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Section 3 -- Printing the dial.

Now that we have a dial blank, and a screen, it is time to put some paint on the dial.

Materials used

- Pallett knife.
- Prepared screens. (One fine for characters, and one coarse for luminous material.)
- Sheet of something with a flat surface for a layout board. (I use a part of an acrylic shower door.)
- Rigid items with right angles, 25--40mm each side. (I use steel corners.)
- Epoxy.
- Two sided tape.
- Gaffer's tape.
- Uniformly thick, but thin pieces of something about 30mm x 80mm. (For raising the screen. I have bits of wood and bits of plastic.
- Blue tack.
- Straight edge.
- Pencil.
- Magnifier.
- Screen printing squeegie.

- Container for mixed paint.
- Smoothing material. E.g., sandpaper, emory sticks, finishing film, rubbing compound, and brasso. (I usually use brasso.)
- Metal primer for acrylic. (I use Halford's.)
- Gesso. (You could use acrylic paint for cars.)
- Acrylic paint. For white, I use Liquitex Super Heavy Body. (You can adjust if you are using oil, laquer, alkyd, or something else. I won't be of any help.
- Thickner. (Optional. I use Liquitex Modelling Paste, their Super Heavy Body Gel would probably be better.)
- Acrlic drying retarder.

Suppliers

I got the primer at Halfords. Any primer for acylic would do. The artist's materials I got at a local art store. There are plenty of places on the internet also.
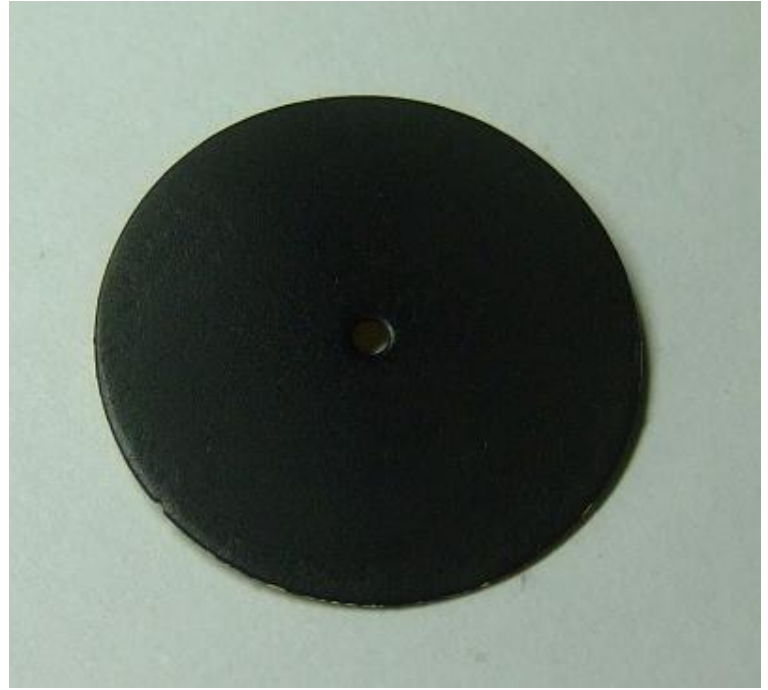
Preparing the dials.

Acrylic paint does not adhere to metal very well, so it needs to be primed. I use a very, very thin coat of automotive primer for cellulose paints. Over this, I put gesso for the dial background. Although I'm using dials with black backgrounds in this discussion, one can use just about any color. There are lots of ways of putting on the gesso. I thin it with water and airbrush it on. I put on a lot of very thin coats, drying each one with a hair dryer. Using a hair dryer speeds things up considerably.

Here is a picture of a dial with the gesso applied. You will notice that it has a rough surface.

The quality of printing is greatly affected by the quality of the surface on which the printing is done. The flatter and more regular the surface, the finer the printing. So, after the gesso has been applied, it has to be smoothed. I'm not very good with sandpaper or finishing paper, so I generally use brasso, water and and a cotton cloth. I've also been playing with rubbing compound.

Here is a picture of a dial somewhat smoothed (I'm lazy, and aim for barely good enough).

Preparing the layout board.

