The following article appeared in this issue of FineScale Modeler.

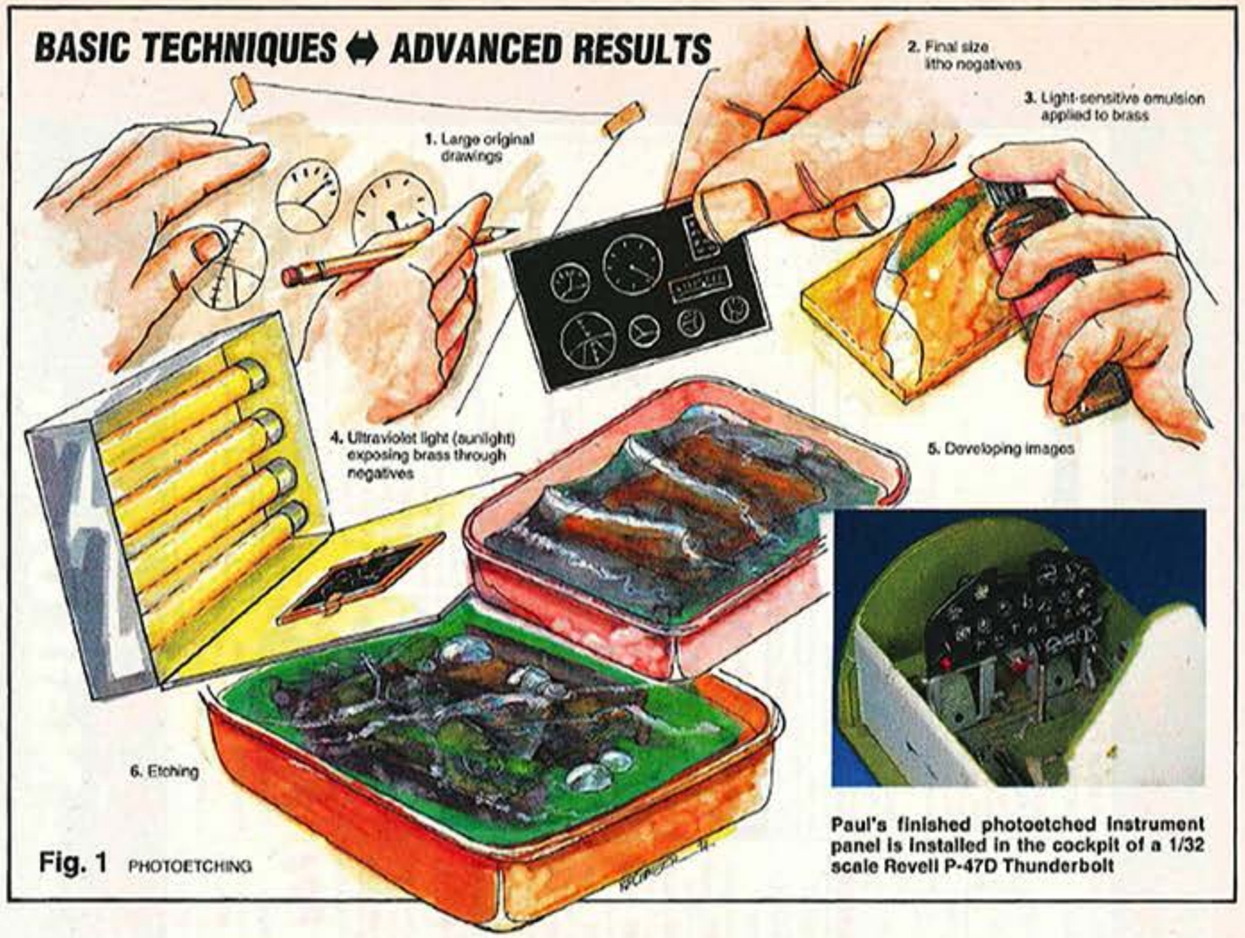

Fig. 1 PHOTOETCHING

Paul's finished photoetched instrument panel is installed in the cockpit of a 1/32 scale Revell P-47D Thunderbolt

