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MELTING POINT

http://meltingpoint.afsinc.org

Bronze Brings Better Sound

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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DEPARTMENTS

LIGHTS. CAMERA. CASTING

Check out these cool videos online!
Visit **meltingpoint.afsinc.org**
to view these videos and more.

If you like our story on page 10 about bronze speakers, check out this video from DeVore Fidelity where owner John DeVore explains how the metalcasting process was used to create his high-end speakers. Watch at https://bit.ly/3B3RlUt.

Local newspaper Mason County Press interviewed Ray Burnes from Great Lakes Castings about the handweights they make for Meijer stores (see story on page 6). Watch the video at https://bit.ly/3HRIUhL.

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.

FROM INTERN TO HIRED:

Rachel Guthrie, Materials Science and Engineering, Class of 2018

Some young people know exactly what they want to pursue as they enter college. Others may have a big-picture idea but don't find their passion until they are exposed to new and different possibilities.

For Rachel Guthrie, the materials engineering classes she took at University of Alabama-Birmingham (UAB) introduced her to metalcasting, which led to her interest in the hands-on process of making a material. And she was hooked!

To expand on her experience and expertise, Guthrie took a summer internship with a company that did a lot of investigative engineering to help solve industry issues and provide root cause analysis for companies, universities, and private customers.

"I got to see different types of projects and gain a lot of industry-related wisdom," she said.

"You get to see this melted, moldable, dangerous material turn into something beautiful and functional."

Did her internships help prepare her for her current job?

"Absolutely. When you're in school and told you have a deadline on a paper, it's vastly different than in a real-world job and being told you have a deadline on a project," Guthrie said. "There's a different weight and responsibility to it, and my internships gave me a taste of what that felt like, so I was a little more prepared for my first job out of college."

Guthrie attended the 2017 FEF College Industry Conference (CIC). Two of the companies she spoke with intrigued her as she was looking for a full-time position following graduation. She accepted her first position with one of those companies (because it was closer to home). Guthrie currently works for the other company she met at the CIC—the Engineering Center of Excellence (ECoE) for Chromalloy in Florida. When asked if her college classes helped prepare her for her position, she said, "Very much so! The knowledge and understanding of how materials work on a microscopic level has been key to helping me figure out the issues that my job requires me to solve."

Guthrie's enthusiasm for the metalcasting industry is obvious.

"I love how transformative metalcasting is," she said. "You get to see this melted, moldable, dangerous material turn into something beautiful and functional, so it's pretty amazing to think about how far humanity has come in engineering capabilities. My current job is great in the sense that it's different every day! I love the new challenges and learning something new every day. It forces the creative side of my problem-solving skills to take effect. I also like the intricate nature of the superalloys I work with." MP


USA
20

foundry-retail relationship works out

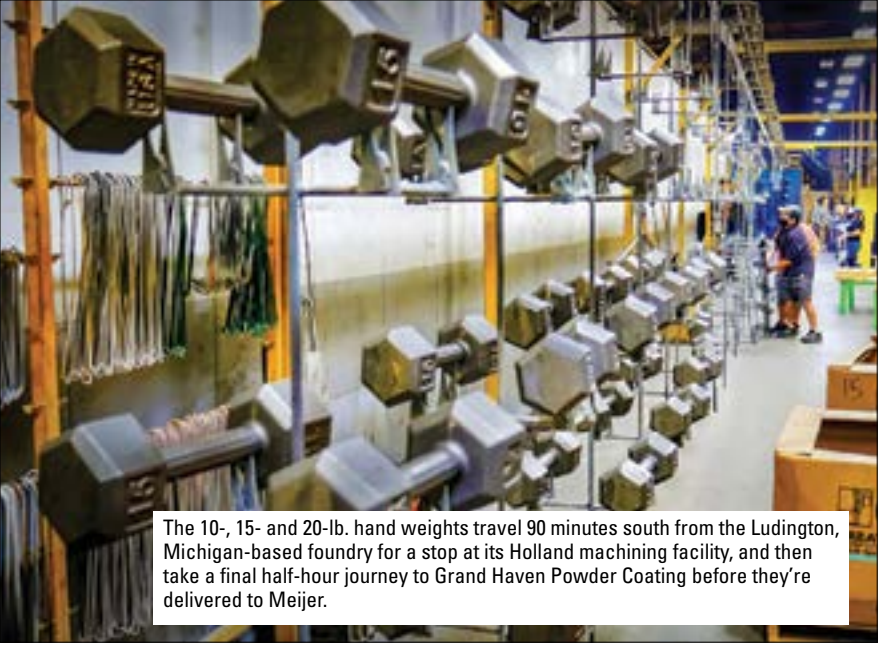
A Michigan foundry stepped in to solve an urgent reshoring need for store-branded fitness products, creating a new, compact supply chain that quickly met customer demand while supporting a Midwest retailer's Made in America mission.

