A single casting poured in 535 Almag replaced a plastic pickhead, an end-of-arm robotic tool in the food industry that lifts half a pallet's worth of goods per cycle.

# Faster, Further, TOGETHER

Pyper's pickhead poured by pros, produced by partnership, heads for patent. Here's the twisting winter's tale of a manufacturer, a foundry, and a 3D-printing expert who collaborated and achieved a casting conversion in just seven weeks.

KIM PHELAN, CONTRIBUTING EDITOR

A man walks into a foundry.

This isn't the beginning of a joke, but it was how an innovative aluminum casting for the food-processing industry got its start.

One frosty day in Wyoming, Michigan, the last week of December 2022, Jon Buland, a machinist at Pyper Tool and Engineering, came through the front door at AFS Corporate Member Quality Non Ferrous Foundry (Quality), located in the same Grand Rapids suburb, and said he needed a casting. Foundry Accounts Manager Doug Schlattman was happy to oblige.

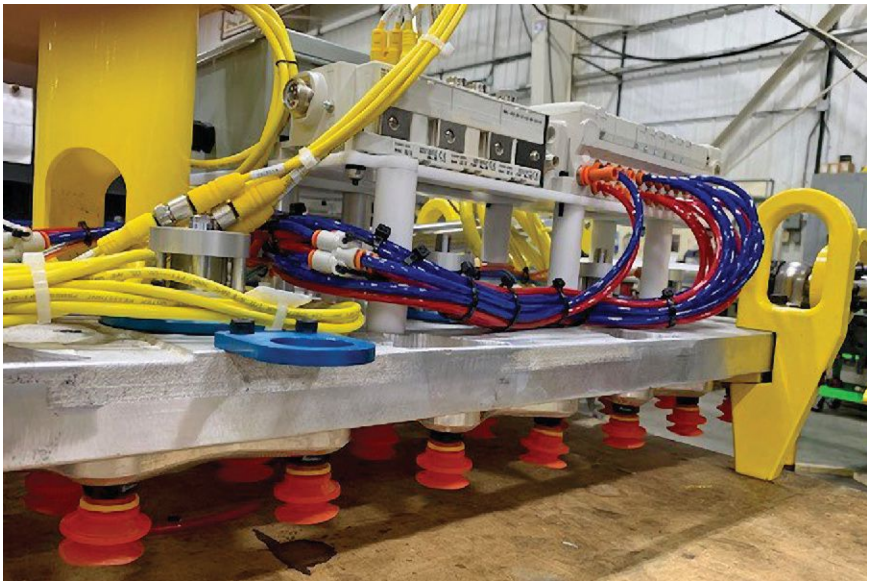
On his arrival, Buland said he'd found the metalcaster on Google

Maps, but in reality, his team at Pyper had researched foundries in their area and had previously done business with Quality's parent company, Roman Manufacturing. Buland, affectionately known by his coworkers as the "door-kicker," had come on an exploratory mission, and he began to describe Pyper's need to the 35-year foundry veteran. Satisfied with the expertise as well as enthusiasm he'd encountered, he returned to Quality shortly after New Year's Day with David Stobert, parts designer at Pyper, to further determine how their objectives could be met with an aluminum casting—and so the journey commenced. Little did they know they'd be driving back to headquarters exactly seven weeks later with their finished, ingenious casting in tow.

Meanwhile, at the Pyper planning table, Buland, Stobert, and their team had been immersed in a redesign conundrum, urgently brainstorming how to solve complications with their customer's plastic fabricated component. By whatever plan or providence that landed Buland at Schlattman's doorstep that December day, the resulting reimagined casting the two companies created—a vacuum pickhead used as an end-of-arm tool by a large industrial robot—solved two application problems and opened up an uncharted world of future possibilities for the Pyper team.

## Time and Toughness

In a factory setting, Stobert said a vacuum pickhead is used to pick up staged packages—utilizing vacuum suction cups—and stack them on a pallet. Some pickhead tools are large enough to pick a full pallet layer while others, including theirs, are designed to pick half of one layer. Most if not all pickheads are fabricated with a UHMW plastic core sandwiched between two sheets of quarter-inch aluminum—the pieces are glued and sealed together with RTV sealant, which takes 24 hours to fully set. It's a flexible, lightweight tool, says Stobert, but has two major disadvantages.



Vacuum suction cups connected in the pickhead casting enable it to pick up staged packages and stack them on a pallet. The strong yet flexible metal casting is able to withstand occasional bumps much better than the industry's standard material, which is UHMW pastic.

"It is not easily cleaned or serviced and causes significant downtime to tear apart and re-glue," he said. "The second issue is that the design is quite fragile. Any slight impact or crash can completely torque the tool, bending it out of shape or even puncturing the plastic. Our cast aluminum vacuum pickhead aims to replace the industry standard design and solve both these issues."

Getting there stretched the Pyper team's creative skills.

