

DIE CASTING ENGINEER

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SUPPLIERS DIRECTORY



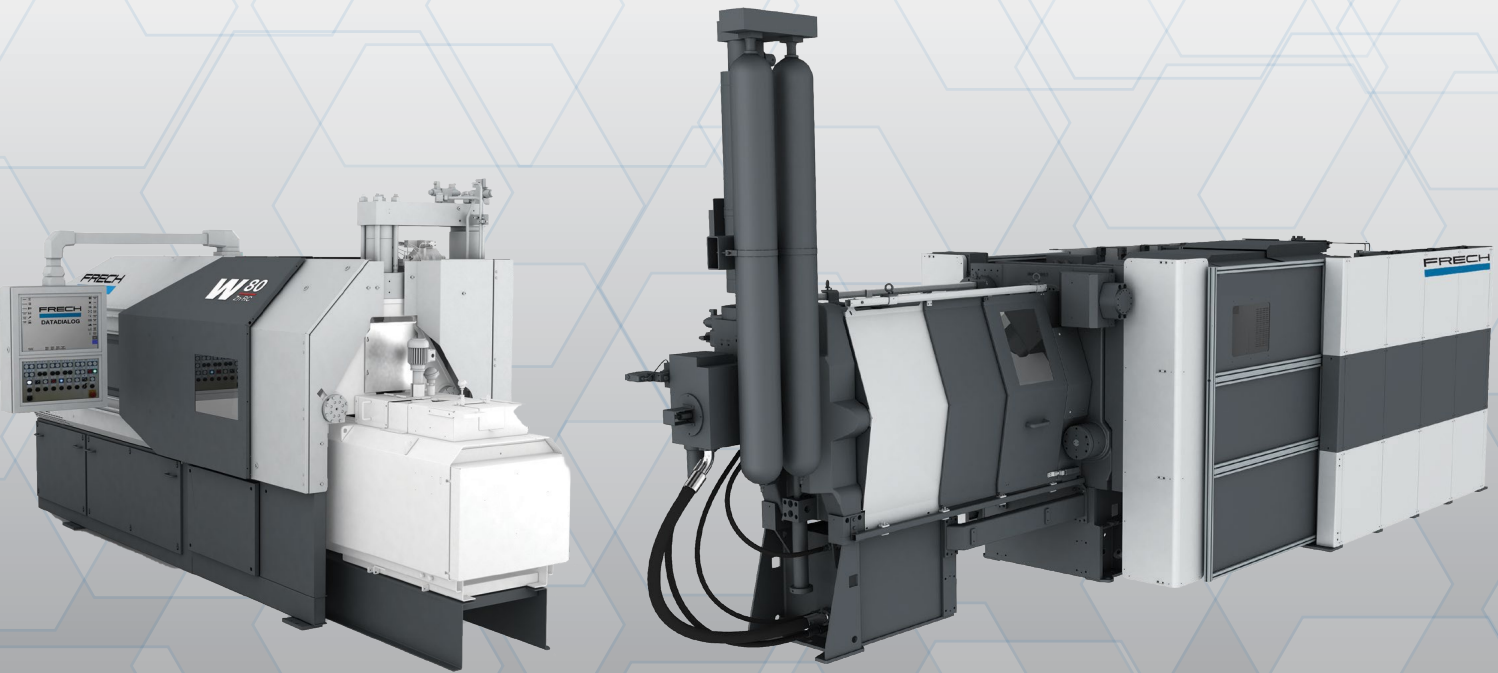
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Chairman's Note

Why Does NADCA Exist?

The mission of the North American Die Casting Association (NADCA) is to be the worldwide leader of and resources for stimulating continuous improvement in the die casting industry.

We provide opportunities for education, marketing, government interaction, networking, expositions, and research and development all focused on improving the die casting industry in North America.

This month, as we focus on additive manufacturing and advanced technologies. I asked Paul Brancaleon, Executive Director of Research, Education and Marketing for NADCA, highlight a few of the new NADCA supported advanced technology projects underway.

"NADCA Started the year with fourteen projects and a total value of \$2.84 million dollars.

The projects consisted of three in additive manufacturing, five in cast materials, three in die materials and surface engineering, one in computer modeling, and two in process technologies.

NADCA has added four projects to the portfolio:

1. Advanced Thermal Management - Sponsored by Advanced Technology International and the Defense Logistics Agency. The P.I. (Principal Investigator) on this project is Dr. Carl Soderhjelm, University of California Irvine. The project will run for 5 years and has a total value of \$788,770. This project will work on advanced technologies to reduce die spray, increase productivity, reduce scrap by improving and developing technologies in thermal management of the die cast tooling for high pressure die casting.
2. Identifying and Controlling factors to improve the production of Thin-wall Ferrous, High Pressure Die Castings - Sponsored by Advanced Technology International and the Defense Logistics Agency. This project is divided into 2 unique projects that will complement each other and work together for the commercialization of the ferrous, high pressure die cast process. The two P.I.s on this project are Dr. Stephen Midson, Colorado School of Mines and Dr. Charles Monroe, University of Alabama. The project will run for 5 years and has a total value of \$1.2 million.
3. A.I. Vision System for Automated Casting Quality Inspection - Sponsored by NADCA. The P.I. on this is Dr. Xiaoming Wang, Purdue University & Dr. Corey Vian, Stellantis. The goal of this project is to develop new or to test emerging AI technologies for defect inspection for diecasting products through computer vision, followed by machine learning. This project will run for 2 years and has a total value of \$80,000. With \$30K coming from industry in-kind contributions.
4. Continued Research into Failure Analysis of Additively Manufactured Components - Sponsored by NADCA. The P.I. on this project is Peter Ried, Ried and Associates. This project will 1) determine the damage/fracture initiation sites and mechanisms, 2) recommend possible design and material improvements, and 3) help other die casters apply the lessons learned for 3D-printed additive manufactured components for die cast applications. This project will run for 2 years and has a total value of \$85,000. With \$35K coming from industry in-kind contributions.

With the addition of these four projects, this brings the total portfolio of NADCA projects to \$5.984 million dollars, including in-kind contributions."

Our organization, through partnerships with industry, government, and academia, continues to meet our stated mission.

Thank you to each one of you who invests your time and talent into these industry advancing endeavors.



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"An organization's ability to learn, and translate that learning into action rapidly, is the ultimate competitive advantage."

- Jack Welsh



Andrew Ryzner
Editor
North American Die Casting Association

"If you would like to get involved in research projects and/or propose new ideas, please contact NADCA and we can help!"

Andrew Ryzner

From the Editor's Desk



Hope NADCA Staff Sees You at the Show!

Greetings Die Casting Engineer readers!

The time has come once again for the show preview issue of DCE magazine. This year we are in line for the "big" show - The Die Casting Congress & Exposition in Indianapolis, IN. If you plan on attending for the show floor alone, admittance is free for those who are members of NADCA. So please do be sure to come attend and at least peruse the show floor, make some new contacts or mingle with old ones and people you already know.

Coinciding with our normal magazine and the special show preview this month, the magazine also contains the 2024 Suppliers Directory - a valuable source of anyone and everyone in the industry who can help you with your needs with their products and services. This information is printed in our magazine every 2 years and is current as of June 1, 2024. Starting on page 55, please see the directory for any information that may be of interest to you.

Also contained is NADCA's yearly R&D Report. Every year, NADCA's Executive Director of Research, Education & Marketing, Paul Brancalion, provides an update on the various research projects being conducted by and with help from NADCA. Always striving to be better at what we do as an industry, NADCA is focused on providing benefits in technological advancements, such as higher performance alloys, solder reduction, cycle time improvements, productivity improvements, scrap reduction, cost reduction and reduced lead-time. If you would like to get involved in such projects and/or propose new ideas, please contact NADCA at research@diecasting.org.

I hope you are having a great summer and look forward to hearing from you in the fall. As always, thank you for reading.





Section 301 Tariff Review Report Issued

The Office of the U.S. Trade Representative (USTR) on May 14 released its review of the tariff actions in the Section 301 investigation of China's Acts, Policies, and Practices Related to Technology Transfer, Intellectual Property, and Innovation. The report concludes that the tariffs have "burdened China's economy, imposing meaningful costs." Not only has China's market share of U.S. imports decreased since the imposition of the tariffs but USTR analysis found that hundreds of companies, including small and medium-sized businesses moved production capacity out of China as a direct result of the Section 301 tariff actions.

While the report finds that the 301 tariffs impacted, "many of the technology transfer-related acts, policies, and practices described in the original Section 301 Report persist and increasingly burden or restrict U.S. commerce." USTR is recommending that the Section 301 tariffs remain in place as well as adding or increasing tariffs for certain products. The increased tariffs are for products in "strategic sectors," such as those specifically targeted by China or industries where the Biden administration has been focused on making investments, like electric vehicles, semiconductors, and critical minerals. USTR will also increase tariffs on steel and aluminum to 25%, if not already at that level under the 301 action.

USTR also recommends establishing a new limited exclusion process for manufacturing machinery and automatic temporary exclusions for certain solar manufacturing equipment. The exclusion process will only apply to certain products listed under HTS Chapter 84 (Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof) and Chapter 85 (Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles). The proposed eligibility list does include "casting machines, of a kind used in metallurgy or in metal foundries" (HTS 8454.30.00). A full list of the products eligible for exclusion under the new process can be found here.

USTR has opened a 30-day docket to accept public comments on the modifications of the Section 301 tariffs included in the report. The agency is asking for comments on whether those goods should receive a higher tariff rate, which other imports USTR should make eligible for an exclusion from being subject to the tariffs, and feedback on solar manufacturing equipment specifically.

Department of Labor Issues Final Overtime Rule

The Wage and Hour Division of the Department of Labor announced a new rule on April 23, 2024, making roughly four million more full-time salaried workers eligible for overtime pay. This rule, titled "Defining and Delimiting the Exemptions for Executive, Administrative, Professional, Outside Sales, and Computer Employees," will take effect on July 1, 2024.

The rule increases the annual salary-level threshold for white-collar exemptions to overtime requirements under the Fair Labor Standards Act (FLSA). Currently set at \$35,568 per year, it will rise to \$43,888 per year once the rule is implemented on July 1st. Additionally, the threshold for highly compensated employees (HCE) will increase from \$107,432 to \$132,964. Starting January 1, 2025, the standard salary-level threshold will further increase to \$58,656 per year, and the HCE threshold will rise to \$151,164.

Moreover, the rule mandates automatic updates to these thresholds every three years, starting on July 1, 2027. These updates will ensure that the standard salary level aligns with the 35th percentile of weekly earnings of full-time salaried workers in the lowest-wage Census Region, and the HCE total annual compensation threshold aligns with the annualized weekly earnings of the 85th percentile of full-time salaried workers nationally.

Final Rule Banning Methylene Chloride Released

The Environmental Protection Agency (EPA) has finalized its regulation on methylene chloride under the Toxic Substances Control Act (TSCA). Published by the EPA on May 8, 2024, the rule titled "Methylene Chloride (MC); Regulation Under the Toxic Substances Control Act (TSCA)" prohibits the manufacture, import, processing, and distribution of methylene chloride for consumer use, and restricts most industrial and commercial uses of the chemical, commonly employed as a degreaser in metal manufacturing.

The regulation establishes a phased timeline to phase out most uses of methylene chloride within two years. Specifically, the prohibitions will take effect as follows: 270 days for distribution to retailers, 360 days for broader retail distribution, 360 days for manufacturers, 450 days for processors, 630 days for all other distributors, and 720 days for industrial and commercial users.



Certain uses of methylene chloride will still be permitted under a workplace chemical protection program (WCPP). These exceptions include the chemical's manufacture; its use as a feedstock for climate-safe refrigerants; as a degreaser for civilian aircraft; various applications at the Department of Defense (DOD), NASA, and the Federal Aviation Administration; and its industrial and commercial use in processing aids and in the manufacturing of plastic and rubber products, including polycarbonate. The WCPP must incorporate inhalation exposure monitoring and limits, recordkeeping, and downstream notification requirements for these limited uses.

Additionally, the final rule introduces a de minimis threshold, exempting products with methylene chloride concentrations below 0.1 percent by weight from the restrictions.

The new rule is effective on July 8, 2024.

Final NEPA Phase 2 Regulation Issued; Lawmakers Move to Block Rule

The White House Council on Environmental Quality (CEQ) has released the final Phase 2 rule overhauling Trump-era National Environmental Policy Act (NEPA) implementing rules. The final "Bipartisan Permitting Reform Implementation Rule" was officially published in the Federal Register on May 1, 2024, and takes effect on July 1, 2024.

