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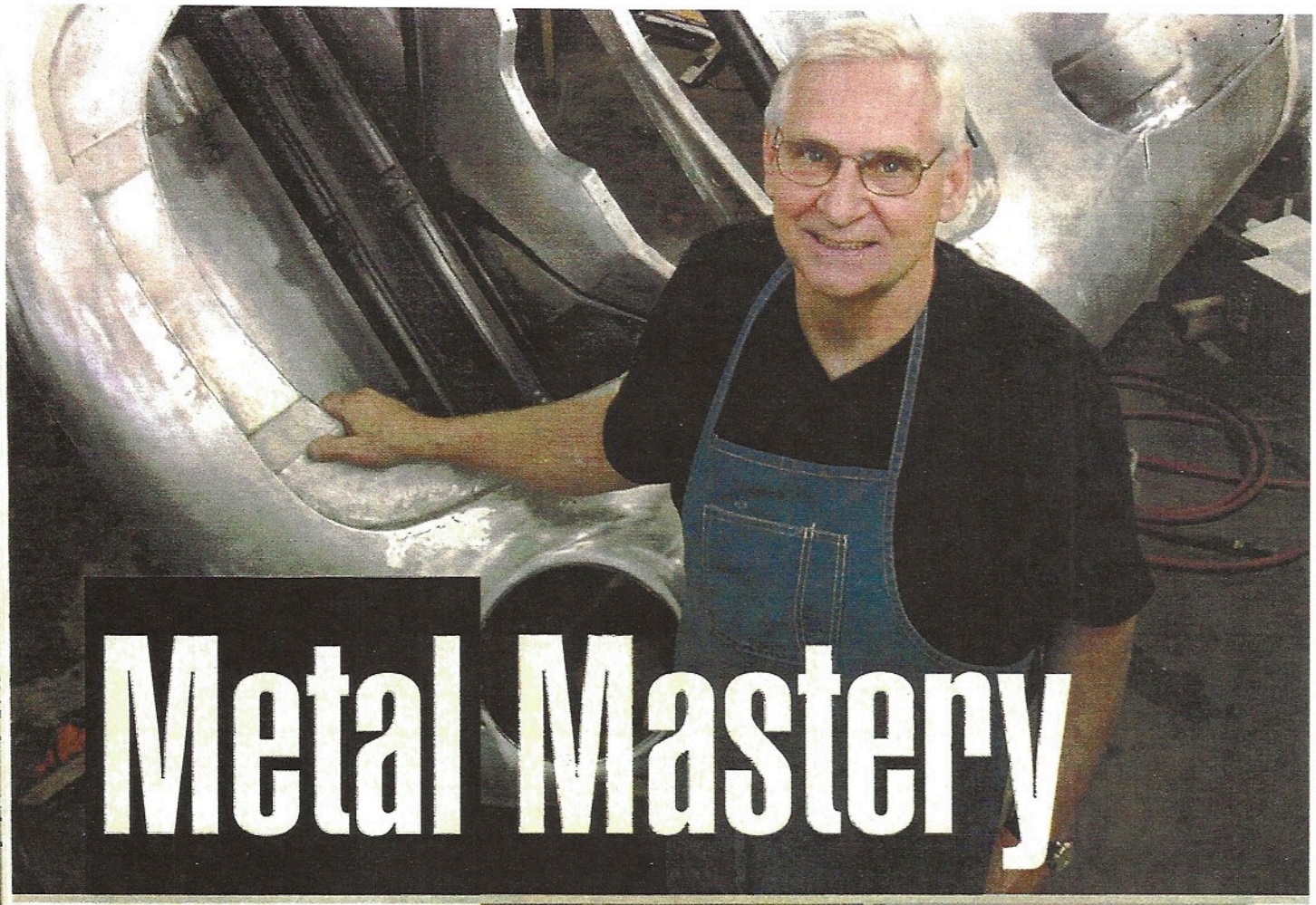


Metal Mastery

USING MOLDS TO CLONE RARE PARTS

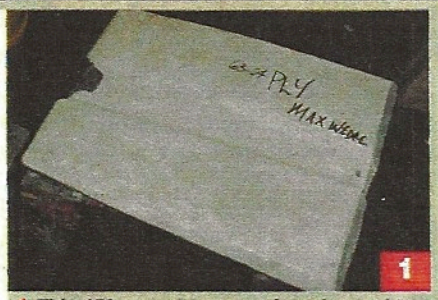
BY STEVE MAGNANTE

Photography: Steve Magnante

You hear lots of wild stories at car shows. Some are even true. One tale that really got our attention involved a shop that's cranking out brand-new aluminum '63 Pontiac Super Duty fenders, '62 Z11 Impala hoods, '63 Galaxie lightweight bumpers, '64-'65 Race Hemi hood scoops, and a dazzling assortment of other exotic goodies. It had to be a joke—this stuff is the rarest of the rare. But it's true. The shop is Wayne Williams Metal Shaping, and his hand-formed reproductions are as close as you can get to original without investing millions on dies and massive stamping equipment.

Wayne opened his first body shop in 1958 back in his home state of Illinois. He specialized in custom bodywork and was the man to see for a shave, chop, channel, or french. Since then, he's perfected a way of duplicating metal stampings with the use of a mold. It goes like this. Say a customer wants an aluminum door for his '64 Race Hemi. He brings a standard steel door to Wayne Williams, and the door is painstakingly disassembled. Welds are drilled, cut, or ground, then a female mold is made from each individual stamping. The female molds are coated with adhesive-backed wax equal to the thickness of the final aluminum part, and special cement is poured into the mold. What results is a male replica that is then used as a hammer form, or buck, upon which an aluminum sheet is clamped and the tedious panel-beating begins. Upon completion, the new hand-formed aluminum panels are welded together, and presto, you've got a door.

Without Wayne's ingenious technique of pulling a mold from the original part, the finished product would be an interpretation of the original, not a duplicate. There's a big difference. Sure, there's still plenty of highly skilled handforming with specialized hammers, but the mold simplifies the process and ensures a perfect replica with all of the original contours, wrinkles, and dimensions. While the demonstrations shown here are specific to the realm of high-dollar factory Super Stock restorations, the technique applies equally to street rod, drag race, or custom machinery. Check it out and let your mind ponder the possibilities. If you want to know more, Wayne will soon be offering a how-to videotape that goes into further detail.



