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MELTING POINT

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SAFETY FIRST

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.

TABLE OF CONTENTS

FEATURES

DEPARTMENTS

LIGHTS. CAMERA. CASTING

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

The popular Lodge cast iron skillets are manufactured in an impressive Tennessee foundry that just opened its own museum last month. See how Lodge makes it's cast iron products at www.lodgecastiron.com/about-lodge/how-its-made.

Did you know copper kills germs? Read more on page 6 and watch how it's being used in public transportation in Vancouver, Canada. Watch the video at https://bit.ly/3AsqSB3.

Know you want to go to college for engineering or metallurgy? Consider attending a college affiliated with the Foundry Educational Foundation. Scholarships are available, and graduates are highly sought after by employers in the industry. Watch the video at https://bit.ly/3LlR6sH.

A STUDENT'S STORY:

My Winding Path to the Foundry

My journey into manufacturing engineering began at a young age. I was raised in several group homes in Southern California until I was adopted at age seven. As a child, I was always taking things apart. I loved figuring out how things worked, and I would try to put them back together, sometimes unsuccessfully.

In 2008, I was accepted into Cal Poly Pomona college right after high school. But the truth was, I was not a good student and had to drop out due to financial reasons. My parents' neighbor was a production manager at an extrusion shop where I spent the next six-and-a-half years, saving money with the goal of returning to finish my undergrad studies.

In 2018, I returned to Cal Poly Pomona. In my courses for manufacturing engineering, I was exposed to the concepts of material sciences and metalcasting. I think learning about the processes and problems of casting metal, as compared to what I knew about extrusion, is what fascinated me.

Unfortunately, in July 2020, I lost my job at the extrusion shop and had a difficult time finding work that could fit around my school schedule. After burning through my savings, I became homeless. I was living in my truck or sleeping on couches as I could. I was still able to go to school with loans, thankfully, so I didn't need to drop out again, but times were tough.

My advisor and professor, Dr. Victor Okhuysen (FEF Key Professor), helped me find an internship at Consolidated Precision Products in Pomona, a foundry that specializes in aluminum and magnesium. I began working in January 2021.

I enjoy metalcasting and its complexity. At the extrusion shop, we had a few experts who had worked there for decades; when problems arose, they would have procedures in place to solve these problems. This is different than at the foundry where I worked. The metalcasting process had many potentially overlapping sources of defects: sand fine grades, binder type and quality, ambient temperature, temperature of the pour pot, and metallurgical composition of the metal in the pot. There was so much to learn in the short time that I was at the foundry. This made work exciting and challenging; the engineers and interns had to sit and think of solutions, not just enact pre-proven strategies.

Now that I've finished my undergrad work, I'm contemplating two paths going forward: take the FE/PE exams or enter a master's program.

Two goals that I want to work toward are buying a house for my mother and niece and running my own shop. I would like a metalworking area (mill, lathe, and foundry) and a woodworking area (saws, lathes, etc.) I love the idea of coming home smelling like coolant and sawdust or just setting up a cot in my shop.

But I see myself enjoying many types of work. I love talking and interacting with people, and I tend to take leadership roles when I can. So, I could see being a manager and/or eventually a chief position. My favorite classes, however, have always been the technical ones. I fell in love with the material sciences from the Manufacturing Processes – Materials course, and because of this course I started planning on a metallurgical or material science master's degree.

I look forward to continuing my journey in the metalcasting industry! MP

Who's Ready for a Copper-Covered World?

Did you know copper has broad antimicrobial properties? Experts are urging more companies to use copper products to halt the spread of illness.

What's the most dangerous instrument known to mankind? Fitness supply-house owner Tom Grace claims its human hands, which transmit legions of germs and diseases through touch. That's why copper is his material of choice for much of his fitness equipment. Copper is antimicrobial, which means it has the incredible ability to kill germs

"It never calls in sick, it shows up for work 24/7 and never quits," he said. "It's a low-tech, very cost-effective solution where you only pay the delta one time."

Grace's company, Black Iron Strength, has served many college and professional athletic teams since its inception in 1992, and was one of many businesses that began using copper after the U.S. EPA first registered the pure form of the metal as a bacteria-killing surface material in 2008.

