

MELTING POINT

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MIKING 3D PRINTING WITH METALCASTING p. 6



Inside This Issue:

College Connection p. 10

Strength, Not Stress p. 14

Cast Iron Fish p. 17

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 p. 20-23.

TABLE OF CONTENTS

FEATURES

Mixing 3D Printing With Metalcasting	6
● Opening Up	10
Strength, Not Stress	14

DEPARTMENTS

LIGHTS. CAMERA. CASTING.	3
FACES IN THE CROWD: Cherry Rises Through Industry	4
CASTINGS DO THAT? Cast Fish Help with Iron Deficiencies	17
SCHOOL WORK: Saltillo Students Host Platteville Counterparts	18
METALCASTING UNIVERSITIES & SCHOLARSHIPS	20
CAREER OPPORTUNITIES	21



LIGHTS. CAMERA. CASTING

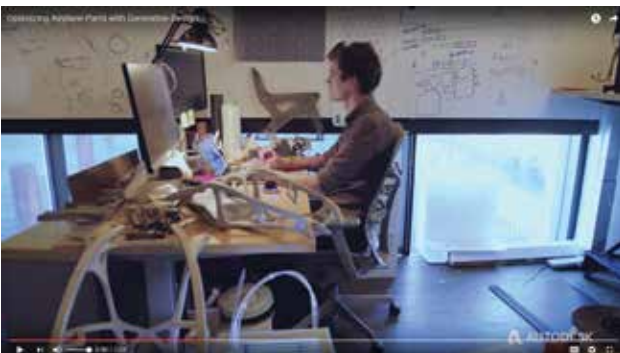
Check out these cool videos online!

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FEF, the Foundry Educational Foundation, explains why students at FEF-affiliated schools are prepared for careers in metalcasting.

Check out the inside of a working foundry, Waupaca Foundry in Waupaca, Wisconsin. This iron plant won Metalcaster of the Year 2018.



See how advanced software tools are helping connect 3D printing with metalcasting to create futuristic, advanced shapes.

Starting a Career in Metalcasting

Niki Cherry started working at Tyler Union on May 21, 2018, as a quality engineer. She met the head of the HR department at the November 2017 College Industry Conference (CIC). One of the most important things she got out of the CIC was learning about the different foundries that were looking for employees.

"I chose Tyler Union because I really liked the company and what they stand for," she said. "All of the research I did on the two companies showed that they were great places to work."

Cherry chose to pursue metalcasting at Tennessee Tech in 2015 after going on a tour of a facility that melted metal down to powder. After seeing that process, she knew she wanted to do something related to that. Cherry went back to campus and told the college of engineering dean that she wanted to change her major to what would help her get there. He sent Cherry to see Dr.



Fred Vondra, the FEF Key Professor at Tennessee Tech.

"He is an awesome professor that taught me everything about the foundry," Cherry said. "I fell in love with the foundry so much I became his teaching assistant and the president of the AFS Tennessee Tech Student Chapter."

When starting a job right after graduation, having hands-on foundry experience walking through the door is always a plus, and Cherry was able to get that experience in her classes at Tennessee Tech.

“The fact that I know the casting process from start to finish is important,” Cherry said. “I enjoy everything about my job, but the best part is knowing we are the ones to make sure the quality of the product is meeting our customers’ expectations.”

Steve Johnson, assistant general manager, Tyler Union, said he and his company look forward to the FEF’s CIC.

“(We) are excited that we get to meet students with a passion for the foundry industry like Niki Cherry and offer them the opportunity to come join the Tyler Union family, he said. “Because of their knowledge of the foundry industry and their exposure to foundry operations while in school, FEF students walk through the door on day one with an understanding of what we are all about and are ready to face new challenges head on.”

Vondra echoed that.

“As the Key Professor at Tennessee Tech, I couldn’t give that opportunity to my students without FEF support,” he said. “Niki Cherry is only the latest of my outstanding students that found an interest in a cast metal career. She has set a new bar for my students in her interest and desire to be a leader in the foundry industry.”