As the inconspicuous Peter Parkers of manufactured products, castings generally go about saving the day unrecognized by most consumers—but in an unusual case of partnering directly with a major retail chain, one foundry has broken the mold of casting concealment from the public. It did so during the nationwide 2020 shutdown mandates, which sparked and then fueled demand for the project.

Great Lakes Castings (GLC) in Ludington, Michigan, produces a store-branded line of hand weights for Michigan-based Meijer, a supermarket and home-goods retailer with 240 "supercenters" in six Midwestern states, thereby putting cast iron exercise weights straight into the hands of gym- and workout-enthusiasts, who were almost universally instructed to stay home starting last spring. Nearly overnight, home exercise equipment became scarce while, at the same time, low-cost overseas suppliers like China (that have "owned" the dumbbell casting market since the 1990s) were suddenly unable to deliver product. Several iron foundries, including GLC, helped fill the demand by working with gyms and retailers, like Meijer, whose buyers were scrambling for a new casting vendor.

"It was just about April 2020 that things exploded," said Meijer Team Sports and Fitness Buyer Scott Schuette. "We went from normal everyday sales volume in most categories to selling six or seven times the number of hand weights we had sold the prior week. Early on, we were watching it and kind of marveling over the business, but it didn't take long to realize that we were going to have to take some unusual steps to stay ahead of this and keep our stocks in place for our customers.

"Our vendor partners' stock evaporated quickly," he added, "And we were buying as much as we could, but the lead time to produce product out of China



The 10-, 15- and 20-lb. hand weights travel 90 minutes south from the Ludington, Michigan-based foundry for a stop at its Holland machining facility, and then take a final half-hour journey to Grand Haven Powder Coating before they're delivered to Meijer.

"Made in USA" cast into each Active brand dumbbell is resonating with consumers—Meijer reports it's selling every weight it puts on the shelf.

was a challenge. There was a void that we needed to fill quickly."

Great Lakes Castings was quickly selected to produce the retailer's "Active" brand of 10- , 15- and 20-lb. hand weights.

The Michigan foundry provided value-added services of product design, finishing at its Holland, Michigan, facility, and outsourced painting at Grand Haven Powder Coating. GLC's sand, which is used to make the molds, is also sourced in Muskegon, Michigan, and its steel scrap comes from regional scrap suppliers, giving Meijer the deep satisfaction of supporting the local economy in its home state. The fact that GLC recycles its metal and sand made the foundry even more attractive as a Meijer vendor.

No Time to Lose

It was now late summer 2020 and the goal was to have abundant product in time for holiday shopping as well as consumers fulfilling their New Year's resolutions. Step 1 was designing the weights, which, according to Schuette, couldn't have gone more smoothly. GLC's engineers collaborated with Meijer to design castings that proved to be reliable to make and cost-competitive while meeting quality and functionality requirements. Hitting the correct weight for dumbbells was clearly a nonnegotiable, but so was creating a very safe casting that would be grasped in bare human hands.