1

2

1 This 150-pound hammer form is used to make aluminum Chrysler Max Wedge hood scoops. It is made from UltraCal 30, a high-density gypsum-based cement that doesn't shrink as it dries. 2 Hiding beneath the cement is a sheet of 5/16-inch-thick steel plate gently bent to duplicate the contour of the hood. Wayne's finger points to the exposed steel around the edge that creates a factory-correct 90-degree roll-under flange on the finished scoop. Because the metal replica is only as good as the hammer form, most hammer forms require a steel substrate to add strength, increase life, and prevent chipped corners.

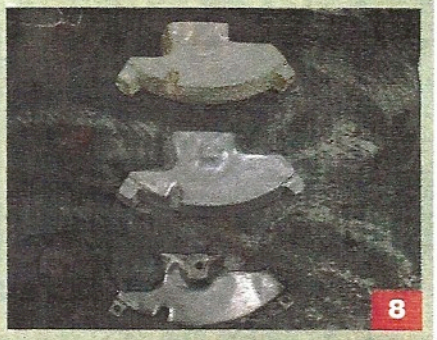
3 Freeman adhesive coated sheet wax is applied to the female mold that makes the hammer form. It compensates for the thickness of the metal. Without it, the hammer form and every part it makes would be 0.050 inch too large.

4 When it comes to panel forming, there's no substitute for experience... and the right tools. The size, weight, and hardness of the hammer face determine how the force of a blow is transferred to the metal. Though Wayne has more than 100 different hammers, these are the basics for aluminum work (from L to R): the large and small leather hammers absorb the force of blows and are used on curved radiuses where a gentle touch is needed; the large and small black plastic dead-blow hammers provide minimal damping and are used to flow long contours; the wood-face hickory hammer is harder, and the increased force is good for concentrated shrinking; the teardrop-shaped Delrin plastic hammer is very effective at transferring force and is used for making radiuses (small end) and helmet-sized shapes like headlight buckets (large end).

5 The aluminum sheet (*not shown*) must be clamped to the hammer form to keep it from sliding around during the forming process. This is another reason the steel sheet backing is necessary. Without it, the clamps would quickly destroy the unprotected cement. Soft, ¾-inch-thick pine planks easily conform when clamped. Wayne begins with a sheet of aluminum that covers the entire form plus an extra inch of overlap to allow tidy trimming. He works from the center outward.

6 Metal forming is essentially a series of coordinated shrinking and stretching operations. Instead of direct blows that compress and deform metal upon impact, use glancing blows that skid across the metal. As the aluminum bends and conforms, it work-hardens and gains strength.

7 When it comes to stamped-steel parts, Wayne devised a similar method but hit a few dead ends along the way. The metal part in this photo is a rare brake backing plate vent cover from a '62-'63 Z11 Chevy. These things don't grow on trees. To make a copy, Wayne tried hammering sheetmetal over a hand-carved wood pattern (*shown*), but it proved to be too soft and quickly deformed under the hard hammer blows required to shape steel.



8 The solution was yet another mold. This time an original metal part was used to make a female mold impression. Then a male pattern was made from UltraCal 30 gypsum cement (*top*). Wayne took the cement pattern, coated it with shellac, and brought it to a local aluminum foundry. By pressing the pattern into foundry sand, female molds were made and filled with molten aluminum that hardened into a durable, reusable hammer form (*middle*).

9 Steel isn't as flexible as aluminum, so the forming process must involve fewer bending operations to avoid fracture. Specialized hammers are required. From L to R: the Delrin hammer is used for roughing the steel over the form without causing compression blemishes; the leather hammer is used for shrinking bulges and restoring flatness; the trio of steel pick hammers is used to form intricate contours and deep recesses.

10 Here Wayne uses a pick hammer to apply the finishing touches. Steel requires a more gradual process than aluminum.

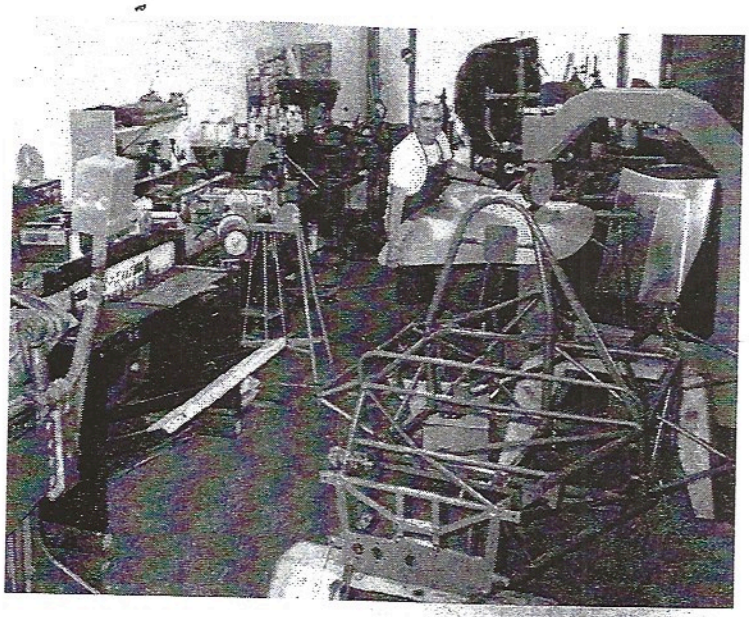
11 This male pattern taken from a steel '63 Chevy front bumper is made of gypsum cement and steel and allows Wayne to periodically check the accuracy of an aluminum replica during construction. It simply slips into the back of the new part and calls immediate attention to unwanted irregularities so they can be corrected. **HR**

Source

Wayne Williams Metal Shaping
Orange, CA; 714/538-1933

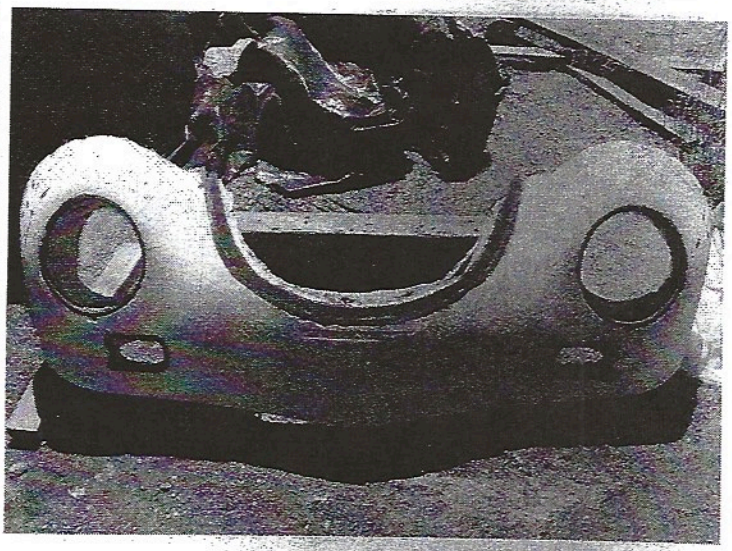
Gypsum Hammerforms

(Top right) In 2007 I visited and interviewed the legendary Wayne Williams at his facility in Coleville, California. As this book goes to print, Wayne is celebrating 60 years as a sheet metal shaper, having starting at age 12. My earliest communication with Wayne was at his City of Orange, California shop, seen in the first photo.