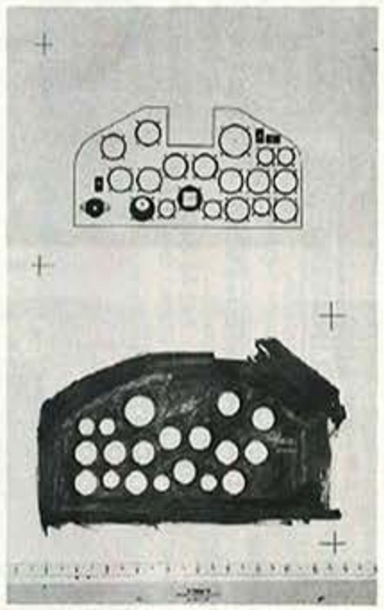

Fig. 2. The large artwork for the front (top) and back of the instrument panel features register marks that will help align the negatives when exposing the brass.

Photoetching for modelers

Creating a bas-relief instrument panel at home

BY PAUL BUDZIK

DESPITE THE FLOOD of photoetched detail parts for aircraft, armor, cars, and ships, you may find a need for parts that aren't available. Just gazing at those aftermarket parts could make you think it's a complicated and expensive manufacturing process only engineers in white coats can comprehend. Not so. Photoetching is a relatively simple process, one that does involve special materials, techniques, patience, and care. Although my techniques should not be considered the gospel of photoetching, they work for me and others who have tried them.

What is photoetching? Photoetching is essentially a chemical-milling process — it's used to make electronic "printed" circuit boards. As its name suggests, it is a photographic process, too. The desired designs are photographically imprinted on light-sensitized metal, which is then developed. This developed image protects the metal underneath, while the etching chemical eats away unprotected material. Figure 1 is an overview of the process, and you can follow it as you read along.

Original image. The example we'll use is a bas-relief instrument panel for a Revell 1/32 scale P-47 Thunderbolt. Although I wanted raised instrument bezels and rivets, I also wanted holes etched through for the instrument faces that would be added later. To make a bas-relief instrument panel, I needed to create correctly sized images of the face and back sides of the panel. The first step is a set of enlarged ink drawings.

Since this process involves a photographic negative, you must make positive images with black ink on good-quality vellum, a frosty, translucent drawing paper. You need to visualize the process before starting to draw: In the negative process, everything drawn with black ink is retained on the final part. (Some photoetching processes use a positive to create the image, but I prefer the negative process.)

One advantage of this system is that you can draw the original larger than the final image. I usually draw my originals eight times larger (8x); this makes it easy to draw fine details. One caution, though: When you produce the original image, you must remember that the weight (or thickness) of the line you use also decreases as you reduce the drawing to the final size. When I draw the 8x original, I never use a line thinner than this:

Anything thinner could disappear after the drawing is photographically reduced and the brass is chemically etched. You can draw to any ratio that you like, but it's a good idea to always draw to the same enlarged size so you get a feel for how heavy your lines should be.

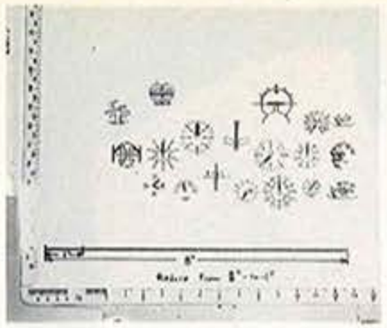

Fig. 3. The instrument faces were also drawn. Here, everything black will appear white on the finished panel.

Fig. 5. The negative/brass sandwich is clamped between two sheets of glass. Once one side of the brass is exposed, simply flip the set over and expose the other side.

Fig. 4. The group of chemicals on the left is made by GC Electronics, while the group on the right is made by Datak Corporation. In the center rear is a bottle of ferric chloride etchant. Front and center is resist lacquer, which can be brushed onto areas of the metal that need to be protected from the etchant. All these chemicals can be purchased at an electronics supply store.

Let's go back to the instrument panel. After the original artwork for the front side is drawn, place register marks outside the panel area. These marks can be simple corners or intersecting lines, Fig. 2. Now flip the original drawing face down and tape a new sheet of vellum to the back. You should be able to see the front panel drawing clearly through both sheets of paper. Draw register marks on the new sheet *exactly* over the marks on the first.