"It was quite a road, a bumpy road," Stobert said. "We had a couple of different designs thrown around, starting with one idea where we were going to get this massive piece of aluminum and drill holes into it. We threw that out. And then we thought of the casting method. We knew we could get all the features we wanted built into this part through one process—and then once it was cast, we would machine it and clean it up, and it's ready to go."

Today, the downtime to clean and service the pickhead casting has been decreased from 24 hours to as little as one hour. To clean it, an adaptor can be installed in place of the cartridge that seals each vacuum zone, Stobert explained. A standard hose can be connected to the adaptor and the entire casting can be flushed, removing any foreign material that may have been sucked into the pickhead.

In addition, cast aluminum is much stronger than UHMW plastic, and the pickhead's cast aluminum body is much more resistant to any impacts that may occur in the day-to-day, rapid-paced, grab-and-place cycle of robotic picking.

"This new pickhead design will save many hours of downtime and will be a much more robust solution to robot palletizing," Stobert added.

The inventing he and his team did will likely be the foundation of future customized solutions for Pyper's customers, and he said they're currently in the process of patenting portions of the design. The final casting is 3.6 in. x 19 in. x 50 in. and weighs in at 112 lbs.

## Casting Masters

Because this would be Pyper's first foray into the world of metalcasting, they needed their foundry partner to

Humtown Products designed and printed a 3D printed mold that was sent to the foundry in two pieces via air ride truck over Midwest winter roads.

guide them through the process, offering expertise and practical, modern solutions to achieve every objective for the newly designed pickhead.

"We didn't know anything about casting at this point," said Stobert, "so Doug helped us figure out what material we should choose, and explained the process and all this vocabulary to us—generally, the process of what needs to happen and how it's going to work. And he explained design parameters and helped us figure out how to be realistic with the design."

The decision was made to use 535 Almag, an alloy Quality pours every day, said Schlattman.

"A lot of Roman's transformer enclosures and housings are poured in Almag—No. 1, it's really strong without heat treat," he said; "and No. 2, it has some ductility, so it's not super brittle and doesn't break easily. The magnesium also helps prevent oxidation and corrosion, which Pyper wanted."

Another key insight Schlattman provided was the importance of rigid connections for all the coring.

"When molten material goes into the mold, you can break off sections of the core internally, which would obviously cause an issue with casting," he said. "I also pointed out that you can't over vent, so we put lots of vents in this mold to make sure we would get a good fill. Those vents also act as a riser if they're placed in particular areas where there are heavier spots and actually help feed the casting."

The pouring system was quite key, as well, Schlattman said.

"Personally, with my experience in the foundry, I like to distribute the heat around the casting as much as possible," he said. "And we actually poured this with six people at six pouring locations all the way around this casting with multiple in-gates. I was like, let's get it in quick, get it filled, make sure we don't have misruns, and make sure the risers are still liquid so they can feed properly. That was one thing that I stressed."

### An Additive Opportunity

But perhaps the foundry insight of greatest import to the project was Schlattman's recommendation to create a 3D printed mold. From the moment he saw Stobert's design on January 3, 2023, Schlattman had a lightbulb click on for this detailed, volume-of-one prototype casting. And with one fell swoop, the prospect of making tooling and core boxes vanished.

"I told them the nice thing about 3D printing is, the mold doesn't care," he said. "I mean, we can print anything in any direction, any angle—it'll print whatever we asked it to print. I'm super impressed with the tolerances, and what the capabilities are with 3d printing."

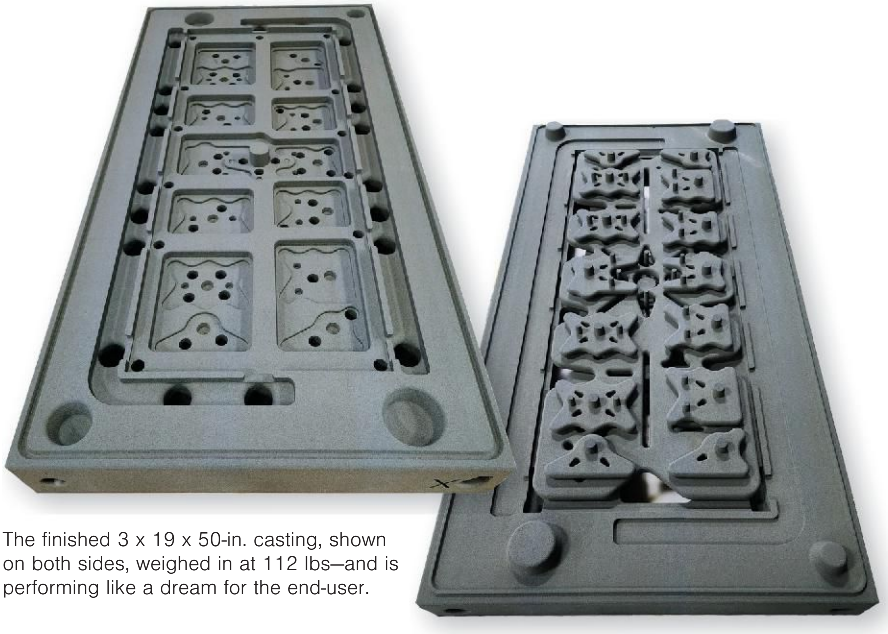
Stobert added, "I don't think this part could have happened without the 3D printed sand mold. There are cores inside of cores, and the only way to achieve that is with 3D printing. I can't see any other way to get the kind of cavities inside the casting that we wanted."