This new rule follows the Phase 1 regulation finalized in April 2022, which introduced three core changes to NEPA: agencies must assess direct, indirect, and cumulative effects; the definition of a project's "purpose and need" emphasizes it is not solely determined by the applicant; and the CEQ rule serves as the minimum standard for agency implementation of NEPA in major federal actions.

The Phase 2 rule, initially proposed on July 31, 2023, aimed to further modify the 2020 rule by addressing issues left unresolved in the Phase 1 regulation. However, some elements of the previous rule were codified in the debt ceiling bill, including the definition of a "major federal action" and expanded categorical exclusions. The bill also mandates a single lead agency for developing environmental reviews and sets time limits of one year for an environmental assessment and two years for a full environmental impact statement.

The final Phase 2 rule updates procedural requirements and strengthens the consideration of climate and environmental justice (EJ) in environmental reviews. Agencies are now required to consider the effects of climate change and identify reasonable alternatives that mitigate climate impacts. Projects with only "significant, long-lasting positive impacts" will not require an environmental impact statement. Additionally, agencies must analyze and mitigate impacts on communities with environmental justice concerns.

Members of Congress are already moving to try to overturn the Phase 2 rule. Following a contentious hearing in the House of Representatives on the White House Council

on Environmental Quality's (CEQ) fiscal year 2025 budget request, House Republicans have announced plans to introduce a Congressional Review Act (CRA) resolution to repeal the rule.

House Defense Bill Report Cites Castings as Critical

The House Armed Services Committee (HASC) began the all-day committee meeting on May 22, 2024, to consider the FY25 National Defense Authorization Act (NDAA), approving the bill by a bipartisan vote of 57-1. The roughly \$895 billion defense policy bill authorizes a total of \$849.8 billion for the Department of Defense, in line with the spending caps agreed to in the Fiscal Responsibility Act (FRA).

Included in the Committee Report accompanying the legislation is directive language regarding the castings supply chain. The section entitled "Ensuring Access to Strategic and Critical Materials in the Castings and Forgings Supply Chain" states that the HASC agrees with the DoD that the "U.S. requires a robust and secure strategic and critical minerals industry to provide reliable and timely delivery of parts used in DoD's operational systems and to produce and sustain new systems. Tungsten, tantalum, molybdenum, and hafnium are essential to the production of nickel superalloy materials which have several defense applications, including in castings and forgings." The Committee Report directs the DoD to provide the Committee with a briefing by the end of the year on the "the Department's efforts to ensure production of tungsten, molybdenum, tantalum, and hafnium from domestic sources – as well as partner and allied sources – and efforts to increase utilization of scrap materials that reduce the nation's reliance on virgin, non-domestically sourced materials."

The Report also contains language on aluminum extrusions stating that HASC "recognizes that aluminum extrusions play a critical role in the defense industrial base for munitions, aerospace, and space applications. The committee supports the existing Department of Defense focus on castings and forgings and is aware that aluminum extrusions are an important supplemental technology option." The DoD is directed to provide a briefing to all the congressional defense committees by March 1, 2025, on "the importance of a robust domestic production capability for heavy press, hard alloy extrusions to the Defense Industrial Base." The Report also encourages the Assistant Secretary of Defense for Industrial Base Policy to "consider heavy press extrusion capability to strengthen national security and reduce reliance on foreign production of extrusions."

The NDAA is scheduled for floor consideration in the House the week of June 10, 2024.



Preliminary Determinations in Aluminum Extrusion AD & CVD Investigations Issued

The US Department of Commerce (Commerce) has issued affirmative preliminary determinations in the investigations of aluminum extrusions from China, Colombia, Ecuador, India, Indonesia, Italy, Malaysia, Mexico, South Korea, Taiwan, Thailand, Turkey, the United Arab Emirates (UAE), and Vietnam. The determinations, published in the Federal Register on May 7, 2024, state that Commerce found that aluminum extrusions “are being, or are likely to be, sold in the United States at less than fair value (LTFV)” from the subject countries.

AD and CVD orders on aluminum extrusions from China have been in place since 2011 with duty rates ranging from 32.79% to 33.28% and subsidy rates ranging from 8.02% to 374.15%. This new investigation expands the scope under the existing orders to capture various additional types of aluminum extrusions.

The scope outlines that the investigations cover “aluminum extrusions, regardless of form, finishing, or fabrication, whether assembled with other parts or unassembled, whether coated, painted, anodized, or thermally improved. Under the scope, aluminum extrusions are shapes and forms, produced by an extrusion process, made from aluminum alloys having metallic elements corresponding to the alloy series designations published by the Aluminum Association commencing with the numbers 1, 3, and 6 (or proprietary equivalents or other certifying body equivalents).”

The final determinations by Commerce for the AD and CVD investigations are expected on July 15, 2024, but Commerce has already indicated that the final determinations may be delayed until mid-September. In the preliminary determinations, Commerce set the following dumping rates:

- China – 4.91% to 376.85%
- Columbia – 8.85% to 34.47%
- Ecuador – 17.23% to 51.20%
- India – 3.44% to 39.05%
- Indonesia – 5.65% to 112.21%
- Italy – 0% to 41.67%
- Malaysia – 0% to 27.51%
- Mexico – 9.18% to 82.03%
- South Korea – 0% to 43.56%
- Taiwan – 0.73% to 67.86%
- Thailand – 2.02% to 4.04%
- Turkey – 45.41% to 594.55%
- United Arab Emirates – 9.13% to 42.29%
- Vietnam – 2.85% to 41.84%

The antidumping duties will combine with the preliminary countervailing duties assessed in March for China, Indonesia, Mexico and Turkey.

EPA Proposes Minor Changes to Secondary NAAQS

The Environmental Protection Agency (EPA) recently announced a proposal to maintain most of the “secondary” air quality standards for nitrogen oxides (NO_x), sulfur oxides (SO_x), and particulate matter (PM) at their current levels. Published on April 15, 2024, this proposal suggests a slight adjustment to the secondary National Ambient Air Quality Standards (NAAQS) for SO_x, while leaving the standards for NO_x and PM unchanged. The Clean Air Act requires primary NAAQS to protect public health and secondary standards to safeguard the environment.

Currently, the secondary standard for SO_x is 500 parts per billion (ppb) of sulfur dioxide (SO₂) over three hours, a standard set in 1971. The proposed rule suggests lowering this standard to a range of 10 ppb to 15 ppb for SO₂, averaged over three years. This proposal differs from a final policy assessment (PA) by EPA staff, which recommended an annual range of 5-16 ppb, averaged over three years.

In the PA, EPA staff also recommended additional tighter standards, including potentially setting NO_x as low as 40-35 ppb annually, tightening the annual PM_{2.5} limit from 15 micrograms per cubic meter (µg/m³) to as low as 12 µg/m³, and retaining the secondary standard for PM₁₀. The secondary standard for NO_x remains at 53 ppb of nitrogen dioxide (NO₂) annually, unchanged since 1971. The secondary annual PM_{2.5} standard remains at 15 µg/m³, and the secondary daily PM_{2.5} standard at 35 µg/m³. The secondary daily limit for larger “coarse” PM, or PM₁₀, stands at 150 µg/m³.

The EPA held a public hearing regarding the proposal on May 8 and will accept comments from stakeholders until June 14, 2024.

USITC Announces Hearing in USMCA Autos Review

The U.S. International Trade Commission (USITC) has announced a public hearing on October 8, 2024, as part of its ongoing investigation into the “economic impact and operation” of the U.S.-Mexico-Canada Agreement’s (USMCA) automotive rules of origin. This hearing is for the second of five reports mandated by the USMCA implementing legislation.

Launched in November 2023, the investigation examines the USMCA automotive rules of origin and their impact on the U.S. economy, their effect on U.S. competitiveness, and their relevance in light of recent technological changes. The Commission must complete and submit the report to the President, the House Committee on Ways and Means, and the Senate Committee on Finance by July 1, 2025. The first report was released by the USITC in June 2023, with the remaining three reports scheduled for release in 2027, 2029, and 2031.



White House Launches Climate and Trade Task Force

The White House has established a new task force dedicated to creating a “climate and trade policy toolkit” and generating “credible, robust, and granular data” for implementing effective climate and trade policies.

John Podesta, the White House Senior Adviser for Clean Energy Innovation and Implementation, announced the task force’s formation during his speech at the Columbia Global Energy Summit in New York City on April 16, 2024.

In his address, Podesta explained that the task force will leverage insights from the ongoing U.S.-EU negotiations on a Global Arrangement on Steel and Aluminum, as well as proposals from Congress and contributions from “policy thought leaders” across both the public and private sectors. Additionally, the task force will collaborate with America’s trading partners to “develop standardized and authoritative ways of measuring embodied emissions,” aimed at enhancing clean manufacturing.






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Dr. Die Cast

Additive Manufacturing Die and Core Cooling Lines Like Never Before

When you hear the term “Additive Manufacturing,” what comes to mind? In today’s common usage, it means using a 3D printer to print a part. In the early days of 3D printers, the 3D model was usually done using a plastic material for the purpose of showing a customer, engineering, or sales what the finished casting would look like. But does printing a die casting come to mind? Or what about die cast die components such as cores and inserts. There are examples of complex low volume castings that are produced for less than the cost of the pattern or die cast die - and much quicker.

How does printing a core/insert benefit the die caster? Some of the best examples of printed die components have complex heating and cooling lines that would be impossible to produce using conventional tooling. Envision a four-inch (101.6 mm) diameter core three inches (76.2 mm) long

(or larger) that produces a hole that requires a uniform diameter and roundness. By creating conformal heating/cooling lines that can maintain a uniform surface temperature, you can overcome many of the irregular shrink characteristics of spot-cooling with a bubbler. Connecting improved cooling lines to a system such a “jet-cooling” or active temperature control system and you can also reduce die lube spray time and usage. Reducing cycle time and improving dimensional repeatability are just a few of the benefits.

Size matters, as the technology advances, we can now go from producing cores and small components to entire cavity inserts. As with any new technology, don’t waste your time designing heating/cooling lines with the same 90-degree water-line designs you would have used to produce using CNC and EDM. Take full advantage of the capabilities of the equipment and materials and

design it as if you had never seen a tool produced with conventional tool room equipment.

There are several companies who specialize in printing tool steel components. There are also a few tool shops who have added equipment to produce printed die components. I am sure there will be plenty displaying and presenting at the next NADCA Expo in Indianapolis.

Who’s Dr. Die Cast?

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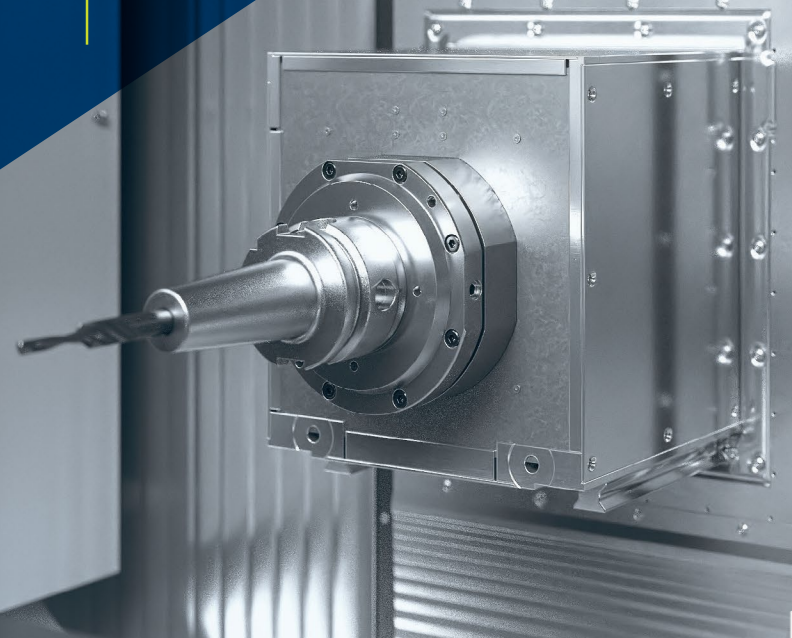
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NADCA NEWS

OSHA Closer to Releasing Heat Rule

Arlington Heights, IL - Assistant Secretary for Labor Douglas Parker on May 7th said that OSHA is nearing release of its proposed rule to regulate indoor and outdoor workstations when the heat index reaches 80 degrees Fahrenheit. Speaking at a meeting of National Advisory Committee on Occupational Safety and Health (NACOSH), Parker indicated that OSHA is working to finish outreach to the Native American community in May. Afterwards, the agency will send the proposed rule to the White House Office of Management and Budget for their review, which is the final step prior to the Labor Department releasing for public input the proposed regulation. This follows an April 24 meeting where the Advisory Committee on Construction Safety and Health voted unanimously to recommend that OSHA move forward with its proposed heat rule.

