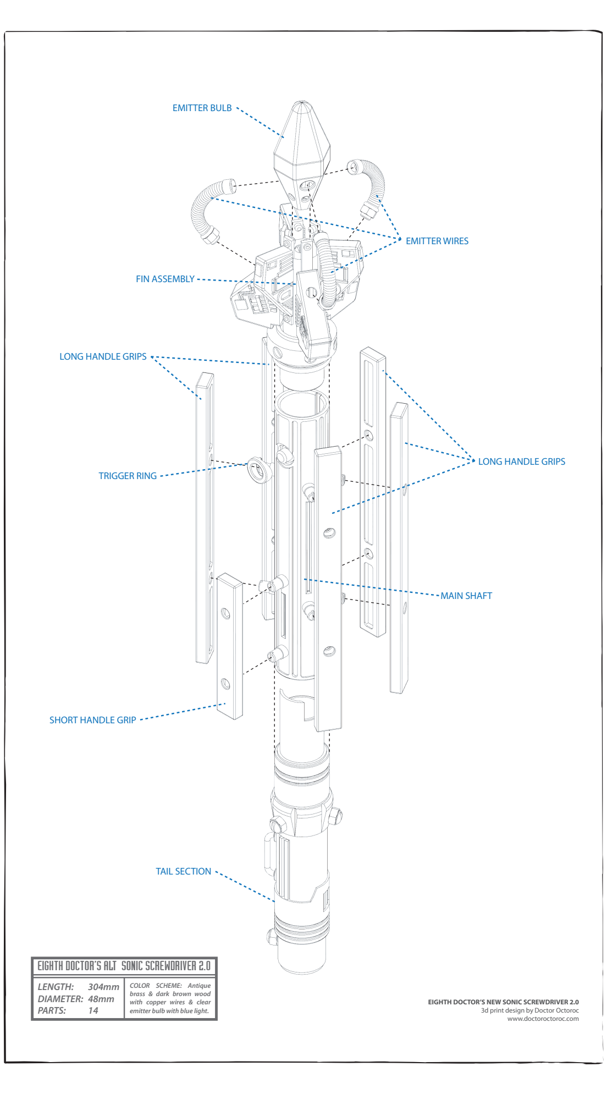
DOCTOR WHO 8TH DOCTOR'S SONIC SCREWDRIVER 3D PRINTED MODEL KIT

Made from Selective Laser Sintered Polyamide Plastic & UV Curable Acrylic

Hello, Doctor Who fan!

First off, thank you for considering to purchase one of my 3d printed model kits. It means a lot to me that you appreciate the time and effort put into making this and I certainly hope that doesn't go unrewarded with anything less than an outstanding product for you to work with. It's important to remember that I'm just one person who does this for fun, but while I can't offer a 24 hour customer support line, any and all feedback is welcome. Don't hesitate to email me at doc@doctoroctoroc.com to ask additional questions that weren't answered for you here, make a suggestion for the next time I design a kit like this, or even just to let me know you enjoyed it. Positive reinforcement never hurt anyone! Thanks again, and I hope the following information helps you build a fantastic looking sonic! Allons- oh wait, wrong Doctor...

~ Doctor Octoroc (aka Levi Buffum)



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An Introduction to 3d Printing

If you've ever worked with a traditional model kit, you know that it takes time and patience to paint and assemble all of the pieces. While this kit differs in many ways from a typical injection molded plastics model kit, it requires the same amount of skill and diligence. It may have less pieces, but each piece will require more attention.

One of the first things you'll notice about your 3d printed model kit is the fine grit texture. This is the nature of the 3d printing process which involves laying down micro-thin layers of loose nylon plastic powder, then fusing it together. Stack enough of these thin layers on top of each other, fusing along the way, and that's the basics of SLS 3d printing. As a result, the entire model is a solidified version of the loose powder that is dug out of the unfused portion around it and cleaned of the remaining loose powder. There will still be minimal powder residue on the model when you receive it, so be sure to clean it out of deep recesses and wash the parts clean. Run them under room temperature water for 10-30 seconds then leave to dry for an hour, flipping them over halfway through the drying time.