The foundry used 3D printing to quickly produce patterns for the weights, then used the green sand molding process with its automatic molding machine, which can make 200 sand molds per hour, according

to GLC Director of Sales and Marketing Ray Burnes.

Building Market Muscle

Five hundred initial cast iron hand weights were put on the shelves at 14 Meijer stores in the Grand Rapids area, and the entire stock sold out in 10 days. As gyms around the country continued their struggle to remain open, the Meijer-GLC project was fast-tracked. Eventually, the foundry and its painting vendor each expanded to three shifts to keep up with an aggressive production schedule as Meijer steadily increased distribution to more stores throughout Michigan, Ohio, Indiana, Illinois, Kentucky and Wisconsin.

In 2020, Meijer sold 1.5 million pieces of fitness equipment, and while the privately-held company doesn't typically share sales numbers, Schuette ventured to estimate the retailer expected to sell over 1.5 million lbs. of the hand weights in 2021. MP

How Meijer's Hand Weights Are Made

1 Iron is melted in a furnace that can melt 10 tons of metal an hour; when it is around 2,400F, the metal is poured into the molds.

2 The molds travel via conveyor to the end of the line, while the iron cools down inside to become solid. Using vibration on the conveyor, the foundry shakes the castings out of the mold at a temperature below 1,200F.

3 At shakeout, the sand from the molding process falls away from the casting. Down the line, the gating—the extra solidified metal that filled the path of the metal to the mold cavity—is separated from the castings; both the cut-off gating and sand are recycled and used again in GLC casting processes.

4 From there, the castings are cleaned via tumble blasting, where small steel balls are shot at the castings to further remove sand from their surfaces.

5 After cleaning, the marks on the casting where the gating was cut off are smoothed down with a grinder. Then the castings are sent out for painting, the final step of the production process.

A GLC worker inspects the pattern used for the molds for the handweights.

Bronze Brings Better Sound

Custom castings are at the crux of high-end hi-fi equipment designed to achieve a new pinnacle of music enjoyment.

Artist, entrepreneur, audiophile, and lover of American manufacturing processes, John DeVore experienced green sand casting the way he experiences other discoveries and creative channels in his occupation—with admiration, fascination, and joy. This too is his wish for how customers will consume music from his masterpiece hi-fi sound system, parts of which he had the "audacity" to reimagine as bronze castings.

This is the story of how DeVore, founder of 20-year-old DeVore Fidelity in Brooklyn, realized his 10-year-long vision for creating the ultimate, no-limits, most exquisite speakers he believes one can make or money buy.

He did so with the collaborative support of manufacturing design expert Christopher Hildebrand, founder of Tektonics Design Group in Richmond, Virginia, as well as the casting professionals at Brass & Aluminum Foundry (Auburn, Indiana), to whom DeVore refers as a "beautiful example" of American manufacturing totally unknown to the audio industry.

DeVore supplied direction as well as gallery-worthy illustrations to Hildebrand (also founder of his own hi-fi company, Fern & Roby), who interceded as consultative project manager and provided parts finishing; and Ball Brass performed the casting production. The outcome so thrilled DeVore, he created a YouTube video as a tribute to the process and the players.

It turns out, perhaps the most pivotal element that separates his new "O/Reference 96" model (O for Orangutan) from previous O series units, as well as all previous members of his "Gibbon" family of speakers, is indeed the bronze casting of woofer baskets, tweeter horns, mounting flanges, and a few other parts. Bronze not only bestowed a warm, pleasing aesthetic but, according to DeVore, somehow elevated the rich sound quality of his speakers to an astounding new height.