Wayne's shop is one of few places, if not the only place in the USA to obtain large, crisp Detroit-style automobile body sheet metal replication in aluminum. Aluminum has had an on-again off-again relationship with USA car companies over the years. In the 60's there were certain Detroit cars built as full race vehicles with aluminum body panels. Because those bodies were factory, their press tooling was used to generate the alloy panels, sometimes in numbers as few as 12.

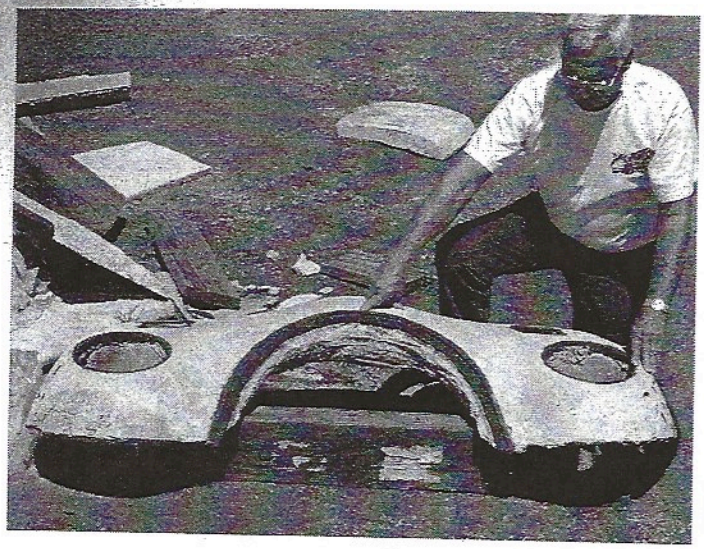
Time marches on and an idea that sounded great to auto executives in the 60's eventually created an unforeseen need. Those alloy panels, once produced on factory tooling, were no longer available. The type of shaping needed required exact tooling, and none was available. As a result, Wayne has been about the only source for these aluminum replacement panels available. The large Detroit press dies were long gone, so how did he perform the work? Wayne made his own full-sized dies from Gypsum.

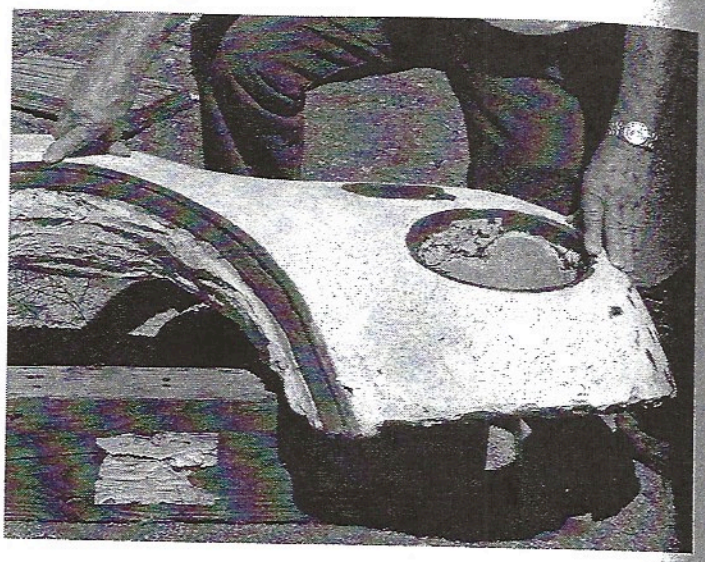


(Bottom left) Wayne standing next to his signature wheeling machine developed for these big panels. It was featured in our Book #2. Build plans are available. Note the two finished customer fenders for a 1962 vintage factory Z11 Impala. (Bottom right) Wayne's Porsche 356 Gypsum hammerform.

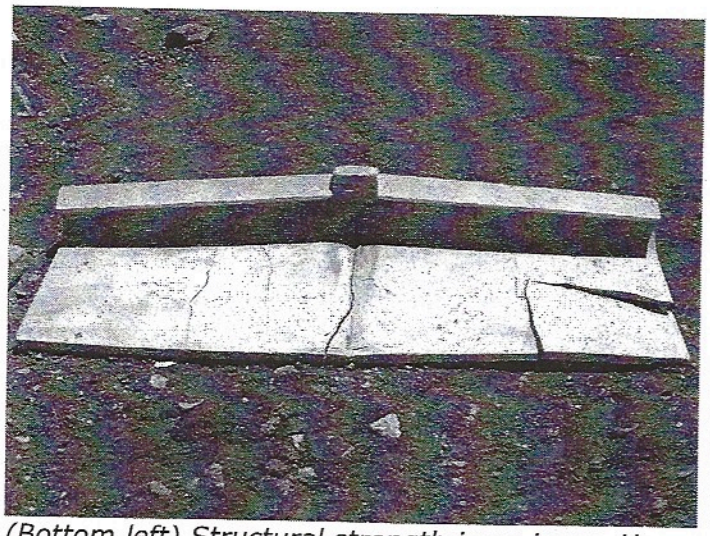
As an aside, Italian coachbuilders have used Gypsum rather than styling clay to produce their styling models for cars like the Fiat 124. For years I have tried to hunt for the tools used by the Italians for sculpting their full car bodies in Gypsum, but to no avail. The great styling house Ital Design also uses a powder substance to be mixed with water called EPOWOOD. It is nicknamed *"Magic Mud"*, and it forms into a hardened substance that can be worked like wood, but features a paintable surface. I've also had equally bad progress in tracing down the GREEN STYLING CLAY sculpting tools that are unique to Japan. I am told they look like small wood planes that can be held in your hands. Any help out there?