The emitter is printed by a different process which involves curing a wax-like substance layer by layer with a UV lamp. The result is a semi-transparent acrylic plastic with much finer details and the ability to print very thin walls. This part will have a waxy residue on the surface when you receive it and washing with mild dish detergent under warm water is recommended before any paint or glue applications.

The pieces included in this kit have been modeled specifically with the tolerances and minimal wall thicknesses of their respective 3d printing materials in mind. All pieces have been hollowed out to cut back on material costs and to allow for as much room as possible to implement electronics or make any modifications desired.

Implementing Electronics in your 3d Printed Model Kit

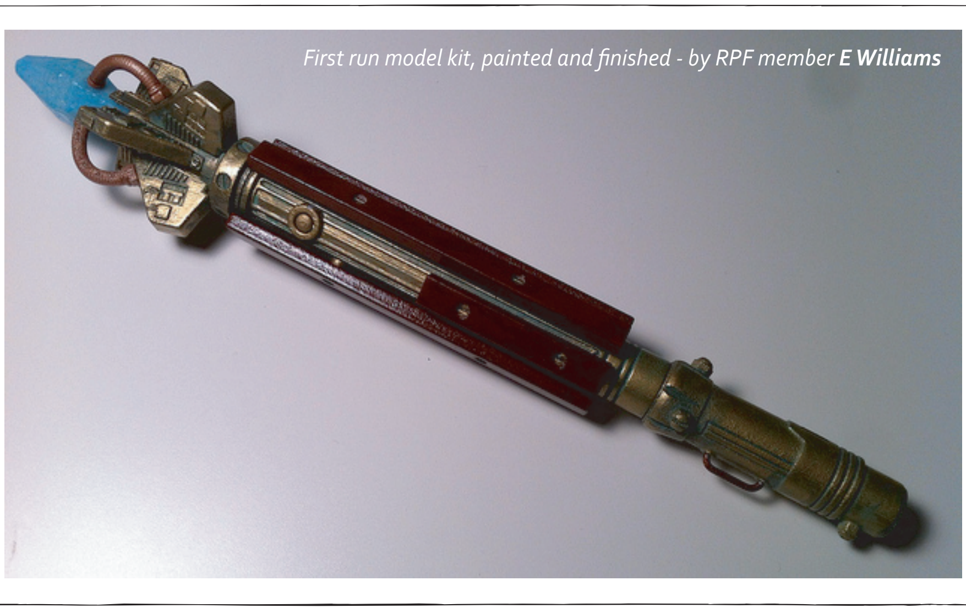
This model has been designed to work seamlessly with the internal core unit that comes with one of two Character Options (Underground Toys) sonic screwdriver toys. Both the *Build Your Own Sonic Screwdriver* and *Trans Temporal Sonic Screwdriver* toys come with this core unit, so if you've purchased one in the past, you already have the complete electronics package for this kit! If you don't have one already, I will be offering them for an additional $10 (USD). Supplies are limited so priority availability will be afforded to those that don't already have one in their possession.

With the core implementation, the light will shine up through the shaft and fin assembly, and into the bulb, although a small length of acrylic rod can be installed within the fin assembly, above the end of the core, to help transmit the light to it's destination for a brighter, more concentrated glow. These are available for an extra dollar, cut to length.

For those that prefer to build their own internal electronics package, or opt to use the inner workings from a different sonic screwdriver toy that is available on the market, some extra work will be required but with all the room inside, there's plenty to work with. The trigger that is designed to activate the tactile push button built into the core unit from the other two toys is affixed to the inner surface of the main shaft section, allowing just enough give for it to be depressed and make ample contact with the push button. This will provide enough flexibility for the nub built into the back of the trigger section to meet with a variety of other applications as there is ample room behind the trigger to install your custom electronics package, as well as clearance all the way up and into the emitter bulb. This means that for custom kits, you can wire the LED separately if you choose and place your light inside the bulb itself.

Since the tail section is also hollow, this is an ideal place to store a battery package, as it's designed for a snug fit which will allow it to be removed and replaced without the need for adhesive to hold it in place. Such access will also allow those who implement the core unit to access the core itself by removing the tail section and sliding the core out through the bottom of the main shaft. There is an extension on the section of the tail that fits into the main shaft that cuts into the bottom of the core unit and holds it in place.

