The "CATALIN CORNER"

by Ed Lyon

Some people call them Bakelites, some call them Colored Bakelites, some call them Catalins, but whatever you call them, they are colorful little radios made of *cast phenolic plastics*. The Catalin Corner logo picture, at the left, shows a variety of these beautiful radios. MAARC has always published a fine newsletter, and one of the all-time favorite series of articles has been the 27-part series called “The Catalin Corner.” MAARC’s library services can supply back issues of the newsletter, called The Mid-Atlantic Antique Radio Club Newsletter until June 1994, thereafter called Radio Age. The Cumulative Index can guide you to the various issues that carried “The Catalin Corner.” This web site will also carry illustrated versions of those articles, so stay tuned.

Catalin was a trade mark name of the cast phenolic made by The Catalin Corporation. Today, the only things still made of cast phenolics are the finest billiard balls, the finest computer track-balls, ball-valves used in food-handling processes, and ball bearings for heavy tank turrets. But during the heyday of Catalin, from 1938 to 1946, everything that was more desirable in a bright, warm color was made up, even if for but a short time, in this plastic. Even the huge colorful curved illuminated panels in Rock-Ola and Wurlitzer juke boxes were made of the stuff, and there were many radio cabinets made of Catalin. The picture to the right shows a Rock-Ola "Magic-Glo" from the mid-forties.

The bright attractiveness of Catalin brought several competing brands out of the woodwork, as well. Bakelite Corporation made it, calling theirs “*Bakelite Cast Resin*,” as did Fiberloid Corporation, a company bought out, in 1939, by Monsanto, calling theirs “*Fiberlon*” and “*Opalon*,” and the little Lancaster, PA, company called Knoedler also made a version of cast phenolic, using theirs primarily for drawer handles, umbrella handles, and kitchenware. But the “Big Gun” in cast phenolics was always The Catalin Corporation, and they called their version simply “Catalin,” since they were first on the market.

But what is Catalin, anyway? And why is it so rare and so expensive? Why does a 1940 radio made of molded Bakelite cost, maybe, $20 today, while the same radio in Bakelite Cast Resin or Catalin costs 40 to 50 times as much? When you’ve seen here just how difficult it was to make radio cabinets out of Catalin, you will understand that this plastic was always expensive, and items made of it were relatively few in number, compared with molded plastics. One additional factor in today’s cost difference is the relative fragility of cast phenolics, with respect to molded phenolics. Catalin-type plastics shrink in size with time, averaging about 4% shrinkage over the first ten years of life. In a radio cabinet, if the radio's steel chassis had been bolted firmly to the Catalin cabinet bottom, the shrinkage of the cabinet and the unyielding quality of the chassis often caused a crack in the cabinet.

Part 1 - Comparing the Manufacture of Molded Phenolic with that of Cast Phenolic

To gain an understanding of the large differences in manufacturing costs involved in making radio cabinets we will compare similar cabinets made of *Bakelite phenolics*, the first one being a molded phenolic (resin plus filler) cabinet, the second made of Bakelite's brand of Catalin-type *cast phenolic.*

Molded Bakelite radio cabinet - - -

Common molded phenolics start out in a reactor vessel, a huge stainless steel or nickel-lined copper kettle with a tight-fitting lid, a steam jacket for heating it, and a cooling water jacket for cooling it. Inside are motorized stirrers for keeping the contents mixed and uniform in temperature. Phenol and formaldehyde, plus an alkali catalyst, are introduced into the reactor and the stirring begins, along with some heat from the steam jacket. Suddenly a reaction starts between the phenol and the formaldehyde, and, since the reaction is exothermic, it starts really heating up.

