

MELTING POINT

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CASTINGS FIT FOR A KINGDOM

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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.



Dive into the fascinating world of metalcasting! Explore the intricate process, grasp its significance in daily life, and uncover rewarding careers with the Spotlight on Metalcasting video from the American Foundry Society and Foundry Educational Foundation.



Learn more about the Hoover Dam, what it does, and how it works, by watching this video from Interesting Engineering. To read about important castings used in the dam, go to page 18.



What would it be like to work as an industrial technician in a factory like Mercury Marine (see story on page 6)? Watch this video and find out!



SCHOLARSHIP WINNER AND HER LOVE FOR METALCASTING



Maria Alverio receives her scholarship award from Jean Bye.

LAST YEAR, MARIA ALVERIO, a recent graduate student from the University of Northern Iowa, was the first winner of the Jean Bye AFS Women in Metalcasting Scholarship. This scholarship was created to invest in creative and technically-trained female students who are passionate about metalcasting. The goal of the scholarship, which is named to honor the extraordinary career of Jean Bye, former CEO of Dotson Iron Castings, is to encourage innovation and leadership for the metalcasting industry while giving back to help the next generation pursue a manufacturing career.

Alverio became interested in metalcasting as a freshman: "Seeing molten aluminum for the first time, I knew metalcasting was what I wanted to do the rest of my life."

She not only excelled in her classroom and lab courses, but Alverio was also involved in competition and fundraising activities with the UNI AFS student chapter and had the pleasure of introducing metalcasting to middle school girls with the SWE New Horizon workshop. During her collegiate years, she expanded her experiences through internships with Clow Valve and Carley Foundry. She graduated in the spring of 2022 and now has started her career as a process engineer at Carley Foundry.

Thanks to generous donations from Dotson Iron Castings, Air Products Foundation, and others, FEF and WIM created this endowment



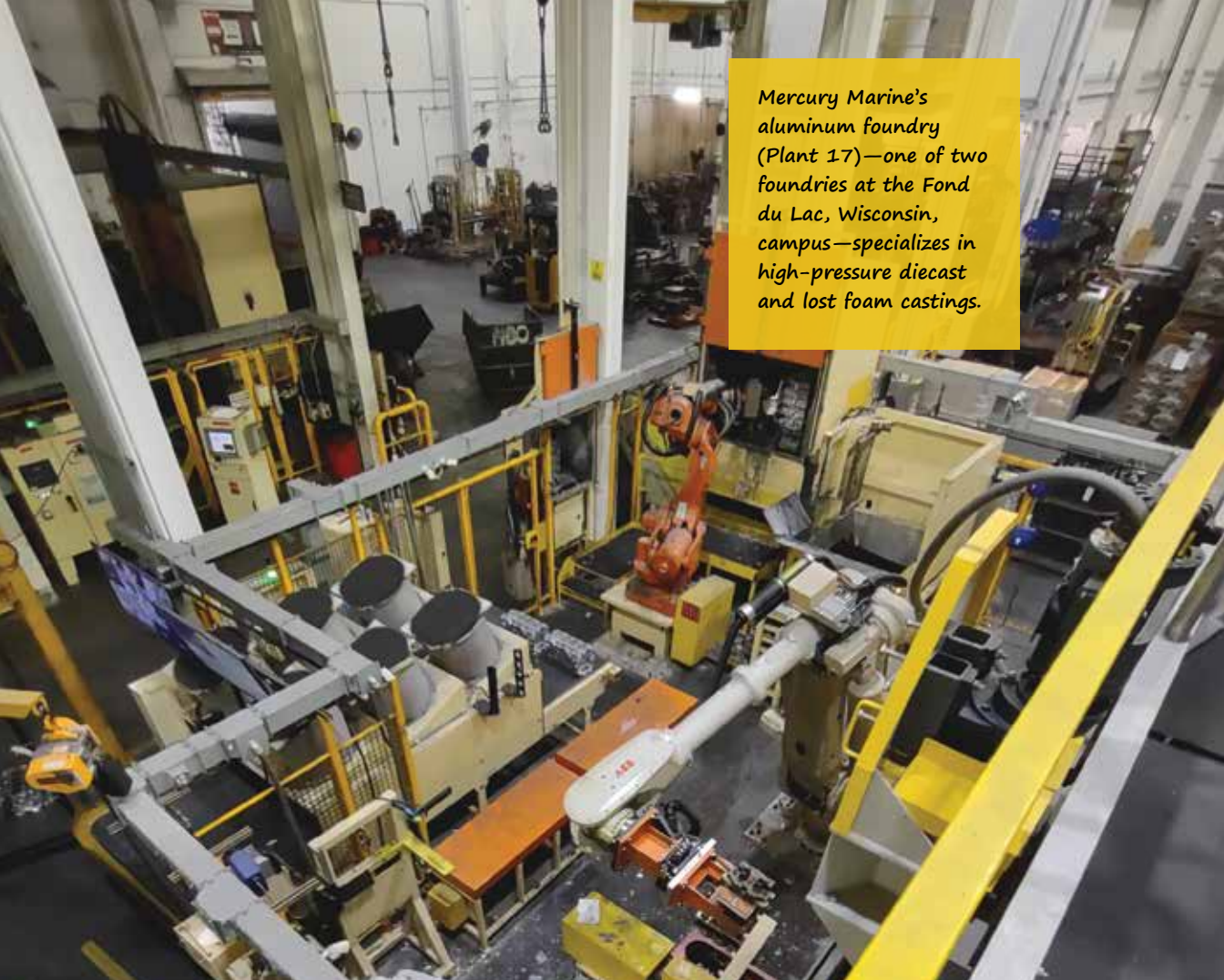
Maria Alverio smiles with a peer at work.