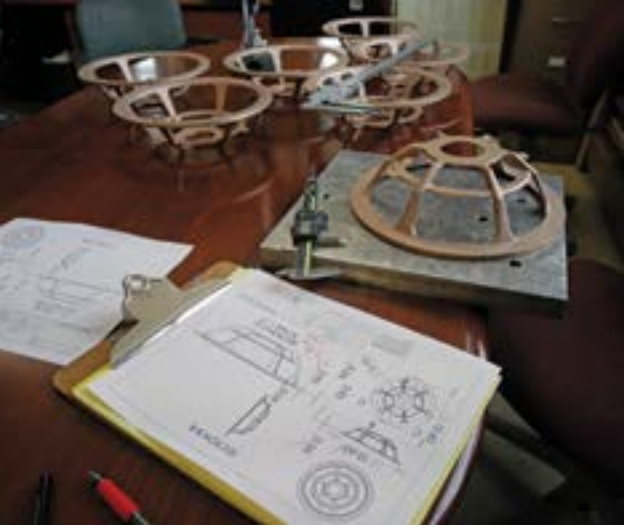
According to *SoundStage Global,* John DeVore names his speakers after apes as a tribute to his uncle, Irven DeVore, a noted primatologist and anthropologist.

Artist's Love for Bronze

Speaker parts from driver manufacturers are typically an "off-the-shelf" kind of commodity cast in zinc—why customize them in bronze? As someone who went to art school, Devore's interest in bronze parts for speakers has been longstanding.

"I approached my driver manufacturer, but they're set up for mass producing in Zamac (zinc, aluminum, magnesium, and copper alloy) and aluminum," Devore said. "I knew it wasn't going to happen that way. In the meantime, my normal line was selling really well. My design process is very slow, so it wasn't until maybe three years ago now that I was ready to kind of reassess this idea of getting bronze.

Prototypes from a foundry in Pennsylvania were my proof of concept that bronze was better sounding; the material behaved better—structurally it was sounder—and aesthetically it was beautiful. We built them and listened to them, and the end results were even better than I was hoping ... The bronze is integral to the sound, but it's also integral to the really beautiful, hand-built in the U.S. pride of ownership for end users." MP



Hildebrand said many design ideas from his customers come drawn on a paper napkin; John DeVore's ideas came presented in beautiful, meticulous illustrations.

His first Ball Brass casting run, managed by Hildebrand, comprised 100 baskets, and 100 were ordered soon after.

DeVore Fidelity, a skilled band of five whose tiny factory resides in the manufacturing hub at the former Brooklyn Navy Yard, has been fêted near and far by the audio technology trade press. Each system produced is hand-assembled and, working with one of the world's leading driver manufacturers, SEAS in Norway, the company has quickly built for itself

Standout attributes

The O/Reference model of Devore stereo.

According to John Devore, the bronze casting surface elevates the equipment.

"The finish that faces the customer is a beautiful, machined sort of fine brushed texture, and it just catches the light," Devore said. "The curve of the bronze around the tweeter is dazzling. Then that visible ring around the woofer just dances as the light hits it.

That was a big part of it—you know, you're asking a customer to spend a lot of money, so they have every right to expect gobs and gobs of pride of ownership. You want them to bring a friend into their listening room, and you want their friend to just lose their breath.

You can make beautiful texture on aluminum or zinc, but it doesn't compare to the depth of color that you get with bronze. And you know, we can do a clear coat if people want that. But I made sure that it oxidized a little bit over time before we brought it to a show because then you get that deeper sort of amber gold color. And all of that contributes to making the speakers worth the money." MP

international respect and repute. But building his top-of-the-line O/Ref 96 that retails for almost $100,000 was a new kind of labor of love for DeVore. He knows he won't recoup the expense of creating this luxe of listening through its sales alone, but he gave himself permission to create without boundaries, reasoning that his new design developments would be repurposed in upcoming mid-range units, and thus nothing wasted.

