

# MAKE YOUR OWN VACUUM FORMING TABLE

By RON WILLIAMS . . . At last! An easily-built vacuum former for odd cowls, canopies, wheel pants, and whatever. Change dimensions to suit your own requirements, but don't make it one inch too small!!

• One has but to read a few how-to articles on U/C or R/C scale (or semi-scale) to realize how often the question of canopy, cowl or wheel-pants comes up; free-flight scale often requires light weight wheels and canopies as well. What to make them of . . . a thin, light plastic shape; but how to get it? Articles often mentioned "vacu-forming" the part. The Mattel Toy Company manufactured a "vacu-form" toy some years ago which has become a valued tool for many free-flight scale modelers (see Bill Hannan's column in the December 1975 issue of MODEL BUILDER). This toy had a small hot plate next to a vacuum chamber with a frame that hinged between the two. Small sheets of plastic held in the frame could be heated on the hot plate, flipped over to the vacuum table and pulled and formed over a small object by a hand-pumped vacuum. It was quite well designed and works very efficiently. For builders of larger models, however, the Mattel unit has limited capabilities due to its small table size (approx. 3 x 5 inches). Canopies and cowlings for a large stunter or R/C job require more "formidable" equipment. There is also the growing problem of finding Mattel units in working condition.

We will explore the process of vacuum-forming at home with the vacuum table described here. Look the drawings over to see what's what. Most canopies for larger models are about 12 to 14 inches long by 2 to 4 inches wide. SIG mail-orders 8-1/2 x 17 sheets of heat formable plastic (styrene, I think). These dimensions seemed reasonable for the development of a useful unit. Smaller sheets of plastic can be handled by bringing them up to the larger size with the addition of heavy bond paper taped to the small sheet.

I decided to start with our family vacuum cleaner. It is a G.E. tank type of unknown vintage. I have seen similar machines for \$30 in local repair shops, second hand of course. Your local repair shop should also have an adapter tube (Fig No. 1) which, though not entirely necessary, will facilitate the attachment of the cleaner hose to the vacuum table.

The vacuum table was made with scraps of birch plywood and masonite found in the cabinet shop's throw-aways. Some straight clear pine is also required. The box sides were made with 3/4 inch birch ply, the top with 1/4

inch birch ply, the bottom with 1/4 inch masonite (tempered) and the frame members with 3/4 inch clear pine ripped to 7/8 of an inch wide. Tite-bond glue was used, and the frame supports attached with 10 No. 10 flat-head sheet metal screws, 1-1/2 inches long. Some 50 thumb-tacks are required (they hold the plastic film in place in the film frame). I used 1/8 O.D. surgical tubing (about 54 inches long) as a vacuum seal between the film frame and the support frame.

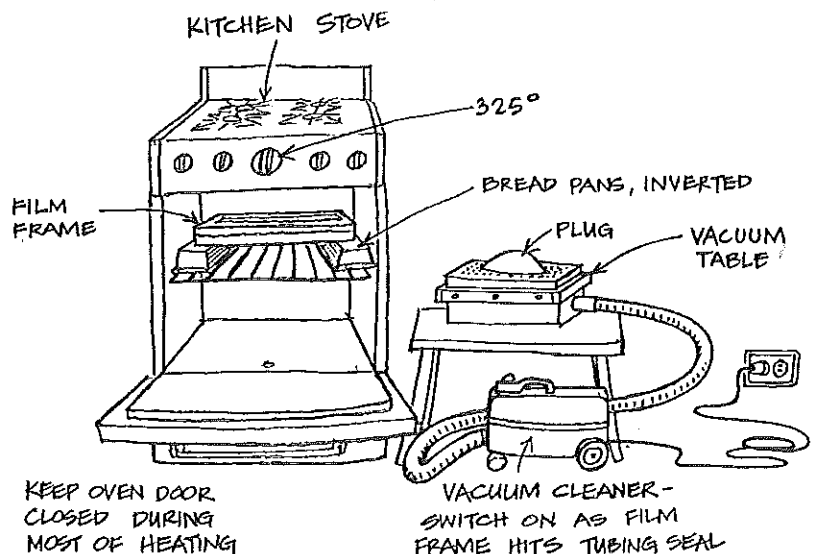
Tools required are a few 1/32 drills, a drill the size of the tack shafts, and one half-again as large. It's nice to have more than one of the 1/32 drills, as they are likely to break what with all the holes to be drilled. A high-speed drill like the Dremel Tool is a great time-saver; a pin-vise is suggested for masochists. Gluing is facilitated with an assortment of clamps, but if they are not available, the joints can be screwed as well as glued. Don't leave the glue out, it acts as a vacuum seal.

