



Metal Forming Success Story

PhygenSM
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Glacier Vandervell Bearings Relies on Quick-Change Tooling and Phygen Ultra-Performance PVD Coatings to Boost Press Uptime and Extend Die Life.

The Bottom Line

No more tool warping.

The Numbers

Up to 10 times longer tooling life.

Glacier Vandervell Bearings, a division of Mahle Engine Components USA Inc., is located just off Interstate 77 in Caldwell, OH, a small town about 25 miles north of Marietta. **Jim Pasquale**, a dedicated member of the manufacturing team for 48 years, is supervisor of tools and design services. **Ron Saling**, who will celebrate 35 years at the plant in October 2007, is tooling supervisor. Together they are working both hard and smart to keep the tooling and stamping operations on the leading edge of technology to serve the fast-paced automotive and transportation industries.

"At the Bearings plant we make parts for automotive engines and transmissions," explains Jim Pasquale. "We manufacture what are commonly called bushings and thrust washers. Other plants in our group make rod and main bearings, and items such as piston rings. In addition to the Caldwell plant, we have manufacturing operations in Iowa, as well as Muskegon and St. Johns, MI. Also, there are plants located in England, Scotland, Italy, and Slovakia."

According to Jim Pasquale, the primary product at Caldwell is the bearing material used to make the bushings and washers they ship to their customers. "We start with 1008 or 1010 steel. It's our standard basic stock that comes in coil form. We cast any number of different bearing alloys on one side of the steel strip. A lot of the materials correspond to the standard SAE numbers—the standard copper-lead-tin alloys for bearing material. We cast a number of versions of these. We also have sintered versions. We have aluminum, tin, and lead-tin, about 40 different alloys altogether."

"One of the words that keeps coming up when we talk about bearing materials is lead," Pasquale says. "There's a lot of evidence that lead is a carcinogenic material. Nobody likes lead in the workplace, so we have lead-free Clevite materials now."

One of the reasons we are seeing so much aluminum being used is because those alloys are lead free. Tin coatings are basically lead-free as well. We make solid bronzes. We make all steel parts, and all types of materials that you would expect to encounter in the bearing industry — friction or frictionless material as the case may be."

By their very nature, most of these materials have a high lubricity surface, but they do wear tools out quickly. "Aluminum is really tough on tools," Pasquale explains. "The process of putting aluminum on the steel back transforms the steel into a real metallurgical nightmare. It's hard. It's discolored. It has a lot of non-forming characteristics and we have to overcome those when we form it."

"We use a number of processes here," Pasquale says. "We have what we call Cast Clevite. Clevite is our old name. We were founded on that material. We have a mechanical-metallurgical bond of the alloy to the steel. It is an old technology but a proven technology. We make some of our material here. The only ones we do not make here are the aluminum alloys. One of our sister plants makes aluminum. We also supply material from this plant to a number of plants around the world."

In the Pressroom

"When it comes to our pressworking operations," Pasquale says, "our basic intention is to reduce setup time and increase uptime. When a job is in the press, I like to keep it in the press, and not have to pull it out to dress tools half way through the run. When we're in the middle of a run and we have to pull the die out, that's not productive time. So we try to do things to maximize our uptime and reduce our setup time, which results in productivity increases, and that's what we're after."

Seeking a Better Tool Coating



Glacier recently began assigning part numbers to elements of its quick change tooling. The shinier sections to the right are polished and coated with Phygen's FortiPhy CrN coating.

Over the years, Pasquale tried a number of different coating materials and processes in an effort to extend tooling life and boost press uptime. Early coatings, such as TiN worked on cutting tools but weren't of much value when it came



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Jim Pasquale (left) discusses the use of coated tooling with a press operator. Sections of a progressive die set, which are subject to abrasive wear, perform better & last longer when they are coated with Phygen's FortiPhySM CrN PVD coating.



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Many of Glacier's tools require contour cuts. These are produced in the wire EDM room, which is equipped with three traveling wire EDM machines. Starting in 1974, the Caldwell, OH plant was one of the first facilities in the United States to produce tooling using this technology.

Metal Forming Success Story: Glacier Vandervell Bearings

to protecting forming tools from the extreme pressure of forming and the abrasive nature of many materials during the forming operation. Until 2002, he used a thermal diffusion coating with some success but there were some important limitations as well.



In the Glacier Caldwell tool room a groover die is being machined on this computer-controlled vertical milling machine.

"One of the reasons we were looking for something else was because we were having a problem with another process," Pasquale explains. "With that application process, the tools had to be heated to about 1800°F or 1900° F, and many of our tools were warping. These were the diffusion coatings and what the coater was doing essentially was re-heat treating the part. Some of our tooling has a narrow slot cut into it and it always warped at the higher application temperatures of thermal diffusion

coatings. When the tools warped we had no choice but to throw them away. There just was no way to salvage them once they warped."