The temperature sensors in the kettle sense this heat formation and signal the start of cooling water flow in the water jacket, and a shut-down of the steam in its jacket. The reaction continues, and steam is produced from the heat and the water formed in the reaction. This steam is drawn off by vacuum pumps, and the reaction turns the contents into a molasses-like brown syrupy resin, which is neutralized by a strong acid, and is eventually poured out into big pans where it solidifies into brittle brownish flaky sheets of hardened resin, called novolak, very similar in appearance to peanut brittle. This resin is powdered by rolling mills and then is mixed with a filler material. If it is a batch of radio cabinets that is the ultimate product, the filler might be finely ground walnut shells, fine sawdust (wood flour), a mix of brown dyestuff and wood flour, or possibly some charcoal and wood flour. The ratio of resin powder to filler is about one to three or one to four.

Then a carefully measured quantity of this powder mixture is forced into a cavity in a heated steel mold, using a pump. The pressure required here is of the order of 10,000 pounds per square inch. The powder mixture heats and liquefies in this environment, and is forced throughout the cavity in the mold. There it hardens, after about ten (or more) seconds, into the finished product, in our case, a radio cabinet. The heating (to the melting point) of the powdered resin mix going into the mold causes an irreversible chemical reaction in the resin, first liquefying it, then hardening it, forever.

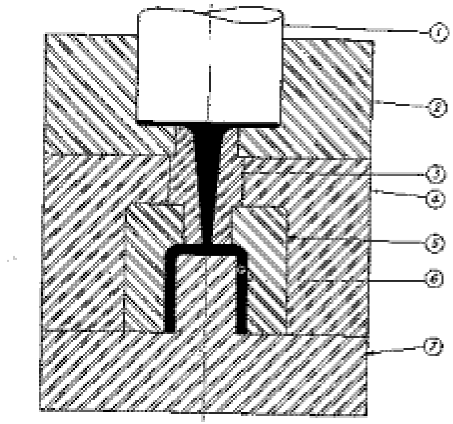
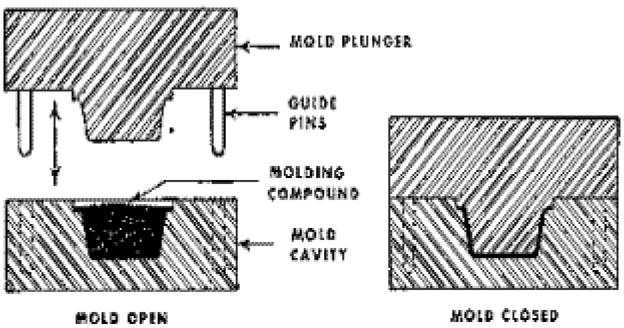


Fig. 2-11. The "integral" or "accordion" type of transfer mold.

1. Plunger
2. Loading chamber
3. Sprue
4. Cavity plate
5. Cavity
6. Molded article
7. Force



The mold is often made of heavy steel interlocking parts, so that it can be disassembled to remove the product, and yet is strong enough to withstand the molding pressure. Upon removal from the mold, the cabinet is completely finished, needing only a quick once-over to remove the paper-thin "flash," remnants of resin that have oozed into microscopic seams between parts of the steel mold.

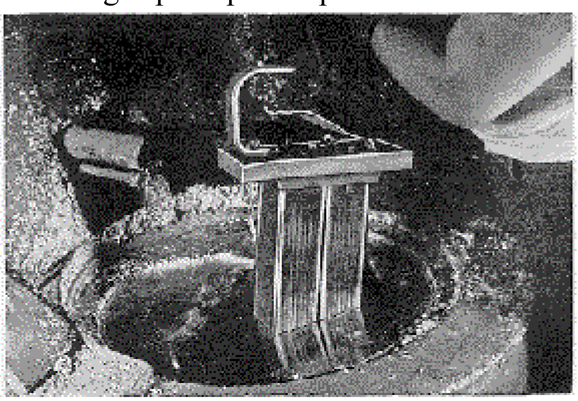
Bakelite Cast-Phenolic (Catalin-type) radio cabinet - - -

Bakelite phenolic casting resin, or Catalin, starts out as phenol, formaldehyde, and an alkali catalyst in a reactor, much like the molding phenolic above. The difference is that the water which is produced in the exothermic reaction of the phenol and formaldehyde is not drawn off, and the alkali catalyst is neutralized very carefully, not by a strong acid, but by lactic acid (yes, the kind that is in buttermilk), The result is a syrupy almost transparent resin which stays liquified. It is dyed the desired color and poured directly into a casting mold, made of lead. If a mottled or swirled color style is wanted, a little of a different batch of resin, colored white, for instance, is swirled into the mold by a worker, using a glass stirring rod. But we should say a word or two about the lead mold, before continuing.

