From concept to kit, the challenge for manufacturers is to make kits that will catch the eyes of 250,000-300,000 buyers. Jim Forbes photo

HOW MODEL KITS ARE PRODUCED

An inside glimpse at how a typical model comes to market

By Edie Boatman
Photos by Paul Boyer

JUST HOW DOES A MODEL go from being an approved concept to that kit you can't live without? How is it designed and molded? FSM thought you'd like the answers, so we went to the Testor Corporation of Rockford, Illinois, to get them.

The grand design. John Andrews, master aircraft designer for Testor (see the sidebar on page 56), filled us in on the design end, which begins after Testor has decided what to build (see the sidebar on page 55). For our walk through the process he used the F-18 as an example. "First, I get the material from McDonnell Douglas, drawings and photography and everything else," says John. "Sometimes we take a field trip and photograph the actual airplane and build up that background material." All of this information is used to begin the design of the model. A list is made of every part that will be needed for the kit and each part is drawn.

"Then," says John, "we go and begin work with a master pattern shop to build master models of every part that's used in the kit. Usually those models are made twice the size of the planned model, sometimes four times the size, because of the little parts." Next the designers complete a mold layout (a type of map for the actual mold, or tool). The last step in the pattern shop is to make a resin casting of each part. They are shipped to one of several mold makers.

The mold maker takes the resin casts and transcribes them into a steel mold using a pantograph. A complex machine, the pantograph has a stylus on one end with which the mold maker "traces the contours of the resin model," says David Carlock, master car designer for Testor. The machine then transfers the three-dimensional contours to a steel-cutting bit on its other end, which engraves them into the metal mold, also called the "tool." "First a rough cut is done with a large carbide bit," relates David. "That eliminates the bigger chunks from the steel mold." Then smaller bits are used for the finer cuts.

Since the resin models are larger than the actual molded parts will be, proportional adjustments are made to the arms and pivots that carry the motion from one end of the pantograph to the other, thereby enabling the mold maker to reduce the model to the proper scale.

Once the mold maker finishes with the pantograph, the mold is hand finished. The cavities are polished, and an engraver may be called in to hand detail the intricate parts of the mold.

Next, retractable ejector pins are placed, so the molding machines can expel models from the mold cavities automatically. They produce the round imprints or raised marks we find on the backs of kit parts. Then the mold is fitted into large steel inserts, ready to go.

Once the mold is complete a test shot (injecting molten plastic into the mold for the first time) is done, " . . . and then we begin to see what we're getting," notes John. "There's a lot of 'tool chasing' in that somebody from Testor has to go out and work with the tool maker – first shots are generally not exactly what we want and we make little changes. With enough time – about a month and a half in tool tryouts – we will have the model kit." Finally, the tool is ready to be shipped to the molding plant.

These tiny beads are the starting point for molding models. You can see here how few dye beads are necessary to produce a very black piece of styrene, in this case, a cap for a Testor spray paint can.

Where it all comes together. The large funnel-shaped hopper on the top of the molding machine delivers the beads, which the machine heats and cools at an incredibly fast rate.

Injection molding. To learn about molding, we went to the source at Testor: Tom Landerholm, molding manager and 24-year veteran.

Testor began using molding machines shortly after it purchased IMC and Hawk in 1970, and Tom has been involved ever since. Even for someone who has been building scale models all his life, Tom says, "it's quite a sight."

Molding even a big model begins small, with tiny beads of styrene and dye. The styrene beads are about 1/16"

in diameter, irregularly shaped, and a filmy white color. The dye beads are roughly the same size, and are highly concentrated, **1**. Only a few are needed to color the styrene, **2**. "From there," says Tom, "it's taken to the machine where it's fed up into the hopper and it feeds from the hopper down into what we call the sprue unit, which feeds the material into the mold," **3**.

On the way to the sprue unit, the beads pass through a series of heaters. They bring the styrene to about 450° F, melting the dye and turning the styrene beads into a molten liquid.

"The hot material is injected into the mold cavities, which are the shape of the parts you want," states Tom, **4, 5, 6**. After the cavities are filled, the mold is cooled. Water runs through a series of hoses that connect at one end to large chilling units and at the other end to cooling passages in the mold. "When the plastic cools, it's not really always cold, but it's cool enough that it'll keep its shape," notes Tom. "The mold will open up, the parts will drop out, and then we package them," **7, 8, 9, 10**.

