General Magnaplate Corp.

CASE STUDY

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"Made in the U.S.A." Audio Component Pioneer Redesigns Efficiency

By Corey Wesnitzer, General Magnaplate Corp.

Elastomeric Polymer-Based Surface Enhancement Coating From Magnaplate Doubles Coil Winding Efficiency And Reduces Rejects 75% For Pyle Industries

Huntington Indiana's Pyle Industries has long been a pioneer in the development and manufacture of "Made in the U.S.A." sound systems for cars, trucks and the home. The first mobile high-power woofers came from Pyle. The first true high-power, multi-element car stereo speakers were perfected by Pyle in the 1970s. In the 1980s came engineered enclosures for pickup trucks and hatchbacks and balanced full-range systems including high-performance subwoofers. Today, Pyle Industries continues as an acknowledged industry leader in world-class subwoofers, speakers, and components including the brand named: PounderT, ToobzT, and Pyle Driver® systems.

Behind every advance in sound amplification technology achieved by Pyle in those four decades lies well thought-out manufacturing processes that are re-engineered, whenever necessary, to assure consistent quality, efficiency and productivity. A case in point is the company's vital speaker component, the high-temperature poly-thermal polyimide film voice coil.

Coils are Wound Wet on Aluminum Arbors

The manufacturing process works like this: The polyimide film (a thermoplastic sheet of three or five mils thickness) foundation of the voice coil is wrapped around a 6061-T6 aluminum arbor, which ranges in size from 3/4" up to 3". Insulated magnet wire coated with a proprietary adhesive system is then wound wet on the arbor. When the winding is completed, it is aligned and reinforcing tape added to the coil.

The coils are baked at about 400°F. for 40 minutes. Following the baking, the coil lead wires are chemically stripped and solder tinned. At this point the coils are removed from the arbors and the arbors recycled back to the beginning of the wet winding process.

That was precisely the way the process worked at first: with virtually no production glitches. As so often happens, though, problems began to crop up as the arbors continued to be reused.

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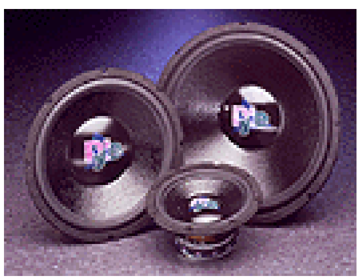
Coils and Arbors Were Often Damaged During Removal

The basic problem encountered was the adherence of the adhesive to the aluminum arbors. Following baking, Pyle's workers discovered that the coils were adhering tenaciously to the arbors, and the company had to develop a method of forcibly removing the coils.

Manager Brian Miller describes Pyle's dilemma: "At first we could do the separation by hand, but eventually we found it necessary to set up a pneumatic cylinder with a tooling arrangement that allowed us to step on a pedal and physically drive the arbor right out of the coil. That worked fine for a while."



As the arbors were reused repeatedly, however, adhesive residues began to build up. Miller found that his people had to exert more and more force during the separation process, and the ends of the arbors began to get damaged. The damage in turn made the coils and arbors more difficult to separate. Some of the arbors became so severely damaged that they wouldn't fit the tooling on the winders. The cost of replacement arbors began to mount as "the problems continued to snowball," Miller reports.

Pyle had to find solutions, and at first Miller thought they had: "We used to wash the arbors in acetone to try and clean off the adhesive. We had some initial success with that, but the problems were not solved by any means. We also tried applying a mold release lubricant to the arbors prior to winding. That, too, was successful for a short time, but the removal problems returned. We also tried anodizing the arbors, but removal continued as a serious problem."

It was at this point that Miller discovered a specialized surface enhancement coating applied by General Magnaplate Corporation - LECTROFLUOR® 615. This multi-step elastomeric polymer-based treatment process lends superior non-stick properties to multiple metals - including the 6061-T6 aluminum of the arbors. One of a series of 5 treatments in the LECTROFLUOR family, this surface enhancement process creates metal surfaces with superior mold release characteristics unaffected by high or low temperatures (from -400°F to 550°F), U/V exposure, or chemicals. It also creates surfaces with superior wear and abrasion resistance and excellent non-wetting characteristics. A sparkling black and gray coating, applied in the thickness range of .0015" to .004", LECTROFLUOR 615 surfaces can be repaired, allowing for extended parts usage.

How the Treated Arbors Performed For Pyle Industries

Interested in Magnaplate's background and evident capabilities, Brian Miller sent the company several arbors to enhance. Then he ran a simple test in-plant: "We took the adhesive we use, put some on an arbor, placed it in our test oven and baked it for about the same amount of time we use in production. When it had cooled, I could take my finger and just flick the glue off.

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"So we wound the coils using the LECTROFLUOR 615-treated arbors and we had no problems with them. When we were finished, the coils just slid off the arbors. We could again do the separation by hand."

Since so many of the old, untreated arbors were badly damaged, Pyle had all new arbors made and has had all of them enhanced by General Magnaplate.

And the savings? "By eliminating the forceful pneumatic separation process, we expect to avoid at least 75% of the arbor damage, even after extended usage. In addition, we expect to at least double the number of coils we can separate from arbors in a given time."

Background Data

Metal Treatments Launched in Space

The LECTROFLUOR family is just one of 14 space-age, high-tech surface enhancement processes developed and applied by General Magnaplate at its Wisconsin, New Jersey, California, Texas, and Canadian Materials Technology Centers and by licensees overseas. In the 1950s and 1960s, Magnaplate pioneered the development of "synergistic" surface enhancement coatings for the broad spectrum of metals used originally in America's space program. In fact, the company's technologies have been utilized by NASA and its contractors on every US space mission since the beginning

Just some of the applications for which Magnaplate developed coatings for NASA are: cameras, telemetry equipment, drills, fuel valves, soil samplers, landing struts, protective shrouds, seat tracks, frames, doors and windows, latches and hinges, lunar surface drills, spacesuit components, the moon vehicle, and toilets.

Today, Magnaplate-applied coatings are used not only in space, but for such "down-to-Earth" applications as the prevention of abrasion, erosion and galvanic corrosion of molds; to increase the efficiency of the huge boring machines used in digging the England/France "Chunnel;" the permanent lubrication and hardening of high-speed machinery's aluminum guide surfaces; the solder-spatter-rejection on double wall copper tubing machines; and a host of other applications.

Coatings With a Difference

The synergistic treatment applied by Magnaplate to the aluminum arbors is created during a multi-step process based on proprietary blends of polymers. In the process, metal parts are first cleaned and prepared in specially designed equipment. Proprietary application of selected polymers is the next step. Selection of which polymers to use is based on several factors: end-use application of the part, its base metal, the kind of hostile environment to which it will be exposed, and the coating buildup permitted.

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Since the resulting surfaces are superior in performance both to the base metal and to the individual components of the surface enhancement, these proprietary processes are identified as "synergistic."

This photo illustrates both the problems Pyle Industries encountered and the solutions General Magnaplate helped them achieve: In the rear left is a voice coil literally glued onto an untreated 6061-T6 aluminum arbor. Note the damage to the coil caused during the attempt to separate the coil and arbor. Often the arbors were "dinged" too, and even though removed, some of them would not fit back on the tooling of the winders. At right rear is an arbor that was black-anodized prior to Magnaplate's involvement with Pyle. Damage and separation problems due to tenacious glue deposits were also evident with the anodized arbors. In front are two LECTROFLUOR 615 coated arbors. The coil at the right has been easily and efficiently removed from the undamaged arbor manually, saving Pyle twice the time required previously when arbors and coils had to be rammed apart pneumatically.