Built into a cabinet on legs with classic midcentury vibe, O/Ref 96 was designed as much for visual effect as audio excellence—and DeVore intends for his customer to incorporate it as a thing of beauty in the living room, not squirreled out of sight. MP

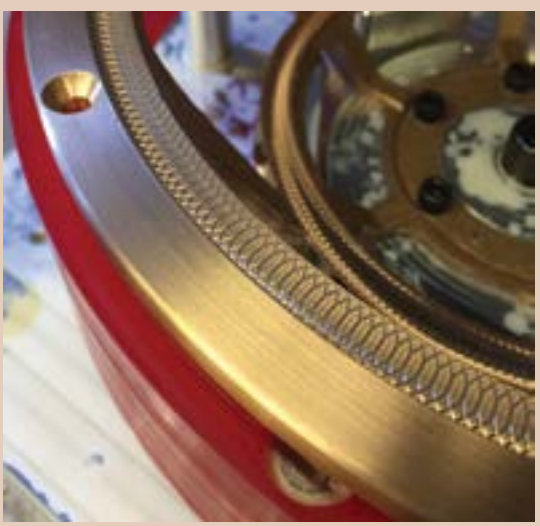
Elegance of Metalcasting

Aside from the sonic end result—because that was the goal and that was achieved, Devore is proudest of the glimpse into American manufacturing that that nobody in high-end audio has seen or uses.

"That's been a huge part of my marketing material: Look at what America can still do," he said. "A lot of the speakers that we compete against are using off-the-shelf parts, and the few that are using completely custom baskets, they get a giant block of aluminum and they just mill out 99% of it and say, 'Here's our custom basket.'

That costs the same to make one as it costs to make 10, whereas with casting, the more you make, the cheaper they become, because literally all of the cost is upfront. You can never machine a basket and end up with something that says gorgeous like those sand cast bronze parts.

I wanted O/Ref to be a proper representation of what can be done in the U.S., and that is 100% what Ball Brass did. You hold one in your hand, and you just want to rub your thumb against that texture. There's no way I could have done it any other way."



The bronze alloy for DeVore's castings contains copper and tin, according to Bryan Greene, operations manager at Ball Brass, making for a good finish. "It's easy to grind, and after polishing, it creates a nice patina on the casting," he said.

SUPERALLOYS

For applications that go to extremes, superalloys meet the need without compromising quality.

Airplanes and space shuttles require components that can withstand extremely high temperatures—sometimes higher than the melting point (the temperature at which a solid becomes liquid) of the alloy from which it is made. The construction and mining industries need parts with high hardness levels so they can be used to crush or grind other materials without quickly degrading.

These types of applications call for their metal parts to deliver beyond the typical, and groups of alloys known as "superalloys" have been specially designed to meet the service requirements of extreme conditions. Here is a brief look at a few of these "extreme" metals and what they can do. MP

COBALT

Cobalt is used in alloyed metals that primarily consist of nickel, iron, chromium, tungsten, along with cobalt. They can be used in temperatures up to 1,900F. Cobalt is a silvery metal, intermediate in the periodic classification between iron and nickel, both of which it resembles. The unalloyed metal is soft and readily corroded by aggressive environments, but certain specific properties that are developed or enhanced by alloying give it technological importance. These properties include high coercive force (capacity for magnetization), exceptional hardness and wear resistance, very high hot strength, and very high resistance to corroding and oxidizing environments both at ambient and elevated temperatures.

The major technological applications of cobalt, which between them account for two thirds of its use, are (1) as a base for hard magnet alloys, and (2) as the major constituent base for superalloys used principally in high-temperature components for gas turbines. They are also often used for dental and bone surgery.

Used in surgery to attach ligaments or tendons to the bone (such as in knee repair), ligament staples are made of cobalt chromium casting alloy and are biocompatible.

Here, a thrust beam for a satellite launch vehicle produced in titanium through the investment casting process is shown (left) as well as an aircraft fan hub that replaced an 88-piece steel fabrication for a 55% weight reduction.