MP



Niki Cherry takes part in a Foundry-in-a-Box demonstration.



MIXING 3D PRINTING WITH METALCASTING

A uniquely shaped motorcycle part portrays the possibilities and opportunities available when combining 3D printing, simulation and innovative design.

It looks more like a spiderweb sculpture than vehicle part, but this swing arm for a motorcycle is all about function.

The part was produced by metalcaster Tooling Equipment International (TEI). The company designed, cast, cleaned, machined and inspected the part in three weeks, meeting its customer's strict deadline.

The swing arm is a prototype commissioned by 3D software company Autodesk to be installed on the Lightning LS-2018 motorcycle. The goal was to show the capabilities of generative design, which automates a part's design based on process-specific parameters.

Basically, the software takes into account details of a specific manufacturing process and combines it with the requirements of the part to automatically produce an optimized design that puts material only where necessary. The results are often unique and com-



plex organic shapes. In manufacturing “organic shape” refers to the curves and shapes typically found in nature. These shapes used to be hard to replicate in manufacturing, but 3D printing has made it possible.

Instead of directly 3D printing the part in metal, Autodesk wanted to see how it would work if a company could combine 3D printing with traditional, proven metalworking methods. The metalcasting process has hundreds of metal alloys to choose from with a wide range of properties, plus there is no limit to size. Right now, 3D metal printing is constrained by price, size and metal options.

As a prototype casting shop, TEI is used to quick turnarounds and relying on technology to achieve castings that push the boundaries of traditional design. Rather than printing a

part directly in metal, it uses 3D printing to produce sand molds which can then be used for pouring molten metal into.

TEI was thoughtful in its approach to the project yet confident the delivery would be made on time.

Others were more pessimistic. That first week, a customer walking through the facility saw a TEI engineer working on the design and declared, "you will never be able to cast that."

TEI proved him wrong.

"We were given an extremely tough time scale to meet, and given the geometry, that was a bit of a challenge," said Oliver Johnson, president of TEI. "We had at best two shots to get this thing right, and we got a good part the first time."

The intricate yet robust swingarm replaces three separate parts that were made by machining the desired shapes out of big blocks of metal. The design reduced the mass of the swingarm by 10% while increasing torsional and bending stiffness. The organic shape hints at the future of metalcasting and the growing opportunities for the industry through 3D printing methods.

Autodesk had worked on some initial designs for Lightning Motorcycle six years ago, and now the company felt it could put those ideas into reality with TEI as the metal-casting partner.

"We had done some previous work with TEI and knew that making more complex shapes was totally possible," said Andreas Bastian, principal research scientist at Autodesk. "We were just looking for the right project to take it for a spin."

TEI turned to AFS Corporate Member Hoosier Pattern (Decatur, Indiana) to produce the two 3D printed molds. To ensure the sand mold was totally clean before pouring in the molten metal, TEI used a small endoscope (a tube-like instrument with a camera





on the end) to travel down every passage of the mold, referring frequently to the 3D design at the workstation.

"It is common for us to push the design boundaries to see what we can or can't do," said Ted Kahaian, TEI process manager.


TEI used simulation to map out the entire manufacturing process of the swingarm, including machining. The prototype mapped out the whole machining operation in a virtual simulation that simulated the cutting tools, fixtures, and the motions of the pallets.

"Everything is simulated because you don't want to have a mess up on a job like this," Johnson said.

The simulation paid off. The two molds both produced good parts without a hitch. After CT scanning, white light scanning, x-ray inspection, and dimensional checks before and after heat treating, the swing arm was ready for the customer within the three-week deadline.

"One of the reasons this has been such a strong collaboration is TEI is an early adopter and strategic user of technology, particularly in simulation technology," Bastian said. "The casting coming out right the first time was pretty phenomenal."

The success of the cast swing arm will help Autodesk further make a case for applying generative design to not just metal printing but also metalcasting.

"Metal printing likes to show all these exotic shapes that can be produced, but we want to demonstrate casting is a technology that is quite well suited to those shapes, particularly when you are making something larger than a bread box," Bastian said. "Metalcasting offers hundreds of materials to choose from compared to metal printing, and the manufacturing base is mature." 