that will fund the scholarship in perpetuity.

"The vision Jean Bye had, with others, to create a space for women to connect, support, and learn from one another led to the founding of Women in Metalcasting," said Liz Ulman, vice president, Dotson Iron Castings. "Jean experienced and has shared some of the challenges and opportunities she faced in the industry. Her goal was to create a more inclusive space for women in the industry. Maria is a great example of how the future of women in metalcasting is bright!"

Mindy Fitzgerald, director of diversity, culture, and engagement at Air Products, agrees. "At Air Products, we are reimagining and creating a workforce where women are present, included, and thriving in manufacturing industries. That's why we are committed to the education of rising female talent. This commitment is demonstrated through our scholarship giving and belief in women supporting women. We are so excited Maria is receiving this award and wish her the best."

During the presentation, Alverio thanked Bye for being a "role model" for all the women who aspire to be leaders in the metalcasting industry. Additionally, she thanked Women in Metalcasting and FEF for providing opportunities for women to learn from each other and for monetary and other support during their academic journeys. **MP**



Mercury Marine's aluminum foundry (Plant 17)—one of two foundries at the Fond du Lac, Wisconsin, campus—specializes in high-pressure diecast and lost foam castings.

METALCASTING CAREER FOCUS:

Advanced Manufacturing, Artificial Intelligence, and Machine Learning

AS MANUFACTURERS BECOME MORE ADVANCED, THEY ARE SEEKING THOSE WITH COMPUTER SCIENCE DEGREES WHO ALSO ENJOY BEING PART OF A COMPANY THAT MAKES THINGS.

Mercury Marine, which is a global maker of boat motors based in Fond du Lac, Wisconsin, could write a guidebook on pioneering through data collection, information technology, and Industry 4.0. Dave Blondheim, Mercury's director of global operations excellence and advanced manufacturing, is leading his company's mission with a four-person "Connected Ops" team that serves not only the company's two Wisconsin foundry operations but all its manufacturing plants in Florida, Mexico, and Asia, as well.

"Data itself does not solve problems; employees use data to solve problems," said Blondheim. "People assume, 'If I collect the data all my problems will be solved,' and it just doesn't work that way. We need the context, we need the people to bring meaning to the data

and solve the problems."

Mercury Marine makes a lot of its own parts that go into its motors. At its campus in Fond du Lac, it operates two foundries, a machine shop, paint house, and assembly line. The aluminum foundry specializes in high-pressure diecast and lost foam castings, while about 1,000 feet away a second foundry produces stainless steel propellers. On the aluminum side of the business, the company makes about 50 million lbs. of castings per year.



Blondheim, who has an MBA, a master's in industrial engineering, and a Ph.D. in systems engineering, started at Mercury in 2013.

During Blondheim's first year, the company invested in packages of software that hooked up to its diecast machines and stored data on a network location. Essentially, they created a connection

"We are looking for people who really like data, statistics, math, and programming but also have a passion for seeing things being made."

—David Blondheim

that allowed them to track and apply information for quality, maintenance, or other problem solving.