Begin construction by cutting the wood to size. Lay out the hole pattern on the table top (plywood or masonite) and drill the holes. My table top had 578 holes; the Dremel Tool enabled me to finish the drilling in 30 to 35 minutes. I broke one drill in the process. Sand the top very carefully after drilling, smooth to 600 paper, and clear all the holes. Glue the outside frame of the box together, making sure the top and bottom surfaces of the frame are flush

(even) as possible. Glue the top and bottom onto the frame, pressing them to the frame so that the joints will be as air-tight as possible. If you haven't yet drilled the hole in the end of the box for the vacuum cleaner adapter, do it now. The hole should be such that the adapter can be epoxied or Hot Stuffed into place firmly and tightly. A hole which is a snug fit for the tube on the vacuum cleaner hose can be substituted for an adapter tube, tape being used to seal it.

It is essential that the film contact the vacuum table top when its frame is pressed upon it. Squash the surgical tube between two pieces of wood and measure the thickness when pressed firmly by hand (lean on it). Add this dimension to the 7/8 dimension of the pine frame material; the resultant dimension is the measurement from the vacuum table top to the top surface of the support frame. Position the support frame pieces, drill and screw them to the box. Loosen the screws, glue generously, then re-screw. Use Hot Stuff to glue the surgical tube to the support frame. Locate the tubing at the center of the support frame so that the tubing can spread freely when the film frame is pressed upon it. Spot-glue the tubing at first to locate it, glue the splice, and then glue the rest of it in place.

Make the film frames from the rest of the 3/4 x 7/8 pine pieces. The frames should be able to be slipped snugly, easily . . . easily down over the table and



Typical kitchen set-up for vacuum forming. A foot-operated switch on vacuum cleaner comes in handy during operation!

onto the support frame. Keep the faces of the frames as flush (in a single plane) as possible by matching the pieces before gluing, and by planing and sanding carefully. Mark the two surfaces which match best when the frames are held together, and on one of them, mark off the positions for the tacks.

Cut the heads from 50 tacks. Drill holes which will leave about an 1/8 inch of the cut tack shaft protruding from the surface of the frame. A piece of masking tape wrapped around the drill can indicate the depth to which the hole is drilled. Rub some balsa dust, microballoons or baking soda into the holes, insert the tack shafts, point up, and add Hot Stuff. It occurred to me that a more satisfactory method might be to drill holes the size of the tack heads and drop the entire tack into the hole, then point up and back fill the holes with epoxy or wood filler.

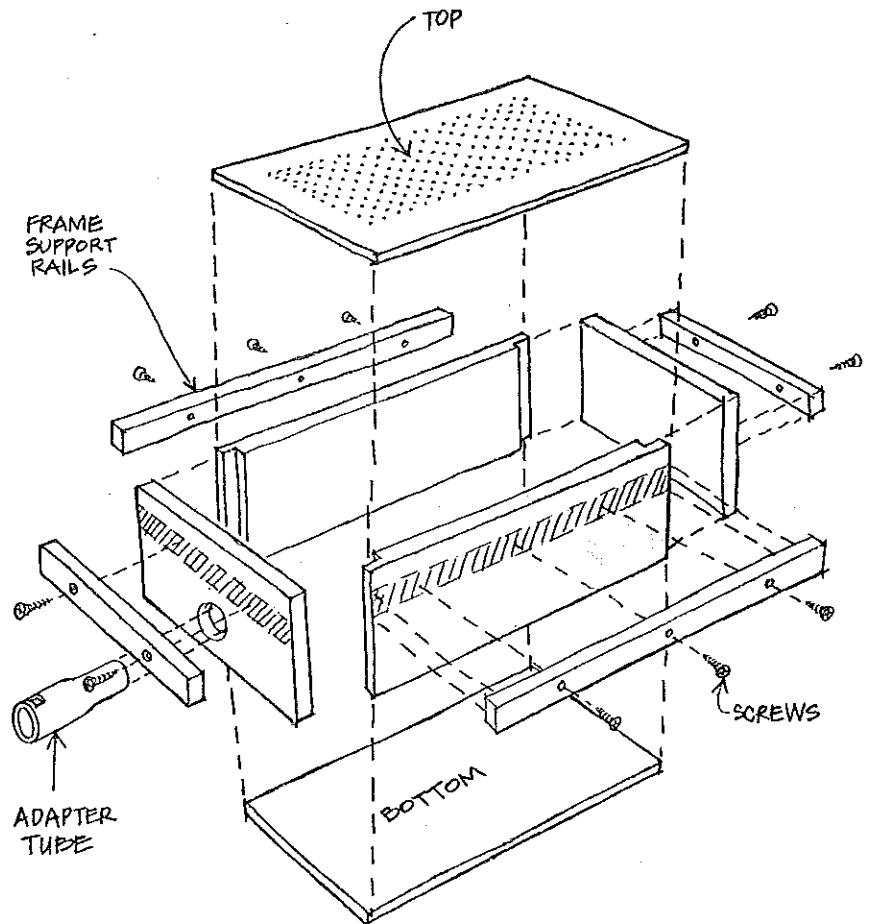
When the tack frame is ready, put it against the second film frame and press them together so the tacks mark the second frame. Drill holes slightly deeper and a half-size larger than the tack shafts, at each of the marks in the second frame. The frames should fall together easily. The assembled frame should drop over the table onto the support frame no matter which way it is turned (up, down, right or left).