Painting & Finishing Techniques


First run model kit, painted and finished - by RPF member ***E Williams***

One concern many people may have is getting a smooth finish. With the gritty texture of these kits, direct painting will result in more of a dying effect, as the paint will soak into the surface and the texture will remain slightly gritty to touch and sight. In addition, another result of 3d printing called "stepping" may be apparent on parts with shallow angles or long curves. The reason that this stepping occurs is due to the layer-by-layer process. Along the floor of the print bed (XY direction), the lasers used in 3d printing are very precise, but vertically (Z direction) the layers are not as thin as the laser is accurate in the XY direction. The layers are super thin but not so thin that they won't appear as tiny steps on some areas of some parts. While the engineers at Shapeways will do their best to orient the parts to achieve the best surface appearance, given the complex shape of the parts in this kit, there is likely to be visible stepping in more than one area. Although the surface texture will remain gritty, these steps can be sanded down, first with a heavier grit, then with a finer grit. Once you've worked the stepping down to the same surface consistency as the rest of the part, there are a number of finishing techniques that can be applied to acheive a smoother surface finish.

Super Glue & Acetone - The technique with what are arguably the best results involves creating a mixture of super glue and acetone, then submerging the parts completely. After the part is removed and left to dry, the acetone will evaporate, leaving a thin layer of the glue on the surface to fill in the small impressions on the surface. The part can then be painted, or if an even smoother finish is desired, sanded down. The drawback to this method is that it has not been used by many, so information on the proper time to submerge and the ratio of acetone to super glue is unknown. For more examples of this technique and to read up before you attempt it, you can search the Shapeways forums or any other 3d printing online community. I personally have not attempted this technique so I'm unable to comment on the topic. I do know, however, that fine details can suffer from the extra coat filling in small spaces around.

Paint, Sand & Repeat - This one is pretty self-explanatory. Paint one layer, sand it down, then paint another and repeat the process until the desired finish is acheived. This is a time consuming labor of love for certain, but the advantage is that it gives you complete control over the level of smoothness in different areas of the same part as well as overall. For this particular prop, the finish is messy and it looks beat up, so a perfectly smooth finish may not be desirable. But for parts that are meant to be smooth, this method makes it difficult to get into smaller crevices with the sanding paper so a smaller tool like a dremel & mini sanding bit might prove useful.

Varnish or Lacquer - This is the method I use 99% of the time. It will never achieve a perfectly smooth finish unless you sand between multiple coats, but for most applications, it's the perfect mix of ease, time saving, and good results. I typically will apply layers of a dark base coat first (unless the part will be a light color when finished) then two or three layers of varnish, after which the model is ready to paint as would any other plastic surface. If you plan to use spray paint on your model, I would complete the paint + varnish technique mentioned here before your first coat. If you're using a spray lacquer instead of varnish, then a few layers of base coat then several applications of lacquer are recommended before painting. Again, for a smoother finish, sand between coats of varnish.

One aspect to consider is the location of your light and how it might affect the rest of the model. Since the parts are all hollowed out, the walls are very thin (as thin as .7mm in some areas). While this isn't a problem for the structural integrity of the model itself, it does mean that light can shine through the sides of parts. For this reason, any areas near the light that you can paint inside should be painted with multiple coats of black paint. For any areas that can't be accessed, the outside will need these added dark-coat layers to prevent the light from shining through. Alternatively, you can implement other materials to block the light from these walls.

How to Choose Your Paints - Brands and Types


Tamiya clear paints.

Every 3d printed model I've painted, I've used the same paints and applications. There are a variety of brands and types you can use, but listed below are the ones that have gotten the best results. Again, feel free to poke around some forums to get more feedback on what will and wont work with these plastics. Some paints may interact poorly, so avoid those brands that are known to do this.


1:5 scale Nintendo 64 - by Doctor Octoroc

Testor's Enamel - fortunately, the most popular brands of paint for model kits work well with the White Strong & Flexible plastic. Enamel paints cover well, often only requiring one or two coats for good surface coverage. Any enamel paint should behave similarly but always test paints on non-visible areas.