“The question was, how do we, in the foundry—who create the casting and all the data associated with it—link that to the paint line, which is then linked to the machining line, which is then linked to our assembly line, and then it goes out to our final customer as a serial number?” Blondheim said. “How do we get all of that operational data tied together to help us make better product and deliver excellence to our customer?”

The definition of Industry 4.0 can certainly be confusing because, in fact, there’s no universal definition, Blondheim contends. For some, these terms mean data collection, for others it’s maintenance people wearing virtual reality devices to make repairs. In total, the concepts comprised under Industry 4.0 include:

- Simulation and Computer
- Modeling
- Virtual, Mixed, and Augmented Realities (VR/MR/AR)
- Additive Manufacturing
- Automation, Robotics, and PLCs
- Sensors, IIoT, and Data Collection
- Systems Integration (Software)
- Data Storage and Cloud
- Cyber Security
- Data Analytics
- Machine Learning
- Artificial Intelligence.



This robot is used for spraying die halves of the mold with lube to help take the parts out of the mold after casting. The foundry collects data points for die lube pressure and volume being used to ensure its process is the same every time the robot runs through its cycle.

Mercury channels the knowledge from its data collection into three main areas and uses data for specific kinds of decision-making. First is business metrics—the ability to identify how many parts have been made. These data points are translated to show gaps in production, how to solve problems, and reallocate resources to help get more parts out the door.

Second, the company uses data to focus on quality. During casting processes, managers can visualize the pressures, the temperatures, the speeds of diecasting—all the aspects of machine functions that affect casting quality. “We use that type of data from a troubleshooting quality perspective,” said Blondheim. “How do we improve our product, and how do we make sure that no bad product is moved from one process to the next?”

Third, Mercury focuses on data that is all about machine performance itself. Managers use data to anticipate and avert machine failure, and understand things like volume of die lubricant used, energy used, and how to make improvements.

As more foundries move to use more machine learning, data analysis, robotics, etc. to improve their processes, a key skill is needed.

The missing talent link in manufacturing, says Blondheim, is computer science programming. Most of the time, he said, manufacturers have a mindset of hiring only mechanical or material science engineers, overlooking the computer science engineering talent that’s actually needed for the future of manufacturing. Simply put, operational and business connectivity involves a skill that many manufacturers don’t have, he said.

“The future is finding people with that cyber-physical expertise and getting them into the industry. We can teach them about foundries or machining or other processes—that’s much easier than hiring someone who knows the process but doesn’t understand the IT and analytics side of it.”

Recognizing the deficiency, Blondheim recently hired an IT computer science major to join his Connected Ops team.

“We are looking for people who really like data, statistics, math, and programming but also have a passion for seeing things being made,” he said. **MP**



Two robots are in this diecasting cell—one is an extraction robot that pulls the casting from the die; the other is a process robot that assists with loading the casting for sawing, laser marking, and other processing. Mercury Marine connects to robots to get signals to help understand the process and the cycle times associated with robot movements.



Mercury recycles aluminum machining chips into its metal for casting. There is a limit on how many pounds per hour can be processed, so the company put in a detailed data collection system to monitor and prevent them from exceeding their hourly rate.

CASTINGS FIT FOR A KINGDOM

DISNEY'S THEME PARKS ARE MAGIC, BUT THEY DON'T RUN ON FAIRY DUST. THEY RUN THANKS TO CASTINGS.

When you go to one of the Disney parks, you'll have an enchanting experience. There are bright lights, cool buildings, fun toys, and all of your favorites from childhood. You'll run into Mickey Mouse, Snow White, Tiana, Olaf, and so many others. But beyond that, the park still needs to function. And it does thanks in part to castings, which contribute to the unique vibe of the world-famous attractions. **MP**



The technology is modern but the look is vintage. The method of choice for production? Yep, casting. The exterior lamps and posts, like this one seen on the Disney Boardwalk in Orlando, Florida, are cast.



Disney World has actual mailboxes. Yes, the antique cast boxes look cool and add more flavor to the grounds, but they are functional and monitored daily like any mailbox you see around your neighborhood.



Walt Disney and Mickey Mouse will be linked together for eternity. They stand hand-in-hand greeting you in front of Cinderella's Castle, as seen here.



They're in the Magic Kingdom, but the cars at Disney parks still run thanks to cast components. Like the cars we all drive, the brakes and other vital systems rely on castings to work.

