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MELTING POINT

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GO BIG AND GET HOME (SAFE)

Inside This Issue

Why Metalcasting?... Metalcasting produces engineered metal components for use in all facets of our world, including what you drive, where you live, what you eat, and how you work. The metalcasting industry maintains its traditions while embracing advanced manufacturing techniques. But the key to metalcasting is what is illustrated in ***Melting Point*** magazine—the diverse ways metalcasting helps propel society forward. If you are interested in joining this forward-thinking industry, look to the sections of the magazine dedicated to Metalcasting Universities & Scholarships and Career Opportunities on pages 20-23.

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LIGHTS. CAMERA. CASTING

Check out these cool videos online!
Visit **meltingpoint.squarespace.com**
to view these videos and more.

Learn what metalcasting is all about in 20 seconds with a video called "5 Facts About Metalcasting" by the Foundry Educational Foundation. Watch the video at bit.ly/3JQIVWw.

Take a virtual tour of an aluminum casting facility that uses permanent (metal) molds to create parts. Watch the video at bit.ly/3JTn9Bq.

Want to see how streetlights like the one on page 18 are made? Check out the Foundry Friday series of videos from Spring City Electrical Manufacturing at bit.ly/3FQmOgx

Trading in the Sea for the Sand

Sauter joined the U.S. Navy after high school and served as an aviation technician before enrolling at Cal Poly Pomona as an engineering student.

AS NIKOLE SAUTER APPROACHED her high school graduation, she hadn't figured out what she wanted to study and felt she needed some direction in her life. She chose to join the U.S. Navy, which she found to be a great experience. The people she met in the service "really helped mentor and guide" her to where she is today.

Sauter was an aviation electronics technician on the F/A-18E fighter jet. Some of her responsibilities included troubleshooting and repairing weapons systems, mission computers, communication systems, and RADAR. Plane Captain was another one of Sauter's titles: she set up the jet for the pilots and made sure everything was safe and ready to go.

"Although it sounds odd, the most interesting thing was the deployments," Sauter said. "No, it's not great being stuck on a ship in the middle of the ocean, but at the same time, I was able to see the world and do some amazing things—like swimming off the coast of Hawaii and seeing land for the first time in months."

After the Navy, Sauter chose to enroll at Cal Poly Pomona (CPP) because of the "engineering programs that were available." During her sophomore year, the university started offering a few on-campus classes (this was during COVID). Coincidentally, her only class on campus was the same day CPP's AFS club was hosting a foundry-in-a-box event. This was her first experience with metalcasting; the whole sand casting process really interested her.

"And, I got to take home a cool little tin teddy bear!" she said.

According to Sauter, so far, sand casting is her favorite process. She likes how much thought goes into designing a part and then creating a gating system that would produce the best results. In the metalcasting class, she thoroughly enjoyed when they had a loose pattern and had to dig the entire gating system by hand.

Putting into practice the things learned from books is very important to Sauter. Currently she is working with classmates on an African spear for the 2023 SFSA Cast in Steel competition; CPP students also continue to host foundry-in-a-box events, which, according to Sauter, are great fun and provide hands-on experiences.

Sauter was drawn to metalcasting after attending a foundry-in-a-box event on the Cal Poly Pomona campus. Shortly after, she enrolled in her first metalcasting course.

Last November, Sauter was able to attend the FEF College Industry Conference.

"Two things I took away from that event: I think it was a great introduction of what job interviews in this field will be like, and I feel like I have so many options for future employment and internships," she said. "It was a great networking experience."