It wasn't Quality's first additive rodeo. That happened back in 2017, and their cast copper housing won the Best Achievement by a Small Foundry in AFS's Casting of the Year competition. They've steadily increased their use of additively-made molds since then, although they do not print them in-house.

For that, Quality steered their customer to AFS Corporate Member Humtown Products, Columbiana, Ohio. Whereas Pyper personnel enjoyed the in-person meetings with their local foundry partner, Humtown's Director of Additive Manufacturing Brandon Lamoncha was able to collaborate face to face in the design of their 1,200-lb. 3D printed furan sand mold by virtue of virtual technology. For one geographically diverse Zoom meeting, Pyper's team met with Lamoncha who was working in Germany while Schlattman signed in from a business trip in North Carolina.

"It takes all three: the casting customer, the foundry, and us, acting as the technology integrator," Lamoncha said. "For some who are taking their first step into 3D printing, it kind of feels overwhelming. It's also expensive and you don't get another shot at it. It can be intimidating. So we walk beside them and let them know what they're getting into and how to be successful."

For this job, Lamoncha agreed it was a perfect opportunity for additive. Throughout his mold design collaborative process, he would incorporate the cores, printing them in place so



The finished 3 x 19 x 50-in. casting, shown on both sides, weighed in at 112 lbs–and is performing like a dream for the end-user.

they wouldn't have to be set. As is his custom, he took the gating and riser design from the foundry and incorporated them into the digital format.

"It was very hands on—we gave it back to them to review, they approved it, and back and forth. It worked out well. It's never good to just throw it over the fence. No matter how many times we've done these jobs, it's always good to have that input from the foundry as well as the end user to understand everyone's needs.

"I really liked the collaboration, and I would encourage more OEMs to really collaborate with their foundries. You go a lot further, faster, together if you collaborate and ask questions and understand. You want to put the technology to its best use—you don't use it for everything, and you don't never use it. Having discussions to formulate the best plan of attack—I really like seeing that, but the industry needs even more of it."

## Perfect Pour

The finished hefty mold, foam-packed and delivered in a Humtown air ride truck, arrived in two pieces at Quality along with some inserts Schlattman's foundry team glued into it.

To get the pour perfect, Schlattman set the stage and then held a dress rehearsal of sorts just beforehand.

"We put the puzzle together and put some weights on top of it, because we wanted to make sure the top didn't lift off the bottom while we were pouring it," he said. "Then we took heat guns and we heated up the internal passages to make sure that the metal would flow through it properly without solidifying and misrunning. And then we did a little trial with six guys around this mold to make sure everybody knew what spot they were going to pour—I didn't want them tripping over each other. After that, it was basically 1, 2, 3, and we poured the metal in.

*"No matter how many times we've done these jobs, it's always good to have that input from the foundry as well as the end user to understand everyone's needs."*

*—Brandon Lamoncha, Humtown Products*

While still in the design stage, Schlattman communicated his concern that the mold could warp during solidification—"potato-chipping" or ends pulling up is a common phenomenon for large flat castings. To compensate for the problem, he recommended adding 3/16 in. to 1/4 in. of machine stock to vulnerable surfaces, which Buland would later machine and clean up. Schlattman's prediction came true and the casting warped 1/4 in.," he said.

"John did an excellent job of setting this up in their machine and working around the warpage of that casting." Later, Quality poured a second, backup pickhead for Pyper's client, and, lo-and-behold, it warped identically to the first. If a third part is ever required, Schlattman says they'll modify the casting design to avert a recurrence.

As planned, the casting was machined but didn't require any other post-processing; however, Pyper's team did perform one final step once they picked up the casting on Feb. 22, seven weeks plus one day from their January 3 foundry meeting. Microporous fractures, common in castings not specifically designed to hold pressure, occurred in the pickhead casting—rather than choosing impregnation, Stobert and the team opted to coat the inside of the casting with an epoxy-based gas-tank sealant.

"This casting will be used with vacuum suction," said Stobert, "so we wanted to make sure we didn't have vacuum leak."

By the time Buland and Stobert collected their aluminum pickhead and drove away, Schlattman recalls the great feeling of "pulling off" a complex casting in seven weeks that's performing great for his customer's customer. For Stobert, it was a personal victory, too.

"I'm proud of myself and my team—I've never done anything like this before," he said. "It was kind of scary at first, to be honest. But as we went along, and we got the design more fleshed out, the pieces fell into place right where they ought to be. It was really interesting just watching it start from 'here's an idea' to 'here it is, completed.'" MC