OPENING UP

Collegiate metalcasting programs have found success by inviting youngsters in to see what the foundry business is all about.

Universities all over North America are introducing people to metalcasting. They educate students about the industry and processes, and help steer kids into fulfilling and worthwhile careers.

Here's a look at how two of those programs, plus FEF, open their doors to the next generation.



Penn State Behrend, Pittsburg State, Kent State, and the University of Wisconsin-Milwaukee all opened their foundries so that young people could have the opportunity to learn about metalcasting.



Members of the Michigan Tech program walk young students through the mold-making and tin-casting process using a metalcasting demonstration kit.

MICHIGAN TECH SPREADS THE WORD

Michigan Technological University (Houghton, Michigan) is an FEF-certified university, and one of its goals is to get the message about metalcasting out to the next generation.

The Materials United program (a combination of Material Advantage and AFS student chapters) is involved in multiple events each year reaching out to students at Michigan Tech and the broader community.

A component of this outreach is the annual Materials Science and Engineering department open house. The event is open to all students at Michigan Tech, but targets the first-year engineering students.

Students are free to explore the materials building where several different demonstrations are held focused on engaging students with materials science and engineering concepts and materials processing methods. Some of the most popular demonstrations include a tour of the foundry complete with a metal pour, making liquid nitrogen ice cream, shape-memory alloys and scanning electron microscopy.

Additionally, Michigan Tech's chapter of Materials United participates in local science fairs, helping younger students understand how much can be learned from materials science. Members walk young students through the mold-making and tin-casting process using a metalcasting demonstration kit.

Not only do these activities help to get the metalcasting message out to a larger audience, they also provide Michigan Tech students with experiences that help to broaden leadership and industry skill sets.

VT FIRE OPENS UP

Every semester, the students at Virginia Tech (Blacksburg, Virginia) hold an open house. They find that's one of the most effective ways to advertise the foundry to people in the community who don't know about the Virginia Tech Foundry Institute for Research & Education (VT FIRE).

During these open houses, guests can make a design in a bonded sand scratch plate mold. The scratch plate consists of a square indent in a sand mold into which the guests scratch any design they desire. This design is reflected in the casting. During a recent open house, 68 scratch plate molds were poured and finished by the VT FIRE students.

One of the other outreach activities that the VA Tech students enjoy is the Foundry-in-a-Box demonstrations they do at local schools and events. There are two different levels of demonstrations: a simple demonstration and an interactive demonstration. The simple demonstration is used at clubs or career fairs. The VA Tech students melt a



During a recent open house at Virginia Tech, 68 scratch plate molds were poured and finished by the VT FIRE students.

tin-bismuth alloy on an induction hot plate and pour it into a permanent mold. This allows for a tangible demonstration of what the foundry industry does.

The more interactive foundry-in-a-box demonstration is taken to high schools, where there is more time and space to allow the high school students to create their own castings. The kids get to make their own mold from a VT pattern and green sand, and pour that mold using the hot plate and tin-bismuth alloy.

During the 2017-18 school year, the Virginia Tech students visited three different high schools, two activity fairs, and one career fair. These types of demonstrations are a great way to reach out to the community and inspire young people to learn more about the foundry industry.

SHARING METALCASTING

“Name and describe the use of the basic parts of a two-piece mold. Name at least three different types of molds. Make two molds, position the pouring gate and vents yourself, make a casting of each of your molds.”

These are several of the requirements for earning a Boy Scout Metalworking Merit Badge. Where would a youngster be able to learn these processes? Where would you find someone who could not only explain metalcasting but also provide an opportunity for the scouts to actually “do” metalcasting?

That’s where FEF universities come in.

During the spring of 2018, several FEF schools hosted events for both Boy Scouts and Girls Scouts (K-12). Penn State Behrend, Pittsburg State, Kent State, and the University of Wisconsin-Milwaukee all opened their foundries so that young people could have the opportunity to learn about metalcasting, as well as creating their own castings.