The lead mold is a story unto itself. We begin with a solid steel replica of the radio cabinet machined out of a solid steel billet, the replica being called an arbor. The front of the cabinet replica is extended and thickened, forming a heavy steel plate, with the cabinet-like sides and rear opening sticking out of it. One of these arbors is shown on the right. It happens to be the arbor for the Emerson AU-190 radio. While the arbors are designed by and for the phenolic company, such as The Catalin Corporation, they are paid for by the radio company, in this case, Emerson. Thus the radio company controls the use of the arbor, preventing The Catalin Corporation from selling identical cabinets to other manufacturers.

(We will see, later, how this prohibition was overcome from time to time.)

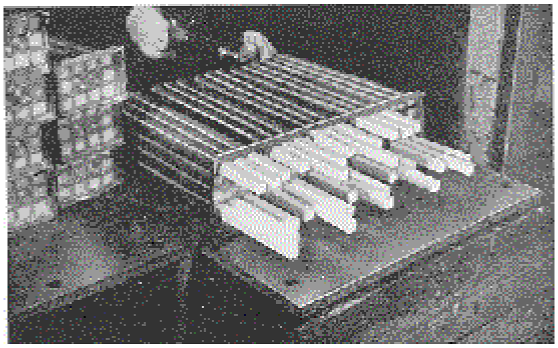
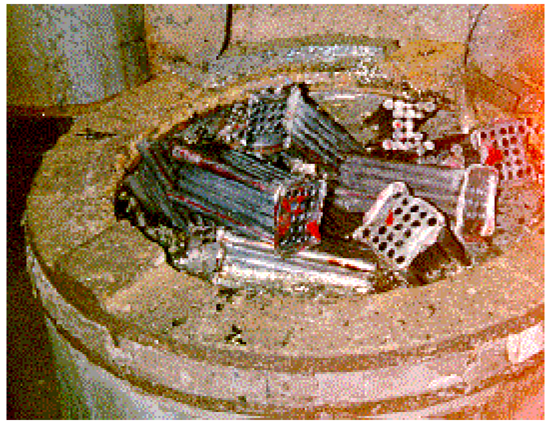
The arbor is highly polished (not rusty like the one in the figure), with a large handle on its topside, which is the flat plate forming the “front” of the radio cabinet. It weighs perhaps 80 pounds, so it is lifted, using its handle, by a hoist system, using chains or cables. It is swung over a heated vat filled with melted lead, and suddenly dunked into the vat and quickly withdrawn. A coating of lead freezes in place on the arbor, which, with the lead coat, now weighs perhaps 130 pounds.



An example of an arbor being lead-dipped can be seen at the left, the picture taken from a pre-war text on plastics. The lead-clad arbor is then slammed downward between two anvils which catch the outboard portions of the extended plate forming the radio front. The lead coating slides off the arbor, and is caught in a padded base between the anvils, so that it is not damaged. Now, the lead has a cavity in it, exactly the shape and size of a radio cabinet.

We noted above that the liquid resin is poured into the lead mold, sometimes with a dollop of another, differing-color, resin swirled into the mold crevices as well, to add a mottling color to the end product. A quantity of filled lead molds is lined up in rows on a steel pallet and the whole is wheeled into a huge oven, as shown at the right. Carefully temperature-controlled at 176° F., the oven cures the phenolic resin in the molds over the next three to eight days, depending on the color of the resin mix. Darker colors, like blue and red, cure in three to four days, while whites require six or eight days. At the end of the cure cycle, the pallet is wheeled out and allowed to cool sufficiently for handling.