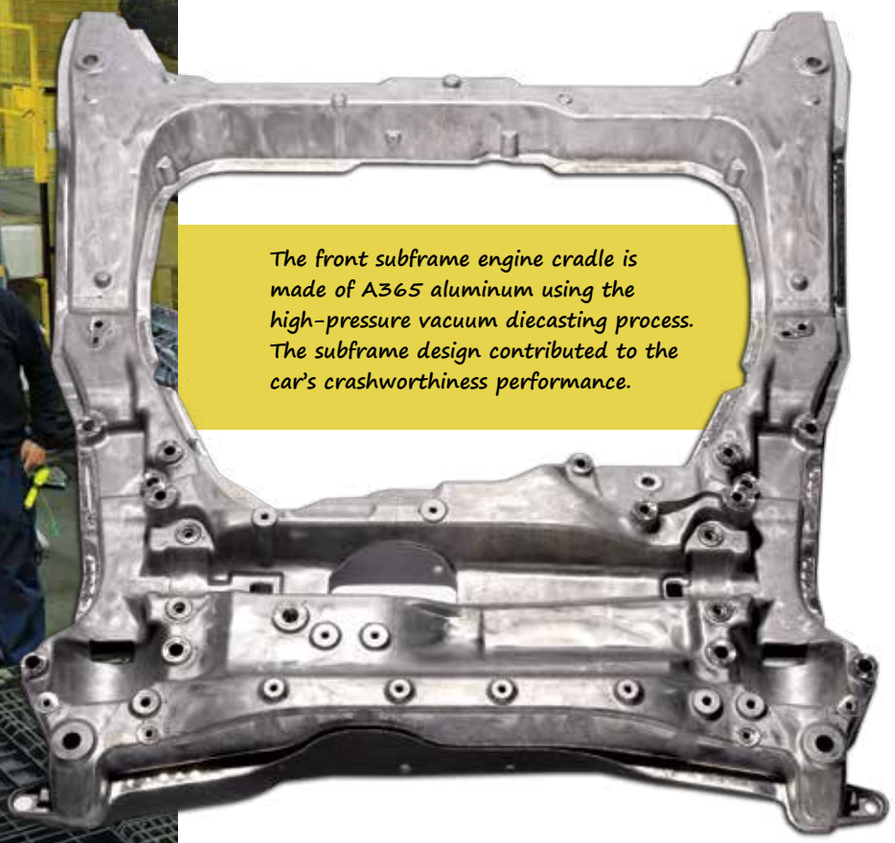
Sauter is looking forward to joining the foundry family as soon as she graduates in 2024. **MP**

GO BIG AND GET HOME

A LARGE ALUMINUM PART FOR THE ACURA TLX ENHANCED THE CAR'S DRIVABILITY AND SAFETY PERFORMANCE.

(SAFE)

The Magna team that worked on subframe included (from left to right) Andrew Fabbro, (CCMi Process & Manufacturing Engineering Lead), Nandha Mariapillai (CCMi Engineering Manager), Randy Beals (Cosma Global Engineering Specialist), Andrea Hill (CCMi Quality Continuous Improvement Manager), Puneeth Lakshman (CCMi Manufacturing /Process Engineer) and Arun Gopal Rajagopalan (CCMi Quality Engineer).



The front subframe engine cradle is made of A365 aluminum using the high-pressure vacuum diecasting process. The subframe design contributed to the car's crashworthiness performance.

Stylish, fun to drive, and safe—that's what drivers want out of their cars, and that's what vehicle manufacturers try to do with every new model they design.

For the 2021 Acura TLX, an aluminum casting helped meet those goals in a big way. Created using the largest diecasting equipment available at the time, the structural subframe is a 4 x 3.5-ft. piece that was redesigned from 17 parts into a single component. Combining all those parts into one means fewer extra steps needed to make the part, eliminating potential failure points.

Magna's Cosma Casting Michigan (CCMi) out of Battle Creek, Michigan, pushed its capabilities and design engineering expertise to produce the 38.5-lb. subframe, which yielded a 29% weight savings (better fuel efficiency) and helped the 2021 Acura TLX achieve "2021 Top Safety Pick+" status, which is the highest safety rating from the Insurance Institute for Highway Safety (IIHS).