The table is now ready to begin forming. It's time for a dry run. Hook up the vacuum cleaner; it should fit snugly. Tape the connection to make it air-tight. Lay a couple of sheets of bond paper on the table top and turn on the cleaner. The paper should be pulled tight to the table. Seal any joints of doubtful air-tightness with masking tape, rubbing it down tight. Fill the corner joints of the frame support.

When you're ready to form film, start the oven (heat source). About 325° F. is good for forming the type and thickness of plastic likely to be used here. I place the box to the immediate right of the oven door (I'm right handed) on a low (24 inch high) table. The vacuum cleaner is placed where I can start and stop it with my foot on the switch. The oven shelf goes in the middle of the oven and two bread loaf pans are positioned upside down at either side of the shelf to support the film frame.

Stretch the film in the frame by placing it on the side with the holes and pressing it firmly against the tack frame until the tacks are through the film and the two frames fit tightly together. This can take quite a bit of pushing with .040 film. With the frames together snugly, run a piece of 1/2 inch, or wider, masking tape around the frame to seal it air-tight.

Position the plug to be formed on the vacuum table after warming it slight-



Exploded view of vacuum table. This looks like what will happen if you don't fasten the parts together and then hook it up to the wrong end of the vacuum cleaner!

ly in the oven (not too hot to touch and hold).

Put the film frame in the oven and while it's heating test the vacuum cleaner, on and off.

Open the oven door after about 30 seconds and take a peek at the film. It will buckle and sag, steam and pull tight again. When acetate steams or "smokes" it's about ready to form. I find that about 50 seconds at 325°F. with the oven door open and closed a few times, works fine with .030 acetate. Experimenting with other film types and thicknesses will improve technique. Remove the frame from the oven and swiftly press it down over the form and table onto the support frame. As the film frame is pressed against the surgical tube seal, kick on the vacuum cleaner. The film will be sucked down upon the table top, shwop, and voila, the canopy! Wait 20 or 30 seconds for things to cool, and after turning off the vacuum, lift the frame and remove the plug from the plastic. The plastic can now be removed from the frame and cut to fit the model.

Easy, eh? Not really so. The most time consuming and fussy part of each forming job is the preparation of the core, form, or plug used to make the final plastic part. The plug should be

wider at the bottom than the top, having no undercuts which make the film difficult to remove from the plug. (fig. 2) It should be very flat and smooth on the bottom. The plug should be higher than required for the finished object so the formed film can be trimmed exactly to fit the model. See Flying Scale Models of WWII for instructions on how to extend the plug for the canopy of an ME-109. Wheels, wheel-pants and other symmetrical parts have to be formed in two pieces and cemented together to form the whole part.

Plugs can be made of balsa or bass wood. The finish of the final plastic piece will only be as good as the finish on the plug. The wooden plug can be finished with Hobby epoxy formula 2 glue, sanded to a 600 paper smoothness, or smoother with steel wools. Do not use wax on the plug.

Another type of plug can be made using plaster. This is done by pouring model casting plaster into a plastic form made from the original wooden plug. The plastic form should be well supported to prevent deforming by the heavy wet plaster. Tap the plastic form rapidly and gently to prevent bubbles from forming on the surface of the plug. After removing from the plastic form,

the plaster can be finished with sanding, and details can be added with tapes and carving.