Each lead mold is flipped on its side and air hammers are used to tap the radio cabinet out of the lead mold, by hammering on the edges of the cabinet, directly through the soft lead. Usually, the cabinet comes out of the mold unscathed; sometimes it is broken up in the process. The picture (below, left) shows the typical Catalin pieces (square rods) being hammered out of their lead mold. The lead mold is always damaged in the process, and is tossed into the molten lead vat for re-use. The picture (below, right) shows a typical firebrick-clad lead pot, filled with used lead molds, ready for re-melting and re-use. The molds had been used in a production of Catalin rod stock.

The cabinet, though, is far from completed, at this point. The next step is what made these radio cabinets fairly expensive in 1939, and prohibitively expensive today. The front of the cabinet is then machined, in a plastics machine shop, using lathes, milling machines, grinders, sanding belts, and polishing wheels, until the whole thing is shaped right and gleams with a soft luster. The Plastic Turning Company in Leominster, Massachusetts, was the largest such finishing plant for cast phenolic radio cabinets, working on all the radios made by The Catalin Corporation, and most of those made by Fiberloid (Monsanto) and Marblette. The Emerson AU-190 cabinet we have been using as an example in this story started out being made by Fiberloid Corporation in 1938, but upon Fiberloid's take-over by Monsanto in 1939, the arbors were ordered by Emerson to be taken to Marblette Corporation, who made all the later cabinets. Finish work was done at Plastic Turning Company.

Part 2 - Differences in the End Product – Molded vs. Cast Phenolics

So we have seen the differences in manufacture, between molded and cast phenolic radio cabinets. Let's see how the end products differ. The *molded phenolic* cabinet must be of a dark color, because the resin (novolak) which it starts with is brown. Any filler material might lighten the color a little, maybe to a tan or yellow-brown, but usually two powdered resin mixes are used, one dark and one lighter, to produce a swirled "walnut" color in the cabinet. Some radio cabinets were painted after the molding was completed, using a baked-on automotive enamel (remember that the molding process transforms the resin into a permanently-solidified plastic which cannot melt under heat, so that baking enamels are well tolerated by the cabinet). The cabinet finish is smooth and polished, owing to the fine finish on the steel mold parts. The cabinet thickness, it will be noticed, is uniform, and thin. It must be uniform in order to get a simultaneous chemical cure throughout the cabinet (otherwise there may be undercured [gummy] areas where the cabinet is thicker, or overcured [cooked or charred] areas where it is thinner than usual).

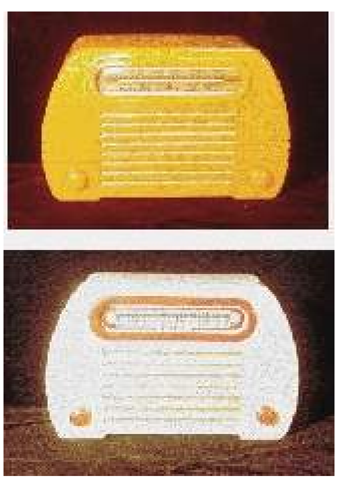
The *Catalin* cabinet stands out because of its color, its thickness, and its polished "feel." It is usually brightly colored, a feat made possible by the relative transparency of the basic phenolic casting resin. This resin characteristic, along with the fact that no added fillers are used, makes the cabinet appear translucent, as well as brightly colored. The lack of fillers makes cast phenolics somewhat less strong than molded phenolics, so that the Catalin cabinet will be made with thicker walls than its molded cousin. The fact that the cabinet is cured over a four- to six-day period means that the thickness can be left to vary throughout the cabinet, according to what the designer wanted, unlike the constant wall thickness requirement imposed on molded phenolic cabinets.

After fifty years of storage, packing, unpacking, and handling, the kind of treatment expected of all household good, let's again compare the two radio cabinets. The *molded phenolic* cabinet, let's say in mottled walnut color, might be dirty and a little bit dull in finish, but is probably intact, with no chips, cracks, or warping of the cabinet. After a good cleaning, maybe using GoJo and a million paper towels, followed by polishing, using a wax-based fine rouge polish and a million rags, it will look like brand-new. If only the dial lens, knobs, and chassis could be made to look this nice!