Between these four schools, over 45 scouts (along with several parents) participated. They made the sand molds, rammed the molds, poured the metal, and finished their castings—starfish, smiley faces, baseball castings, fidget spinners.

“Programs like this help to promote careers in metalcasting to the next generation. It also helps build hands-on skills to build-on for their future,” FEF said in a news release.

One of the FEF students who helped with the event said “it gives local kids an introduction to the metalcasting industry. I feel like the metalcasting industry is largely unknown despite its influence on manufacturing.”

One of the goals of FEF schools and AFS student chapters is to expose the next generation to the world of metalcasting and the possibilities that it holds. Some of these activities are made possible with FEF funding.

“That funding is made possible through the generous contributions of our donors,” FEF said. “Thank you for your part in reaching the next generation.”



STRENGTH, NOT STRESS

A college wrestling coach had an idea for a new workout product. Cast iron made his vision a reality.

Ryan Birt had a vision for more comfortable workouts. It was realized with a cast iron product called the Birt Plate. But it wasn't an easy or quick trip.

Birt, a former college football player and wrestler at Upper Iowa University, suffered an elbow injury on the gridiron. Football weight training consisted of powerlifts and Olympic lifts, which was difficult

because Birt couldn't straighten his arm. Instead, Birt did plate workouts (lifting without a bar) because it was easier on his arm.

During wrestling season, Birt's coach required the team to do plate workouts in a sauna, but there was no way for Birt to hold onto the weight. The circular plates also weren't ergonomically sound, and there wasn't a way to have a full range of motion.

"It hurt my joints," Birt said.

Birt told his coach how much the workouts hurt. The coach told Birt to "suck it up" or find a better way to do them. One night in 1998, Birt sat up in bed and "had a vision" for how he could improve his workouts and get full range of motion. He had an idea for a plate that was ergonomically sound, one that he could grip and move around his



The Birt Plate was created to be more ergonomically sound than traditional weights, and can be used in hundreds of exercises.

The Birt Plate is usable with traditional bars and comes in many different colors.



body without putting pressure on his joints.

"I just started putting the idea together," Birt said. "It popped in my head and the rest was history."

After graduation, Birt began his teaching and coaching career and life got busy. While the idea didn't come to fruition, it never left Birt, who went on to become the head wrestling coach at Millikin University in Decatur, Illinois. Birt was recruiting a potential wrestler for then-employer Loras College and told the recruit's father, Dan Butler, about his idea for a new plate design.

Butler liked the idea and worked with Birt, who eventually made an accurate wooden prototype of the H-shaped weight with grips and a circular hole in the middle.

"One night we were sitting down and he tells me his idea," Butler said to the *Decatur Herald-Review*. "I drew it on a napkin and then on the legal pad."

Butler and his family then worked to create a name but one stood out.

"We decided 'Birt' was just strange enough to stick," he said to the newspaper.

Birt moved onto Millikin in 2015 and has built a strong Division III wrestling program that

recently had three All-American wrestlers. He's equally optimistic about his invention, for which he has three patents.

"The sky's the limit with where we can take it," Birt said.

FROM IDEA TO REALITY

Butler, the president of a petroleum supply company in Decatur, knew of pattern shop Micro Tek and he took Birt's ideas and drawings to owner Robin Shively.

Not only could Micro Tek help create prototypes and patterns for the product, but Shively helped direct Birt to multiple green sand foundries.

Micro Tek and the chosen casting supplier already enjoyed a successful professional relationship. That helped when any challenges or issues came up during the casting process.

"They've done a great job making these castings for Ryan as he needs them," Shively said. Casting this product had several advantages.

"Being myself and another guy starting this up and trying to do it with little to no funding, casting was the first thing we thought of. I used to do plate workouts with 45-lb. cast iron plates. Why would we not make it out of cast iron?" Birt said.

"I think it mirrors what most people think in a weight room. The average person that's never lifted weights walks into a weight room, cast iron is what they would see."

The plates are powder-coated, machined and packaged in Decatur.

"We got so caught up in the project because it's such a feel-good thing all around," Shively said. "It's taken off in some areas."