Back to Gypsum hammerforms. Wayne Williams does make those huge body panels by hand, but to hold to a tight tolerance fit as used by Detroit in those years, he must build his body panels over his own tooling. The difference is countless hammer blows over one die versus one pressing between two dies. What should we know about using Gypsum as a construction media for hammerforms? Probably the most important thing is to plan around strength issues in two separate areas.





(Top left & right) Surface strength is an issue when there is an edge that metal must fold over. Wayne, constructing this hammerform to generate a limited production run backs-up these areas with 5/16" thick steel edges, which prevent chipping. In the two images above, there was a double-fold-over using sheet steel, which required reinforcement. With aluminum you can sometimes use raw Gypsum edges.



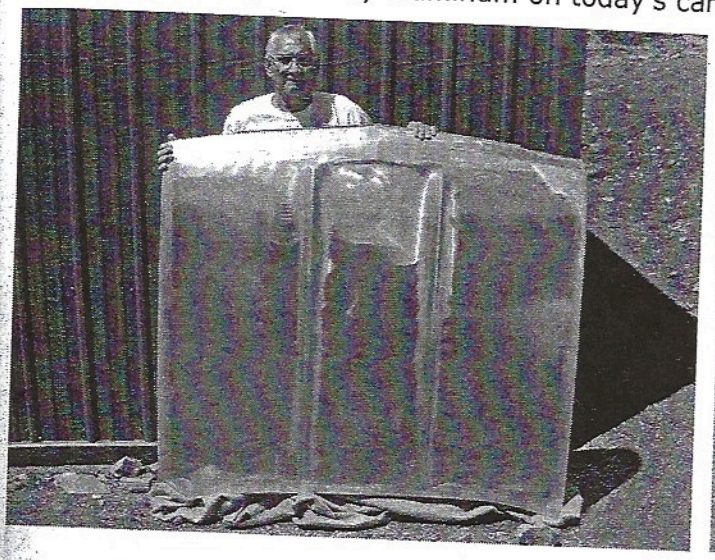
(Bottom left) Structural strength is an issue. Unsupported Gypsum is vulnerable to dropping, as well as to hard hammer blows. (Bottom right) This is the backside of the Gypsum Porsche 356 nose section. You will note that a standard rebar rod is exposed in one spot. Rebar is made specifically for implanting within concrete and cement to prevent the kind of breakage seen in the left photo. Depending upon production volume and part size, you may want to run formed, shaped, interlaced and spot-welded rebar as an internal structure. Whether you are pouring a mold or hammerform, the size of the hammerform, the lower production volume needed, and the softer the metal are factors that will allow for various strengthening choices.

Next, Wayne will show us a few secrets about building muscle car hoods with Gypsum. He has chosen two separate hood hammerforms as examples of some of the options. Whenever Wayne gets an order to construct aluminum replacement panels, he will first start by analyzing what type of Gypsum, wood, and in some cases metal hammerforms will be needed. Some of the more intricate hammerforms will

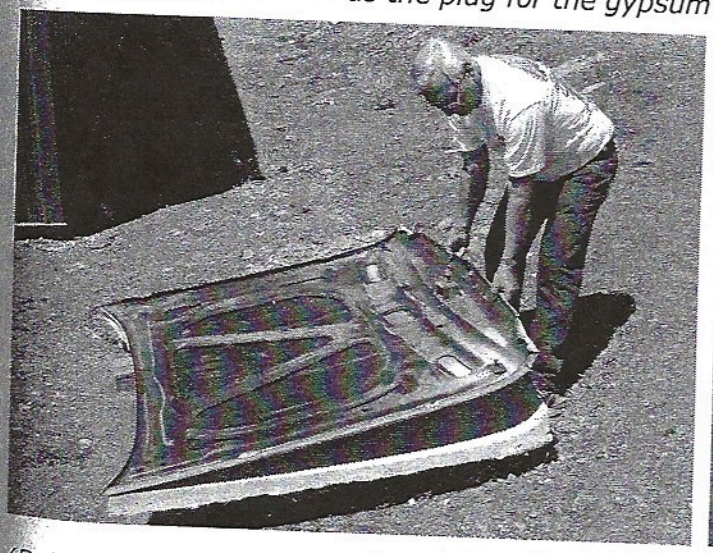
require assembly in sections so that they can be disassembled to remove the hammerform from the final panel - because the metal wraps around the hammerform.

For our first example, let's use a 1962 Chevy Z11 hood panel. In this case Wayne located a flawless steel hood from a '62 Impala as a plug. Wayne cautions to hold the dam for the pour VERY TIGHT to the hood, so the crisp new seams match the car properly. No large tolerances here!

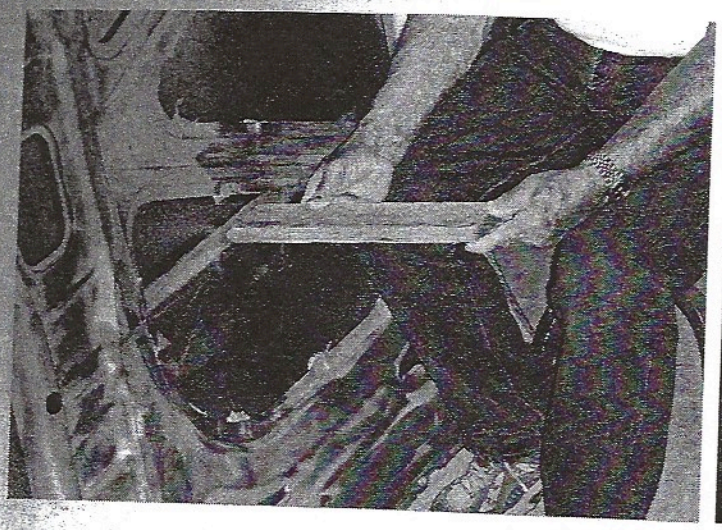
A HINT TO THE WISE: In this age in which the Japanese cars are becoming more dominant in racing, weight has become far more of an issue than it was in the 60's when Detroit was trimming the weight on 60's steel-based cars like the Impala Z11. Think what would be gained by having fenders, full doors and the hoods replaced by aluminum on today's cars! Wayne can do the job without big press dies!