That was the last major EPA decision on copper's antimicrobial properties for the next 12 years—then COVID-19 showed up.

Suddenly, decades of research on copper's antimicrobial heroics compiled by the Copper Development Association (CDA)—and a good many other studies, including a pair of

eye-openers from the CDC and the NIH—shifted EPA into an abrupt fifth gear. In February 2021, the agency announced it was recognizing "less pure" copper alloys as having the ability to kill viruses, as long as they comprised at least 95% copper.

Overnight, companies across every industry could put the EPA-approved virus- and bacteria-killing claims of copper on their product labels, as long as they sourced EPA-registered copper alloy compositions from EPA-registered suppliers. And while no one anticipated or remotely desired the global pandemic, it was indeed an inflection point for copper to potentially star in a host of applications well beyond hospitals, encompassing often-touched surfaces in schools, restrooms everywhere, restaurants, hotels, food processing factories, mass transit, airports, laboratories, cinemas, retail and office environments, fitness, HVAC, and more.

"It certainly stimulated a lot of activity and innovation in the supply chain as more and more companies became curious about these materials and were trying to figure out how they might be able to incorporate copper surfaces into some of their products," said Adam Estelle, CDA director of rod and bar.

Marketplace Snapshot

Grace first read about copper's germ-killing properties in 2009 and became so zealous about its potential health and safety advantages in the fitness industry that he spent four years of R&D—and considerable consultation with the CDA—to engineer a process for incorporating a solid copper alloy into the knurled handle grips of his company's free weights. His first customer for copper products was the U.S. Olympic Committee, which was outfitting a new training center in Colorado Springs.

Black Iron Strength's copper orders went from 40% pre-COVID to 90% today, and both college and professional sports teams have been early adopters—with high stakes in the health of their star athletes.

"I'm a privately-held company, and I have a long-term vision," he said. "I'm all in. I see the big picture, and I know this is going to grab on once things start getting back to some new type of normal. I'm very patiently waiting for that."

His optimism springs from positive persuasion that copper has no downside. The material only costs 10% more on average, and with EPA's science-backed stamp of approval, Grace said he's confident copper adoption in the fitness world will indeed trickle down from pro and college sports to mainstream workouts.

"What are the negatives? There really aren't any," he said. "OEMs have the opportunity to provide whatever product they make using antimicrobial copper, which, now more than ever, the world desperately needs."

International Snapshot

The world of academia continues to join with industry in the pursuit of more understanding about copper and developing more ways to harness its protective activity. On December 13, RMIT University in Melbourne, Australia, announced it had developed a new process for creating copper surfaces in castings whereby bacteria—and antibiotic-resistant superbugs—are killed 100 times faster than standard copper. The university, together with Australia's national science agency, CSIRO, published its findings in "Biomaterials." (https://bit.ly/RMIT-copper)

"A standard copper surface will kill about 97% of golden staph within four hours," said RMIT Distinguished Professor Ma Qian, who began his career in metalcasting. "Incredibly, when we placed golden staph bacteria on our specially-designed copper surface, it destroyed more than 99.99% of the cells in just two minutes."

According to RMIT's press statement, the release of copper's ions—toxic to bacterial cells as well as virus cells, per the U.S. EPA—is a slow process and researchers worldwide are racing to discover how to speed it up.

Because copper kills harmful microbes continuously and seems unfettered by metalcasting as well as metal forming and fabricating processes, the sky's the limit on how humans will apply the germ-shield gifted from nature.

"We're going to continue to see all sorts of different ways that we can capitalize on this property of copper," said Estelle at the CDA, "and we're working to make sure we get more and more options out there to do that." MP

DON'T FALL!

A fall-protection system hinged on a hook that had to be light and super strong—after years of trial and error, what this persistent inventor wanted was a metalcasting "witch doctor." What he got was metalcasting science at its best.

In oldies radio, being "Up on the Roof" may be "as peaceful as can be," but in the real world, working on a rooftop is a darn scary proposition. In fact, Flent Ballantyne called it horrifying. But one man's rational fear of falling was the catalyst for inventing a unique fall-protection system—and an aluminum casting proved to be the solution.