Bigger Is Better

You might have heard of Tesla's 6,200-ton Giga Press used to make giant cast metal pieces for its vehicles. In 2016, Idra Group's 4,400-ton press was the larg-

A central gating system in the mold directs the liquid metal into and throughout the cavity so the entire casting is filled with metal before solidification. This avoids leaving pockets of space within the part that would make it defective.

est machine available when CCMi and Honda sought to design an aluminum cast front subframe for the 2021 Acura TLX. Producing subframes is nothing new for Magna's body and chassis business unit, Cosma, which has been making the product for years—first in steel and then in aluminum in 2012. But the dimensions of this single aluminum casting would test the limits of the existing machinery and inspire innovative ways to produce defect-free castings.

Diecasting a subframe at this size helped Acura achieve critical weight savings for the TLX. The super-integrated one-piece casting trimmed 7.1 kg. Attachment points for the front lower control arm, steering gear, stabilizer bar, and torque strut were all incorporated into the cast design. These locations are machined after casting to meet the dimensional requirements.

From Liquid to Solid

One of the challenges of casting a component at this size with thinner walls is to make sure the cavity of the mold is completely filled with molten metal. Molten metal enters the mold cavity at specific points using a network of passageways called "gates." The last thing an engineer wants is for the metal to solidify near the gate before the rest of the mold cavity is filled, because it will leave holes in the casting. Even tiny holes can hurt a part's strength and stiffness.

Using computer modeling, Cosma engineers built the prototype tool.

Following computer simulated trials, Cosma engineers added features where needed for strength. This allowed the stiffness to be increased—improving the ride performance and vibration characteristics for the 2021 Acura TLX. They also implemented process changes to thermally manage solidification—making sure the metal remains liquid where needed to avoid the production of tiny holes (also called shrinkage porosity) and other defects.

"In a larger casting, especially with this thickness in the gating system, you can expect to have some dimensional distortion coming from the diecasting, heat treating, or quenching," said Nandha Mariapillai, engineering manager at CCMi. "We had to perform several development studies at each stage of the process. And then we would attack the issue and optimize the process."

A few key creative solutions resulted from the product development phase. Along with a central gating system, CCMi incorporated squeezer cores and jet cooling.

"When we have specific areas where we see shrinkage is a concern on simulation, we apply pressure by activating a core movement in the die with a hydraulically actuated cylinder," Mariapillai said.

The pressure is applied when the casting is in the partly solid, partly liquid condition. A squeeze pin in the mold moves the shrinkage from the critical location while maintaining an optimal cycle time for production efficiency.

A jet cooling pin helps further reduce porosity; it serves as a cooling channel to use a mix of air and water at high pressure directed at a specific location of concern.

Besides reducing weight, producing the part in the high-pressure vacuum diecasting process led to other benefits. Reduced part count meant fewer resources required for assembly. Fewer assembly joints resulted in a safer, stronger, and better performing subframe.

According to Acura, the cast aluminum subframe reduces the vertical and fore/aft forces felt in the front end, and contributes to better weight distribution in the car, which improves handling and fuel efficiency.

The success of the 2021 Acura TLX front subframe highlighted there is more and more opportunity to make big and bigger aluminum castings in vehicles while keeping the ride smooth and its passengers safe. MP

TOUGH LITTLE FOUNDRY TAKES ON BIG CASTING

WITH HANDS-ON, CAN-DO GRIT, AND FORWARD-THINKING AMBITION, SUDDENLY ONE SMALL PLAYER IS PRACTICALLY IN A LEAGUE OF ITS OWN.

Late one wintery day in 2020, a huge 3D-printed sand mold—wrapped in mountains of memory foam—traveled by truck from Cedar Falls, Iowa, to Webster, South Dakota. Upon its arrival to a small, gray and ductile iron foundry, recipients at AFS Member Dakota Foundry felt a mix of elation and trepidation. Though it represented a bargain compared to the $100,000 cost of making tooling, the mold for a one-of-a-kind manufacturing replacement part was still a $30,000 investment. Dropping or bumping it was out of the question.