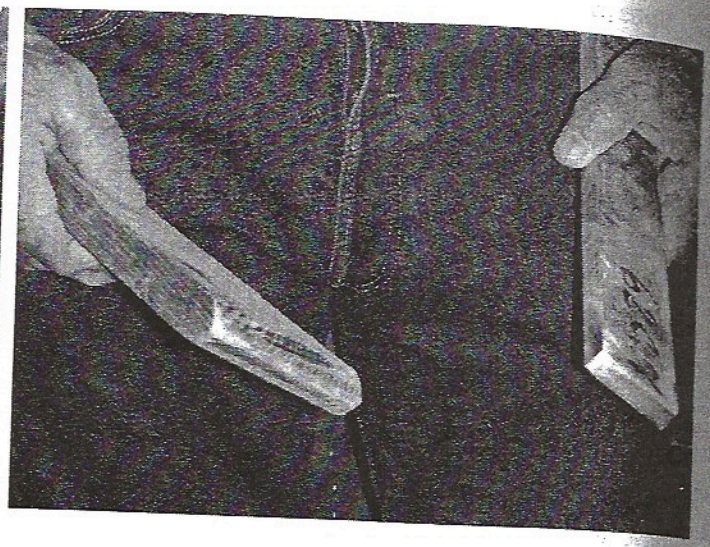


(Top left) The workmanship on this 1962 Chevy Impala Z11 aluminum hood is amazing! To hold all of those sharp factory lines in proper proportion requires a large tool as a hammer guide.
(Top right) In this view, Wayne is demonstrating the Gypsum hammerform construction. A stock steel '62 Impala hood is used as the plug for the gypsum pour.



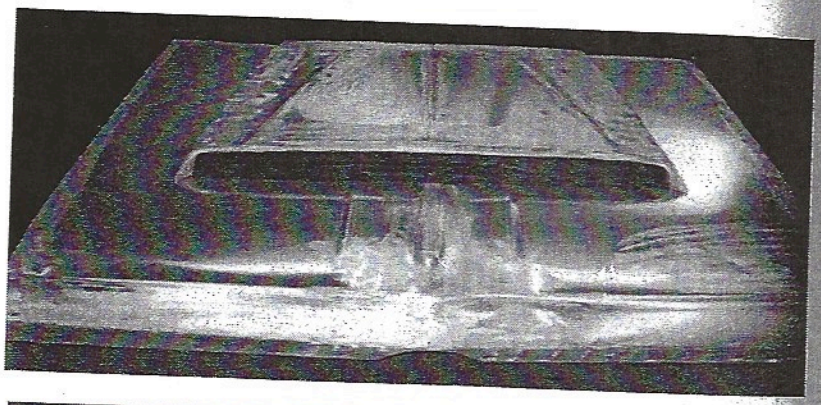
(Bottom left) The combined pour of this hood hammerform is 5" to 6" thick. About 1-1/2" to 2" of the thickness is Gypsum. Hemp is purchased at your local home builder's superstore, is mixed with Gypsum for strength. Then steel rebar is laid in place. Follow the Gypsum with regular mixed concrete from your home-builder's superstore, adding several more inches of thickness. The use of concrete saves cost.
(Bottom right) The female hammerform after the steel hood has been removed. Gypsum will capture the exact factory surface of the hood as seen in the upper section of the photo. On some jobs a pour will involved a female mold used to pour a matching male hammerform of Gypsum. In that case a thin sheet of Freeman wax is applied to female surface to represent the thickness of the aluminum.



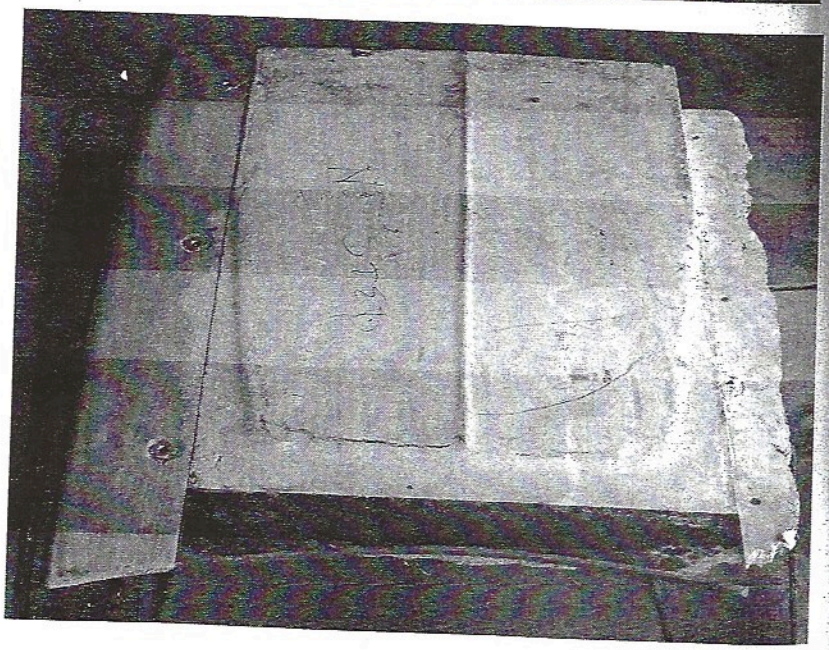


(Top left) Wayne uses drivers made from a number of materials. In this view a piece of wood is shown as it was used to qualify the crease down the Impala hood.

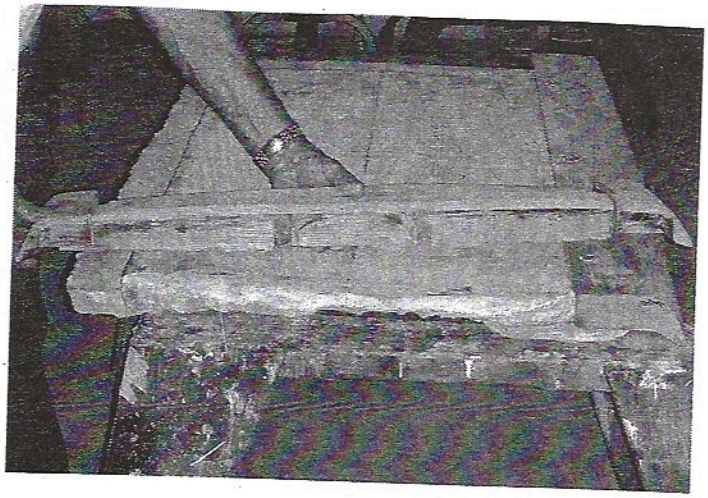
(Top right) The business end of that same piece of wood, and a stick of aluminum used in other areas. One great tip for finding wood is to break apart shipping pallets. They are plentiful, cheap, are made of very hard wood, and pallet wood fits the hand quite well.