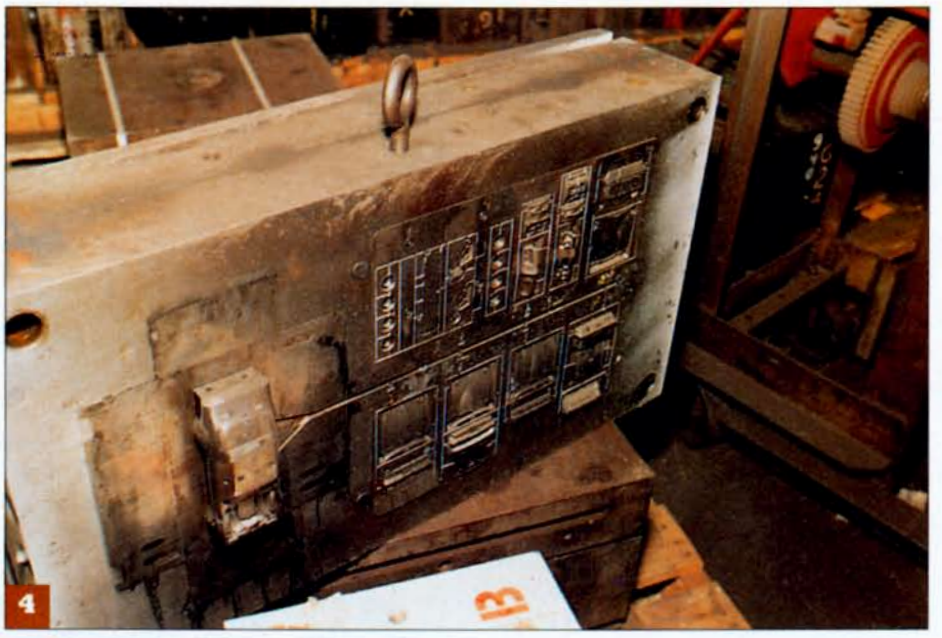
This entire process takes about 30 seconds, which means a machine can produce approximately 960 kits per eight-hour shift. That's more kits than many modelers build in a lifetime.

Molding isn't without problems, as Tom knows. At times there is flash, those annoying pieces of plastic that bleed from what should be a clean edge. Flash occurs when the mold halves aren't clamped together well, or when a mold begins to wear.

Another problem is parts sticking to the mold, which requires those cavities to be polished before the molding can continue. And sometimes a model will have burn marks. "The material creates a gas when it's heated and if it's not vented properly you'll end up with a burn mark," says Tom. When this happens the timing cycle is adjusted. But these are only minor problems, notes Tom. "Most of the tools run pretty well."

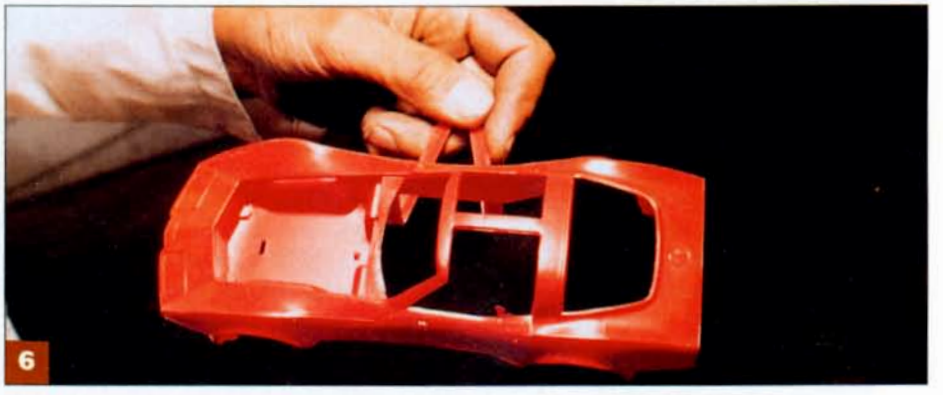
Testor has eight machines, which produce anywhere from six to 12 different kits per month. The variance in numbers comes from the fact that some kits have only one tool, and some have three or four. The UFO that Testor produced, for example, used three different tools, so it took more time to complete its run.

A run is the number of kits produced



The molds are huge, heavy chunks of metal. The halves need to fit together perfectly to create quality models.

A multi-piece mold with "side actions" allows a complex form, like a car body, to be produced in one piece. . .



. . . yielding a car body like this little red Corvette.

What to produce?