For the 1:5 scale Nintendo 64 3d print shown here, I applied two layers of Testor's for the main body, then two more of each subsequent color. Finally, I applied three layers of varnish. As you can see, there is some visible stepping on the top of the console where it curves down from the center. I did no sanding of any sort on these areas as I wanted to see how much only a paint and varnish application would hide it. Still, at first glance, you might think it's the real deal...out of focus!

Tamiya Clear Paints - Once again, a popular choice of paints predominantly for plastic models. These are commonly used on parts that start clear, like headlights. On their website, they are mainly advertised for use on police, emergency and construction vehicle models. These paints work great on the Frosted Ultra Detail material used to print the emitter. Since it's a cured acrylic plastic, the Tamiya Clear paints cover as they would on any other plastic part. As few as three coats will get the desired effect but additional coats may be required to avoid the visibility of streaks in the paint when light shines through. For the emitter on this prop, a very light coat of their standard blue clear paint will probably be preferable, but certain dyes work as well. The dye I used for my emitter is Alumilite, which is made for adding to liquid resin for molds, but it did the trick to dye the FUD.

Assembling the Kit & Preparing Surfaces for Glue

The majority of the parts in your kit will fit together snug but for some parts, glue may be required. Most model glues work just fine, so long as it's not a glue that requires complete surface to surface contact to bond, like super glue or certain epoxies. Read the label on your adhesive to determine how it bonds and if it will be compatible with the 3d printed plastic. If it's viscous, like a model cement, it will most likely bond. If it's liquidy, chances are it won't.

To ensure the best chance of a proper fit, every piece in the digital model is aligned perfectly with it's neighboring joint, but as 3d printing creates a high-friction surface, some sanding may be required to get some parts to fit, while others will fit more loosely. This is why the removeable sections of the model, like the tail and fin assembly, are designed with much longer extensions into their corresponding neighbor parts, to increase surface contact and ensure a more snug fit. Still, some of these parts may encounter too much friction and be too snug, so don't force them together if you encounter considerable resistance. Sand down the contact layers a bit, try again, and repeat until you get a nice, snug fit that allows it to be inserted and removed with relative ease, but wont fall out on it's own when heavier components are inside.

An option that I've never tried but may be worth looking into is to fill empty parts with other materials, like pouring in a liquid resin that cures hard, or gluing wooden dowels inside. One aspect of a great prop replica can be the weight, so adding additional items from around the house (batteries, old pieces of small hardware, etc.) can be a great way to add the desired weight to your kit. Just be sure to secure these items so they don't rattle around. A good sonic screwdriver shouldn't have loose parts! If you've opted for the core implementation, the entire tail section will remain hollow, so adding some weight inside this part is an ideal way to acheive a good, heavy feel. And while the fin assembly requires empty space to let the light shine through to the bulb, the fins themselves are hollow, so they can be filled with resin or other items (although tricky to get to due to their deep location in the assembly - or as mentioned before, you can implement an acrylic rod to both transmit the light and add weight.

As with any plastic model kit, it is important to avoid painting any surface area that will be glued. For this reason, it's crucial that you test fit the pieces not only to ensure proper fit but also so you know where pieces need to fit together and where the boundries of painted areas are. A small overlap in the paint coats is good so no small edges of unpainted areas will be visible once the model is assembled, but don't overdue it because the glue wont bond to surfaces with too much paint on them.

Design Features

As 3d printing is a new technology, the design for this model kit has been an ongoing process for the last few years, with much trial and error throughout. What is being offered in this kit has seen many changes to it's design, overall scale and the techniques used to model all of the parts included. The result is a fine-tuned design that has been optimized to make it the perfect kit for the right price. Below are just a few of the newest features for this version of the kit.

1) Designed specifically to fit the core unit - This is perhaps the greatest improvement on the old model. For those like me who are rubbish with a soldering iron, a complete, all inclusive electronics package is available. It's as simple as popping it in and you're ready to make your sonic glow and buzz!

2) 133% larger - For those privy to the previous run of sonic screwdriver props, you'll see a significant price increase from the previous version of this model. This is due in large part to the increase in size as new reference material gave a better indication of the props actual scale.