(Center right) You are looking at a reproduced aluminum Chrysler Max Wedge hood with scoop. Would this hood look great above the new big block HEMI crate engine? This would be impossible to make without a hammerform.



(Bottom right) This hammerform tool is by requirement multi-segmented. Here is a view of the rear section. The scoop itself presents a number of challenges, but it must blend into a lightly crowned base. Finally, the edges must all roll at the factory required 90 degrees. To accomplish this, the two sides are a blending of wood plus either Gypsum or Bondo. The rear section facing the windshield is a steel plate. All of these segments unbolt in sections for removal after all of the sheet metal has been formed around the hammerform.

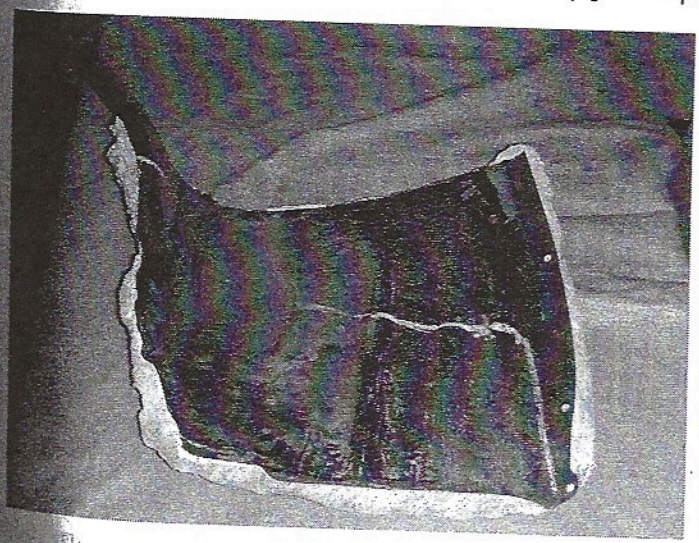


(Top left & right) The scoop opening features the leading edge turning 180° inward. You can see that this wood & Gypsum section of the die is segmented. How the hammerform is removed afterward will be based on the builder's strategy. The sheet metal in this example was completed in one piece, and the front segment of the hammerform was removable for clearance due to the wrap. Segmented hammerform dies are always an option.

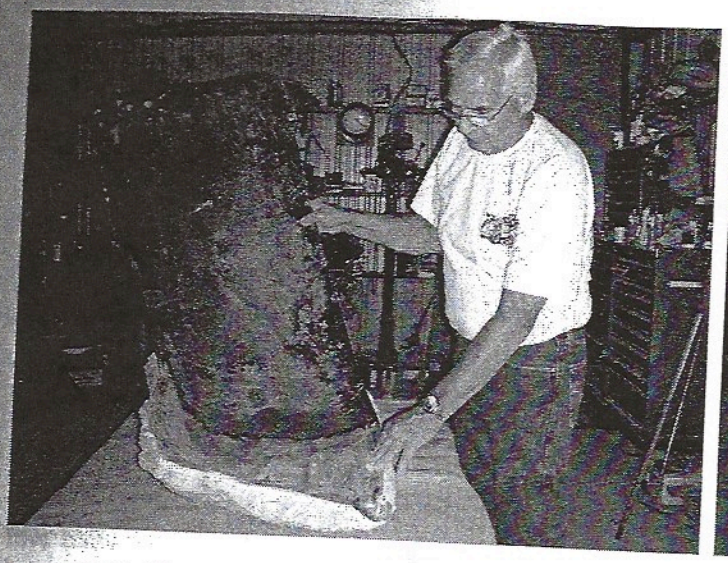
Please check out the chapter on Caulking, as the technique for working metal from the center-out is explained, and it applies here as well. To hold down the sheet metal to the hammerform, Wayne uses 3/4" thick pine wood over the metal. Pine wood under the c-clamp is soft enough to conform to mild curvature, yet will apply enough pressure from the C-clamps to hold sheetmetal in place without any movement.

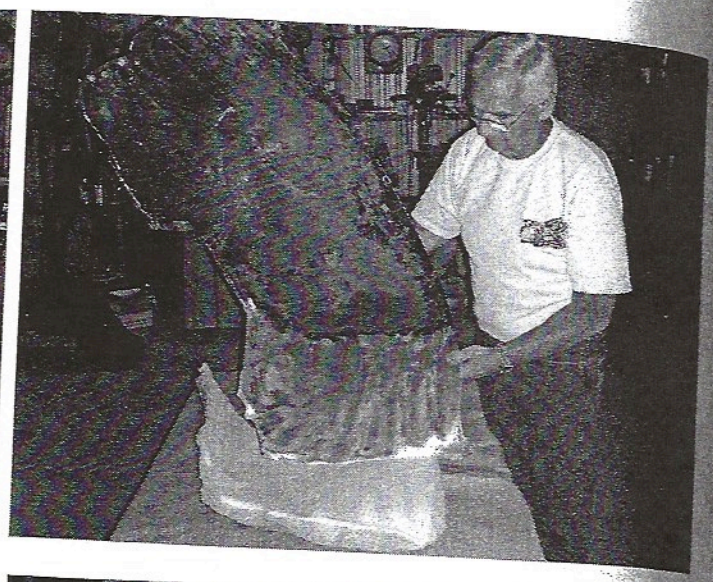
Repairing Aluminum Sections Using Gypsum Hammerforms

The following photos involve repairing with aluminum patch panels made in Gypsum hammerforms. The aluminum-bodied 1962 Chevy Impala Z11's experienced a time in their life history in which they were used at drag strips. It was not uncommon to cut our a section of the front wheel houses for a header exit; many did. When doing proper restorations it was not necessary for Wayne to replace the complete wheelhouses. The job could be resolved by just replacing the damaged sections.



(Bottom left) The best strategy involved Wayne buying a pair of pristine steel wheelhouses from a wrecking yard, sections from which were cut away to make Gypsum hammerforms. The white cut line shows how much new aluminum is needed.
(Bottom right) The Gypsum hammerform will serve two purposes. First, the new aluminum section will be shaped over the hammerform. Second, the Gypsum form exactly registration of the usable section of the old aluminum wheelhouse with the newly-shaped aluminum panel section.