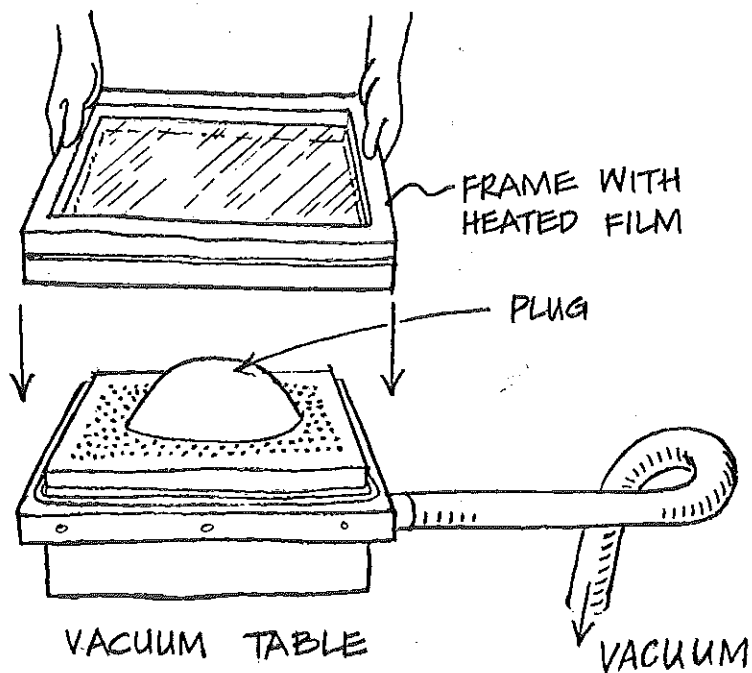
Four plastics are generally available for vacuum forming. They are, in order of their formability, butyrate, styrene, vinyl and acetate. Butyrate is fuel proof, somewhat unstable over long periods, hard and clear. Styrene is usually hard to find, tends to be fragile . . . smells like vomit. Acetate and vinyl are tough, but are susceptible to some fuel ingredients and cleaning solvents. Acetate tends to fog when cooled too quickly or not heated enough; it tends toward brittleness. Vinyl is obnoxious (an unclear description, but if you use it you'll know) and the original dust collector, but is more resilient than the others; it requires lower temperatures.

Smaller objects and pieces of film can be accommodated by adding heavy bond paper edge-to-edge to the smaller plastic sheet. Use masking tape on both sides of the joint, pressing the tape firmly to make a strong connection. More than one small object can be formed on the table at the same time. Just leave a generous space between each object for clean forming and ease of trimming.

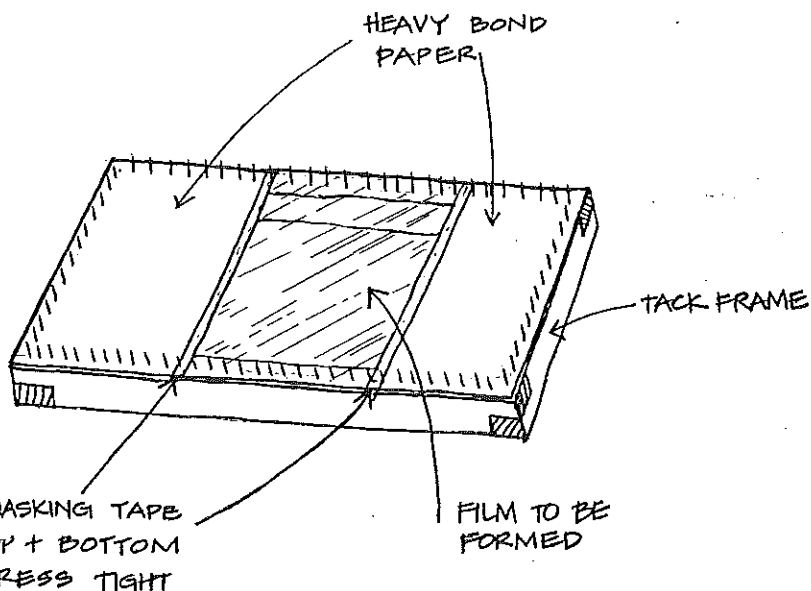
Small parts can be formed from .0075 to .015 film, and larger parts can be formed with .020 to .040 film. Film of up to .050 thickness can be formed, but it is difficult to work with. However, the results can be outstanding on the larger size model. The maximum pull I've attempted with the unit described here is about 3 inches, with a 2 by 8 inch plug, and .040 film. Experience is, as usual, the best teacher.

Craft shops sell glass cutters for cutting bottles. These can be used to cut glass bottle bottoms off for making cowl forms. After making the first plastic form, make a plaster plug. Remove (?) words like "Coors", "Rheingold", or "Olympia", add details, and re-form. The possibilities are quite extensive. I'm about to do some compartmented trays for small parts, my wife would like a few original Christmas tree ornaments, and the kids have thoughtful looks when they watch me pull canopies.

So, there it is. All those planes that looked promising for a building project



Pressing frame down on vacuum table. For proper removal of plug after forming a part, plug sides must be straight, or taper toward a wider base. Undercuts will stick in finished part.



Set-up for making smaller parts. Heavy bond paper is taped (both sides) to sheet plastic to bring it out to tack frame. Basic frame dimensions can be changed to suit your expectations.

but for the wheel-pants, fillets, cowling, etc., etc. are suddenly possible . . . Well, not so suddenly, but the forming process itself does seem to be anti-climatic;

it all happens very quickly. Look through the heavy-scrap box, pick-up what's necessary, inject a bit of ingenuity and improvisation and . . . Pop! . . . Voila!