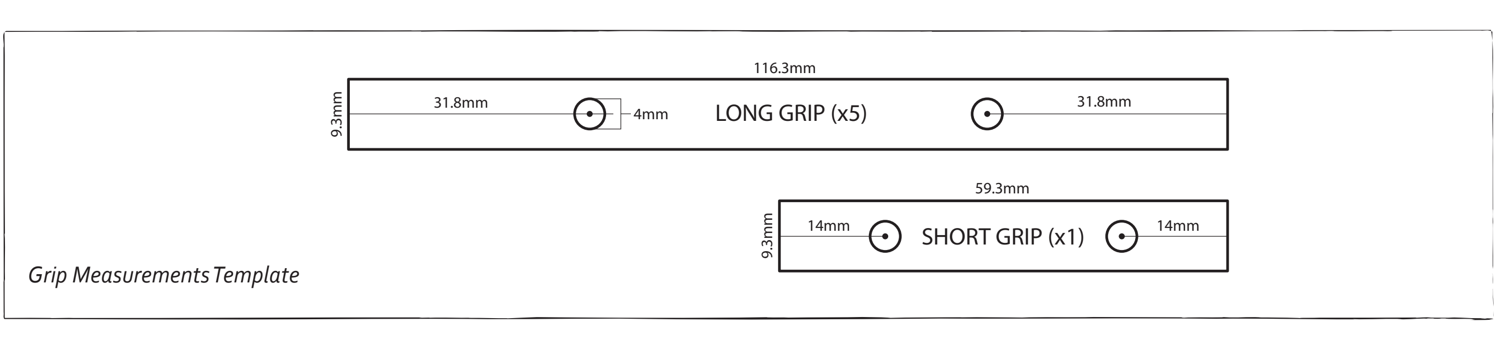
3) Affixed trigger switch - The old kit had the trigger switch as a separate part that would be placed into the model after electronics were installed to keep it from falling in and the trigger ring placed around it to keep it from falling out. However, this piece was very small and multiple members, including myself, lost it along the way. Since then, the redesign has the trigger attached to the inside of the main shaft by a length of a thin plastic which is flexible enough to allow the trigger to be depressed and make contact with the tactile button switch of either core unit, the guts from another sonic screwdriver toy, or a variety of DIY electronics packages.

4) Choice of wood or 3d printed grips - The six grips that encircle the main shaft are an extra expendature to the 3d print. Though I found a loophole to minimize the extra cost, they are simple enough in shape that fashioning them by hand from real wood is a reasonably simple task. Therefore, I have offered kits with either wood or 3d printed grips. There is also the option to try out both, or to save some money by having no grips included with your kit and making them yourself, using the printable template below which is to scale with the kit and includes measurements and markers for the holes.

5) Sound slits in main shaft - No matter where sound is coming from in the old model (if you managed to not only acquire a sound chip & speaker but to implement it in the old, smaller model) it was enclosed within the plastic body. For the new version of the model, slits have been cut lengthwise out of the main shaft, just behind the grips, in order to let as much sound as possible escape from within. In addition, the 3d printed grips are also hollow on the back to both cut back on material costs and act as a nominal amplifier for the sound. With the design of the prop, neither the slits nor the hollow backs of the grips are readily visible.

6) Snug, no glue assembly of main section - To allow easy access to the main shaft for either the core implementation or your own DIY electronics, both the tail section and fin assembly have been designed to allow the pieces to be inserted and removed with relative ease but stay in place until you decide otherwise. Additionally, guide grooves have been modeled into these parts to ensure proper alignment with the main shaft.