NADCA filed comments (<https://www.regulations.gov/comment/OSHA-2021-0009-1071>) last fall raising significant concern over OSHA's proposed framework that would require employees to take a ten minute break every two hours when the heat index reaches 80 degrees, and fifteen minutes at 87 degrees or higher. Changes in shift times, weather acclimatization policies, mandating water at all workstations, and temperature monitoring throughout the shops are among many of the possible components of OSHA's heat rule. NADCA will file comments on how the proposed rule will impact its members once the Labor Department releases the indoor/outdoor heat regulation, which could occur prior to Labor Day.

UPCOMING EVENTS

NADCA is Heading Back to Indy for the 2024 Die Casting Congress & Exposition

Arlington Heights, IL - The Die Casting Congress & Exposition will be held September 30 - October 2, 2024, at the Indiana Convention Center in Indianapolis, IN. This event will include three days of Congress sessions given by experts from around the world.

In addition to the Congress sessions, this exposition show will feature more than 150 exhibitors, the International Die Casting Design Competition and the Die Casting Industry Awards Luncheon.

For more information or to register please visit: www.diecasting.org/congress.

NADCA Casting Congress Slides Over to the West Coast

Arlington Heights, IL - NADCA is excited to announce Die Casting Congress West!

Save the date for October 22, 2024 Anaheim, CA. The Congress will feature technology highlights from our Congress in Indianapolis, last fall. The event begins with a full day of presentations, networking and exhibits.

More information on topics and exhibitors coming soon.

TOOLS & RESOURCES

12th Edition of Product Specification Standards for Die Casting Now Available

The newest edition of NADCA's Product Specification Standards for Die Castings is now available.

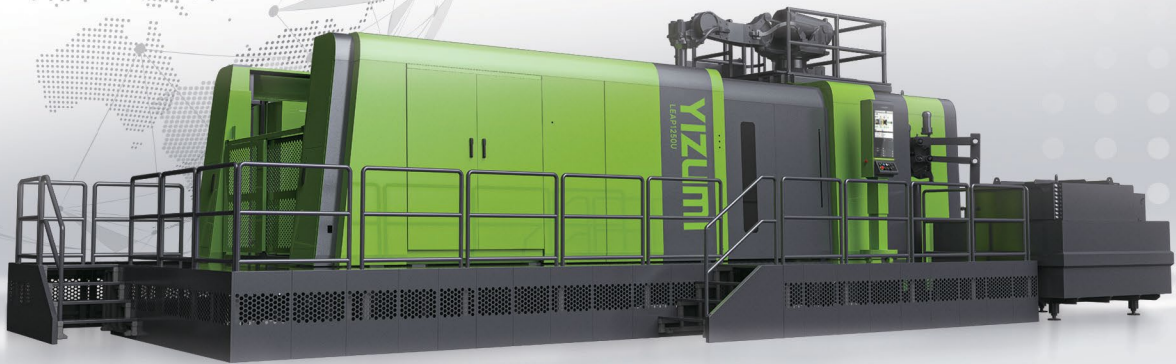
This manual covers specification, design and production guidance for both users and manufacturers of conventional high pressure die castings. The manual presents tooling and processes information, alloy properties, standard and precision tolerances, GD&T, design guidelines, quality assurance provisions and more.

Revisions for this edition include: rewrite of the first chapter to focus on an overview of the die casting process; additional information about die technology and sizing; new information about loose inserts; considerations for datum locations; moved around the order of alloy families to cover the more common alloys first; updated alloy reference tables; added P-20 as a possible option for miniature die casting die material; updated casting examples with more recent products; minor typographical errors have been corrected through.

The cost for this essential publication is \$70 for Corporate Members, \$100 for Individual Members and \$140 for Non-Members.

You can order yours by visiting www.diecasting.org/marketplace and search PUB-402.

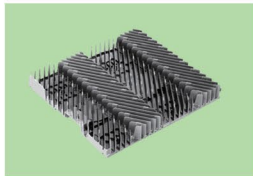
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High Performance Tool Steel for Additive Manufacturing

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Abstract

In an answer to the die casting industry need for a powder tool steel designed specifically for additive manufacturing using Laser Powder Bed Fusion (L-PBF), Uddeholm AB has developed Uddeholm Dievar for Additive Manufacturing. In wrought form, Dievar is a well-known NADCA certified hot work material with properties exceeding that of Remelted H13. Now, Dievar for AM further enhances the already superior tooling properties of wrought Dievar with engineering know how and solutions based developments. A commonly used material for AM inserts is W.-Nr. 1.2709 maraging steel, a material selection based on printability while neglecting important requirements for high pressure die casting. To address those concerns, printing parameters for Uddeholm Dievar for AM have been optimized for chromium martensitic tool steels, which results in high printability to ensure high physical and mechanical properties. With state-of-the-art powder production, optimized process control and tailor-made printing parameters, higher toughness values than seen in P-ESR bar material are achieved. As an additional consideration, hybrid solutions combining machining and printed Uddeholm Dievar material result in die inserts with an interface that is homogeneous in both mechanical and physical properties. This paper will provide information how 3D printed inserts of Uddeholm Dievar can improve tool performance in aluminum high pressure die casting.

Introduction

Additive manufacturing (AM) is generally considered a new process within the field of manufacturing core inserts for High Pressure Die Casting (HPDC). During the recent years the development has been rapid. Today, AM is an accepted production method, but a technology still in its infancy. The AM materials investigated in current reports exclusively were produced with the Laser Powder Bed Fusion (LPBF) method, thus only the laser melting AM process will be presented in this paper. In a survey done by Klocke et.al 2017,¹ hot work tools are described as one of the developing frontiers in the AM field. Many attractive AM attributes such as 3D manufacturing complex geometry and conformal cooling channels generates a market need for AM hot work tools. The main reason for 3D printed inserts in HPDC is to extract heat from the casting process which is possible due to the design freedom of conforming cooling channels. This gives main advan-

tages such as lead time reduction, increased casting quality due to a lower level of shrinkage porosity and to lower the soldering tendency which is a common failure mechanism in HPDC see Figure 1. However, the processing of hot work alloys in AM has proved to be challenging, and intricate process development is needed. Klocke et.al further state that the high material mechanical property profile demanded in hot work applications, to a great extent is fulfilled by highly refined conventional raw material manufacturing processes, and the new processing technology inherent to AM therefore must produce like worthy materials for AM inserts to be market process applicability. The processing parameters used in AM manufacturing of the material, therefore intimately correlate with the mechanical properties of the produced material, and hence the AM hot work applicability.



Figure 1 - Soldering formation on water jacket inserts and conforming cooling design.

In LPBF processing, the feedstock raw material is metal powder. Powder feedstock can be produced by gas- and water atomization or centrifugal atomization, where the molten alloy is atomized into a fine powder. For LPBF processing Close Coupled Gas Atomization produces a

suitable powder with high morphology based on spherically shaped powder and tight chemistry tolerances. Many parameters are used in feedstock powder characterization such as particle size distribution, sphericity, aspect ratio, density, tap density, flowability etc. For LPBF processing the particle size distribution and flowability are important powder characteristics. Powder particles with trapped atomization gas act detrimental on mechanical and fatigue behavior of AM components, and the entrapped gas cannot completely be removed from the component. Therefore, it is imperative to use high quality feedstock powder to ensure the highest possible AM printed part quality.² During AM processing, the un-melted feedstock powder is recycled for use in future builds.

Hot work tool steels are considered challenging materials to process in AM. Process windows are small and sensitive, hence demanding highly refined process parameters in order to achieve good material properties. Inherent fault artifacts such as pores, lack of fusion and cracks are responsible for lowering the part density in the AM process. A compilation of reported density measurements of AM processed H13 is directed towards Mazur et.al 2015 reporting as-built densities ranging from 70.53 to 99.99%.³ The optimization of the build parameters made it possible to reach near maximal density, and thereby enabling reaching high mechanical properties.

The hot work grade Uddeholm Dievar is a 5% chromium martensitic steel grade manufactured through the Pressurized Electro Slag Re-melting process (P-ESR) to provide homogenous properties. The material is well known for its impact toughness and hot strength making it used often in HPDC inserts to delay failure mechanism such as thermal fatigue. With the gas atomization process the P-ESR material is atomized to fine powder grains with a fraction of 20-50 μm making it processable for LPBF.

HPDC AM inserts with its complexity have experienced short amount of production cycles before cracking issues. Application input hence have shown an increased need for mechanical properties such as high impact toughness.

Initial Experiment

Based on process parameters of Uddeholm Dievar for AM on EOS M290 LPBF a printer evaluation was made to investigate the process stability for HPDC inserts. The evaluation was based on:

- Printing process
- Density
- Mechanical properties comparison with Uddeholm Dievar bar material
- Impact Toughness comparison with W.-Nr. 1.2709 and AM AISI H13
- Soldering comparison with W.-Nr. 1.2709

Materials

All tests are performed in hardened and tempered conditions according to NADCA Uddeholm Dievar parameters with a hardness range of 44-46 HRC if nothing else is

stated. The reported properties of Uddeholm Dievar bar material are representative of samples which have been taken from the center of a 610 x 203 mm (24" x 8") bar.

Uddeholm Dievar for AM is a vacuum inert gas atomized powder with a sieved particle size between 20-50 μm .

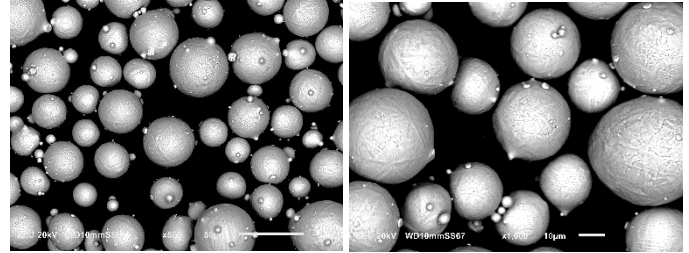


Figure 2 - Powder fraction of Uddeholm Dievar for AM.

Printing on EOS M290 machine allows a pre-heating temperature of the base plate up to 200 °C (392 °F). This allows a build rate of 20 cm³/h with density of 99.99-99.997 % and lowers the stresses in the print job to avoid microcracks, see Table 1.

Table 1 - Printing features of Uddeholm Dievar for AM.

Layer thickness	Pre-heating	Build rate [cm ³ /h]	Density (%)
30 μm	200°C (392°F)	11.3 (0.69 inch ³ /h)	99.999
60 μm	200°C (392°F)	~ 20 (1.22 inch ³ /h)	99.99-99.997

One of the aims of this concept study has been to see if it is possible to scale up the printed volume without getting issues with cracking. To avoid cracking after printing of complex mass parts or during heat treatment design recommendations to minimize stress concentration is minimum radius 6 mm (¹⁵/₆₄ in) between print job and base plats, and radius of minimum 2 mm (⁵/₆₄ in) in the printed geometry. The printed geometry was a demonstrator with internal cooling typical for HPDC cores with a printed volume of 2955 cm³ (180.3 inch³) see Figure 3.



Figure 3 - Printed geometry with design recommendations.

The microstructure of Uddeholm Dievar for AM has been studied in the as-printed and hardened & tempered conditions both samples printed on the EOS M290 printer. In the as-printed condition the melt pools are clearly visible in the microstructure, see Figure 4. The microstructure in the as-printed condition consists of martensite with some 25-30 % retained austenite.