The layout board is used to set up printing. The most important thing it is used for is registration of the image on the substrate on which we are printing. Registration involves getting the image in the right location. For example, if the dial is round and the image a standard one, we want all the seconds markers the same distance from the center, and from the edge. For industrial printing, the item being printed is in a specific location, and the screen is moved to place the image being printed in the right place. (If I understand undustrial printing correctly.) I'm more or less reversing that. I try to get the screen in the same place everytime, and move the object being printed to be under the image. This won't work well if you have to print lots of items.
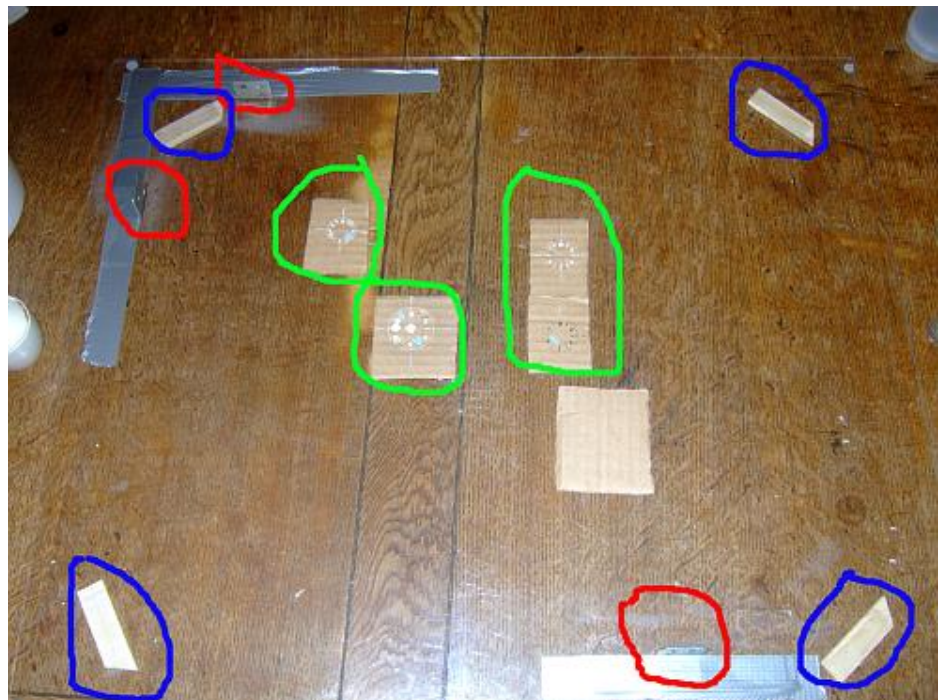
Here is a picture of my layout board.

The circled red things are the right angle bits of steel that are used to provide a three point registration for the screen. One edge of the screen is put in the corner having two of the points. The screen is then moved so that the other edge hits the third point. Since the points are unmovable and flat, and the sides of the screen are flat, it should slide into exactly the same place each time. Of course it doesn't. It is always within about .1mm, but you may have to adjust the screen by eye, just a bit, if you are printing one colour on top of another. More on this later. The points are steel edges. They are fixed using epoxy and then gaffer's tape. So, the images on the screen should be over exactly (or nearly so) the same place each time the screen is placed on the layout board.

The blue circled areas are the screen hight adjusters. At the base, I have thin pieces of wood held to the layout board using two sided tape. On top of these, I have pieces of plastic held to lower layers using two sided tape. The distance of the screen from the substrate depends on the fineness of the screen, the viscosity of the paint, etc. I have it between .75 and 1mm. The closer it is, the better the registration will be.

The circled green things are pieces of cardboard fixed with double sided tape to the layout board. They are larger than the dial image under which they are fixed. Once they are fixed, the dial image is printed on them. This allows one to see where the image is going to be printed. Given this information, one can place the dial in the right place with the right orientation.

I hold the dials in place with blue tack. I also put holes in the cardboard for the dial feet.

Even with the image, etc., the dials usually aren't placed exactly right. Using Blue Tack to hold the dial in place means that it is relatively easy to make very small adjustments. There are a number of things one can do to get the location more precise. Here is a list of some, but you will have to experiment. It usually takes me 3-4 minutes to get a dial just right, but it has taken up to 15 minutes.

- Line up the three o'clock mark on the dial with the registration mark on the printed image.
- You can see the outline of the dial under the image on the screen. Make sure that the outer chapter is the same distance from the edge all the way around.
- Using a straight edge, mark the center of the dial, and the center of subdials with a pin hole. You will be able to see these through the dial holes. Use these to center the dial. (It is extremely difficult to get the pin holes exactly right.)
- Looking through the screen, make sure that the subdial holes are centered in the image.

Here is a closeup of a dial image printed on the cardboard.

The paint.