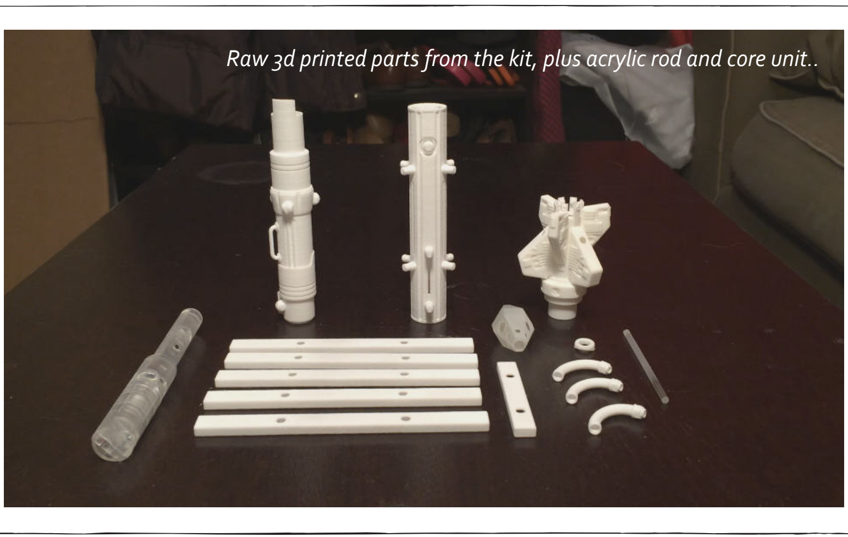
7) Extra tolerance in the emitter "setting" - The six prongs that hold the emitter in place used to be a perfect fit, so perfect that it was a pain to get out, and hard to do without breaking the emitter. This new design provides a fit that holds the emitter in place just as well, but is tailored for easier removal if need be. However, the new emitter is still made with thin walls to save material costs, so caution is still recommended when working with this piece.



Grip Measurements Template

My Process

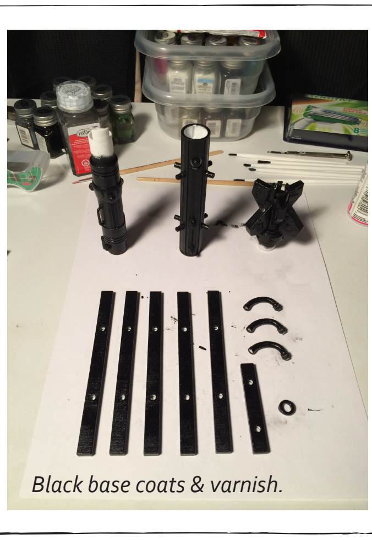
I've decided to include a step-by-step on my own process for building the kit. I'll reference the previous information included in this kit so look above for additional information on methods for which I don't go into full detail during this section.


Raw 3d printed parts from the kit, plus acrylic rod and core unit..

When you first get your kit, it will look like the picture to the right. The first thing I did was clean the white plastic parts, removing any additional powder stuck in deep recesses by blowing it out (air in a can is also useful for this) then rinsing them in room temperature water. Then I cleaned the FUD emitter, using my hands to carefully spread a small amount of detergent over the surface and rinsing it in warm water, lightly rubbing it with my fingers to get the detergent off. I left the pieces out to dry thoroughly and used a Q-tip to dry the interior of the emitter. Once the parts were clean, I did some test fits to make sure everything fit the way it should - except for the emitter. While it has been designed to stay in place, it is tricky to remove, so your best bet is to only place that in the setting as the very last step. The smaller parts all fit into their respective joints well and the tail section and fin assembly fit snug, but not too snug. If the fit is too tight, you can sand down the outside of the joints on the tail section and fin assembly little by little until they fit right. Alternatively, you can insert the part until you encounter resistance, then pull it out, and repeat until it can fit all the way in without meeting excess resistence. Remember, these should stay in but not have to be forced in.

After fitting the whole kit together (but remember, don't put the emitter in place until everything else is finished), I took it apart and began painting. When I tested the core unit inside of the test-assembled kit, I noticed light bleed coming through the white plastic. Obviously, we don't want a sonic that lights up itself, just the emitter, but don't worry - after a few base coats of a dark color, this will be minimal.

I started with two base coats of Testor's flat black enamel. There are a lot of small details and crevices in the design, so I started with a small brush to get into the finer nooks, then finished off each coat with a larger brush to get full coverage. Due to the graininess of the plastic, you'll need to really work the paint into the surface, so don't hold back on the amount of paint you apply. Just be sure to spread it over the surface so none globs up. After the two coats of flat black, I applied a layer of varnish to smooth out the surface.


Black base coats & varnish.