DESIGNED FOR DIGGING

TWO WAUPACA FOUNDRY PLANTS WORKED TOGETHER TO DELIVER A CASTING FOR A COMPACT UTILITY TRACTOR THAT SHORED UP THE SUPPLY CHAIN FOR CUSTOMER AMEREQUIP.

Amerequip, which makes construction, lawn and garden, and industrial equipment, reached out to Waupaca Foundry because it couldn't get teeth fast enough to meet production demand for its backhoe buckets (think of the equipment you see digging up dirt). The steel teeth, which were sourced from China, were welded onto a shank that

was then attached to the bucket.

"We were running out of teeth—as was the rest of the industry," said Tim Dorn, vice president of sales and engineering at Amerequip. "It was going to be a serious issue."

The same day Amerequip asked Waupaca to give them an estimate to make the teeth, members of the Waupaca team happened to be visiting Amerequip's facility in Kiel, Wisconsin, doing a "line walk."

"This is where we look at the parts in production to identify any potential casting conversions," said Marcus Johnson, account manager at Waupaca Foundry. A casting conversion is when a part that was made in one method has been redesigned to be made via the metalcasting method. "We saw the bucket as a possibility. The initial quote for the teeth started conversation about casting the bucket too."

The backhoe arm this bucket attaches to is meant for compact utility tractors. The customers for these are typically individual landowners and small farmers with five acres or more who need to do trenching or digging around their property. Each bucket was made up of nine steel parts welded together. Changing to the casting method would allow the bucket to be made as one single part—no welding needed.

The bucket is the first cast iron bucket on

THE BUCKET BREAKDOWN

12-in. Bucket Assembly.

Waupaca Foundry Plants 4 and 5 (Marinette, Wisconsin, and Tell City, Indiana)

Material: Ductile iron.

Process: Green sand vertical molding.

Weight: 65 lbs.

Dimensions: 18 x 11.8 x 11.8 in.

Application: Compact utility tractor.

Waupaca Foundry aided in the redesign and launch of the first-to-market cast iron bucket attachment for a compact utility tractor. The teeth of the bucket, which had been made in China, were also reshored to stateside production.

Working off a model supplied by the customer, Waupaca Foundry engineering created a bucket design that could be produced as an iron casting. The cast iron bucket includes a slightly wider opening, allowing scooped material to fall out more easily. Even with this tapered design, the bucket did not sacrifice volume.

Adding a slight flare to the design allowed the wedge-shaped bucket teeth to slide on and off for easy replacement. Waupaca Foundry achieved significant cost and time savings by using a pattern with four cores capable of producing 16 teeth in a single mold. The teeth are then heat-treated prior to assembly to increase hardness and obtain maximum strength and durability.

the market, and the cast iron teeth assembled to the bucket, which had been cast in China, are now being made in the U.S. Together, they were the answer to customer Amerequip's supply chain and capacity challenges.

Passing the Tests

Converting the fabricated bucket assembly to a casting was not without challenges. But Terry Schwalenberg, who has 30 years of experience at Amerequip, and the Waupaca engineering team attacked the problem with patience and perseverance.

The cast iron bucket needed to look the part for its homeowner end-user—rugged and well built. Amerequip also wanted the bucket at the same weight or less than the original steel fabrication and, of course, handle the same volume of material. And the bucket needed to directly interchange with the original buckets when it came to mounting to the backhoe.

"We were on the phone every morning reviewing the casting simulation software to make it work until we felt confident in the design," Schwalenberg said. "I think we ultimately ran 81 or 82 simulations. We can't thank the engineers at Waupaca enough for not giving up."

Waupaca Foundry manages the entire supply chain from casting to final delivery of the machined, assembled, and painted bucket,



The iron teeth outperformed the old design and are expected to last longer, too.

The first-ever cast iron 12-in. bucket assembly goes onto a backhoe attachment, like this one, which is used by residential customers on their compact utility tractors.

coordinating among the two foundries, heat treat, machine shop, and painter.

"What makes this collaboration unique is the fact that we took this to the market and subsequently, Amerequip," said Waupaca Executive Vice President John Wiesbrock. "It's exciting to make new cast iron components and be the first to bring them to market. I congratulate the Amerequip and Waupaca Foundry teams for an excellent collaboration and a job well done."