Getting the right paint (or ink, as it is always called by professionals, no matter what the stuff is) is not easy. This is because the painting is being done on a relatively non-porous surfaces. (Using gesso helps here.) I'm inclined to use as viscous a paint as possible for the characters. So, when printing with white, I use 2 parts Liquitex Super Heavy Body paint, to 2 parts modelling paste, to 1 part acrylic drying retarder. This makes something that is much thicker than cream. It leaves a surface which, under magnification, shows that a screen has been used. I don't care, but you may want to play with the paint if you do. The drying retarder is crucial. If you don't use it, the acrylic paint will dry in the screen, ruining the screen.

For luminous paint, I have been using 2 parts Daler-Rowney System 3 Screen Printing Medium to 1 part luminous powder. But, this has been overloading the medium, making it almost flaky when it is dried. So, I've decided to add an additional part of clear acrylic medium.
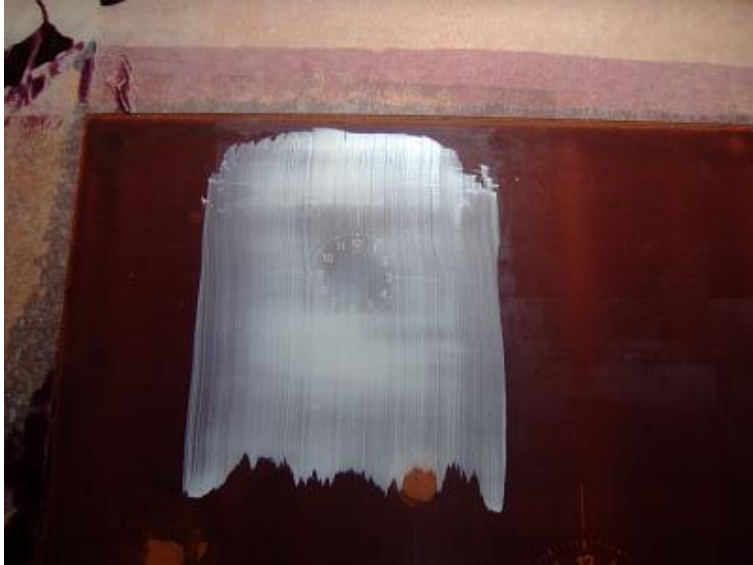
Printing the dial

The dial is in the right place, and the paint is mixed. Now to put it on the dial. This is the easy part. Look at the screen printing instructions referenced in the previous section.

Using the pallett knife, put some paint above the image.

It will look something like this.

Then, using the squeegie, load the screen with paint. The "fill" stroke is very light, and the squeegie does not come in contact with the dial.

It will look like this.

Finally, again using the squeegie, move the ink from screen to the dial. A smooth pull, just touching the dial works best. For an even print, have both hands on the squeegie. Although I use a small squeegie, I seldom get an even print if I use just one hand. (It took me ages to work this out.)

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You can see that the paint is now missing from the dial image, where it has been painted on to the dial.

Here is a picture of the squeegie action.

That's it.

After printing the dial, clean the screen out with water. And do it fairly quickly. If you let the acrylic paint or luminous material dry in the screen, the screen is ruined. Also clean it from the squeegie and the pallette knife.

Adding luminous material.

I use a slightly different method when adding luminous material. First, the final registration is a different. After the dial is on the image printed on the cardboard, final registration is done through the screen. The white of the already printed characters should fill the open space in the screen. (The open bit of the stencil.) If you can see black though the screen (when pushed down), it isn't quite aligned correctly.

Instead of pulling the squeegie to print, I use the SCRAD method, a mixture of screen and pad printing styles. I load the screen in the same way using the squeegie, but don't use the squeegie to get the paint on the dial. Instead, I take a ceramic cup just bigger than the dial image, and put it over the dial image and press down. This puts the screen in contact with the dial, and the luminous paint is pulled out of the screen. Since the luminous mixure isn't as viscous as the white paint, it is easier to smear, and this reduces the likelyhood of that happening.

I repeat. After printing the dial, clean the screen out with water. And do it fairly quickly. If you let the acrylic paint or luminous material dry in the screen, the screen is ruined. Also clean it from the squeegie and the pallette knife.

Dials

Here is a dial of 24.75mm.

Here is a dial of 28.5mm.

Here is a closeup of 12 on that dial. You can see the character is sharply defined, but that it has a "screen" texture.

Here is a dial of 35.5mm. I ended up doing this one over as the seconds markers weren't even enough. Luckily, it is pretty easy to remove the white paint and clean the dial, if you decide to start over before the paint has dried. Just wash the dial, use a bit of brasso to remove the ghost image, and rinse it off.

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