Now that his product is a reality, Birt is enthusiastic about its merits.

"It's really cool. The safety of lifting with the plate is amazing," Birt said. "Not to mention the full range of motion."

LOOKING TO THE FUTURE

During the pre-production process, Micro Tek was able to produce some prototypes made from billet steel so Birt could sell his product even before it was completely finished.

Ease to work with was a key for Birt, who's a father and trying to continuously improve his wrestling program. Because, as much as he loves the Birt Plate, he's got a lot of other things happening in his life.

"You just have to surround yourself with really positive people," Birt said. "Once you surround yourself with really positive people who believe in you and give you the confidence, it doesn't get held back. At first I wasn't going to go through with it."

Birt did, and his plate is in use at the University of Illinois, the NBA's Indiana Pacers and the Iowa Army National Guard, among others.


"I'm pretty excited about where it's at and what he's been able to do with it," Shively said. "It's just been a real good success story."

MP

CAST FISH HELP WITH IRON DEFICIENCIES

A portion of the world's population suffers from iron deficiency and anemia. One way to combat this is to add more iron to the diet. How can that be done? Lucky Iron Fish Enterprise (LIFE) has a solution.

Made from a specially formulated cast gray iron at an Ontario foundry, LIFE's Lucky Iron Fish releases absorbable iron into the food or water it is cooked in when boiled for 10 minutes. For each product sold, the company donates one to a family in need.

Every batch of fish is tested to assure the fish aren't releasing too much iron, and the company makes sure the iron doesn't have harmful contaminants. 



The fish are manufactured at an Ontario foundry.



The Lucky Iron Fish is used to help people with iron deficiencies.

From Wisconsin to Mexico

Casting Students Connect

The FEF Key Professor and students of FEF-certified Instituto Tecnológico de Saltillo (ITS) hosted several students from the University of Wisconsin-Platteville (UWP), along with their FEF Key Professor. One of the reasons for this visit was to allow students from completely different backgrounds to come together and bond over something that they are all passionate about: metalcasting.

The students spent several days casting, touring metalcasting companies, and visiting multiple museums in the area.

Touring four different foundries in the Saltillo and Monterrey areas allowed the students to learn about the different processes of aluminum and gray and ductile iron casting.

During the trip, they also experienced networking and the innovations in place at the facilities.

“Each foundry does things a little different and it was interesting to see how they all have their own way of getting the job done,” a Platteville student said.

During their casting opportunities on the ITS campus, the students molded and poured aluminum to create little ladles. Although the students represented two different countries, the general process of casting is the same, which allowed them to have many discussions about the various aspects of metalcasting.



Along with the business side of the trip, the students from Instituto Tecnológico de Saltillo added fun. There was a barbecue and dance lessons.

“The trip was a huge success thanks to the hospitality of all those involved. We always felt welcomed and well taken care of,” the Platteville student said.

Students from both schools considered this a great experience for all, creating lasting friendships and networking possibilities, learning what each school is doing, all while being exposed to new customs and cultures. **MP**



Students from Instituto Tecnológico de Saltillo and the University of Wisconsin-Platteville pose for a photo.

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.



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, Michigan

Instituto Tecnológico De Saltillo
Saltillo, Coah, Mexico

Kent State University
Kent, OH

Michigan Technological University
Houghton, MI

Milwaukee School of Engineering
Milwaukee

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

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

University of Wisconsin—Milwaukee
Milwaukee, WI

University of Wisconsin—Platteville
Platteville, WI

College Scholarships
Available...

YES!