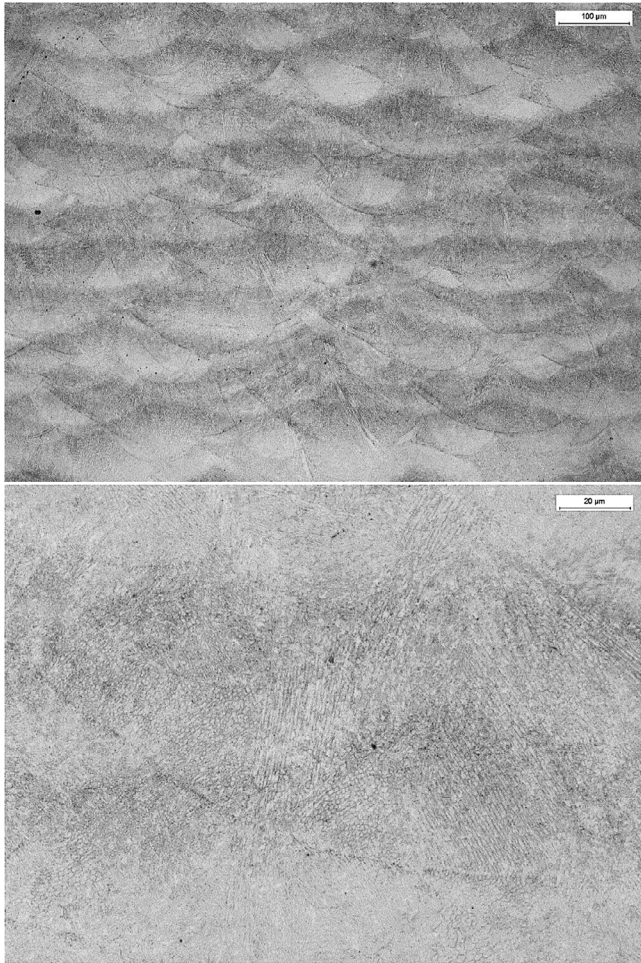


Figure 4 - Microstructure in as-printed condition.

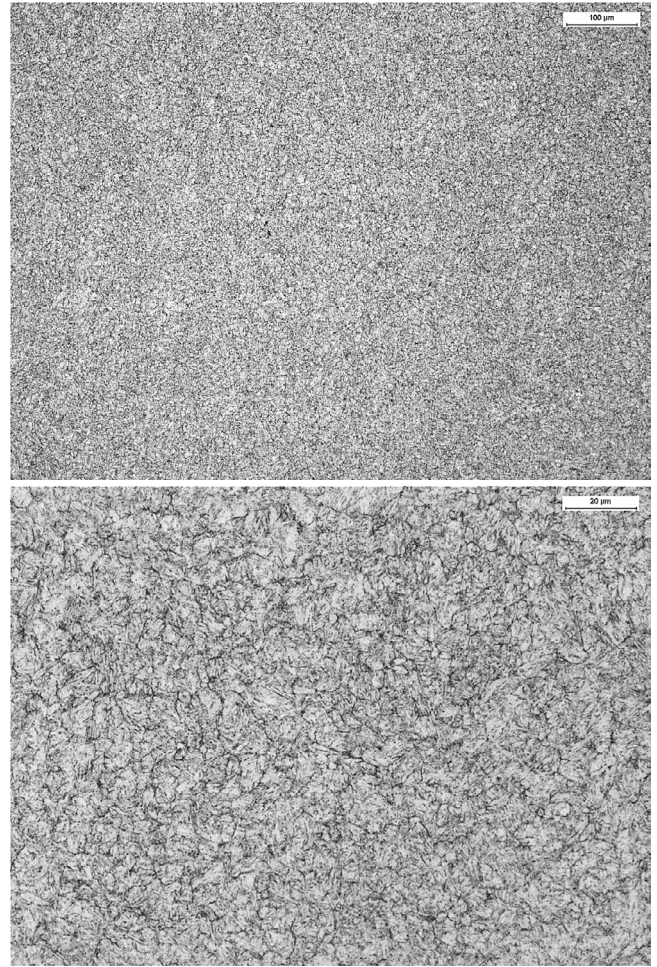


Figure 5 - Microstructure after hardening and tempering 44-46 HRC.

Hardening and tempering is conducted according to NADCA for Uddeholm Dievar. After hardening and tempering the microstructure is homogenous and the melt pools are no longer visible, see Figure 5.

Dievar for AM Evaluation

Physical Properties

To investigate if the physical properties is the same for printed and wrought P-ESR material, experiments were conducted up to 400°C (752°F) and 600°C (1112°F). The results are found in Table 2. and shows that the comparison difference is within the normal variation for the measurements of 15%.

Table 2 - Comparison in physical properties between Dievar bar material and Dievar for AM.

Temperature	Material	Density [kg/m ³]	Coefficient of thermal expansion per °C (°F) from 20°C (68°F)	Thermal Conductivity [W/m °C]
400 °C 752 °F	Dievar	7 700 (0.278 lbs/in ³)	12.7x10 ⁻⁶ (7.0x10 ⁻⁶)	31 (215 Btu in/(ft ² h°F))
	Dievar for AM	7 668 (0.277 lbs/in ³)	12.55x10 ⁻⁶ (6.9x10 ⁻⁶)	29.4 (204 Btu in/(ft ² h°F))
600 °C 1112 °F	Dievar	7 600 (0.275 lbs/in ³)	13.3x10 ⁻⁶ (7.4x10 ⁻⁶)	32 (222 Btu in/(ft ² h°F))
	Dievar for AM	7 608 (0.275 lbs/in ³)	13.2x10 ⁻⁶ (7.3x10 ⁻⁶)	28.3 (196 Btu in/(ft ² h°F))

Table 3 - Comparison in mechanical properties between Dievar bar material and Dievar for AM.

Temperature	Material	Tensile Strength R _m , [MPa]	Yield Strength R _{p0.2} [MPa]	Elongation A5 [%]	Reduction of area Z [%]
RT	Dievar	1480 (215 ksi)	1210 (175 ksi)	13	55
	Dievar for AM	1496 (217 ksi)	1300 (189 ksi)	13	57
400 °C 752 °F	Dievar	1235 (179 ksi)	1022 (148 ksi)	15	62
	Dievar for AM	1205 (175 ksi)	1035 (150 ksi)	10	62
600 °C 1112 °F	Dievar	926 (134 ksi)	663 (96 ksi)	18	83
	Dievar for AM	887 (129 ksi)	711 (103 ksi)	16	75

Mechanical Properties

To investigate if the mechanical properties is the same for printed and wrought P-ESR material, tensile test at room temperature and elevated temperature were conducted at 400°C (752 °F) and 600°C (1112°F). The results are found in Table 3 and shows that the comparison difference is within the normal variation for the measurements.

Soldering

The soldering resistance of AM-Dievar and reference materials was tested using an agitated soldering test. The molten aluminum A380 was held at 680°C (1256°F) during all experiments. The samples were submerged into the crucible and spun around at 200 rpm (equivalent to approx. 30m/min= 0.5m/s velocity) for 2 hours. 200 rpm was the highest possible velocity tolerated by the current setup. Material weight loss caused by the agitated soldering corrosion was measured with a novel helium gas pycnometry metrology method. The loss of mass was used as a wear criterion to compare the resistance to agitated soldering performance for the different materials.

Figure 6 shows cross sections of agitated soldering samples schematically; a) unaffected sample, b) worn sample with aluminum residue (marked blue) and c) worn sample with removed aluminum layer. By weighing the unaffected sample before and after soldering, the wear can be presented as weight loss per time unit. Using helium gas pycnometry, there is no need to remove the adhered aluminum layer, the samples mass loss can be calculated with volume measurements from the pycnometry combined with density and weight measurements.

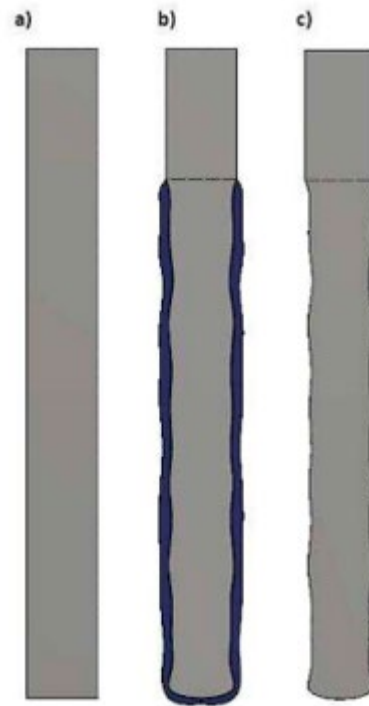


Figure 6 - Schematic cross section view of agitated soldering samples. a) showing unaffected sample, b) worn sample with aluminum residue and c) worn sample with loss of steel due to soldering.

The results from these tests show that the soldering resistance of Uddeholm Dievar for AM is superior to that of W.-Nr. 1.2709, see Figure 7.

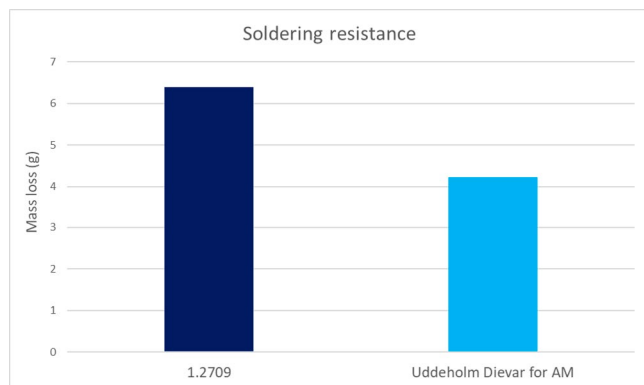


Figure 7 – Mass loss for the agitated soldering experiment. The mass loss in gram [g] is shown on Y-axis for each material. 1.2709 suffered from bigger mass loss than Uddeholm Dievar for AM.

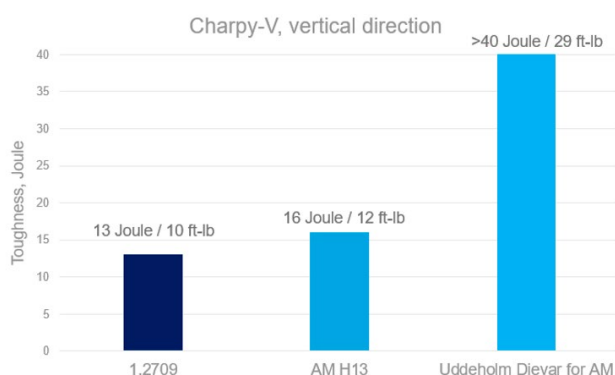


Figure 8 – Shows the mean value of the experimentally measured impact toughness [J] in the vertical printed direction.

Hybrid Evaluation

Hybrid evaluations were performed with Uddeholm Dievar for AM printed on bar material of Uddeholm Dievar and Uddeholm Orvar Supreme (superior NADCA 207 Grade B H13). The base materials were in the soft-annealed condition and Uddeholm Dievar for AM could be successfully printed on the substrates. All print jobs were heat treated (hardened and tempered) to 48-50 HRC.

Results of the interface were investigated under light optical microscope in the etched condition. The results show the homogeneity between printed and bar material of Uddeholm Dievar, the interface is more visible when selecting different material as can be seen with Uddeholm Orvar Supreme as substrate see Figure 9.

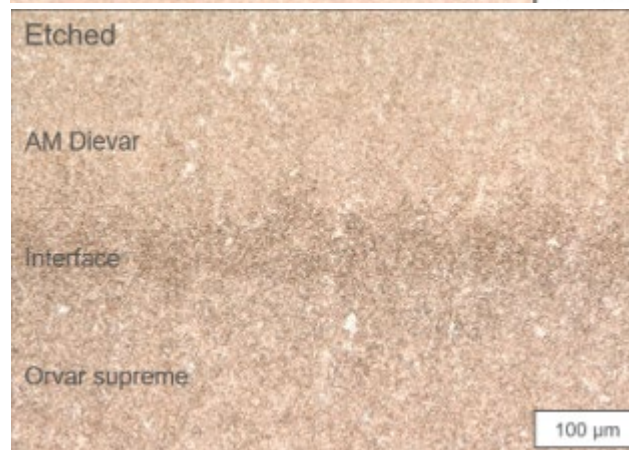
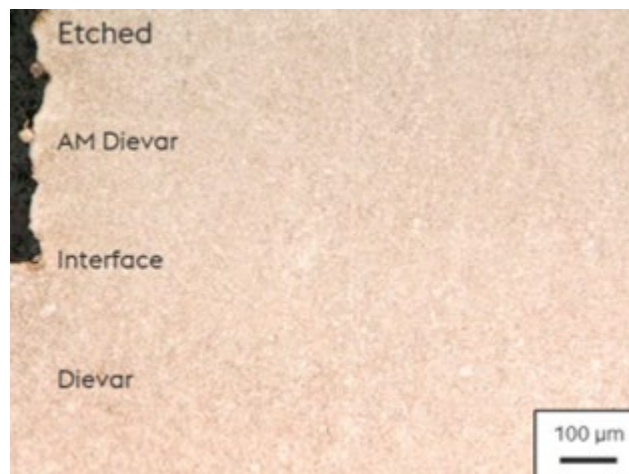


Figure 9 – Microstructure at 500x magnification of interface for different substrate materials.