Now draw the back side of the panel by following the lines of the front panel underneath. (Remember, if you're working with the negative process, everything you draw with black ink is protected during etching.) In this case, the entire panel is black except the circles for the instruments, which will be etched through. When you're done, separate the two drawings.

A third drawing is for the instrument faces. Tape another sheet of vellum to the instrument panel face drawing and draw the instruments, Fig. 3. Thinking in the negative again, everything you draw with ink will become white on the finished panel — more on this later. You won't need register marks on this drawing.

High-contrast negative. Making negatives is the only step most modelers can't do at home. You need to have high-contrast "litho" negatives made from the original artwork, and your artwork must be reduced to the same size as the final metal parts. Check the telephone book for "lithographers" or "lithographic services." Explain what you are doing and they will know what you need. You'll be charged by the size of the film provided.

If you have drawn the artwork eight times larger than the final parts, have it reduced to 12.5 percent. Four-times-larger (4x) artwork needs to be reduced to 25 percent, and so forth. Make sure the service you use can reduce your artwork to the size you need: Some litho cameras reduce only to 25 percent.

Have all three drawings shot at the same time to eliminate reduction errors. Make sure that the register marks appear in the negatives.

Photo-sensitizing the metal. Just as photographic film is plastic with a light-sensitive emulsion applied to one side, the sheet brass needs a light-sensitive emulsion applied.

K&S sheet brass is available in most well-stocked hobby shops. I cut what I need from the 4" x 10" sheets of .005"-, .010"-, and .015"-thick brass. The thicker brass is best for bas-relief etching. Clean the brass with fine sandpaper or pumice and wipe it with alcohol or lacquer thinner.

All the chemicals used in photoetching (photo resist, developer, and etchant) are available in electronic supply stores, Fig. 4. The chemical that forms the light-sensitive emulsion is called photo resist. Depending on the brand you buy, it can be applied as a dip or a spray. I prefer Datak's pump-bottle spray. Since the vapors from photo resist are harmful, wear a respirator mask and make sure your work area has plenty of ventilation.

Apply two heavy coats with the metal laid flat so the chemical settles

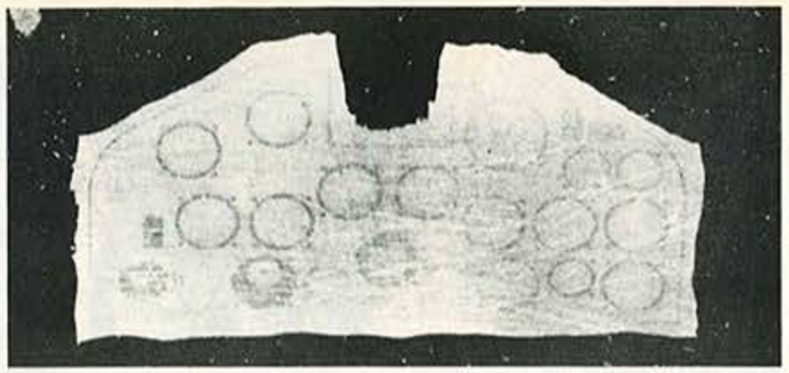

Fig. 6. The developed image can barely be seen on the brass sheet. Paul used black lacquer to reduce the amount of metal to be etched.

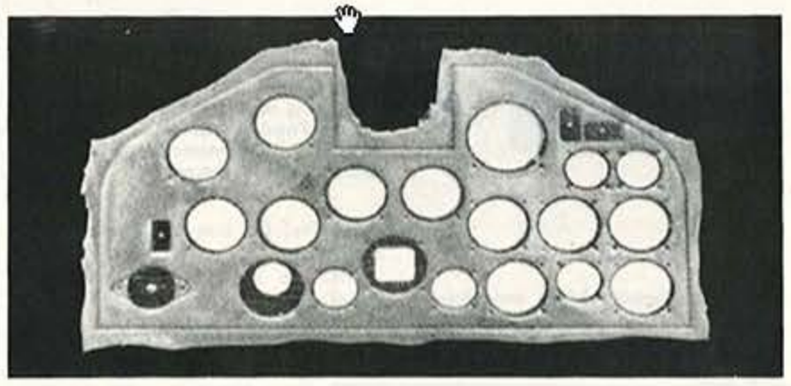

Fig. 7. The instrument panel as it appears after etching. Note the raised bezels around the holes for the instruments.

evenly over the surface. Since the chemical is light-sensitive, apply it under subdued light. Total darkness isn't necessary; just be aware that ultraviolet light (there's a lot in sunlight) "exposes" the emulsion. The emulsion takes up to 24 hours to dry (per side), so I put the coated brass in a light-tight container while it dries.