TITANIUM

Titanium is the fourth most abundant metallic element in the Earth's crust and was first discovered in the 1790s. It's considered a superalloy because it has a high strength-to-weight ratio, meaning a part can be made with very thin walls in titanium and still be strong enough to avoid damage under high strains. In fact, titanium's density is one-half that of steel but its mechanical properties (like strength) are similar. So, an application that may require a 990-lb. steel part can instead use a titanium part that weighs just 595 lbs.

Titanium also has excellent corrosion resistance, fatigue strength and fracture toughness.

NICKEL

Nickel's greatest value is that when it is alloyed, or mixed, with other elements, it adds strength and corrosion resistance for a wide temperature range. In metal-casting, it is often used in the production of stainless steels. Nickel's other properties also include good corrosion resistance to many gaseous and liquid environments at normal temperatures, resistance to oxidation at elevated temperatures, good mechanical strength at high temperatures, and special physical properties including electric, magnetic, and dimensional.

Typical applications for nickel alloys include food processing, water treatment, power generation, and gas turbine engines.

This NASA component for the space shuttle crawler transporter was produced in 4320 steel alloy, which is a steel mixture containing significant portions of nickel, chromium, and molybdenum.

MEANINGFUL INTERNSHIPS LEAD TO CAREERS

What exactly is an internship? What is the benefit to a student? Is there a benefit for the company?

For students who attend an FEF-certified or affiliated school, an internship is one of the highlights of their education. FEF (the Foundry Educational Foundation) is an independent extension of metalcasting educational programs at colleges and universities across the country. The primary objective is to bring top-quality men and women into the metalcasting industry. FEF-certified schools have Key Professors who handle the partnership between students and FEF. They know the students, teach the courses, and handle administrative requirements from FEF headquarters. This personal approach has proven very successful in the 75 years FEF has operated.

When participating in an internship, FEF students put into practice theories they have learned in the classroom and the foundry lab. It's an opportunity to see how those exercises translate into a real-world business environment.

Being an intern at a company also allows the student to interact with professionals who are in their chosen industry while providing the opportunity to "try out" different aspects of the industry.

Companies also experience a wide variety of benefits. Hiring an FEF intern brings in an individual who already understands their business, processes, and goals. FEF students can take on that project that businesses have been wanting to complete but haven't had the staff to do so. FEF students also have a desire and enthusiasm to contribute to the company's success while elevating their metalcasting skills.

In one example, four students representing four different FEF schools not only created friendships, they learned more about the metalcasting industry and made significant contributions at Waupaca Foundry in Wisconsin in the summer of 2021.

David Foltz, Pittsburg State University, said he took the internship "to test my skills and knowledge about metalcasting ... and learn more about the processes that go into producing cast products."

When asked what his best experience was during his internship, Clay Barlow (Purdue University), said "I can't narrow it down." But a couple of the highlights he mentioned

were: "leading co-workers for the first time on a project and learning some dos and don'ts of real-world leadership the hard way" and "attending company events, shooting the breeze with the other metallurgists, and feeling like more than an intern—a real part of the foundry."

According to Dr. Russ Rosmait, FEF Key Professor at Pittsburg State, one of the important reasons for internships is they "allow students to experience the metalcasting industry firsthand and help to shape their impression of our industry."

Each summer, Rosmait takes the opportunity to visit several interns at their place of employment. While onsite, he speaks with the intern's company supervisors to see how the internship is going and to understand what abilities and skills a student needs to make a contribution to that company while serving as an intern.

For more information on studying metalcasting in college and for help finding schools with FEF programs, visit **www.fefinc.org**. MP

Interns receive hands-on experience in real-world applications.

The Saugus Pot: Symbolizing the Birth of the Foundry Industry in Colonial America

In 1642, a small and fledgling industrial enterprise called Hammersmith (now the Saugus Iron Works National Historic Site) cast what has come to be known as the Saugus Pot (Figure 1). To the casual observer this pot might be viewed as rather insignificant in the scope of a developing nation. But to the informed citizen, the casting represents freedom and independence. In the overall scheme of events, the small, fat pot may have greater significance to America than even the Liberty Bell.