To investigate the hardness difference after heat treatment following Uddeholm Dievar recommendation, hardness profiles of HV10 type were used. Measurement across the interface were measured where the hardness difference was low between Uddeholm Dievar for AM printed on Uddeholm Dievar see Figure 10, some lower hardness could be expected on Orvar Supreme when used as substrate due to the difference in heat treatment see Figure 11.

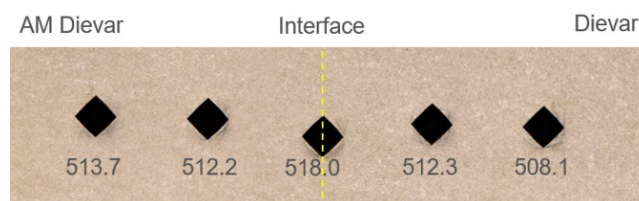


Figure 10 – Hardness profile across interface, with same material as printed and substrate.

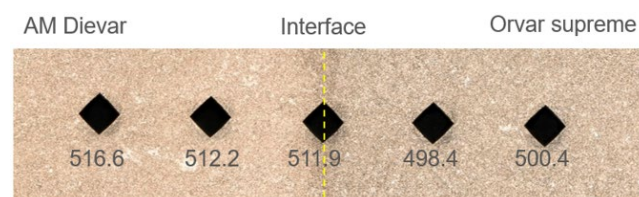


Figure 11 – Hardness profile across interface, with different material as printed and substrate.

Mechanical Properties

Hybrid evaluation of mechanical properties were performed through tensile testing at room temperature with interface center of the specimens according to Figure 12. Comparison were made with fully vertical printed Uddeholm Dievar for AM specimens.

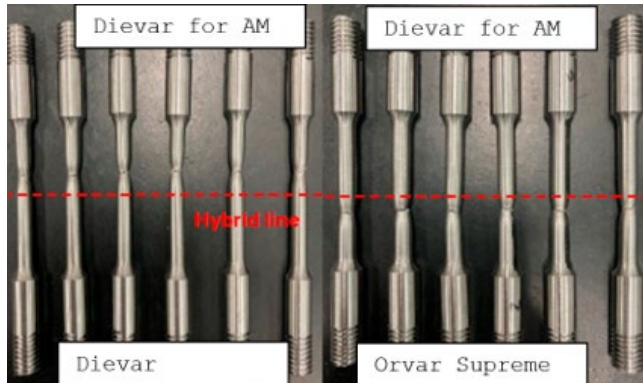


Figure 12 - Tensile test samples.

Results of tensile tests is shown in Figure 13. From the results in can be seen that highest strength is received in the Uddeholm Dievar materials.

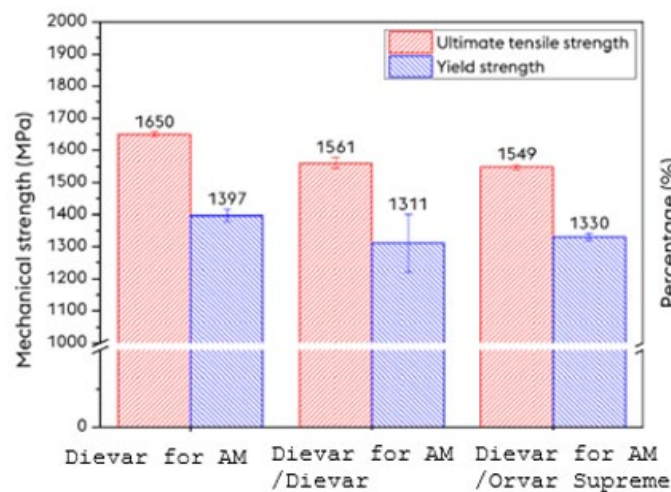


Figure 13 - Tensile test results.

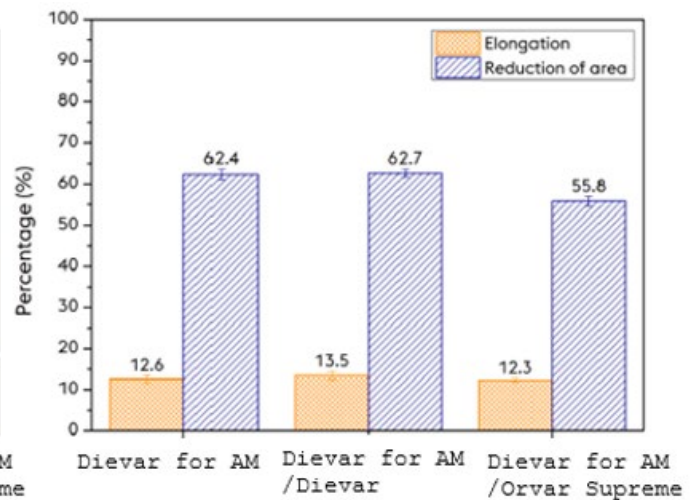
Simulations

To investigate the influence of physical properties of a HPDC inserts such as thermal conductivity which effects cycle time and heat extraction (and hence soldering tendency) simulations were made using MAGMASOFT®. Three different materials were selected, AISI H13 with traditional spot cooling, 1.2709 with conforming cooling typical for AM inserts and Uddeholm Dievar for AM with the same design as 1.2709. Values on thermal conductivity are shown in Table 4.

Table 4 - Thermal conductivity for the steel grades.

Material	Dievar for AM	1.2709	AISI H13
Thermal Conductivity [W/m °C]	28-32 (194- 222 Btu in/(ft² h°F))	14-20 (97- 139 Btu in/(ft² h°F))	25-30 (173- 208 Btu in/(ft² h°F))

Results are shown in Figure 14. and Table 5. Based on design freedom AM inserts can have a positive result of soldering index and cycle time due to higher heat extraction compared to traditional spot cooling. Results of Uddeholm Dievar for AM shows a combination of suitable thermal conductivity and heat extraction based on design hence lowest soldering index and shortest cycle time according to the simulation.



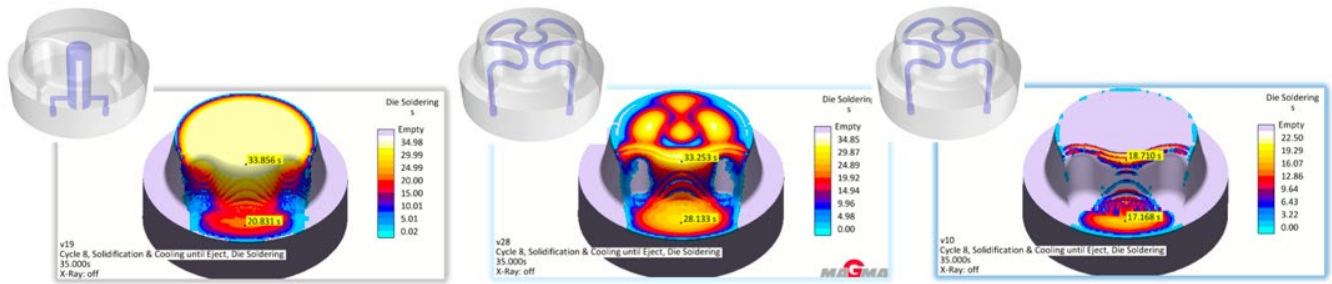


Figure 14 – Design of HPDC inserts.

Table 5 – Results of simulations.

	Die spot H13	1.2709	Dievar for AM
Die soldering index, sec	33	33	18
Cycle time, sec	34.5	29.5	21.7
Comparison	Conventional solution	Less soldering area Improvement of cycle time -14.5%	Significant improvement of soldering Great improvement of cycle time - 37%

Through simulations using MAGMASOFT®, it was observed that AM inserts, particularly those made from Uddeholm Dievar for AM, exhibited improved heat extraction and lower soldering index compared to traditional spot cooling methods. This suggests that AM inserts have the potential to reduce cycle time and mitigate soldering issues in HPDC processes.

Overall, this study highlights the potential of AM, specifically LPBF with Uddeholm Dievar for AM, for 3D printing of high-quality HPDC inserts. Further research and development in AM process optimization and material characterization will contribute to advancing the applicability of AM in the hot work tooling industry, allowing for enhanced manufacturing capabilities and improved performance in HPDC applications.

Conclusion

In conclusion, additive manufacturing has emerged as a promising production method for HPDC inserts, offering advantages such as the ability to manufacture complex geometries and incorporate conformal cooling channels. The focus of this study was on LPBF as the AM process for producing inserts using hot work alloys, specifically Uddeholm Dievar for AM.

The evaluation of Uddeholm Dievar for AM in comparison to its bar material counterpart demonstrated similar physical and mechanical properties within the normal variation for measurements. This indicates that the AM process does not significantly compromise the material's characteristics. Furthermore, Uddeholm Dievar for AM exhibited superior soldering resistance compared to the traditional material 1.2709, making it a favorable choice for HPDC inserts.

The impact toughness of Uddeholm Dievar for AM was found to be higher than that of other materials tested, indicating its ability to absorb a significant amount of energy before fracture. Additionally, hybrid evaluations combining AM-printed Uddeholm Dievar with bar materials showed homogeneity at the interface and comparable mechanical properties.

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Self-Lubricating Nanocomposite Coatings for Metal Forming Dies

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Abstract

The metal-forming and die-casting industries have a need for protective coatings on dies to increase die life and performance at high temperatures. Conventional lubricants are widely used for die release as well as for cooling assistance on die surfaces. However, lubrication is difficult at high temperatures. Oxidation and scaling occur on the work pieces that lead to poor surface finish and possible warping of the material during cooling. The aim of the work is to develop a self-lubricating nanocomposite coating system for metal forming dies and investigate the self-lubricating behavior and thermal fatigue resistance of the coatings at elevated temperatures. The designed coating system consists of a dense ceramic coating matrix doped with solid lubricant phases, e.g. noble metals. The composite structure offers multifunctionality, including wear resistance, oxidation resistance, thermal fatigue resistance, and self-lubricating properties at elevated temperatures. In this study, a nanocomposite coating matrix of CrAlN, was doped with different levels of Ag. The CrAlAgN coatings were deposited by plasma enhanced magnetron sputtering (PEMS). The elemental composition, structure, and mechanical properties of the coatings were studied by different means. The thermal stability and thermal fatigue resistance of the coatings were evaluated using thermal cyclic test by cycling the coatings from room temperature to 800°C with a total testing cycle up to 1200 cycles. The tribological properties and self-lubricating behavior of the coatings were evaluated using a high temperature tribometer at 800°C. Excellent thermal stability and thermal fatigue resistance, and high temperature lubricity were observed in the coatings with an optimal Ag content. Finally, preliminary in-plant trial testing results of a coated forging punch are reported.

Introduction

Metal-forming processes use high-value dies and tooling to produce thousands of parts in a run. Die failure is a constant problem that results in substantial losses of time and money. The major mechanisms leading to premature die failure include but are not limited to: adhesive and abrasive wear, thermal cracking, and thermal fatigue.¹ The performance and reliability of dies are significantly limited by these mechanisms of failure. Many of tools and dies in metal forming industry are now being treated by a combination of plasma nitriding with subsequent deposition

of protective physical vapor deposition (PVD) coatings to improve wear-resistance and decrease machine downtime for maintenance. The most used PVD coatings for dies are binary or ternary transition metal nitride, e.g. TiN, CrN, TiAlN, CrAlN.^{2,3,4} However, catastrophic failure and wear-based failure (parts begin to go out of tolerance) of the die metal itself are still a major problem. In addition, lubricants are widely used for die release as well as for cooling assistance in the die cavity surface. However, lubrication is difficult at high temperatures. Oxidation and scaling occur on the work pieces lead to poor surface finish, less precise tolerances, and possible warping of the material during cooling. Applying lubricant also adds time to the process cycle and hence increases the cost. Furthermore, spray-on lubricants are known to be a source of porosity, so reducing the usage of die lubricant adds great benefits to metal forming industry.

In this work, we present the development and evaluation of a self-lubricating nanocomposite coating system that was designed for extending die life and performance at high temperatures. The coating system consists of a ceramic coating matrix doped with solid lubricant phases, e.g. noble metals and/or amorphous carbon. At elevated temperature, solid lubricants diffuse toward the surface of the coating and provide lubrication for reducing friction and wear. This type of nanocomposite coatings showed multi-functionality, including self-lubricity, low sliding friction, wear resistance, and good thermal fatigue/cracking resistance at elevated temperatures. The nanocomposite coating system has been developed using plasma enhanced magnetron sputtering (PEMS) technique, which received an R & D 100 Award in 2009.