Ballantyne, who owns a lawn treatment business in North Texas, began a side business of installing residential Christmas lights to supplement his income with winter work. He quickly realized the risks of sloped roofs on homes, and he was surprised there was no product on the market that would keep him safe in the residential environment. The only adequate protection he could find involved hammering a piece of steel into the roof and securing ropes to that—an unpopular if not impossible option among most homeowners, he said.

So, this trained musician, lawn pro, and lights hanger became an inventor who set out to develop a non-penetrating hook device specifically designed to protect workers from falling off sloped roofs. Priority 1: He wanted a minimum of 7,200 lbs. of strength; Priority 2: He insisted on a solution light enough to be carried up a ladder.

Little did he know he was about to embark on over a decade's journey to invent his final "EVEOOK" system based on a 20-lb. cast aluminum, C-shaped hook produced by Carley Foundry in Blaine, Minnesota.

The device, which is attached to wheels and rope, hooks below the eaves on two opposite sides of a house. It's installed from either the ground or a ladder (with fall protection) in as little as seven minutes by two people or under 15 minutes by one. Able to withstand twice the OSHA standard for weight force—10,000 lbs., not 5,000—EVEOOK meets ANSI Z359 standard for fall protection and restraint as well as other related OSHA standards.

"It is freaking extraordinary," Ballantyne said. "It's light, just 20 pounds; the thing is 23 inches tall, 32 inches long, it holds 2,000 more pounds than we asked for. It's so easy to install and to use. It's like if we would have said 'I have dream' and this is better than perfect.

"We incorporated all the common-sense things that nobody else does. And the strength in such a light product is just amazing."

The first prototype was made from a steel rod; a later version was an I-beam from sheet aluminum that required some gluing in the manufacturing process. Ballantyne also explored sophisticated plastics, which proved cost prohibitive. He worked with engineers and plants from Texas and California to China and

Canada—all of whom struggled to achieve Ballantyne's concept for a lightweight hook that could stop at least 7,200 lbs. of free-falling force. All struggled, that is, but one: Carley Foundry.

The final EVEOOK part was cast in aluminum via a process called semi-permanent mold casting, which uses a metal mold and cores made out of sand.

A fundamental shortcoming in the hook's early versions was low torsional rigidity—no one falls in a perfectly straight line, and the hook needed to stand up to pull forces that twisted against them. Carley corrected the issue by creating heavy walls where it would be highly stressed and thin walls where less stressed.

To reduce weight, the EVEOOK design incorporates several holes. The foundry uses another business to paint and label the hooks before delivering the ready-to-assemble castings to Ballantyne's distribution warehouse in Colorado.

In the end, Carley Vice President of Engineering Randy Oehrlein said Carley Foundry was gratified by the opportunity to bring their creativity and expertise to the designing of a successful part and to make their customer happy.

Did Ballantyne imagine it would take him 14 years to see his invention to completion? Assuredly not. But one of his engineering comrades along the way affirmed that Flent would've traveled the path to create the EVEHOOK even if he had foreseen the challenges.

"I said, 'why would I have?'" Ballantyne recalled. "He said to me, 'because it was what you should do.' He was right." MP

Manufacturing Returning in America

Global supply chain disruption is a phenomenon we have all experienced, from being unable to find your favorite sriracha hot sauce to scrambling to find toilet paper.

Component and raw material shortages are derailing production, and soaring shipping rates may take more than two years to return to normal levels, all amidst growing tensions with China. Companies are looking for ways to be more resilient and studying the costs and risks of extended global supply chains. After decades of U.S. businesses sending manufacturing to lower cost countries, a shift to bring those jobs back to the U.S. (reshoring) or neighboring countries (nearshoring) has occurred. More people are recognizing the importance of the ability to make things closer to home.

Data from Reshoring Initiative, which tracks information on manufacturing trends in the U.S. (www.reshorenow.org), shows that reshoring and foreign direct investment (FDI) job announcements for 2021 were over 220,000. Manufacturing employment is three million higher than would have been predicted just 13 years ago.

For many years, businesses were buying goods based on the lowest price—but they weren't always considering the total cost. Harry Moser of the Reshoring Initiative, has been working with U.S. companies to calculate the total cost of ownership (TCO) of a part so they can objectively quantify, forecast, and minimize total money spent. It takes into account 29 different costs and risks associated with sourcing a manufactured good—such as the cost of not being able to sell a product because of supply chain disruption.