How do manufacturers decide which kits to produce? "It varies," says John Andrews, Testor's senior model designer. "Sometimes we have an idea and we'll ask the marketing department to determine whether or not they also see a need for a particular product. Have any of the buyers asked for something? Are the modelers or other customers asking for something that we don't have? I think that's the way almost anything is done as far as all the manufacturers are concerned."

According to Testor Vice President Ernie Petit, the company has to sell 250,000-300,000 copies of any new design to make the project worthwhile. "The biggest payoff is to figure out on the front end what we're going to do with this thing to make it not just a one shot deal," says Ernie, "To have enough variants out of it . . . so we can advertise it over a bigger time span. That way we can afford to put the product on the market at a decent price rather than having to pack all the tooling costs into one item."

According to Ernie, that ability to make variants of models is a big factor in deciding which models to produce. He said that's because tooling today costs $150,000 to $200,000 – just for small kits.

Another way the company can expand a model's marketability is to produce it in different scales. Once the master model has been produced, it's relatively easy to produce molds in different scales. That capability works out well with international marketing, since foreign and domestic consumers differ. European modelers, for example, prefer 1/72 scale aircraft, while Americans like 1/48 scale planes.

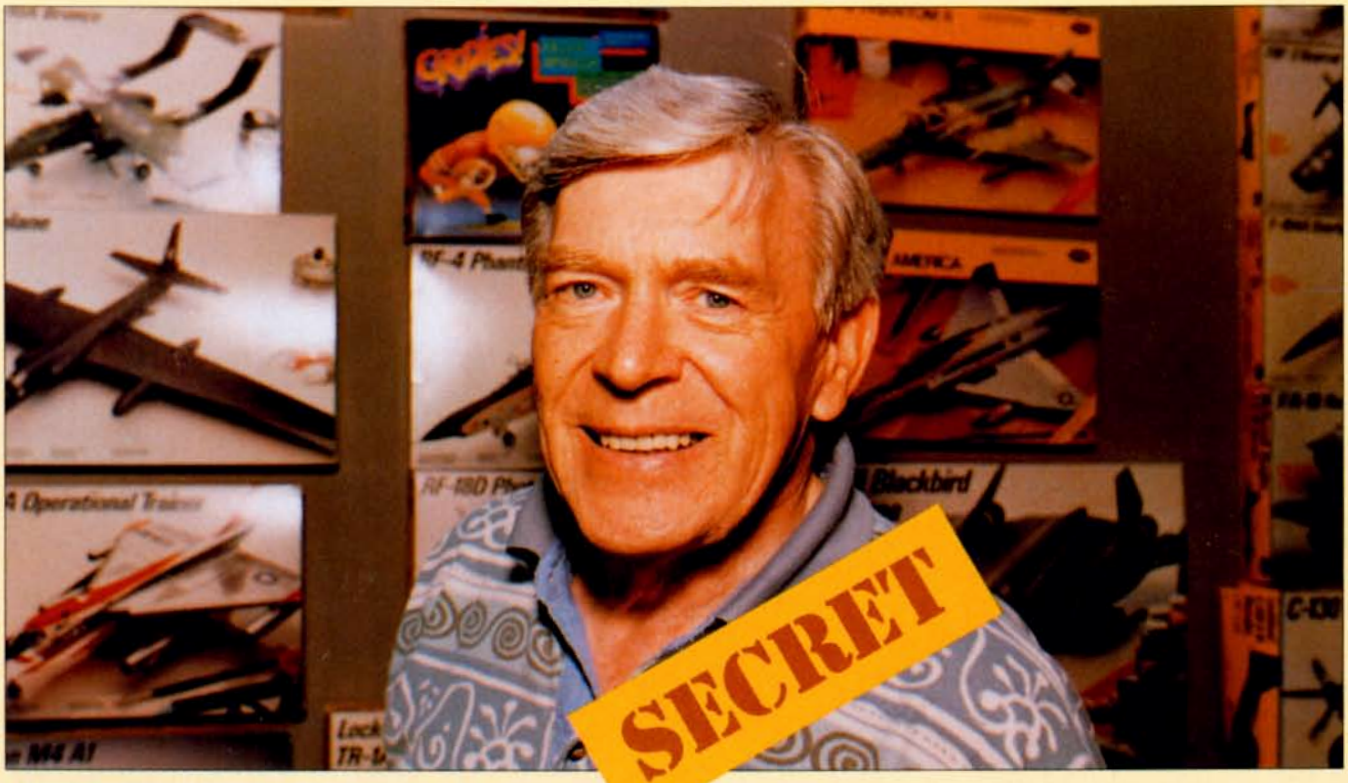
"The perfect example of that is our C-130 we did in 1/72 and it got to be a very, very good item," Ernie says, "Then we thought there was a market for it in 1/48 and that's a big hummer in that scale. And that is also very successful. Now we have three variants of the C-130 in both scales."