Printed and shipped in nine sections that the foundry assembled and glued together like a puzzle, the mold would shape the casting of a 2,000-lb. wire-stripper (wire drawing) block used in rare, old manufacturing machines at Parkway-Kew, North Brunswick, New Jersey. Parkway-Kew's owners, a father and son in their 90s and 70s, used a broker to locate a few U.S. foundries with the capability of casting a replica of the part that was last produced in the 1970s and for which no pattern existed.

The finished wire-stripper block casting weighed 2,000 lbs and measured in at 48 in. by 17 in.

"We were the only ones that looked at the prints they sent us, which were from 1951," said Dakota Sales Manager Travis Monson. "They're just hand drawn, and we looked at it like, what the heck is this thing? We were the only ones that got back to him, and that's how the relationship started.

"These machines were made from the 1930s to the 1970s—they're used in the manufacturing of wire. They have about eight total blocks that wrap thick strands of wire around the block while spinning to stretch them to smaller gauge wire," he continued. "They had tried to refurbish it numerous times, trying to add material, but it just kept wearing out. It turned kind of urgent when their equipment was beginning to not operate anymore. There's only very, very few of these places left in the country that do this work, so there's no manuals, there's no parts. There's only prints from the '50s '60s, and '70s—basically a drawing of what the part is and its dimensions."

Each wire stripper block sits on a large motor, Monson explained, and spins at high speed to stretch wire. It's a process that generates a lot of heat, which is why cooling fins are incorporated into the design. The technology of 3D mold printing made it possible to cast the many fine details embedded in the

University of Northern Iowa produced the heavy and intricate 3D-printed sand mold. It then traveled six-and-a-half hours northwest to Dakota Foundry located in the northeastern part of South Dakota.

old prints, which a part designer converted to CAD files for the customer. As a result, Dakota Foundry was able to cast the cooling fins as well as the wire feed grooves with exacting precision.

Specializing in large and rare parts, such as those used in restored steam locomotives, the metalcaster partnered with the University of Northern Iowa (UNI) to produce the 3D-printed mold, which not only saved the customer money but at least two months in turnaround as well.

Big Part, Big Challenges

Communication and collaboration between part designer and foundry is always mission critical to achieving castability, and even more so in the case of producing one very large, detailed, component. One theme of concern Dakota Foundry addressed with the customer and their CAD designer was the thin walls—under a quarter of an inch—for the cooling fins. It became a delicate game of give and take, widening as much as they could, but, said Monson, one adjustment in the simulation model had a ripple effect on other areas. Some tweaks would make the casting design too big and they'd have to creatively configure how to shrink the size back to required parameters.

"We would have a meeting with their CAD designer," said Monson, "and he'd be asking us questions; then all of a sudden you'd hear Gene (the senior owner of Parkway-Kew) in the background saying, 'All those fins got to be bigger than that!' He might not have understood the technology, but after 50 years of running his equipment he knew the fins had to be a certain size."

And so it went, back and forth with emails and calls for about two months, Monson added, till the foundry received the final design.

As you'd expect, once Parkway-Kew received its replacement wire stripper block, which fit and performed to their expectations, the manufacturer now had its go-to supplier for additional parts on other pieces of aging machinery. In fact, Dakota Foundry has already produced two more similar castings.

Student Hired

Owned by entrepreneur and inventor Kory Anderson, who also restores antique steam-powered machinery, Dakota Foundry encountered a setback over the course of its recent casting work for Parkway-Kew. Contacts at UNI for 3D-printed molds informed the foundry that the school could no longer devote the extensive student time required for fulfilling commercial orders.

Dakota Foundry saw so much success with a 3D-printed sand mold for making a wire block, it purchased an ExOne S-Max Flex 3D sand printer after president Kory Anderson saw it in action at a metalcasting industry trade show.

But Anderson, who has a knack for turning obstacles into opportunities, was not deterred. They'd come too far with shortening lead times and cutting costs for customers with the 3D-printing technology to chuck it now. So, Anderson opted to purchase an ExOne 3D printer for the foundry.

The printer was installed in the fall of 2022, and the team is learning how to use their new technology now that they're one of a few foundries in the country to offer 3D-mold printing in-house. To make the transformation complete, Dakota Foundry hired a new foundry engineer, too, but not just any engineer.