More Bang for the Bucket

Ultimately, the final design met and exceeded all customer and casting engineering requirements. The cast iron bucket has a tapered opening, unlike the original, allowing scooped material to fall out of the bucket more easily. In tests performed at Amerequip, the cast iron bucket was found to be multiple

times stronger than its fabricated counterpart.

After being cast in Wisconsin, the teeth are heat-treated and sent to the machining and assembly supplier to mate up with the bucket, which is cast at Waupaca Foundry's Indiana plant. Next, the assembled buckets are shipped to the painter, where Amerequip picks them up for final attachment at its facility.

The conversion of the fabricated bucket assembly to cast iron bucket and teeth took about a year and a half. Amerequip is now looking at other bucket sizes for conversion.

"Waupaca Foundry saves us a lot of handling," Schwalenberg said. "They guided us through the process and took on the challenge of doing 'more.' We welcome that here at Amerequip." **MP**

BACKGROUND PHOTO: © IOAN PANAIT / ADOBE STOCK

BACKGROUND PHOTO: © IOAN PANAIT / ADOBE STOCK

BIRMINGHAM HIGH SCHOOL STUDENTS MEET METALCASTING

WHAT DO UNIVERSITY of Alabama-Birmingham (UAB) FEF Key Professor Haibin Ning, college students taking his metalcasting courses, and 40 Birmingham City Schools high school students have in common? Their excitement for metalcasting!

Earlier this year, Ning invited the high school students to spend a day in the UAB foundry.

“For decades, UAB has been fully dedicated to educating students at all levels, from elementary- to college-age, about metalcasting,” Ning said. “Outreaching to the students from local high schools is critical in getting them involved in metalcasting; recruiting students meets the future needs of metalcasting industries for engineers/technicians, as well as markets our (UAB) foundry program.”

Outreach in this region is especially important because of the opportunity it represents to



reach traditionally underserved communities.

With the help of several of Ning’s students, the foundry was set up for the visit. His students were tasked with the responsibilities of explaining the casting process to the visitors, assisting throughout the hands-on activities, and answering questions.

Each of the high school students made their scratch plate design and watched the steel being poured into their molds. Then, with the

help of the UAB students, they cleaned and sand blasted the final product so it was ready to take home with them.

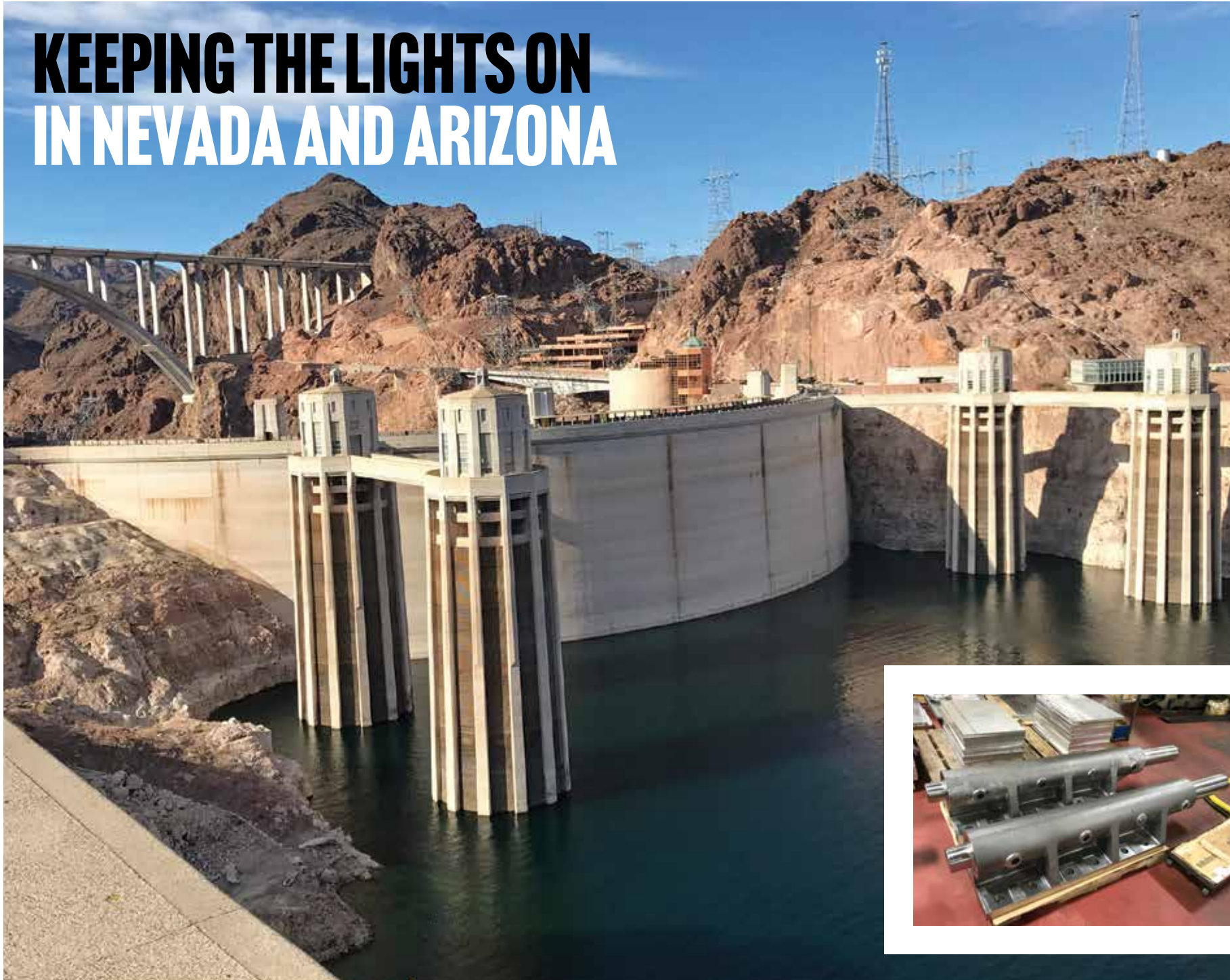
“I’ve lived in the Birmingham area my entire life, and getting to meet the young people who will literally be building the future of this area was a privilege,” said UAB student Derrick Armstrong. “It may be a challenge to keep the attention of some but seeing the spark in those who have an interest in metal-