The PEMS technique is an advanced version of the conventional magnetron sputtering (MS) technique.^{5,6} A comparison of the schematics of conventional MS and the PEMS process are illustrated in Figure 1. Besides the discharge plasma generated in front of the magnetrons in conventional MS (Figure 1a), the PEMS technique generates an independent global plasma in the entire vacuum chamber with hot filament assistance (Figure 1b). The mechanisms of generating such a great amount of gas ions by hot filament assistance can be explained by electron thermionic emission and collision ionization. As shown in Figure 1b, this technique draws electrons off from Tungsten (W) hot filaments when electrons have gained enough energy to exceed the work function of the hot filaments. The electrons collide with neutral gas atoms (e.g. Ar) and generate a large number of gas ions through impact ionization and form the global plasma in the entire chamber, which is independent to the magnetron discharge plasma. By applying a negative

bias voltage on the substrates, the ions in the global plasma are accelerated towards the growing film for enhanced ion bombardment. The ion flux to the parts to be coated can be increased to more than 25 times in PEMS as compared to conventional MS. As a result, the density, adhesion, and the properties of the coatings are greatly improved.

More importantly, the PEMS process generates the high ion fluxes with a low kinetic energy in the range of 0-10 eV.⁶ This low ion energy and high ion flux plasma is efficient for not only densifying the coating and refining the grains, but also reducing the risk of displacing/inserting lattice atoms and introducing high residual stresses in the coatings. Applied research at SwRI has shown great advantages of utilizing this highly ionized plasma to obtain tough, low residual stress, and thick coatings (typically 20-50 μm), which is critical to increase survivability of coatings in harsh working environment.⁷

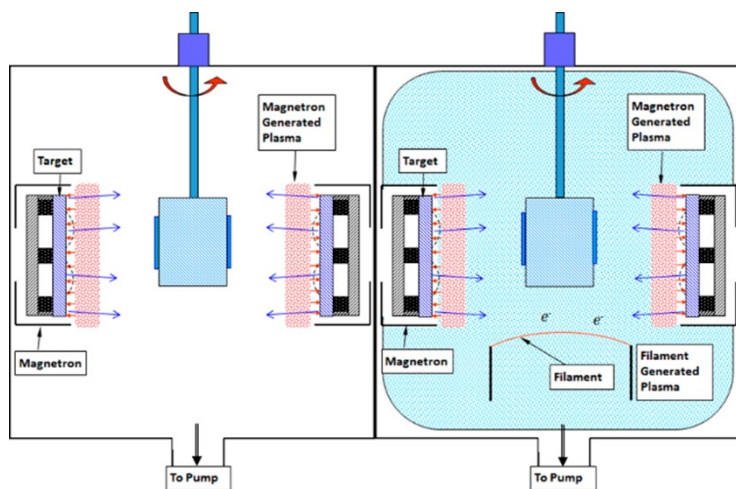


Figure 1 - Schematic drawing of (a) conventional MS, and (b) PEMS deposition.

In this study, self-lubricating nanocomposite coatings using CrAlN ceramic coating as the matrix were doped with different levels of Ag. The thermal stability and thermal fatigue/cracking resistance of the coatings were evaluated using a thermal cyclic testing rig by cycling the coatings from RT to 800°C with a total testing cycle up to 1200 cycles. The tribological properties and self-lubricating behavior of the coatings at elevated temperatures were evaluated using a high temperature tribometer. Finally, a forging punch has been coated with the optimized coating and evaluated in industrial forging in-plant trials.

Experimental Details

Coating Depositions

Coating depositions were carried out in a dual cathode magnetron sputtering system. Figure 1b shows a schematic drawing of the deposition configuration. The chamber contains two rectangular magnetrons, which are installed vertically on the chamber wall and face one to another with a distance of 250 mm. The dimension of the targets is 102 mm x 298 mm x 6 mm. A CrAl (40:60) target and a Ag target were used for coating depositions.

The substrates are mirror polished Dievor hot-work tool steel coupons (10 mm x 10 mm x 10 mm). The Dievor material contains 7.49 at. % C, 4.62 at. % Cr, 1.89 at. % Mo, 0.77 at. % Si, 0.57 at. % V, 0.37 at. % Mn, and balanced Fe. The Dievor coupons were polished to a mirror surface finishing using 6 μm diamond polishing paste. All substrates were cleaned in acetone and alcohol before being loaded into the chamber. As shown in Figure 1b, the samples were installed on a planetary rotation substrate holder. The closest distance between the targets and the substrates is 60 mm. During coating depositions, the substrate holder was driven by a central rotation motor at a speed of 6 rpm.

The chamber was pumped down to a base pressure below 3.0×10^{-4} Pa using a diffusion pump. Prior to coating depositions, the substrates were firstly cleaned using the hot filament generated plasma at a DC substrate bias voltage of -120 V. The CrAlAgN coatings were deposited by reactive co-sputtering of the CrAl and Ag targets in a mixture of Ar and N₂. The CrAl target power was maintained constant at 4 kW. The Ag target power was varied systematically from 0 W to 500 W to vary the Ag content in the coatings. The Ar and N₂ gas flow rates were kept constant at 190 sccm and 60 sccm, respectively. The working pressure was 2 mTorr. A -60 V DC bias voltage was applied to the substrates during all depositions.

Characterization and Evaluation of the Coatings

The cross-sectional microstructure of the coatings was examined using scanning electron microscopy (SEM) at a 10 kV accelerating voltage. Energy dispersive X-Ray spectroscopy (EDS) was used to investigate the chemistry of the coatings.

The adhesion of the coatings was evaluated using the Rockwell-C indentation adhesion test (HRC) using a standard Rockwell-C hardness tester. A Rockwell C diamond stylus (cone apex angle 120°, tip radius R = 0.2 mm) was used to perform the tests. The applied load on the stylus was 150 kg. After the tests, the morphologies of the indentations were examined using an optical microscope (OM) to evaluate the cracks and degree of coating delamination around the indents. The damage of the coating was compared with an HF adhesion strength quality as standardized in the VDI guidelines 3198, (1991).⁸

The thermal stability and thermal fatigue resistance of the coatings was evaluated using a high temperature thermal cyclic test rig. Figure 2 shows photos of the thermal cyclic test rig and the profile of a testing cycle. During the thermal cyclic tests, coated samples are placed on top of a moving stage, which is moved in and out of the annealing furnace by a motor-driven moving mechanism. In one testing cycle, the samples are moved into the furnace and heated up to the testing temperature. After a desired exposure period, the bottom plate of the furnace is lowered and the moving stage is moved outside of the furnace area for forced air cooling of the samples by two air blowers. After the cooling step, the samples are inserted back into the furnace and the next test cycle repeats. In this study, the samples were exposed at 800°C in the furnace for 10 minutes and then moved outside of the furnace area for forced air cooling of the samples for 10 minutes in each test cycle (Figure 2c).

After the tests, the microstructure and morphology of the coatings were characterized using SEM and EDS.

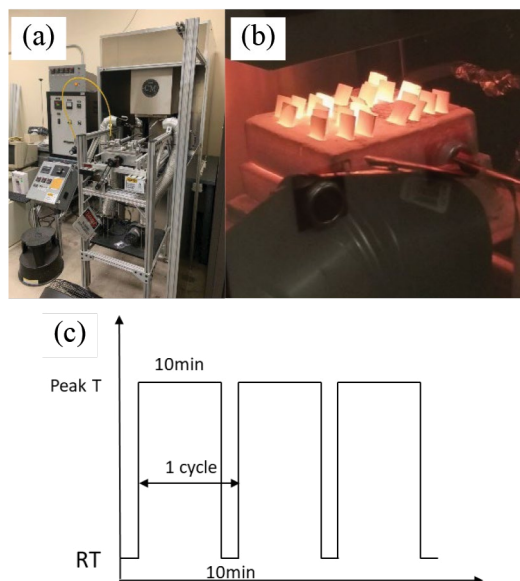


Figure 2 – (a) and (b) Photos showing the thermal cyclic test rig and coupon samples during the test; (c) thermal fatigue/cyclic test profile (10 min at 800°C and 10 min forced air cooling to room temperature).

The wear behavior of the coatings at elevated temperatures was measured using a high temperature microtribometer (Bruker UMT3) in ambient air at 800°C. Figure 3 shows the setup of the high temperature wear test. The test sample was mounted in a fixture and heated up to the testing temperature in a heating chamber at a heating rate of 10°C/min. The sliding counterpart against the coating was a ZrO₂ ball with a diameter of 6 mm. The reciprocating wear tests were carried out by moving the ZrO₂ ball along the surface of the specimen under a normal load of 1 N. The stroke length was 6 mm. The test speed was 60 mm/s. The test period was 30 min which resulted in a total sliding distance of 108 meters. During the tests, the coefficient of friction (COF) between the ZrO₂ ball and the coating surface was recorded. After the test, the morphology of the wear track were examined by an optical microscope (Zeiss Axio Observer).

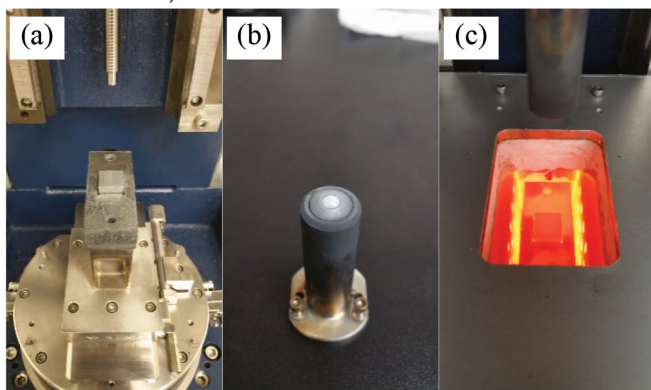


Figure 3 – Setup of the high temperature wear test: (a) Mounting fixture for the specimen, (b) counterpart pin (ZrO₂ ball), (c) heating chamber.

Results and Discussion

Microstructure of the Nanocomposite Coatings

The elemental compositions of the CrAlAgN coatings were measured by EDS. As the Ag target power increased from 0 W to 500W, the Ag content in the coatings increased from 0 to 22 at.%. The N content increased from 32.6 at.% to 45 at.%. In contrast, the contents of Cr and Al decreased from 19.7 at.% to 10 at.% and from 47.7 at.% to 23.5 at.%, respectively. Figure 4 presents the cross-sectional SEM images of the CrAlAgN coatings with different Ag contents. The thickness of the coatings was in the range of 11 to 13.6 µm. All coatings exhibited columnar grain structure. The CrAlAgN coatings containing 0-15 at.% Ag showed dense columnar structure typically observed for PVD hard coatings in industry. However, the coatings containing 18 at.% and 22 at.% Ag exhibited decreased density. Some porosities and particles can be seen between columnar grains due to the segregation of Ag phases, as Ag is unmixable with other elements in the CrAlN lattice.

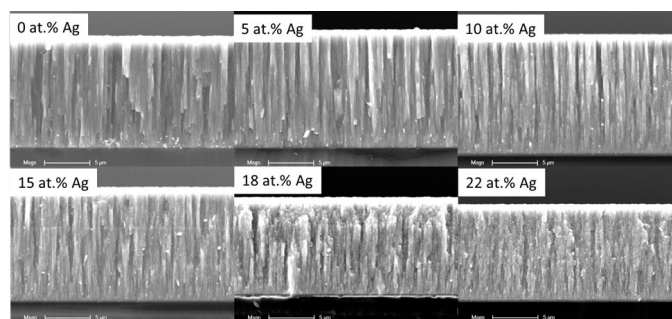


Figure 4 – Cross-sectional view SEM images of CrAlAgN coatings with different Ag contents.

Figure 5 shows the OM images of the indentation morphologies after the HRC indentation tests on the coatings. Excellent coating adhesion was identified in the coatings with Ag content less than 10 at.%. These coatings show no delamination but fine lateral cracks along the indentation circumference. The adhesion strength of these coatings is rated as HF1 according to the VDI guidelines 3198.⁸ However, as the Ag content further increased in the coatings, the adhesion of the coatings decreased. For the coatings containing 15 at.% to 22 at.% Ag, a large amount of coating chipping and delamination along the indentation circumference can be seen, which suggested an insufficient HF5-HF6 adhesion strength of the coatings to the substrate.