"He just graduated from the University of Northern Iowa," Monson said. "Taylor was one of the guys who used to do our work! Kory saw that he was graduating, and he's like, 'Hey, what are you doing after graduation?' And he says, 'Well, I need a job.' And Kory's like, 'I think I've got something for you.'

"We're already getting a lot of interest and inquiries," Monson continued, "and from customers, too. They're like, 'We're so happy to hear you're investing in your foundry.' And that's all on Kory—he's a forward thinker who says you have to be growing, you have to be advancing. The technology's there, let's get it. Fifteen years ago, I would never have thought we'd have a 3D-printer in this place. This is big news for us. We're a pretty small player in the grand scheme of things, but we can do a lot of things that big places can't, and we're proud of that." **MP**

FOUNDRY CAREER SPOTLIGHT: ROBOT PROGRAMMER

EAGLE ALLOY INVESTED IN BUILDING ROBOTIC GRINDING CELLS—AND IN TRAINING EMPLOYEES TO PROGRAM THEM.

IN MANUFACTURING, robots are often associated with high volume production—where a robot is on an assembly line performing the same tasks over and over again. But robots are used by a wide variety of manufacturers, including foundries that make smaller quantities of complex parts. In these businesses, robots need a lot of programming to perform activities that change from part to part frequently.

Eagle Alloy in Muskegon, Michigan, began its robot journey in 2016 to eliminate labor-intensive jobs while teaching new tech-savvy skills to its existing employees.

Eagle Alloy makes steel castings for about 20 different industries. The average casting it produces is comparable to a 20-lb. valve at a quantity of 1,000 pieces a year. Prior to robotic grinding, its manhours-per-net-ton was between 55 and 60.

When Eagle Alloy first began exploring robotic solutions on the market, the foundry discovered that the available options had very high initial cost yet were slower than manual production. Eagle Alloy's parts were not ideal for robotic programming, and surface finish and flaws would affect part locating.

Eagle Alloy's three robotic cells netted the company a savings of $350,000 in labor and freed up the equivalent of seven full time employees to be reassigned elsewhere in the foundry. Two employees were trained in robotic programming to prepare parts to be processed through each cell.

Ultimately, the company decided to create its own robotic grinding cell that would fit its facility.

The first initial concept was to incorporate two robots, with one performing plasma cutting and heavy grinding, and a second, smaller robot working on finer details of the casting. A conveyor removed the cut-off gating, and two shuttles brought the parts into the cell.

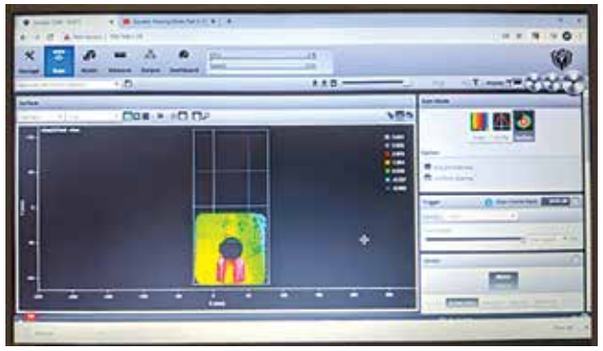
The robot cell was first built in a spare warehouse for testing out the concept. Initial trials were conducted by the foundry's engineering department and an outside programmer who was local but not familiar with the foundry industry.

Once the engineers were confident in the working robotic cell design in the spare warehouse, they disassembled and easily re-assembled the cell for production trials to begin in the production environment.

Based on the success of the first cell, Eagle Alloy gradually added a second, third, and fourth robotic cell, each improved upon the last.

By 2019, Eagle Alloy felt comfortable enough with the robots to try to do its programming in-house. Each part design that would be processed in the robotic cell required programmed steps specific to that parts dimensions. The outside programmers Eagle Alloy had been using had little understanding of foundry needs and often took longer than desired to program a new part.