Figure 1. Photograph of the original Saugus Pot. Note prominent parting line, sprue location and handle lugs. The pot was relatively small, with a diameter of 4.5 in. and weight of about 3 lbs. with the lid. (Clyde A. Sanders and Dudley C. Gould, History Cast in Metal. Cast Metals Institute, American Foundrymen's Society, 1976, flyleaf.)

Saugus Pot & the Birth of a Nation

Life for early settlers in America was harsh. To build settlements that could provide for the colonists and protect them against the harsh wilderness, they needed hardware. America had vast amounts of forests that could supply the chief building material of the time: lumber. On the other hand, metal goods such as nails, horseshoes, and cookware had to be imported from Great Britain at huge expense. For New England to truly thrive, metal-producing facilities needed to be established in America.

At about this time in the early to mid-1600s, England's forests that produced the charcoal necessary for iron production had become so depleted the British began looking to America to provide the pig iron to England. Thus, in 1641 the Company of Undertakers of the Iron Works in New England was founded under John Winthrop's direction with money from English investors.

Back then, blast furnace iron production required ore, flux, charcoal, waterpower, and skilled labor. A location near the town of Lynn, Massachusetts, on the Saugus River met all the key criteria. Skilled labor in the form of a clerk, a miner, a founder, a finer, and a smith was imported from Britain.

Saugus Iron Works operated until sometime between 1676 and 1678. It generated a modest profit, but not nearly as much as the shareholders demanded and all operations ceased. The unemployed ironworkers spread out across New England plying their trade in new locations, helping to spawn more metalworking plants across the colonies and laying the foundation for the foundry industry in America. It provided an economic base for the colonies and ensured their self-sufficiency,

Top: Saugus Iron Works is now a National Historic Site. Bottom: The finished and mounted Saugus Pot produced with modern methods.

which soon became a source of tension between New England and Great Britain.

Ironworking & Rebellion

The 1750 Iron Act made it illegal for colonists to build the equipment used to produce nails, wrought iron and steel. The Iron Act also discouraged the production of iron goods that had been made with this equipment in the colonies. The law meant that colonists would have to purchase finished iron goods at a much higher cost from Great Britain.

To colonial foundrymen, the Iron Act of 1750 was an excessively restrictive law imposed on American manufacturers by King George and the British Parliament that would have severely limited the American colonies' ability to meet their own needs for finished goods.

The Stamp Act of 1765, imposing a tax payable in British currency on all printed goods without colonial consent, only increased tensions between colonists and the British. The passing of the infamous Tea Act of 1773 was the final straw that brought seven foundrymen to the signing of the Declaration of Independence on July 4, 1776.

The ability of colonists to provide for themselves was symbolized by the Saugus Pot. However, when that autonomy was stripped away by British law, the ensuing unrest ultimately led to independence for the 13 American colonies.

Casting the Original

The making of the Saugus Pot, ostensibly the first utilitarian iron casting in America, is credited to Joseph Jenckes Sr., a cutler and foundryman. No record remains of the technique Jenckes used to produce the pot. However, features of the Saugus Pot itself and period writings give clues about the design and production of the artifact.

An original Saugus Pot is held at the Lynn Public Library in Massachusetts. Recently, a couple of metalcasters set out to cast a recreation of the pot using modern methods. 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
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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
- Human Resources
- Safety Managers
- Accountants
- Quality Control Technicians
- Marketing & Salespeople
- Mechanical Engineers
- Metallurgists
- Skilled Tradespeople