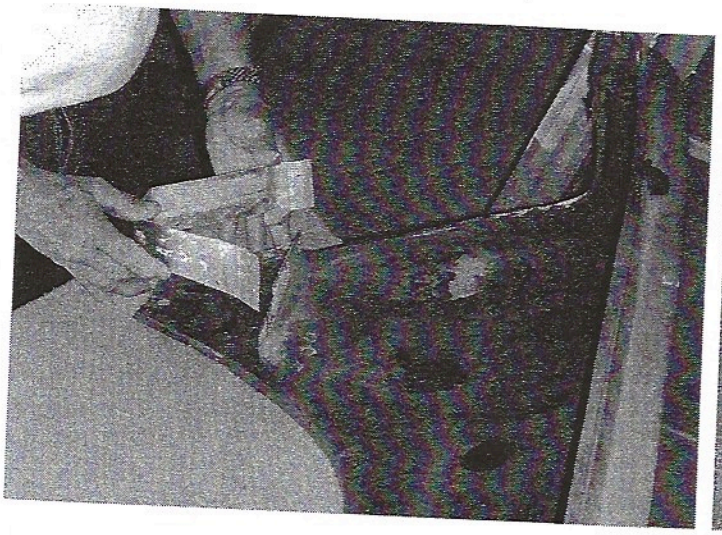


(Top left) The new aluminum section has been aligned with the good portion of the original aluminum wheelhouse. They have been trimmed, welded, and dressed down.

(Top right) After test fitting the complete finished panel in the form, it is removed to be shipped back to the car's owner.

(Center right) A rear view gives another visual on the completed panel after shaping and joining.

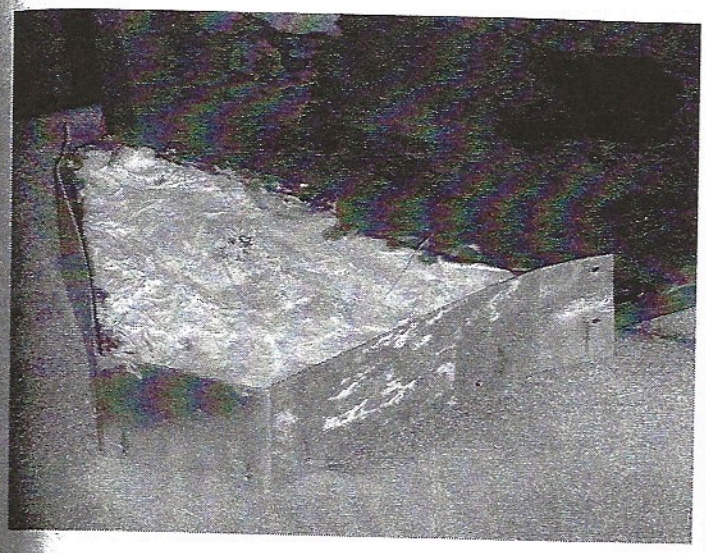
Gypsum HammerForms For Aluminum Dies



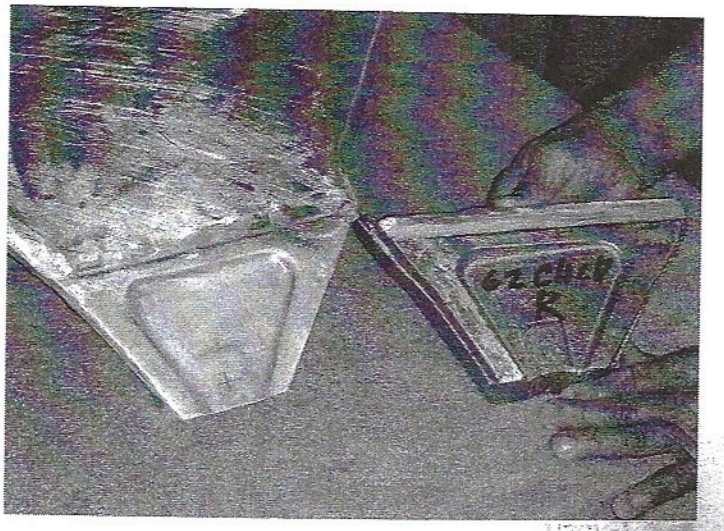
(Bottom left) The Z11 aluminum-bodied drag racing Impalas destroyed a small front fender section that fit inside the bumper area. They were removed for appearance at the same time that the front bumpers were removed. This exercise to make a new set of sections will involve either hand-carved wood hammerforms, or two cast Gypsum hammerforms from a virgin steel fender first.

(Bottom right) After a useable steel front fender is sourced, a dam area must be built around the section to make a hammerform of Gypsum that is thick enough to pound. The dam must be a very tight fit to the fender.

Wayne felt that he had enough orders for these pieces to justify a more permanent tool. The decision was made to cast an aluminum tool. In this case it involved pulling a Gypsum mold casting from a hand-carved exact wooden piece that was made to the actual outer size as well as the desired tool thickness. After pulling the Gypsum mold from the wood, Freemans wax sheet was applied to the inside of the mold to represent the thickness of the aluminum. Then a Gypsum plug was pulled from the mold that reduced the surface size of the aluminum tool to compensate for the thickness of the aluminum. The part was sent to an aluminum foundry for duplication.



(Top left) A bit of Freeman's Wax sheet is used to represent the thickness variation between steel and aluminum. (Hammering sharp edges is easier with aluminum hammerform dies).
(Top right) With the dam removed the Gypsum hammerform is ready to remove, clean and use.



(Left center) A view of the steel fender that was duplicated, the carved wood master, and a Gypsum plug with a bit of wax sheet still on the surface.
(Right center) After receiving the cast aluminum hammerform tool, an aluminum part is finished, and is welded to the customer's aluminum fender.

Making Porsche Air Ducts

Wayne Williams spoke of an early Gypsum job involving a Porsche Carrera. It needed two large, shaped air ducts built. After making the two pattern pieces of wood by hand, he made the forms of Gypsum. This was an eye-opening experience for Wayne. The two wooden plugs took *about 8 long hard hours* of

sculpting the plugs from wood and Bondo. Afterward he made the two Gypsum hammerforms in "minutes!"