Foundry leadership selected one shop floor employee and one engineering intern with an interest in robotics to train for this programming role. Eagle Alloy took advantage of ABB University's training classes and partnered with a local community college for specific training classes. It also used a training grant from the state of Michigan.



<< Automatic dimensional inspection helps the robot can "see" the part and know exactly how to grab it. The robot will make the necessary adjustments so the part is given to the grinder at the right spot with the right pressure.

The in-house programming was a game-changer for Eagle Alloy. Where it would take an outsourced programmer two weeks to develop a new part program, the foundry is now only two days away from grinding a new part number.

ABB also has Robot Studio programming that can be done offline to avoid stopping work in the cell. This has allowed the foundry programmer to quickly construct robotic programming code using CAD built-in Solid Edge and create it for multiple robotic cells.

As of September 2022, Eagle Alloy had more than 32 part numbers programmed on its first three robotic cells. A fourth robotic cell was just completed in July 2022. Most of the parts are programmed for multiple robot cells to avoid delays. The parts are chosen first based on volumes, and second based on issues surrounding the part—the pieces the operators hate to manually grind. Setup times vary from 10–25 minutes with one operator.

Eagle Alloy estimates the robotic cells have reduced the manhours per net ton from 55-60 to around 40-48. The labor savings amounts to about 15,000 hours per year, or approximately seven full-time employees who can now fill labor gaps elsewhere in the facility.

Based on the success of the robotic cells, Eagle Alloy continues to work to improve robotic cycles and is constantly increasing its list of programmed part numbers across all four cells. Theh foundry is building in redundant programming so the same part can run across multiple cells.

While automation may at first make you think of high-volume production—like in a car factory, at Eagle Alloy, robots have proven to be just as useful in a low-volume shop. They improve safety and make businesses more productive. **MP**

TEACHING YOUR TEACHERS AT INDUSTRIAL ARTS CAMP

ONE OF THE FOUNDRY INDUSTRY'S missions is to support partnerships among students, educators and industry and draw a continuous supply of students toward metalcasting.

The Foundry Education Foundation (FEF), FEF universities, FEF partners, and industry societies are providing opportunities to educate teachers through summer camps.

The University of Northern Iowa participated in a camp in 2021 that was part of a statewide initiative to allow teachers to gain credit for their certification.

"The purpose was to provide advanced training in various technology areas for high school industrial arts teachers," said FEF Key Professor Scott Giese. "Metalcasting was selected because the activity is a hands-on, interactive experience."

One of the best ways to learn is by doing. This camp included an activity in the foundry performing the green sand molding process with molten aluminum.

Another camp was held in 2022—the ASM Teachers Camp at the University of Michigan. This was a Year 2 camp for teachers who have completed a camp previously and want to learn more about materials science and teach more of it in their own classes. About 20 teachers (mostly high school, but a few middle school and two-year college teachers) spent a half day doing Foundry in a Bucket with several volunteers from ASM, AFS, and FEF joining in the fun.

These teacher camps help educators see the vibrancy of the metalcasting industry and its career opportunities. **MP**

PHOTO: © WARUT / ADOBE STOCK

CASTINGS DO THAT?

Streetlights Add to a Capital Design

STREETLIGHTS DO MORE than just add light to an area. Their design can set a vibe and enhance a landscape.

One example is the work done by Spring City Electrical (Spring City, Pennsylvania) at the Maryland state capital in Annapolis. Their "Clearwater Luminaire" adds a colonial touch to the grounds, and even has a pole and flag bracket so the Maryland flag can be flown.

"Spring City's Clearwater Luminaire is the preferred style when trying to achieve a colonial landscape," the company said in a brochure. "Maryland's state capital is steeped in historical relevance and the Clearwater represents modern technological advances while paying aesthetic homage to the capital city's historical roots of street lighting."

The ductile iron lamppost is made in a horizontal green sand floor mold, and the core is made of chemically bonded sand. The lighting fixture is made of aluminum castings and uses LEDs, and Spring City president Alan Brink said "aesthetics are very important in that people have close contact with these posts."