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

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

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
- Human Resources
- Safety Managers
- Accountants
- Quality Control Technicians
- Marketing & Salespeople
- Mechanical Engineers
- Metallurgists
- Skilled Trade

Careers: Post High School

- Molder, Melter & Welder: \$16+ /hr
- Patternmaker, Crane Operator: \$17+ /hr
- Maintenance & Electrician: \$20+ /hr

Careers: Post College

- Supervisors-Plant Floor: \$50,000+ /yr
- Production, Quality, Safety Manager: \$60,000+ /yr
- Top Manufacturing, Human Resources, Engineering Executives: \$90,000+ /yr

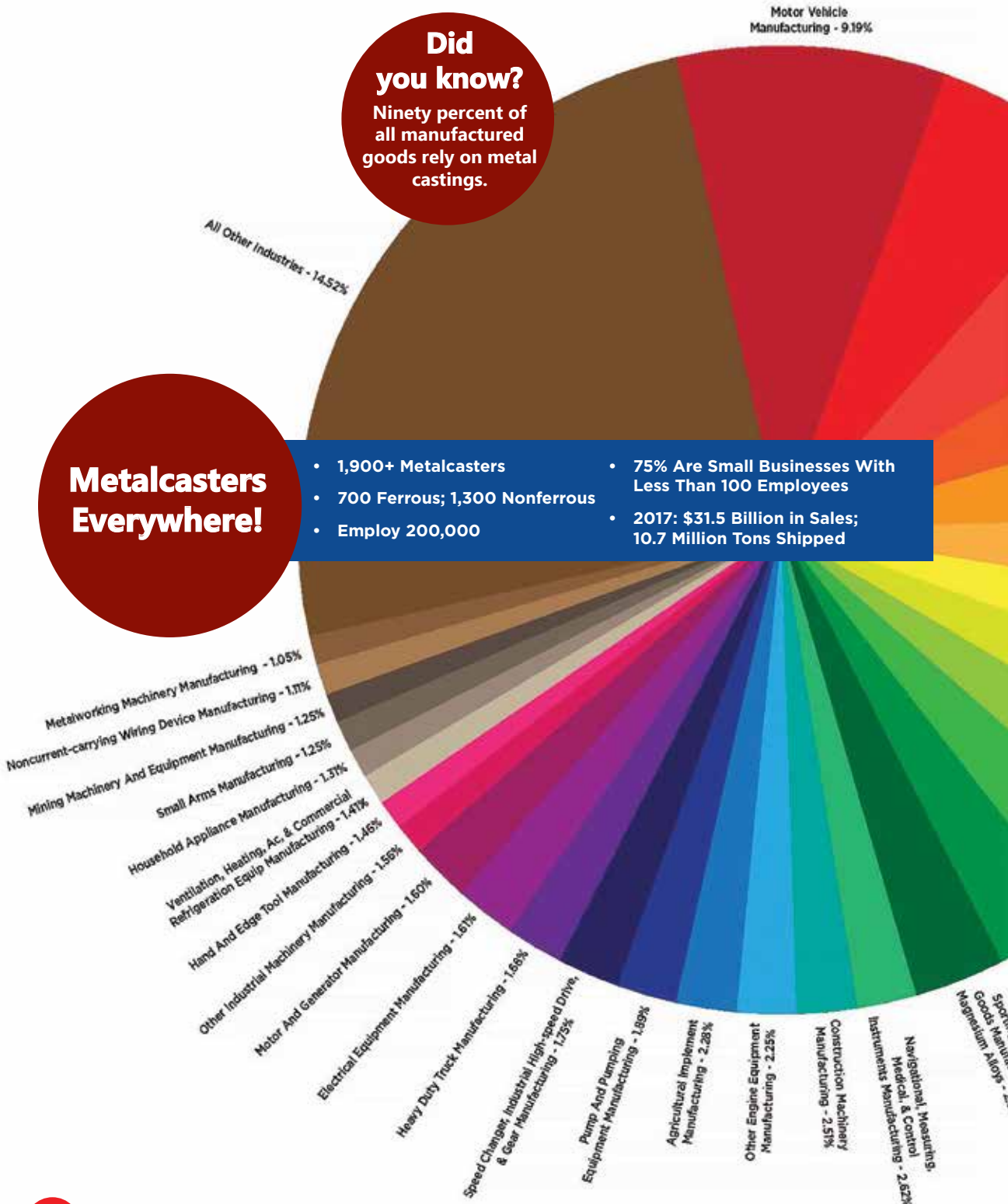
WHERE DO CASTINGS GO?