Next, an additional coat of metallic black enamel. At this point, I was ready to start the actual paint job that would determine the look of the prop.

From what I had on hand, none of my metallic colors matched the light brass color, but I had a gold paint that was close enough. However, I decided to apply a coat of a darker brass first. The reason for this is that I would be weathering the prop later on by scratching the surface with a screwdriver to create the banged up look and I didn't want the transition between scratches and the lighter gold color to be too sharp. So after the brass layer, I applied a layer of the gold to get the color of the actual sonic, using a dry brushing technique to ensure the color wasn't too light.

For weathering, as I mentioned before, a small Phillips head screwdriver was handy to scratch the surface. In doing so, I removed a few layers of paint to let the black layer show through and replicated the look of the original prop. As I also mentioned, the dark brass coat was a nice layer to add so that the edges between the gold and black would transition between the dark and light colors on either side, and also show through for lighter scratches, adding more depth to the finish. After scratching, I used a large brush to sweep away the debris.


Dark brass & gold paint coats, plus weathering.


Patina effect on the main parts.

After this weathering technique, it was time to add a patina effect. I mixed together a flat army green and flat light blue to get the proper shade, then applied it with paint on the end of a small brush, focusing on recesses, inside edges and other areas that it would be likely to occur. As you can see, this adds a lot of character to the prop that is lacking without it.

Next, it was time to paint the grips. Since the weathering on the body turned out to my liking, I decided to try a similar technique to simulate wood grain. I didn't have a brown paint that matched the prop, but I did have two flat brown paints that fell on either side of the brightness. So first, I painted the grips with the darker shade, after which I took to it with a small flathead screwdriver.

Wood grain generally runs end to end, so I scraped the surface with the corner of the screwdriver as such, varying the pressure and deviating from too straight of a line along the way. I did a number of passes, doing my best to copy the way wood grain looks, then did a number of additional passes with much lighter pressure to add variation to the texture. I used this technique for the main front face, as well as the sides. On the ends of the grips, however, I made straight lines at a light pressure to give the impression of end grain, which is different from face grain. These are the ends that, on the actual wood grips, would have been cut across the grain, therefore the texture would be a cross section of the main grain.


Comparison of grips before and after wood grain.


Finished wood grips with lighter coat applied.

The result wasn't fantastic at first, but once I added the lighter coat, the details popped. The light coat was more streaky, and I brushed end to end. As a result, the black that showed through on the deeper scrapes maintained a darker color while the rest was made lighter. You'll also notice some 'streaks' that run side to side. I didn't do this on purpose but as a result of the layer-by-layer 3d printing process, the 'grain' of the printed plastic ran side to side, so as I brushed end to end over the various coats, a layer here and there caught some excess paint and it ended up with the appearance of a rushed staining job. I personally like it, but if you'd prefer a more refined look, you can sand the face and sides of the 3d printed grips first to even out the surface before painting.


Emitter tests; left side is painted, right side is dyed.

For the emitter, I wanted to try a number of techniques. On the left, I painted the inside of the emitter with a Tamiya clear blue acrylic paint using a small brush. I did my best to make the coat consistent and ended up with a more patchy look than I wanted. The color is nice, but not what I realy wanted.

For the emitter on the right, I used an Alumilite dye that is meant to be added to liquid resin. It turned out a nice consistency after wiping it down to remove small concentrations on the surface but the color itself was too dark for my taste.

On the final prop, I tried again using less of the dye and got the color I wanted, which was a lighter pale blue closer to the clear paint test, but with the more cloudy look I liked from the darker blue dyed emitter.

In the end, it's just a matter of preference, as the emitter on the actual prop is perfectly clear.

The wires were painted a stock brass but I did some minor weathering to match it to the rest of the prop. Once everything was painted, I left the parts to dry for a full day then assembled it, needing no glue to keep things together. If you plan to carry the prop around to conventions and such, however, I recommend gluing the wires in place where they join the fins.