Brink also highlighted the finishing efforts on the posts.

"All grinding marks are covered with filler prior to painting," he said. **MP**

PARCHMENT IMAGE: © ROMAN'S PORTFOLIO / ADOBE STOCK

METALCASTING UNIVERSITIES & SCHOLARSHIPS

Find a College to Study Metalcasting

Ready to launch your metalcasting career? Want to know where to get started? These colleges are optimal institutions to consider if you are interested in metalcasting as a career.

Arizona State University
Tempe, AZ

California Polytechnic State University
Pomona, CA

California State Polytechnic University
San Luis Obispo, CA

California State University—Chico
Chico, CA

Central Washington University
Ellensburg, WA

Eastern Michigan University
Ypsilanti, MI

Georgia Southern University
Statesboro, GA

Instituto Tecnologico De Saltillo
Saltillo, Coah, Mexico

Kent State University
Kent, OH

Michigan Technological University
Houghton, MI

Milwaukee School of Engineering
Milwaukee, WI

Missouri University of Science & Tech
Rolla, MO

Mohawk College
Hamilton, ON, Canada

Ohio State
Columbus, Ohio

Penn State Erie—The Behrend College
Erie, PA

Pennsylvania State University
University Park, PA

Pittsburg State University
Pittsburg, KS

Purdue University
West Lafayette, IN

Saginaw Valley State University
University Center, MI

Tennessee Tech University
Cookeville, TN

Texas State University—San Marcos
San Marcos, TX

The Ohio State University
Columbus, OH

Toronto Metropolitan University
Toronto, ON, Canada

Trine University
Angola, IN

University of Alabama—Birmingham
Birmingham, AL

University of Alabama—Tuscaloosa
Tuscaloosa, AL

University of California—Irvine
Irvine, CA

University of Michigan
Ann Arbor, MI

University of Northern Iowa
Cedar Falls, IA

University of Wisconsin—Madison
Madison, WI

University of Wisconsin—Milwaukee
Milwaukee, WI

University of Wisconsin—Platteville
Platteville, WI

University of Wisconsin—Stout
Menomonie, WI

Virginia Tech
Blacksburg, VA

Western Michigan University
Kalamazoo, MI

Youngstown State
Youngstown, OH

College Scholarships Available...

YES!

Visit American Foundry Society Chapters at:
www.afsinc.org/chapters

Visit the Foundry Educational Foundation at:
www.fefinc.org

CAREER OPPORTUNITIES

Do You Like:

- Science?
- Building things?
- Designing things?
- Being creative?
- Working with people?
- Solving problems?

Consider Metalcasting. We Need:

- Business Managers
- Chemical Engineers
- Computer Engineers
- Electrical Engineers
- HR Professionals
- Safety Managers
- Accountants
- Quality Control Technicians
- Marketing & Salespeople
- Mechanical Engineers
- Metallurgists
- Skilled Tradespeople