The growing trend of American businesses re-examining where their goods are coming from can be seen in the number of investments made into the manufacturing plants in the U.S. over the past several years. Many examples of this are shared here.

New U.S. Investments

General Motors is investing $51 million in its aluminum diecasting facility in Bedford, Indiana, to support production of drive unit castings for the Chevrolet Silverado EV and other current products.

Toyota West Virginia (TMMWV) recently announced a $240 million investment to add a production line of hybrid transaxles. "This project is more than just a new product. It demonstrates the need for TMMWV and our path forward as we increase our powertrain capabilities to better support Toyota Motor North America's growing manufacturing footprint by building vehicles where we sell," said Srini Matam, president of TMMWV.

Acme Alliance LLC, a leading diecaster in Northbrook, Illinois, received the 2021 National Metalworking Reshoring Award in recognition of its success in bringing

manufacturing back to the U.S. Acme Alliance was chosen for its record of reshoring products for its customers. In one case, its reshoring fixed a quality problem and cut the customer's inventory by 94%. Acme also has successful facilities in Brazil and China. By not shipping from those facilities to the U.S., Acme has proven that reshoring is not only possible but the right business choice.

Companies Prosper With a U.S. Footprint

Chicago-based, charcoal and gas grill manufacturer Weber Stephen Products experienced overwhelming demand for its grills due to more people cooking at home during the pandemic. But Weber fared better than many with pandemic-induced disruptions because they retain a large U.S. manufacturing footprint.

"We still have some impact when dealing with ocean containers, but it's generally reduced compared to our competitors who are mostly importing from China," said Chris Scherzinger, CEO of Weber. "Because we have a large U.S. manufacturing footprint, we've been insulated to some degree, but it still means when the demand spikes like it has, we have to rally and produce at record-setting levels." Scherzinger credits localization, new technology, and a dedicated staff for a successful response to the increased demand.

Stanley Black & Decker has been building a competitive edge through digital transformation with a dedication to innovation, technology, and training. Sudhi Bangalore, Stanley Black & Decker's CTO for global operations and global vice president of industry 4.0, said one of the goals integral to supporting this transformation is to "Build where we sell, and source where we build."

Stanley Black and Decker CEO John Loree concurred: "We have a philosophy of 'make where you sell.' When we purchased Craftsman in 2017, we were determined to revitalize this iconic U.S. brand and bring back its American manufacturing heritage."

In 2019, Stanley Black & Decker invested $90 million in a 425,0000 sq.-ft. facility to shift production of its Craftsman tools from

China to Texas, creating 500 new U.S. jobs. The company reported no increase in costs and "much less impact from the coronavirus than would have been the case if it had remained in China."

Foreign Direct Investment

Family-owned German automotive supplier Kirchhoff Automotive is investing $15 million in its sixth U.S. factory in Lawrenceville, Georgia, creating 73 jobs. Kirchhoff, which prides itself on operating factories near its customers to reduce parts inventory with a just-in-time strategy, makes structural auto body components like front ends, chassis, and cross beams for Mercedes-Benz, BMW, and other automotive customers.

A $2.7 million investment in a joint venture between German and Japanese chain manufacturers (iwis-Daido LLC) will bring production of automotive engine chains to Murray, Kentucky. The facility, originally opened in 2015, was the first U.S. operation for iwis for the production of timing drive systems for engines. The partnership will add 10,000 sq.-ft. of space to produce automotive engine chains for major auto manufacturers and create 37 jobs.

Setting Up Shop in the U.S.

Southern California-based Mullen Automotive announced plans to create 800 jobs and deliver 100,000 electric vehicles (EVs) within a five-year time period. With a long-term lease on an 820,000-sq.ft. facility in Memphis, Tennessee, and the recent purchase of a facility in Tunica, Mississippi, both facilities will provide advanced engineering and manufacturing capabilities to support Mullen's manufacturing requirements for the next decade.

"Memphis' location makes it a primary logistical hub for distribution throughout the U.S. and will provide Mullen with key strategic advantages. The local and state-level administrations are both fully supportive of our manufacturing plan and are showcasing their commitment with significant financial incentives that will help us grow along with the city and state over the next decade," said John Taylor, vice president of Manufacturing for Mullen.