The *Catalin* cabinet, being less tough (the only reinforcing filler in the cast resin is the water retained in its manufacture – and this water is in the form of microscopic droplets having some strength, but not a lot) because of the lack of fibrous fillers found in the molded phenolic, might be cracked or chipped. If the radio chassis had been tightly bolted to the cabinet bottom, the cabinet is very likely to be cracked now, fifty years later, just because the cast phenolic is certain to shrink, and the chassis is certain not to. Result: cracked cabinet bottom. Maybe the cabinet is made of two pieces of Catalin – a basic cabinet and a bezel or dial surround fitted into a hole in the cabinet front – and maybe they are of different colors – and just maybe the two Catalin pieces did not both shrink exactly the same amount over the next fifty years. Result: either the cabinet became cracked, or the inserted bezel fell out and became lost.

This very basic difference in viability is another reason the Catalin cabinets are more expensive today. This problem is aggravated by the fact that there really is no effective cement for cast phenolic plastics – except the phenolic casting resin itself.

Part 3 - *Colors !*



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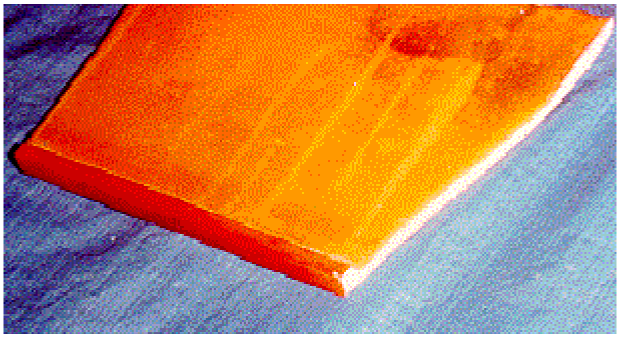
Above: "As-found"

Below: Restored

You're probably wondering, "What's with the Catalin colors? Why are so many things 'butterscotch' or 'pumpkin?'" *Ultraviolet light*, that's what. All those radios and knife handles you see in 'butterscotch' color these days started their lives as white plastic. In many cases it wasn't plain white, but heavily marbleized white, having streaks of transparent swirled throughout. But the phenolic resin itself is chemically converted to phenyl alcohol through the action of ultraviolet (UV) light – and phenyl alcohol is brownish in color. That's the bad news. The good news is that phenyl alcohol is an excellent UV block, so that its presence on the plastic surface prevents the UV light from penetrating into the Catalin cabinet walls; thus the yellowing effect is only skin deep. This yellowing effect turns the whites (Catalin Corp. called their white phenolic 'alabaster') into dull yellow, or butterscotch. It turns bright blue (Catalin called their blue 'lapis lazuli') into a dull olive drab. What was originally green onyx is now deep butterscotch, and that brilliant red marble is now brown. All it takes to restore a cabinet to its original color scheme is very fine and careful abrasion with a wet (250-400-grit) abrasive paper, followed by restoration of the polished finish, through buffing with rouge and wax. One of the Catalin Corner articles in Radio Age detailed the method of color restoration.



A freshly-broken piece of 50-year-old Catalin, butterscotch on the outside, white inside.

The original makers of Catalin-type cast phenolics knew something about colors – which ones were more or less permanent, and which were so temporary that they didn't survive the oven cure of the plastic. Some green dyes, especially, were apt to fade over the years, so that by now they are nearly transparent. It might be the highest irony that with all the yellow Catalin radios we now have, there were no radios made originally in yellow, with the sole exception of a gold Tom Thumb model made in 1938.

This has been a summary story of Catalin-type plastic radios – the details will be here at this web site over the next several years. They can also be seen in back issues of Radio Age and its predecessor, the MAARC Newsletter.