For the best results, I recommend assembling the finished prop in this order:

1) Attach the trigger ring to the main shaft around the trigger. I ended up not needing any glue as with the paint coats, it was a nice tight fit. I put it in place with the top side first (there is a small bit that fits into a groove on the shaft just above the trigger to indicate orientation) then holding it up against the top side, pressed the bottom in, then firmly pressed it into place. Again, you probably should use glue but I didn't need it since my sonic is just going to be on display in the custom stand kit that is available as well for $25 (with option "core cap" for an extra $3).

2) Attach the grips. One small mistake I made while painting is that I added coats to the area of each bolt that they share with their corresponding grips. The ends will be visible, and the base of each bolt is designed to leave some room between the back of the grip and the shaft, but the middle section should be left unpainted, or only have base coats on it. After varnish and an additional 2-3 coats of paint, there was too much for the grips to fit properly, so I had to scrape off the paint in this area with my trusted flat head screwdriver, being careful not to scrape off any on the front or base of the bolts. After this, the 3d printed grips popped into place, with the layers of paint on the ends acting as a thicker area that will keep the grips on. With the hand made wood grips, the tolerences will be a bit looser so you may actually want the extra coats of paint to hold them in place.

3) Insert the core/attach the fin assembly. You can attach the fin assembly first if you want, but since my core was a tight fit, I had to squeeze it into the shaft, making sure it was lined up as I pushed it in. Your kit, however, will have better clearance for the core unit, both inside the shaft and fin assembly, so you should be able to do it the other way around from mine. Either way, make sure the cut-in on the bottom, thicker end of the core is facing forward along with the push botton as you slide it in. Test the trigger response as well once it's all the way in.

4) Insert the tail section. The fit between the tail and the main shaft should be snug, and the snap joint located on the front side should hold it in place, but if it happens to be loose you can do what I did and wrap a single piece of masking tape around the joint between the tail section and main shaft to add extra thickness and make the fit even tighter. I only recommend this if your tail fits loosely, and you can use the same method for the fin assembly if need be. The guide groove will ensure proper orientation and the extended section of the tail that will sit into the core cut-in should fit nicely. If it doesn't then check to make sure the core is properly aligned. Alternatively, if the core on your kit slides in easy, you can insert it part way after the fin assembly is in place and use the tail section to guide it into it's final placement.

5) Insert the acrylic rod. If you got one with your kit, it will be cut to the proper length but will need sanding around the outside of the length where it will be inside of the emitter itself. This will create some good diffusion for the light and give you a proper glow but be sure to avoid sanding the area that will be inside the tail section as the smooth surface inherent on the rod will be best for reflecting more light upwards. Without the sanding, the light would just bounce of the inside length and shine through the end, giving you a concentrates glow on the tip of the emitter, which you don't want. For this reason, you'll also need to sand the end of the rod, and round out the edges that will fit up to the very tip of the inside of the emitter shell. The pre-cut length is approximate, and it's length will be determined by which core unit you use. The Trans Temporal core has an extra bit of rounded plastic on the end, which will push the rod an extra mm and some upwards, so more sanding will be needed to shorten the rod for use with that core. Once you slide the rod down into the fin assembly and it meets the end of the core unit, compare the emitter side by side to gauge how much sanding is needed to have it sit as flush as possible against the inside end. It's better to sand of a little too much since the rod will fit nicely inside the fin assembly.

6) Attach the emitter. This piece simply needs to be lined up with each of the six smaller holes facing the corresponding pegs on the fin assembly, and the three larger holes being lined up with the lower three fins where the wires will go. Make sure the three holes are lined up before placing the emitter in the setting! Once you have it oriented properly, simply push it down and the six pegs will click into place. Also be sure to double check that the acrylic rod is not too long before pushing the emitter all the way into the locking position or it will press up against the inside of the emitter. Again, it's better if the rod is a bit too short than too long.

7) Attach the wires. Each wire has one end with a small peg that fits into the hole on top of each lower fin and a wider, open end with a taper that fits just inside the emitter. I found it helpful to insert the wire backwards first and twist it into the hole, turning it 180 degrees as it pushes in, ending at the proper alignment with the emitter. You will have to be careful near the end of this rotation to pull the wire back ever so slightly from the emitter to give clearance for that end until it reaches the hole in the emitter, then it can be slid into the hole and you can ensure the bottom end of the wire is fully pushed into the fin.