Careers: Post High School

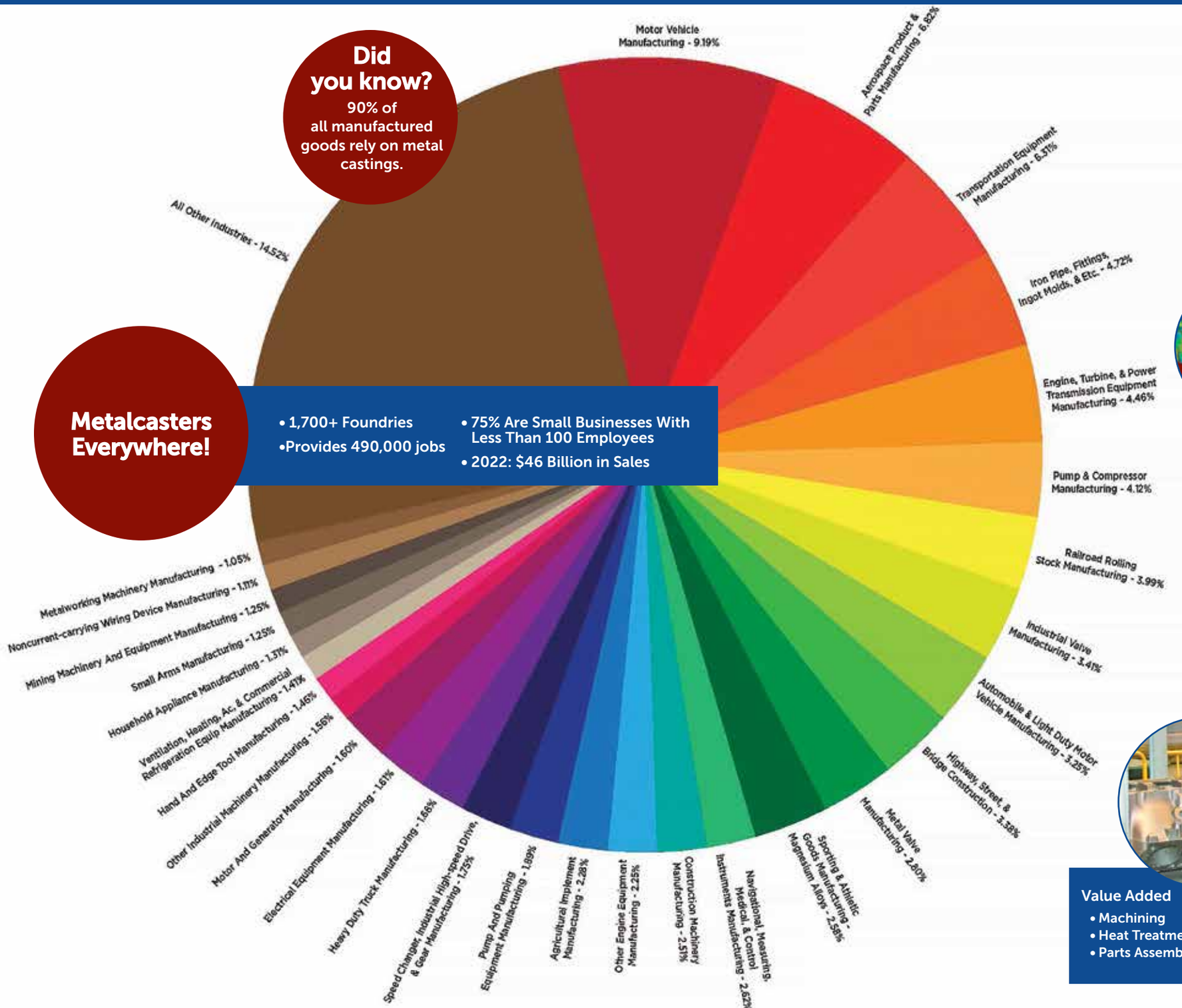
- Molder, Machine Operator, Pourer, CraneOperator
- Lab Technician, Quality Assurance, Welder, Furnace Operator
- Patternmaker, Maintenance Mechanic
- Electrician

Careers: Post College

- Metallurgist, Quality Assurance Manager, Facilities Manager
- Engineering Manager, Plant Manager, HR Manager, Controller
- Sales Manager, Technical Director
- VP, President

WHERE DO CASTINGS GO?

Did you know?
90% of all manufactured goods rely on metal castings.



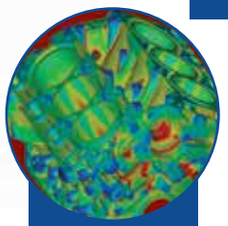
Metalcasters Everywhere!

- 1,700+ Foundries
- Provides 490,000 jobs
- 75% Are Small Businesses With Less Than 100 Employees
- 2022: $46 Billion in Sales

METAL CASTING SUPPLY CHAIN

Pattern & Tooling

Raw Materials & Equipment



Engineering

Metalcasting Facility

Value Added
- Machining
- Heat Treatment
- Parts Assembly

End Users of Castings

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