Reshoring and Economic Growth

Reshoring enables risk mitigation, resilience, agility, responsiveness, and faster time to market. As the reshoring trend accelerates, it will drive more economic growth by creating jobs, reducing unemployment, and balancing trade and budget deficits.

New York-based Hardinge is shifting the manufacture of its milling and turning machining center solutions from its Taiwan plant to its plant in Elmira, New York. They cite supply chain interruption, natural disaster, and political instability risk as negative factors to offshore; image/brand and impact on the domestic economy are positive factors that made reshoring attractive.

"We are very excited to make this move, as it brings the products closer to the customers we serve and leverages the many years of experience we have in Elmira. It also enables us to bring capabilities back to the U.S., which we are extremely proud to do," said Chuck Dougherty, who was then president and co-CEO at Hardinge.

Through reshoring, American businesses can meet consumer expectations and reconcile concerns about far-flung supply chains. At the same time, they deliver quality products while eliminating the hidden costs and risks of offshore manufacturing. MP

education through research

Luis Trueba is the FEF Key Professor at Texas State University. Margaret Lee is one of his students. In the fall of 2019, Professor Trueba approached Lee to see if she was interested in working on a research project that involved investigating the ability to repair casting defects in aluminum alloy 201 by a procedure called friction stir processing.

"I approached Margaret because she was working as an undergraduate teaching assistant in the introductory foundry course and was concurrently taking the senior-level foundry course that I was teaching," Professor Trueba said. "It was clear to me that Margaret had an exceptional interest in foundry science and outstanding academic skills."

Lee jumped at the opportunity.

"Although the project area was unfamiliar to me, I thought this would be a good opportunity to learn new technology while furthering my education," she said. "It was exciting to know this project should be beneficial to the foundry industry because it develops a technique that can be used to repair castings and improve their mechanical properties."

Learning by doing is an important facet of FEF schools' metalcasting courses. What has Lee learned so far working on this project?

"I have learned how to navigate unforeseen challenges due to COVID (leading to a few delays)," she said. "I have also learned to deal with unexpected research challenges. I learned to use solidification modeling software, to design and produce foundry patterns, perform mechanical testing, and I have gained more experience with CAM and generating code to run a CNC. And, of course, I have learned about friction stir processing!

"This work has really suited me because I enjoy hands-on work, and I have found it to be a very interesting area. I believe I will be able to apply the knowledge and skills I have gained in my future career as a foundry engineer." MP

Making Things That Matter: Opening and Closing a Dam's Gates

Visit Liberty Utilities' Powersite Dam in Forsythe, Missouri—one of the first original hydroelectric dams in the state—and you'll come away with two different perceptions depending on where you spend your time: Picnic and play outdoors at the site's park-like grounds and feel refreshed, or, for insiders only, tour the inner-workings of the 100-plus-year-old dam structure.

Either way, Taney County's dam on the White River, which, upon its completion, created Lake Taneycomo in 1913, is a historic landmark cherished by the community, especially locals like Mike Renfrow who value the preservation of old things that tell stories of the past. Renfrow, who is general manager at Monett Metals foundry, is now a part of the dam's story, having worked with a team that reverse-engineered replacement cast-iron crossheads needed for each of the dam's four generators.

The crosshead is critical to the opening and closing of the dam's 36 gates, which are held closed by the river itself. Each crosshead bears up to an estimated 1,500 ft. lbs. of torque.

Over time, the dam's original equipment has been updated, retrofitted, and digitized. Hydraulic rams have been added to one end of each crosshead so they are controlled with hydraulics, but they can still be manually adjusted. Today, a bar attached to the crosshead digitally sends a signal between crossheads and gates. In the dam's control room, old, original dials remain side by side with a

new, state-of-the-art control system that displays real-time data. The aged crossheads are next on the list of necessary upgrades to keep the dam functioning.

The first replacement casting sample was approved in August, and the finished, machined part was installed at the dam. A month later, the remaining three crossheads were completed then installed at the end of September, and Renfrow was glad to be part of the "backstage tour" and hands-on experience of putting his company's work into place as part of the dam's continued legacy.