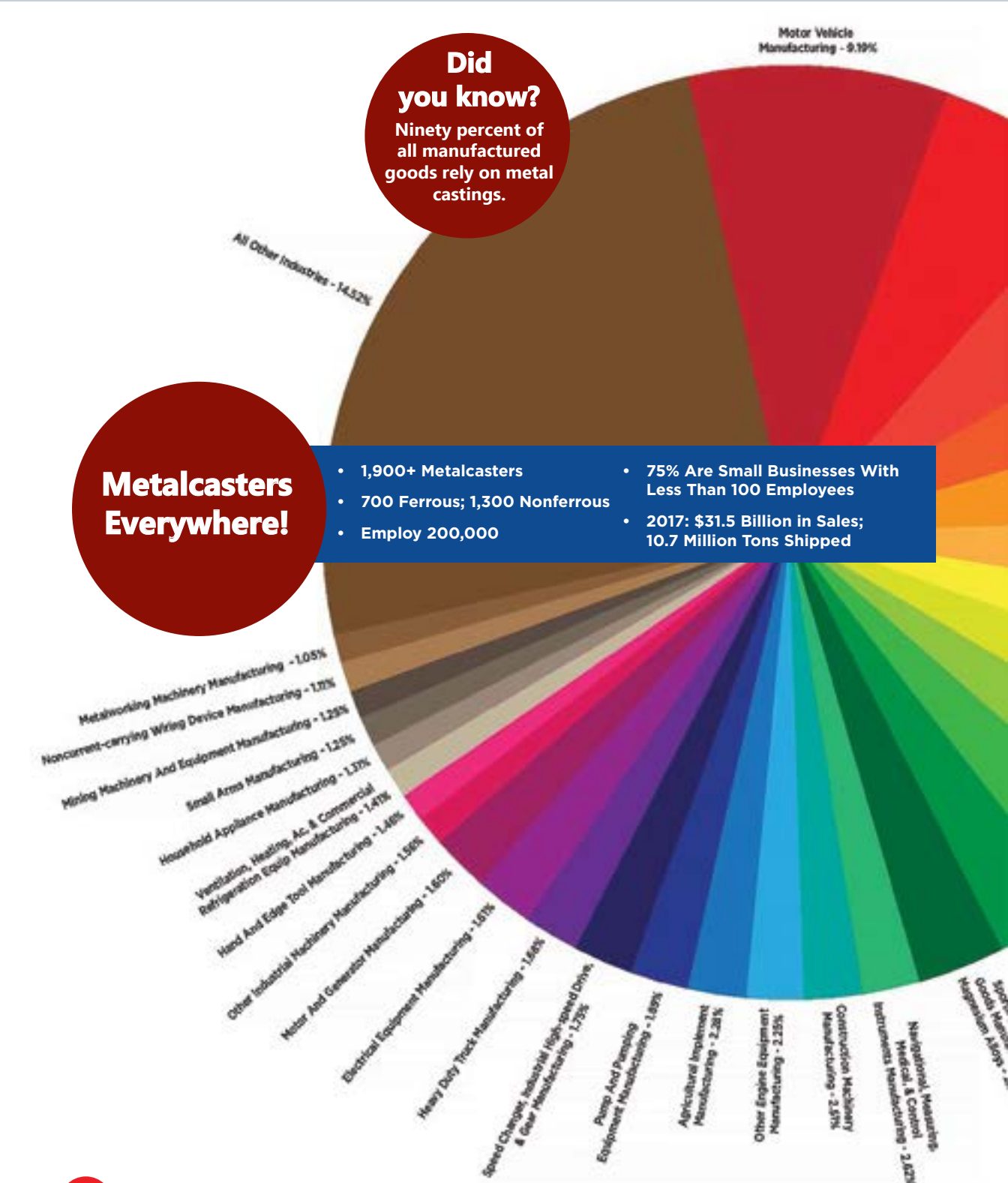
Careers: Post High School

- 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

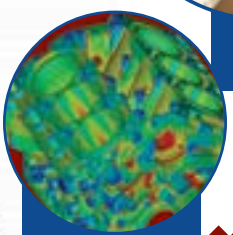
WHERE DO CASTINGS GO?



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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