Can modelers influence the kits that Testor produces? "Absolutely!" says Ernie. "All they have to do is write a note. I have a little file that I keep and as we review the products to determine what we're going to do next, I pull that stuff out and take a look at it and determine how many guys are asking for particular items." Then, according to Ernie, it's a matter of running the numbers to see if it can be sold in a large enough quantity to be reasonably priced for modelers.

"I have to look at some of that stuff and determine whether it's best to let the guys that do vacuum-form kits take that kind of an item and sell it or should I do it in resin," Ernie says, "Of course, resin tools are a fraction of the cost of injection molds. So there are several directions to go."

Ernie says Testor's goal to keep the price of most models under $20 also has an impact on the choice of kits. "You have to evaluate the thing and ask yourself if it makes sense for the consumer. You have to look out for the consumer first, because if you gouge him, you're killing yourself."

Dick McNally



John Andrews and his secrets of success

Many modelers research the past, but John Andrews is one who studies the future.

John is a longtime model designer for Testor Corporation, and makes it his business to be the first to know what types of exotic futuristic aircraft are being fielded by the government. That sometimes translates into modelers being able to buy kits for aircraft they're not even supposed to know about.

John established his reputation with such offerings as his UFO (supposedly held by the U.S. government), and an SR-75 reconnaissance plane which carries a Mach 7 XR-7 "penetrator jet" on its back. Those designs, according to John, were based partly on information from people who had actually seen the machines.

The designer's most famous model, though, was the F-19 Stealth fighter released by Testor in 1986. By coincidence, Testor marketed the kit about the same time an actual stealth fighter, an F-117, crashed in California. Such an airplane had been rumored, but the accident heightened speculation because of Air Force security measures surrounding the incident.

All of a sudden, modelers and non-modelers alike were clamoring for Testor's kit. John was bombarded with requests for interviews on all three major television networks as well as scores of radio stations and newspapers. The F-19 broke all industry records for aircraft models, with 700,000 produced.

"I think the news media really did it for us," John says, "That was advertising we could not buy. I really like it when the government covers up things, and we just uncover it just a little bit."

John's model was not a true replica of the first stealth fighter, but it was close enough to capture the public's imagination. "There were senators holding up our model on television and saying they couldn't get any information on the Stealth and here we had this toy company doing these models. We just happened to be in the correct place at the right time and we had a model."

John says he knew about the stealth fighter back in 1978 – some eight years before he released his model. "I had just started my research," he says. "Little bits and pieces from the various magazines just kept building up, and then I had an airline captain who reported he saw something very strange in the sky and gave me a little sketch."

John decided to "come up with a design that would satisfy most of the criteria for a Stealth fighter. On our box we said it was (a Stealth fighter) – but we didn't say it was a scale model and used the term F-19 because that was what was being used in all the news media."

According to John, the the fabulous success of the F-19 stems from the ironic fact that the more secret an airplane is, the more the public wants to buy it. "There's a lot of 'look what I've got' because you're getting into the Walter Mitty psychology of the public. They want to know something that is secret, whether it's UFOs, Stealth fighters, or stealth bombers."

Dick McNally

Once it's cooled enough to touch, the mold releases the model and it can be pulled from the machine.

After a model is removed from the molding machine, it's ready to be bagged...

...boxed up...

...and put in its case for shipping. From Rockford, Testor ships all over the world.

from a mold once it is placed into the machine. Far from the total number of kits produced of a mold, a typical run generates about 5,000 kits. The largest run that Tom has ever seen at Testor, however, was much bigger. "We ran 60,000 of the Stealth," he recalls. "And right after that we ended up running another 60,000. That was a big seller." In fact, Testor ended up making more than 700,000 kits of the Stealth.

Once a mold has completed a run, it's stored. "We never throw a mold away unless it can't be repaired," states Tom. The old molds are then brought out when Testor decides to reissue a model. The company has more than 200 tools in storage, all waiting for their chance to be issued again.

When it comes to the molding process, Tom, who enjoys building 1/25 scale cars and trucks in his spare time, is still intrigued by it all. "I'm fascinated by how those little beads of plastic turn into the model," he says. **FSM**