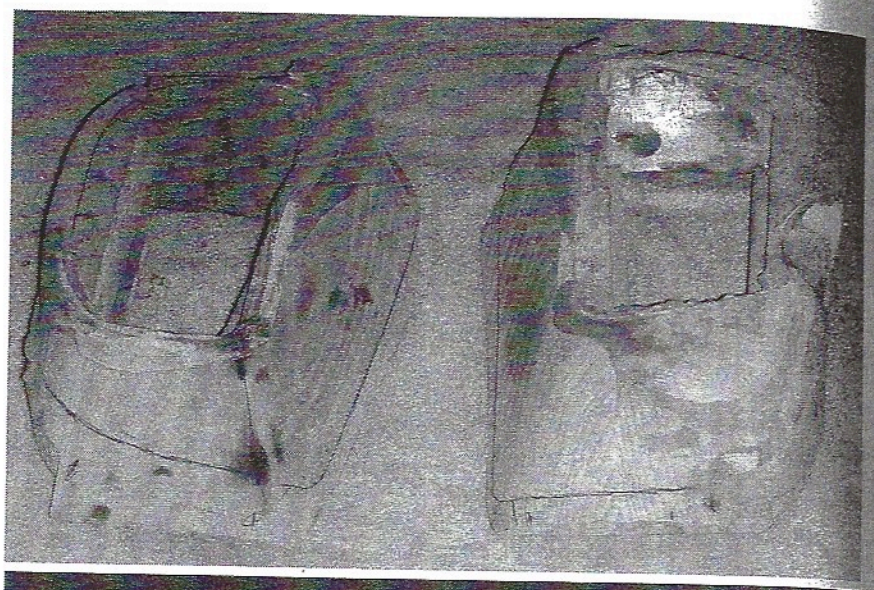
This was Wayne's introduction to a new world. Not only was the structure built quickly, but exacting surface details were captured effortlessly. His system captures a level of surface accuracy for low-volume vehicles that rivals factory press dies.

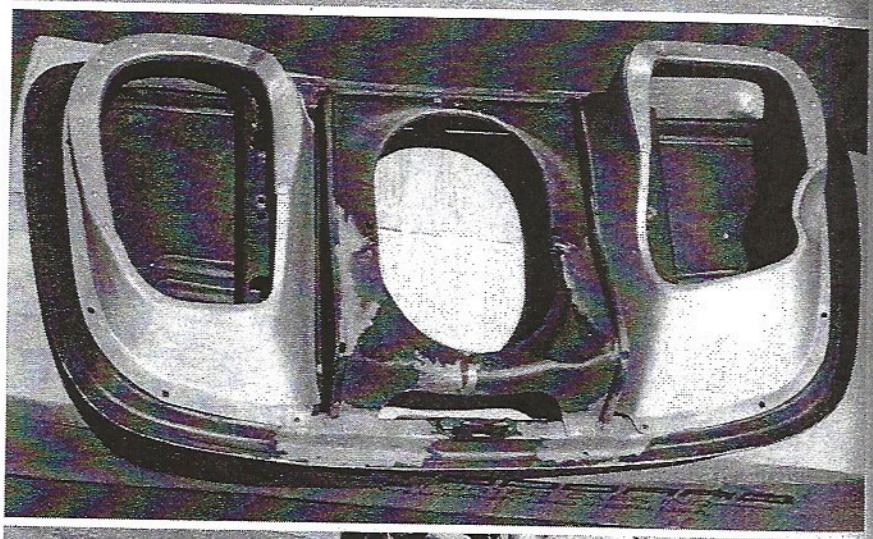
(Top right) Porsche Carrera wood-carved air boxes. Bondo was used to augment the wood.

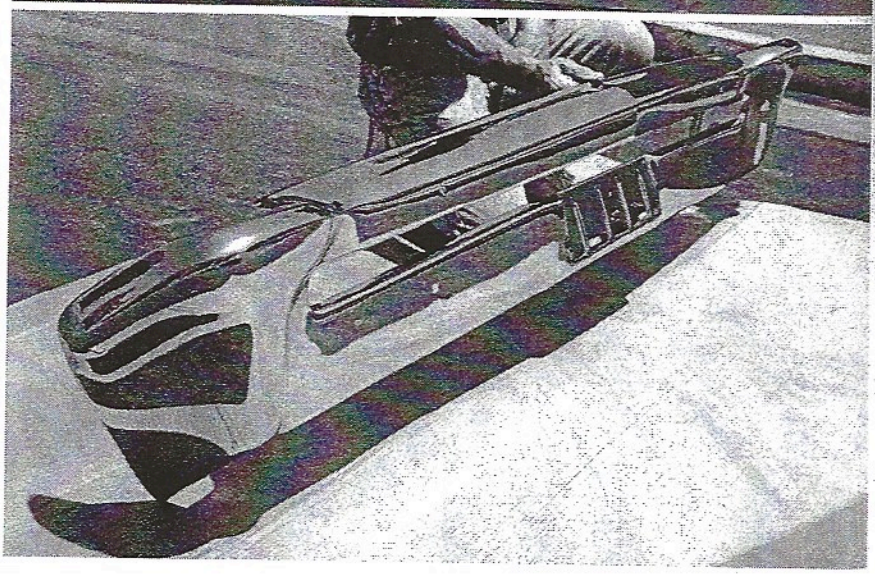
(Center right) Afterward the Gypsum forma were cast from the wood plugs, and these two pieces were hammered into the Gypsum forms.

(Bottom right) This will kill you! Wanted to leave you with this photo of a 60's era POLISHED ALUMINUM hammerformed rear bumper.

The bumper was hammerformed in one piece using Wayne's Gypsum and wax system that he developed and perfected over the years. Any readers know any other way to produce a bumper this highly detailed in one piece without press tooling?







This book has repeatedly urged metalshapers not to die with their music still in them. Wayne Williams has developed a system that simply must be documented. Perhaps a metalworking group might make a deal to document this as a project.

Here is my thought. Wayne's location and Kent White's location are reasonably close. Would anyone be interested in talking them into a joint A-Z Gypsum hammerform & portable flowforming seminar on DVD?
Can you say GAME CHANGER?

Where To Buy Gypsum

Purchase your Gypsum products from United States Gypsum Company in Chicago. Their contact information is in the APPENDIX. Please consult with them about the best Gypsum to use for your particular project. Wayne Williams uses ULTRACAL 30, a high-density tooling Gypsum that does not shrink while curing. U.S. Gypsum has most recently introduced RAYITE 100 Machinable Media, which has been introduced for the new age of prototype mold-making. Check with U.S. Gypsum about possibly using this new product for your application. Note that US Gypsum also sells mixers as well.