowing me to have good data for making the 3D model.

You may find better or worse information on what you want. Nicely detailed drawings are great. Photos are not too bad if you can determine some of the basic dimensions and create more dimensions by scaling the photographs and taking into consideration any perspective distortion.

Step 2 – Creating the 3D Model

You will need a decent 3D modeling software package. I looked at three packages, all free for non-business users:

3D Builder – this software is included in Microsoft Windows 10 (ug – not a fan of Windows 10). This is a good package if you are new to “CAD” – computer aided design 3D software (also known as solids or solid modeling). It is very limited on what one can create but is good enough to introduce you to the idea of merging simple solid objects such as spheres, boxes, cylinders, etc.

123D Design – if you are familiar with AutoCad, 123D Design is another one of Autodesk’s products. This is the one I use. 123D Design is not simple but is a

compromise between products like 3D Builder and much more complicated products. Just about anything can be created with 123D Design.

Blender - this is a complicated, professional package. I downloaded it and despite my years of experience with CAD and solid modeling software (I retired 20 years ago) I determined that 123D Design would suit my needs and it would take a month to learn Blender sufficiently enough to create models.

Once you get used to whatever package you are using, you can generate your 3D model. You have the option in using any scale you want and rescaling it later to match your model. With 123D Design you can make the model at full scale. When done you can with a few clicks rescale the model.

For instance, I usually build my models at full scale, save it, then rescale a copy to what I want. As the PT Boat is 1/20 scale I use "scale" and enter the factor of ".05" which is 1/20 of the original.

Rather than make one part you may need or want to make multiple parts. Shapeways charges for the material based on volume, then has a processing charge, the shipping. For example, to make one part might be \$2 in material, \$5 processing and \$5 shipping making the part cost \$12. If you model 5 on a sprue (like the plastic model kits) your cost might be \$10.50 (guessing .50 for the sprue) so the total cost might be \$22.50 for five, making it \$4.50 per part.

This is done easily; just copy a paste like you do in a word processor, email, or whatever. Once you add the duplicates just draw in some sprues using the same solid objects you used to make the model. Merge them all together (a simple command) and you have your multiple parts on a sprue.

You can take the above one step further. Supposed you are building something that has multiple parts. Create each model in a separate file. Create a new file and add all of the models in one file, moving them around, and adding a sprue. Merge them and now you can have it printed as one part so when you receive the physical part you can gut off the sprues and cement the parts together. This could be the case where you want to assemble the parts in different positions, something like a gun turret. Rather than make a 3D model with the gun in a fixed position, you might want some guns up, some down, some at different positions.

Step 4 – Preparing the Model of Submission to Shapeways

The 3D model file that is created within the software is not suitable for 3D printing. What is needed is a stereolithography or "STL" file. This is easily done in each of the three software packages I described above. Once you create the STL file you upload this to the printer's web site (like Shapeways.com).

Step 5 – Uploading the File

If using Shapeways (Shapeways.com) you might find it easier to keep track of your models by creating a free account. Once that is done follow the easy instructions for uploading. Once you have done that you will be given a list of all the different materials and whether or not your model is successful. It will point out where there are problems (if any). It takes a little time but not too much.

If successful, you get to see all the materials and cost (not including the shipping), even if you want it in gold or stainless steel.

So at this point I will mention some of the common materials that seem to be applicable to a good scaled model part. So far I have used the following materials:

- Strong and Flexible Plastic. This is the lowest price material and is pretty tough too boot. Even though it says “flexible” it is somewhat stiff but will give. Think of this as being a piece of nylon. Great for parts not having minute details or features.
- Frosted Detail Plastic. This comes in two choices, Ultra, and Extreme. The Ultra (which I use) is a little more than double the price of the one above. It has good detail, I use this for my 1/20 scale BMGs which have some small detail features. I have not used the Extreme as of now. The extreme is about 60% more than the Ultra. Both of these plastics are on the brittle side, so if you have small features, they may break. Case in point, I made a set of 1/20 scale US M1 (WWII – Vietnam) helmets. The wall thickness is about scale size. So think of one of those divided by 20 as the finished thickness. I cracked one out of the 20 I had made. Very fragile for small or thin features.

There are other materials available on the Shapeways web site. There is plenty of information available there as well. Take a look at this as well as “You Tube” where there are plenty of videos.

There are considerations for what you want to part to look like as well as strength, depending on the function of the part. As the parts that we built for our scale model boats have to be somewhat durable because they are frequently handled the material has to be a somewhat durable. In some instances the part may have to be very durable to handle loads.

Step 6 – Ordering the Part(s)

Once you have finished with the 3D model and created the STL file, you upload the STL file to Shapeways on their site. This takes a little while depending on the STL’s file size. I could be minutes to maybe a half hour.

The reason it takes so long is because when it is done you will get the results back. This includes any problems with the model and a list of materials and prices. This list will be from simple plastic up to gold and platinum. Some materials may pass and some not. You will have all the options to either use a specific material or information on what is wrong with the model and possibly some hints on how to fix it.

Step 7 – Handling the Parts

When you get the parts in you will need to handle them in the right manner for the material you have elected to use. Some materials are fragile, especially in small or thin areas of the parts. Some will be pretty tough.

Step 8 – Preparing the Parts of Your Model

Most of them will require cleaning any residue from the printing process. Some may need additional UV exposure (the sun) to make sure they are cured. Here you will need to see information on post processing. This is important as most likely you will be cementing and painting the parts and will need that to happen where cementing and painting need to be successful.

Some materials will require sanding or polishing to remove the horizontal stripes from the printing process. Remember how most of the printers work, building one layer on top of the previous.