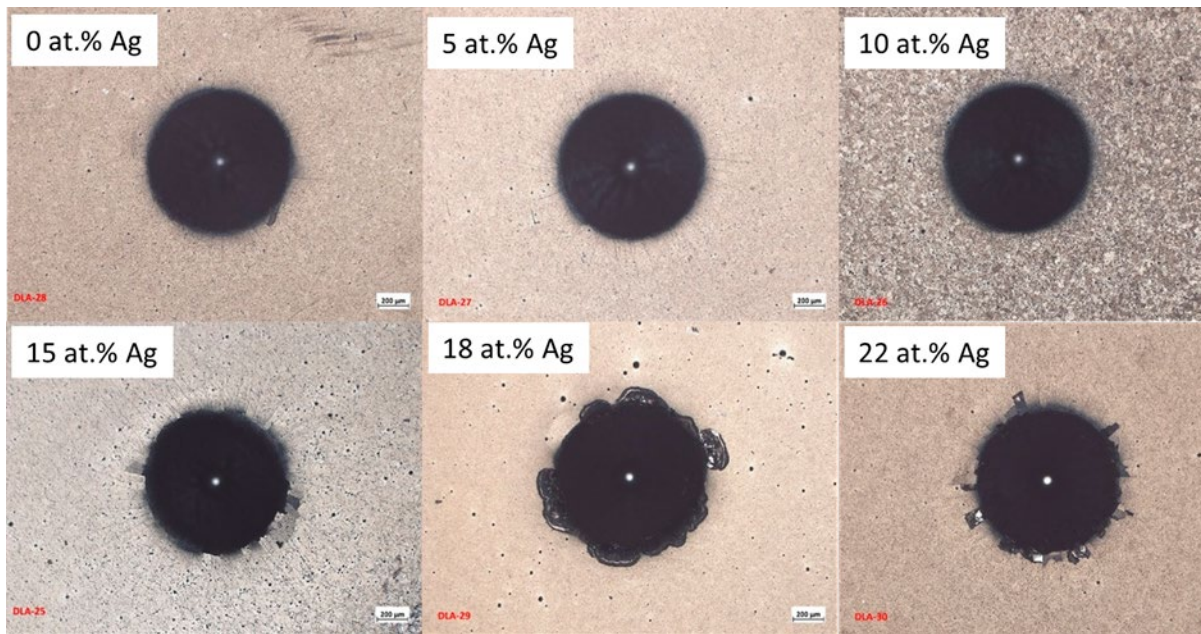


Figure 5 – Optical microscope images of the indentation morphologies after Rockwell C-Brale indentation tests of CrAlAgN coatings containing different Ag contents.

Self-Lubricating Behavior of the Nanocomposite Coatings

To verify the self-lubricating behavior of the CrAlAgN coatings at elevated temperatures, the coatings were thermally annealed at 600°C in ambient air for 120 minutes. Figure 6 shows the SEM images of the top surface of the CrAlAgN coatings with different Ag contents after thermal annealing. The outward diffusion of Ag towards the surface was observed in all CrAlAgN coatings except for the CrAlN (0 at.% Ag) coating. The density and size of Ag particles on the surface increased as the Ag content increased in the coatings. For the coating containing 22 at.% Ag, a continuous Ag layer was formed on the surface. It is expected that these Ag

particles act as solid lubricants for reducing surface wear and friction at high temperatures.

Thermal Fatigue Resistance of the Nanocomposite Coatings

The thermal fatigue/cracking resistance of the CrAlAgN coatings on Dievar steel has been studied using thermal cyclic test. One testing cycle includes 10 min annealing at 800°C and 10 min cooling to room temperature. The thermal cyclic test provides testing conditions for the coatings in simulated metal forming cycles in ambient air. The total testing cycles was 1200 cycles.

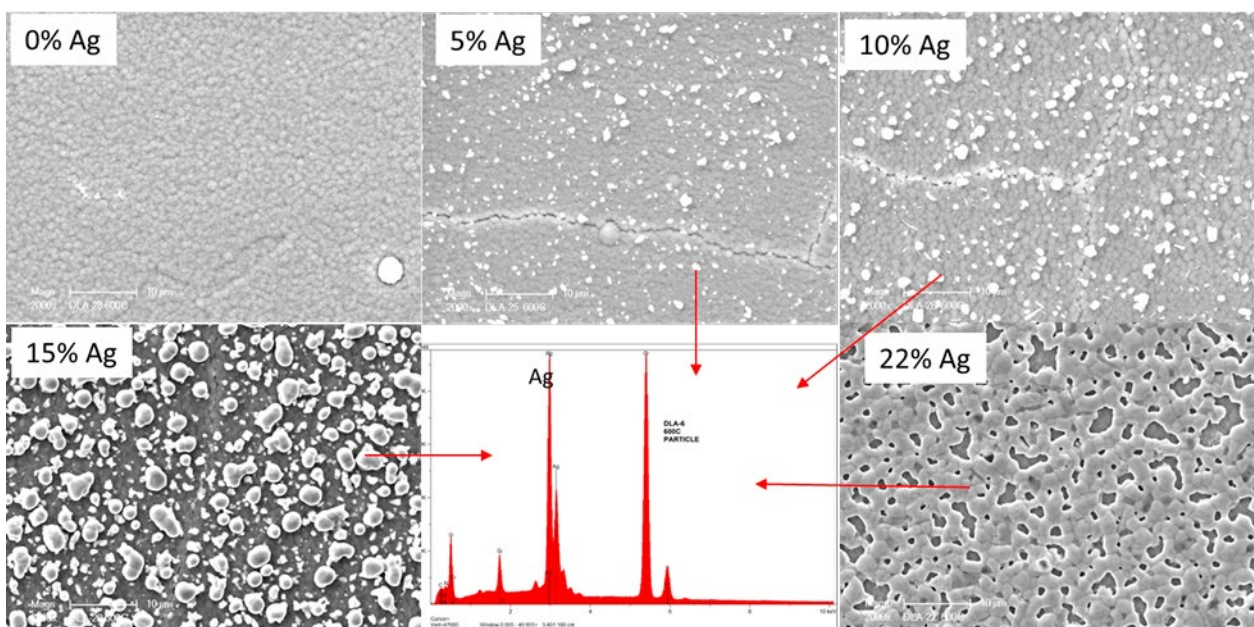


Figure 6 – SEM micrographs of the surface of the CrAlAgN coatings with different Ag contents after thermal annealing at 600°C for 120 min.

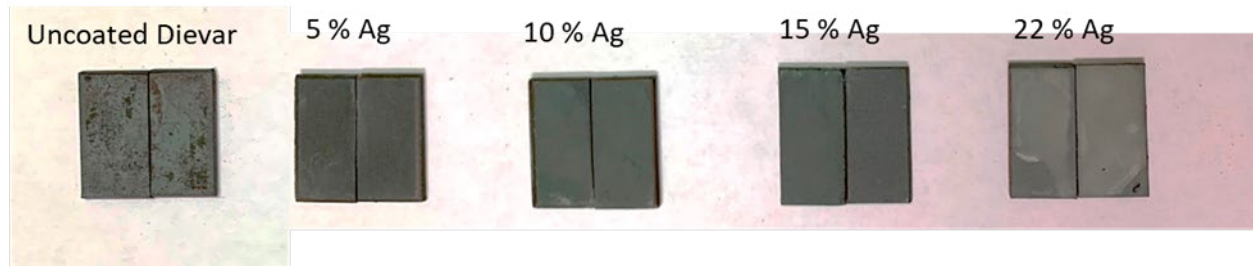


Figure 7 - Photograph of the CrAlAgN coating system with different Ag doping levels after the thermal cyclic test of 1200 cycles.

Figure 7 shows photographs of uncoated Dievar and CrAlAgN coating samples after thermal cyclic tests at 800°C for 1200 cycles. It can be seen that the surface of the uncoated Dievar sample was significantly oxidized and damaged. In contrast, the CrAlAgN coatings showed no visual cracking or delamination with the Ag content in the range of 5% to 15%. As the Ag content increased to 22%, the coating still maintained good integrity but showed small chipping at a corner.

Figure 8 shows a cross-sectional SEM image and EDS profile line scan of the CrAlAgN coating with 10 at.% Ag after the thermal fatigue test. The CrAlAgN coating maintained a dense microstructure and excellent adhesion to the substrate after the thermal cyclic test. No micro-cracks were observed in the coating. The EDS line scan confirmed a significant amount of Ag diffused towards the surface and formed a thick Ag layer (white layer on the top). A decent amount of Ag (white particles in the coating) also retained in the bulk of the coating after 1200 cycles. It is also interesting to see that no oxide layers were observed on the coating surface, which demonstrated excellent oxidation resistance of the coating at this temperature.

The thermal cyclic test results demonstrated that the CrAlAgN coatings with Ag contents in the range of 5-15 at.% showed excellent thermal stability and thermal fatigue/cracking resistance. Excessive doping of Ag in the coatings to above 20 at.% was detrimental to the thermal fatigue resistance of the CrAlAgN coatings.

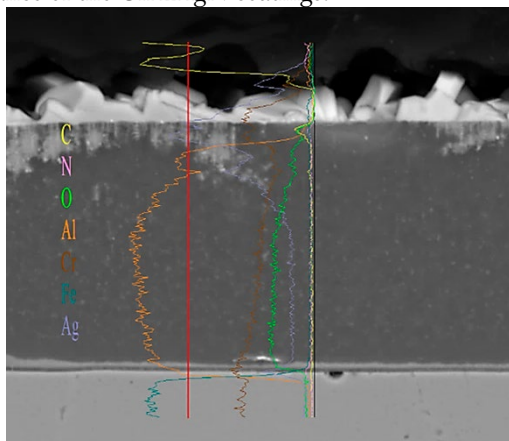


Figure 8 - Cross-sectional SEM image and EDS line scans of the CrAlAgN coating with 10 at.% Ag after the thermal cyclic test at 800°C for 1200 cycles.

High Temperature Wear Behavior of the Nano-composite Coatings

The high temperature wear behavior of the CrAlAgN coatings was evaluated using a high temperature tribometer in ambient air at 800°C. An uncoated Dievar sample was also tested under the same conditions for comparison. Figure 9 shows the COF curve and a 3D optical image of the uncoated Dievar sample after the high temperature wear test. The uncoated Dievar sample showed a rapid increase in the COF to 1.8 in 7 min testing period and the test had to stop due to the extremely high COF. The optical image confirmed the surface of the Dievar sample was severely damaged due to oxidation attack.

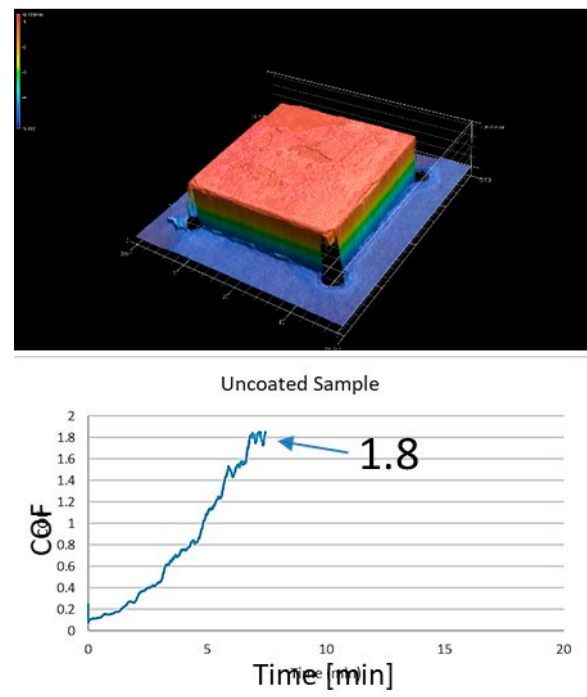


Figure 9 - COF and 3D optical images of an uncoated Dievar sample sliding against a ZrO₂ ball at 800°C.