Exposing the image. Now you must expose the sensitized brass sheet with the negatives and a strong ultraviolet light source. Sunlight is the handiest source, but grow lights or ultraviolet bulbs work, too. Tape the face panel and back panel negatives together at the top, emulsion (dull side) to emulsion with the register marks lined up. In subdued light, slip the brass in between the negatives and insert this sandwich between two pieces of glass. Clamp the glass together, Fig. 5, and expose the brass to sunlight for two to five minutes per side, according to the instructions on the photo resist label.

Developing the image. After exposure, return to subdued light and remove the brass sheet from behind the negatives. To develop the image, mix developer and water according to the instructions and pour enough to cover the brass sheet into a print developing tray (available from photographic supply stores) or a glass jar. To keep fresh developer in contact with the sensitized plate, you need to agitate (stir) the liquid every 30 seconds or so. Lifting and lowering one side of the tray about half an inch create enough wave action in the solution. Development time varies with the brand, but it usually takes two to five minutes. Stop development by rinsing the brass thoroughly with water, then let it dry.

Inspect the developed image. Some brands of developer turn the image blue or green; the Datak brand I prefer leaves a transparent but shiny image you can see by holding the sheet at a certain angle, Fig. 6. The rest of the process can be accomplished under ordinary room lighting.

Chemical etching. Brass etching is done with a warm (100 to 125 degrees Fahrenheit) ferric chloride solution. The solution is strong stuff, so wear chemical-resistant gloves. Pour the etchant in a photo tray or jar. Holding the brass sheet with a spring clothespin, place the metal in the etchant. With agitation, etching time is about 15 minutes.

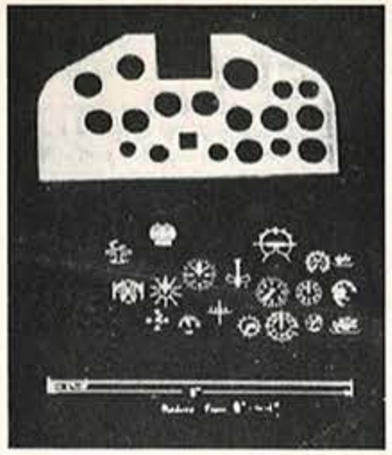

Fig. 8. The instrument negative is placed behind the finished brass panel. Painting the back side of the negative white produces a white-on-black look when the negative is viewed from the front.

Since the etchant is working from both sides of the brass, you need to leave the panel in only long enough to eat through halfway. If I start with .010"-thick brass, an image exposed on both sides of the brass will be etched all the way through — .005" from the front side, .005" from the back.

Monitor the etching process carefully. When the etchant has cut through the holes for the instruments, it's done, Fig. 7. Rinse the brass with tap water to stop the etching and dry with a towel. Remaining photo resist and protectant can be removed by soaking the brass in lacquer thinner and scrubbing with a wire brush.

Remember that third negative with the instrument faces? Paint the emulsion (dull) side with white paint and set it aside to dry. Flip it over and you'll see black instrument faces with white arrows and indexes, Fig. 8. After you've painted the brass instrument panel black, slip the instrument negative behind the panel and align the faces with their respective holes. The finished product looks so real you could swear that the dials are working. FSM

REFERENCES

• Kodak information pamphlets No. G-184, *Photofabrication with Kodak resists*, and No. G-185, *Characteristics of Kodak Photoresists*, Eastman Kodak Company, Dept. 454, 343 State St., Rochester, NY 14651

SOURCES

• Photo resist and chemicals: Datak Corporation, North Bergen, NJ 07047
GC Electronics, Division of Hydrometals Inc., Rockford, IL 61101
• Brass sheet: K&S Engineering, 6917 W. 59th, Chicago, IL 60638