casting was amazing.”

Ning said it was important to bring new individuals into the foundry setting to elevate interest in the industry.

“Any event we host at our foundry will hopefully attract more students to pursue degrees in the metalcasting field and, in turn, meet the needs of the metalcasting industry for engineers/technicians well into the future,” he said. **MP**

KEEPING THE LIGHTS ON IN NEVADA AND ARIZONA



THE HOOVER DAM in Black Canyon, Arizona, is a popular tourist destination, and it also provides residential water supply, hydroelectricity, agricultural irrigation, and flood and silt management.

The massive structure dams the Colorado River and forms Lake Mead, the country's largest water reservoir. It generates around 4 billion kilowatt-hours of hydroelectric power each year that is used by residents and businesses in the surrounding states or Arizona, Nevada, and California. Castings are an important piece of the puzzle to generate this electricity.

Currently, Hoover Dam is undergoing renovation of its intake towers, which control the water supply for the powerplant turbines. Each of Hoover Dam's four intake towers has an upper and lower cylinder gate to allow Colorado River water to enter for hydroelectric generation.

Monett Metals foundry is supplying castings for the project. So far, a complete set of castings has been delivered for the first tower. The five-year project will replace the gate stem assemblies of all four towers.

The contractor for the reno is New-Hampshire-based Quabbin Inc., a replacement component supplier for the water, wastewater, hydroelectric and power industries.

To make the replacement parts for just one of the four towers, Quabbin purchased 165,750 lbs. of stainless steel and machined 1,602 ft. of stem, which is 352 ft. more than the height of the upper observation deck of the Empire State Building and 148 feet more than the tip of its antenna. **MP**

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

Central Washington University
Ellensburg, WA

Eastern Michigan University
Ypsilanti, MI

Georgia Southern University
Statesboro, GA

Instituto Tecnológico 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

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 Michigan
Ann Arbor, MI

University of Northern Iowa
Cedar Falls, IA

University of Wisconsin—Madison
Madison, WI

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 Wisconsin—Milwaukee
Milwaukee, WI