"When we were unloading the crossheads at the dam and I was running the hoist, it gave me a lot of pride," Renfrow said. "You know, foundry work is a hard job. But when I have a young employee who I see has potential, I tell him, 'You can go down the road, and you can work at a call center, or you can go somewhere and put widgets in a box. But here, we make things that matter. When I drive around town, I'm looking for something that we made, and it gives you a sense of pride that you make something that matters.' That is certainly true about this project." MP

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

Penn State Erie—The Behrend College
Erie, PA

Pennsylvania State University
University Park, PA

Pittsburg State University
Pittsburg, KS

Purdue University
West Lafayette, IN

Ryerson University
Toronoto, ON, Canada

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

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

College Scholarships Available... YES!

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

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

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

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, Crane Operator
- Lab Technician, Quality Assurance, Welder, Furnace Operator
- Patternmaker, Maintenance Mechanic
- Electrician

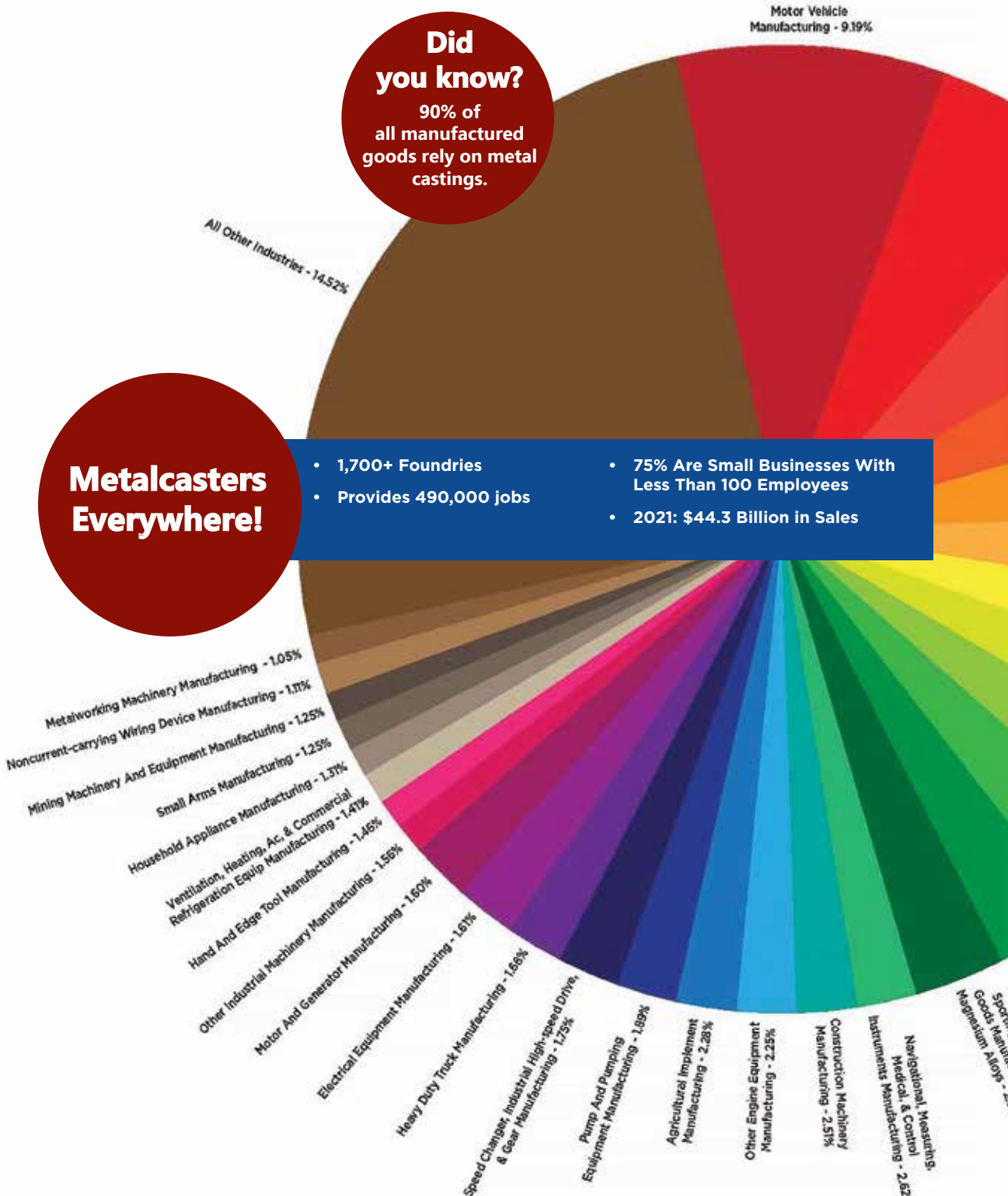
Careers: Post College

- Molding, Melt Superintendent
- 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?

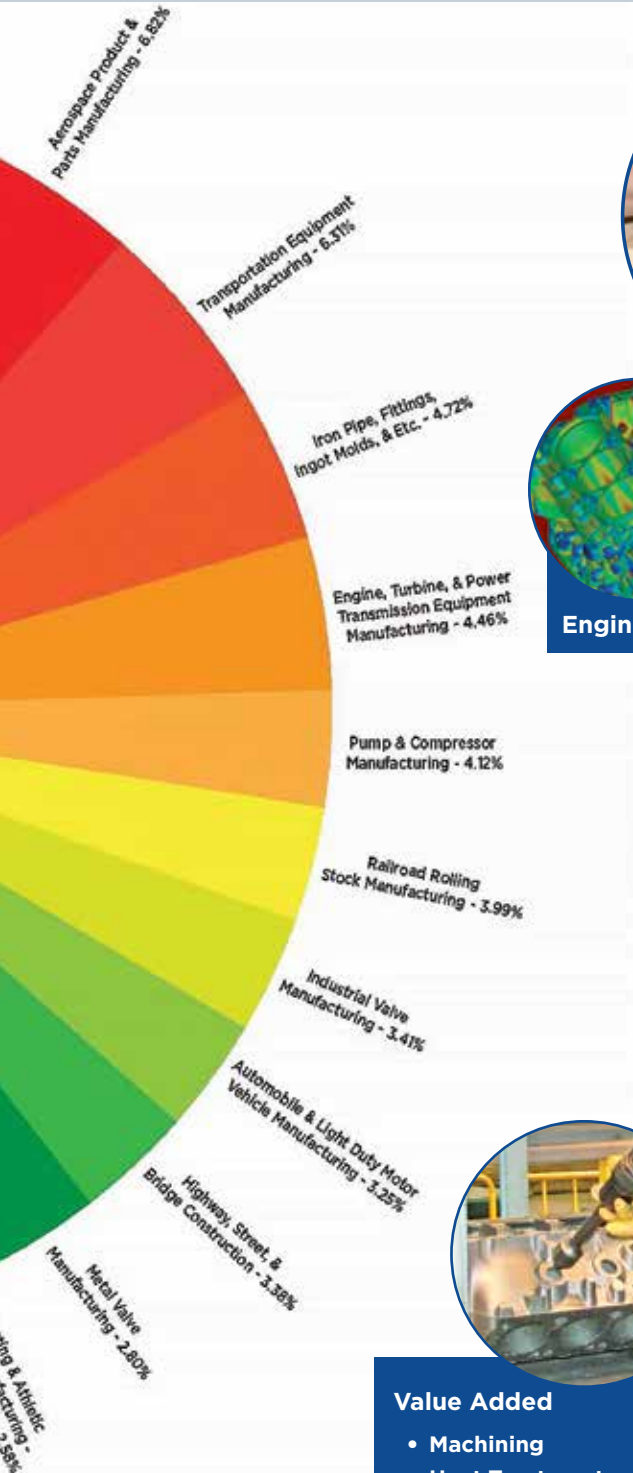
90% of all manufactured goods rely on metal castings.



Metalcasters Everywhere!

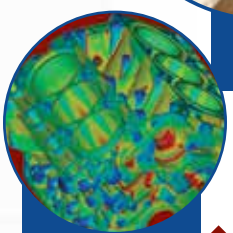
- 1,700+ Foundries
- Provides 490,000 jobs
- 75% Are Small Businesses With Less Than 100 Employees
- 2021: $44.3 Billion in Sales

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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