"With our type of tooling geometry," Ron Saling adds, "we found that the low-temperature Phygen PVD process solved the problem. We simply have not run into any warping with this process. The first thing we do is take the die steel (mostly A2 or D2), square it up, and cut it to the blank size we need. Then we heat treat it. We heat treat it first because, if we don't, we run the risk of warping the tool. After heat treating, we run it through the wire EDM process and cut the final shape. We then send it to Phygen Inc. for coating with their FortiPhySM UltraEndurance coating."

"When we cut tooling on the EDM units," Pasquale says, "the surface layer of the material is slightly different. However, we do skim cuts in a lot of instances and we also glass bead the surface. We send the parts to Phygen when they come off the burnishing operation. That's the finish we give them. We could polish them here but we're not polishers. I think it takes a special person to polish. Obviously Phygen has some of those special people. I seriously doubt if we could achieve that good a finish here since we're not set up to polish."

"Occasionally we use O1 steel," Pasquale adds, "but oil-hardening materials are not as good as air-hardening steel when those will do the job. I'd say that 99 percent of our tool steels are A2 and D2. Plus, we heat treat in-house and we have complete control. The only thing that is a limiting factor for us is sheer physical size. For most of our parts, we do everything in-house. This is much, much better. We have complete control time-wise and process-wise."

"Heat treating in-house also allows us to cut down our lead time," Saling adds. "If we have to ship a blank off-site for heat treating, it adds quite a bit of time to the job."

Coping With Abrasive Material

Many of the materials formed at Caldwell are extremely abrasive. "Especially aluminum," says Pasquale. "It will wear through an uncoated piece of tooling making grooves and gouges and destroys the surface. The Phygen coating has prolonged the life of our tooling immensely. On some jobs we get three times the life. On some ten times. On others eight times. It just depends upon the particular application and the abrasiveness of our material. Also, the formability of our product in a coated die is much better due to the highly polished surface and

the lubricity of the coated surface. This results in a quality product. All in all, we are very satisfied with the Phygen coating."

Development Comes Before Coating

"We won't coat anything on a new die until we first try the die," Pasquale points out. "There's no sense in spending the money to coat it and polish it and then get to the press and find that we have to open a dimension up two or three thousandths. In that case we'd be grinding the new coating off and it does no good. We send a new die to the press and we allow a development period. Some of our people assist in that development—the designer, the press operator, the tool room people—and we will come up with a tool that we feel will make the part after development. Then we make spare tools for that job, and those go out for coating."

Some things are a given, however. "We always coat the groovers," Pasquale says. "Nobody wants to make a groover ten times a year when they can make it just one time per year. So that's a cut and dried decision, but we don't coat it the first time because the part may be all right in the flat stage but when it's wrapped up into a bushing we may have to change the shape or the depth of the groove. So we don't coat anything until we're reasonably sure it is going to work."

"Aluminum is one application where the tooling doesn't last very long," Saling says. "The press operators are in the tool room saying, why don't you coat this tool? The press operator is actually my customer. When it comes to how good something is or how long something lasts, the operators let me know."

"This is the best information," Pasquale agrees, "when the operator tells us that what we did solved his problem. I don't know what better testimonial there could be."

"We've been into quick change tooling for probably eight or ten years now," Saling explains. "The big thing about quick change tooling is that it's driven by just-in-time delivery. Our customers want their bushing and washers shipped on time. Our customers also want smaller orders. They want parts when they need them and we don't want to carry any inventory. So, we have to have tooling that we can get into the press, get it ran, get it out, and get the next one in. If the order is for 5,000 pieces, we need to run 5,000 pieces. We can't run 50,000 pieces, put them into inventory, and pull them out when the customer wants them. That cost too much money."

"Quick change tooling also provides an opportunity to take care of it when it comes out of the press," Saling continues. "It can be serviced after every run and it's always ready to go when the next order comes through."

"Another thing that quick change tooling has done for us is that it allows us to standardize on the design of the tooling," Pasquale says. "All tools are designed on a CAD system. We have programs where we put in our strip layout and the computer programs that we wrote internally position all the components in the right spot and tells us where to drill all the mounting holes. Everything is standard. I think that goes a long way to enable the toolmaker to make the style of tooling that's going to perform time, after time, after time. It works out well for us. It also works out well for our customers, and that's really what's important."

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These completed tooling sections will be shipped to Phygen Inc. for polishing and coating with an abrasion-resistant coating. A patented, low-temperature PVD application process assures that even thin sections can be processed without the distortion commonly associated with high-temperature, thermal diffusion coatings.



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Die sections with a narrow slot, such as the one shown on the right, can be coated with Phygen's low-temperature PVD process without fear of warping the tool. According to Ron Saling, tooling supervisor, attempts to coat this part with a high-temperature, thermal-diffusion coating resulted in having to scrap as many as half of the sections because of warping.