University of Wisconsin—Platteville
Platteville, WI

University of Wisconsin—Stout
Menomonie, WI

Virginia Tech
Blacksburg, VA

Wentworth Institute of Technology
Boston

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

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

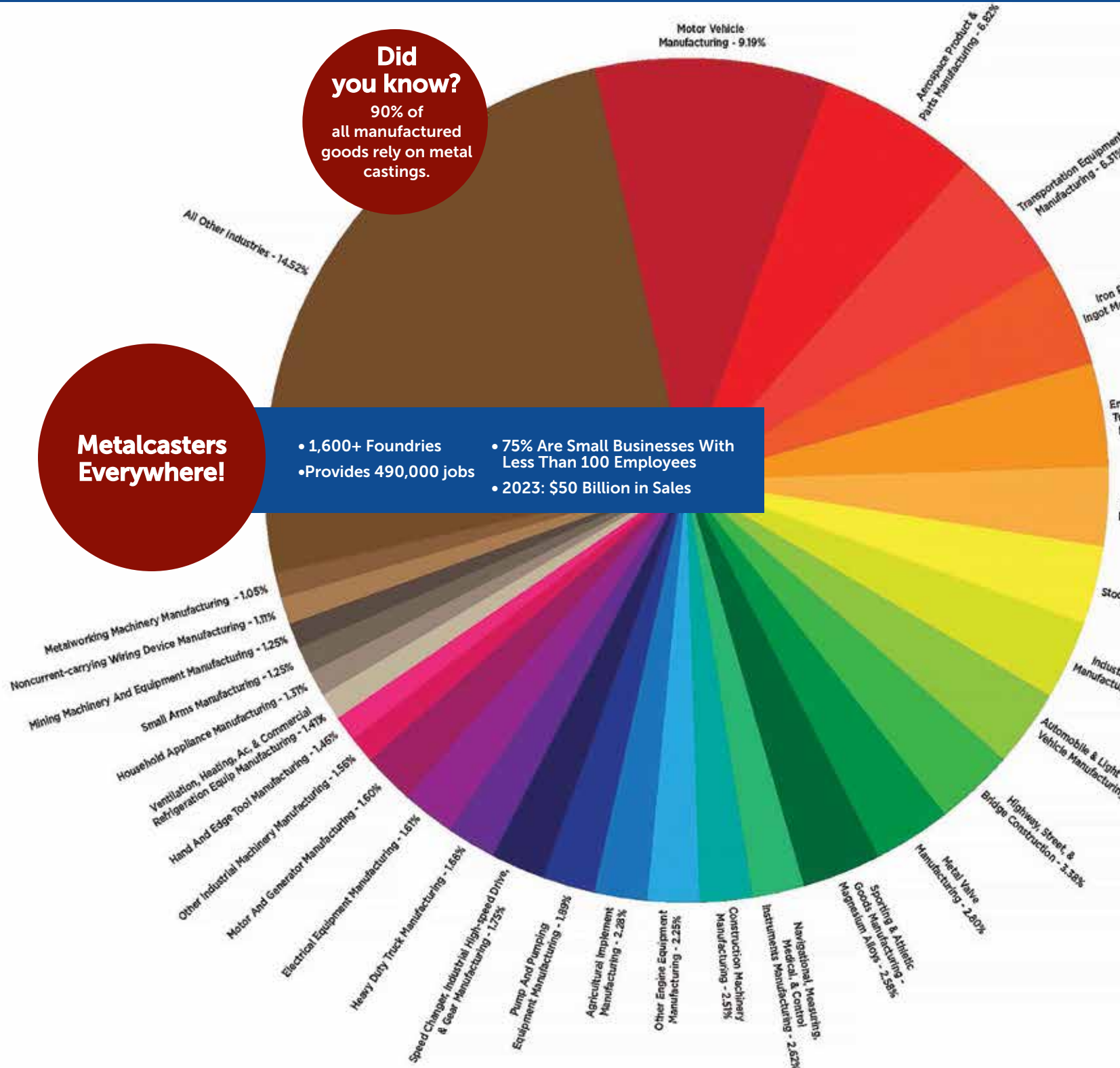
WHERE DO CASTINGS GO?

METAL CASTING SUPPLY CHAIN

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

Metalcasters Everywhere!

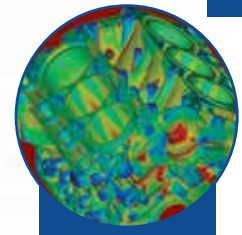
- 1,600+ Foundries
- Provides 490,000 jobs
- 75% Are Small Businesses With Less Than 100 Employees
- 2023: \$50 Billion in Sales



Pattern & Tooling



Raw Materials & Equipment



Engineering



Metalcasting Facility



- Value Added**
- Machining
 - Heat Treatment
 - Parts Assembly



End Users of Castings



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