Did you know?

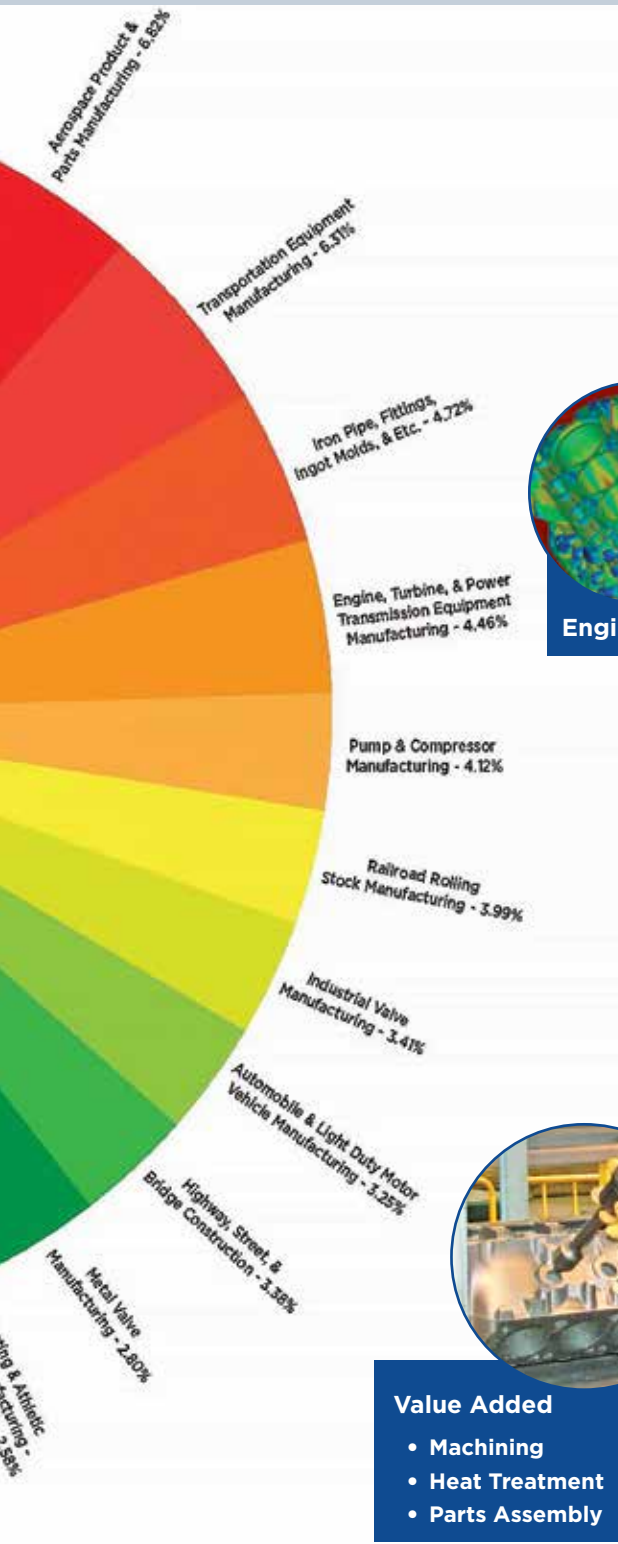
Ninety percent of all manufactured goods rely on metal castings.

Metalcasters Everywhere!

- 1,900+ Metalcasters
- 700 Ferrous; 1,300 Nonferrous
- Employ 200,000
- 75% Are Small Businesses With Less Than 100 Employees
- 2017: \$31.5 Billion in Sales; 10.7 Million Tons Shipped



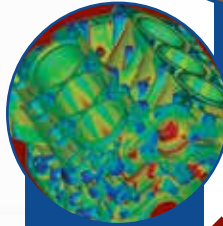
METAL CASTING SUPPLY CHAIN



Pattern & Tooling



Raw Materials & Equipment



Engineering



Metalcasting Facility



Value Added

- Machining
- Heat Treatment
- Parts Assembly



End Users of Castings



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