Figure 10 shows the COF curves and 3D optical images of CrAlAgN coated samples with different Ag contents sliding against a ZrO₂ ball at 800°C. In the COF curves, the total testing period was 30 min. The COF of the CrAlN coating with 0 at.% Ag started with low values between 0.1 to 0.2 in the first 15 min. However, the COF gradually increased to 1.2 after that. The wear track on the coating surface exhibited a wide and deep track, which indicates a high wear rate of the coating. In contrast, the COF and the

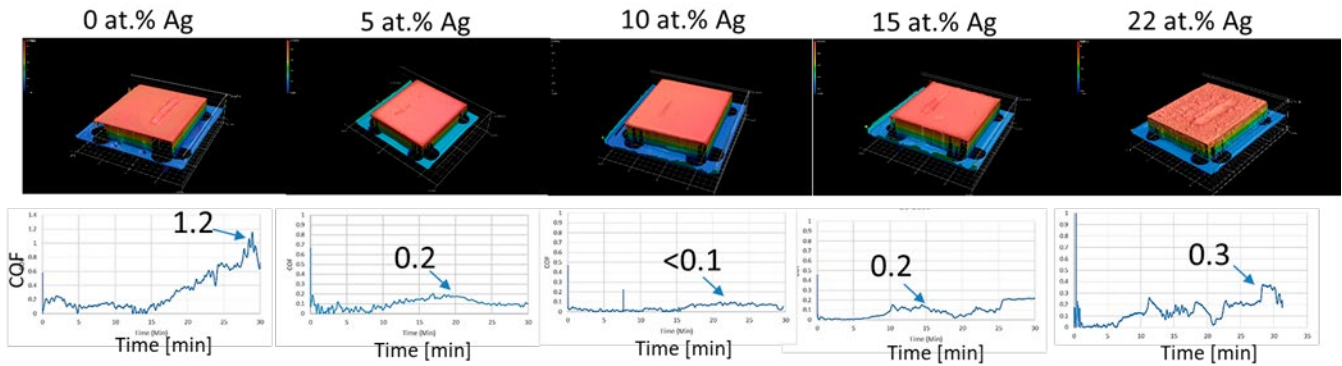


Figure 10 – COF and 3D optical images of CrAlAgN coatings with different Ag contents sliding against a ZrO₂ ball at 800°C.

width of the wear track both decreased in the CrAlAgN coatings. The coatings with 5 at.% and 10 at.% Ag exhibited relatively stable sliding COF curves and low COF values in the range of 0.1 to 0.2. These results demonstrated that the CrAlAgN coatings containing 5 at.% to 10 at.% Ag showed excellent high temperature sliding lubricity and wear resistance. As the Ag content further increased to above 15 at.%, although the average COF values of the coatings are still below 0.3, the COF curves became unstable, which indicated decreased wear resistance of the coatings. The 3D optical images confirmed that the coatings with high Ag content (e.g. 22 at.%) exhibited increased wear and a rough surface.

The characterization and evaluation results of the coatings demonstrated that Ag solid lubricants doped into a ceramic coating matrix, e.g. CrAlN in this study, diffused towards the coating surface to provide consistent lubricity at elevated temperatures, which significantly reduce friction and wear of the coatings at high temperatures. However, the Ag content in the self-lubricating nanocomposite coatings needs to be carefully controlled to avoid a decreased in the density and adhesion of the coatings.

In-Plant Trial

The optimized self-lubricating nanocomposite coating has been further evaluated by Ellwood Texas Forge using in-plant trials. Figure 11a and 11b present photos of a hydraulic forging punch before and after applying the optimized self-lubricating coating. During the hydraulic forging process, the punch was driven by a high-pressure hydraulic system at 8,000-11,000 Tonnage into ingot to shape metal parts. The forging furnace temperature was 1287°C. Table 1 summarizes key parameters of the forging process.



Figure 11 – Photos showing the in-plant trial punch: (a) before and (b) after depositing the self-lubricating nanocomposite coating.

Table 1 – Key processing parameters of the forging in-plant trials.

Parameters	Value
Die pre-heat temperature [°C]	426-482
Forging furnace temperature [°C]	1287
Velocity [inch/min]	90
Tonnage [T]	8,000-11,000
Deformation Time [s]	6
Forging time per piece [min]	5-7

Per the dimensional scans, the uncoated punch started at 10.999” in length and 3.824” in width of the punch tip. At “mid-life” of the trial after forging 120 pieces, the length of the punch had worn most of the way down to 10.677” and the width of the punch tip increased to 4.052”. In contrast, the coated punch started at 10.974” in length and 3.824” in width of the punch tip. After “mid-life” of the trial, the length of the coated punch was measured at 10.844” and the width was measured at 3.910”, which significantly outperformed the control punch. As compared to the control punch, the coated punch showed 150% less in the wear from the length and 250% less in the expansion from the width of the punch tip after the “mid-life” of the in-plant trial. From visual examination, the coated punch showed no fatigue cracking and damage on the surface at “mid-life” of the trial. The coated punch is still in service at this time. The total number of pieces the coated punch is able to forge

with it and final dimensional measurement will be reported at the end of the in-plant trials.

Summary

In this paper, a self-lubricating nanocomposite coating system designed for protecting metal forming die components has been developed using plasma enhanced magnetron sputtering (PEMS). The coating systems consist of a CrAlN ceramic matrix doped with solid lubricant phases (e.g. Ag in this study). The lubricity of the coatings at elevated temperature (e.g. above 600°C) was achieved by self-diffusion of Ag towards the coating surface which acted as solid lubricants for reducing friction and wear at high temperatures. The Ag content in the CrAlAgN coatings needs to be carefully controlled to avoid a decreased in the density and adhesion of the coatings. The CrAlAgN coatings with a Ag content in the range of 5 at.% to 10 at.% exhibited excellent thermal fatigue resistance after thermal cyclic testing between 800°C and RT for 1200 cycles in ambient air. The coating also exhibited a low sliding COF of 0.1 at 800°C in ambient air. Preliminary in-plant trials have been conducted by an industry collaborator on one of their forging punch compared to an uncoated control punch. Although the trial is still underway, the coated punch showed improved wear resistance and less degrees of

out of tolerance as compared to the control punch. Based on the research, the self-lubricating nanocomposite coating system showed potential for applications where friction reduction at elevated temperatures is needed. The coating system is promising to reduce the usage of spray-on lubricants at high temperatures for different applications, e.g. metal forming, firearms, and injection molds, etc.

Acknowledgments

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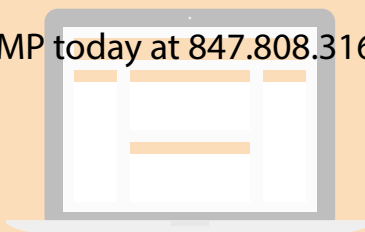
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Overview of the 2025 R&D Strategic Plan & Roadmap

Paul Brancaleon, Executive Director of Research, Education & Marketing
North American Die Casting Association
Arlington Heights, Illinois

This article is a review of the 2024 NADCA R&D Strategic Plan and Roadmap. This overview research results from select projects and presents a brief objective and current research for each project in the portfolio.

The NADCA Research & Development Strategic Plan and Roadmap provides guidance for the current and future direction of the NADCA R&D Program. This plan is updated on an annual basis. The NADCA Strategic Plan and Roadmap is in alignment with the most recent Metalcasting Industry Roadmap. The development of the Metalcasting Industry Roadmap was managed by the American Metalcasting Consortium (AMC) for the entire metal casting industry and funded by the National Institute for Standards and Testing (NIST). The research needs identified in the AMC Roadmap, as well as input from members of the NADCA Technical Committees and the die casting industry are considered for the NADCA Strategic Plan and Roadmap. To address the needs, specific research projects are defined. Based on the defined projects and level of available funding, the 2024 R&D Strategic Plan and Roadmap consists of 14 projects with a total leveraged value of these projects (funding plus cost share) of \$2.837 million. This supports a portfolio of projects that addresses various needs within reasonable time periods. Sources of funds include the United States Department of Defense (DOD) Defense Logistics Agency R&D (DLA/R&D) Program, and the American Metalcasting Consortium (AMC), NADCA, ReMade, and America Makes.

The Research (or R&D) for NADCA is divided into 2 distinct Committees of Die Materials and Research and Development. For each committee there is a chairman and a set of projects that are being led by Principal Investigators and others involved in the specific projects. At the end of this is a list of the projects and the title of each project. (See table 1)

Overview

The NADCA Strategic Plan identifies main topic areas that have been identified by industry as strategic. This plan also ensures that efforts are applied toward further development and advancement of the main topic areas. Several strategic areas have been identified and are targeted for technological advancement. The primary strategic areas are Process, Materials, Design, and Workforce. Each of these primary areas contain sub-categories such as cast materials development, computer modeling, die materials and die surface engineering, process technologies, additive manufacturing, and others. Process, Materials, and Design

are covered in the Die Materials and Research and Development committees. Workforce, the fourth main topic, is covered in the NADCA Education Program. Process, Materials, and Design each have sub-topics or focus areas such as additive manufacturing, advanced casting technologies, cast materials, die and tooling materials, design tools for manufacturing, and design tools for casting. Within each of these focus areas are more detailed research and actionable paths to advance a specific state of technology. It is these detailed areas that define the NADCA roadmap and specific R&D activities or research projects.

Technological advancement of the detailed focus areas is targeted to provide many benefits such as: higher performance alloys, solder reduction, cycle time improvements, productivity improvements, scrap reduction, cost reduction and lead-time reduction.

Research Results

Additive Manufacturing

Project 234: Modeling Conformal Cooling of Additive Manufactured Die Cast Tooling. Dr. Xiaoming Wang, Purdue University

Research Objectives: The proposed research will model the fluid flow and thermal history of diecasting dies with conformal cooling channels. The objective is to design dies with proper thermal management for high quality diecasting products. Also, extending die life is an objective of the proposed research work.

Key Accomplishments: A simple model was established for the prediction of temperature distribution and stress behavior between two CFD's (Computational Fluid Dynamics) software packages. Results obtained from Ansys Fluent cases demonstrate a stronger correlation with the actual state in the real world. Specifically, in terms of vapor generation within the cooling channel and cooling water velocity, Ansys Fluent exhibits a clear advantage over Flow-3D CAST. The real world application showed that continuously Aerated water produced more corrosion while interacting with steel. (Figure 1) Along with this the rough surface of the printed cooling lines leads to advanced corrosion in the water lines.

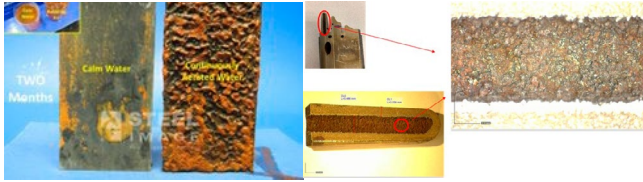


Figure 1 – The rough printed, downward facing cooling surface along with continuously aerated water leads to excessive corrosion on the internal cooling lines.

Project 231: Failure Analysis of Additively Manufactured Die Components. P.I. Peter Reid, Reid & Associates.

Research Objectives: This project will examine failures experienced by Additive Manufactured / 3D printed steel inserts used in production tooling for producing die castings. This project will, 1) Determine the damage/initiation sites and mechanisms, 2) recommend possible design and material improvements, and 3) help other die casters apply the lessons learned.

Key Accomplishments: Several Additive Manufactured components that have exhibited failures were collected and the downward facing surfaces are exhibiting more defects than the upward faces. Also, corrosion cracks have been observed in the cooling channels. These corrosion cracks show that propagation of the crack started inside the rough area of the cooling channel and propagated toward the surface of the tool. Along with 3D prints components, multi piece fusion welded components are being examined to determine the root cause defects creating leaking conditions.

Project 242: Surface Roughness on the Fatigue Resistance of Die Inserts Additively Manufactured die steel (A. Lausic, GM)

Research Objectives: Determine the effect of surface finish and alloy type on the fatigue resistance of Laser Powder Bed Fusion 3D fabricated steel samples containing internal holes.

Key Accomplishments: The overall objective is to perform a series of experiments to determine the effects of a range of parameters on the elevated temperature fatigue performance of steel alloy die inserts produced by Additive Manufacturing (AM) (3D Printing). The parameters are being examined include AM build parameters, AM process, surface roughness, surface finishing, HIP, and corrosion of conformal cooling channels. (Figure 2 & 3)

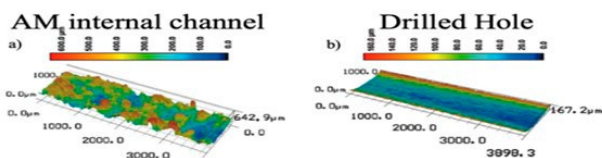


Figure 2 – Comparison of the surface roughness of (a) AM cooling channel and (b) traditionally machined cooling channel [2]

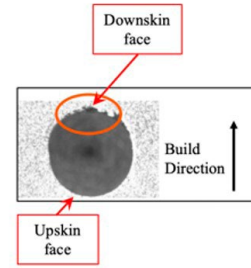


Figure 3 – Photograph of a section through a cooling line fabricated by AM, showing a significantly rougher surface on the downskin side.

Cast Materials

Project 237: (ReMade) Achieving 100% recycled aluminum in Structural Die Casting Applications (Dr. A. Luo, OSU)

Research Objectives: To achieve our overall goal of 100% use of recycled aluminum in die casting applications, the following objectives must be realized: substitute 100% secondary materials for primary alloys (e.g., EZCast and Aural-2) in structural die castings with no degradation in properties; and improve the mechanical properties of the current secondary alloys (e.g., A380 and A383) for non-structural applications.

Key Accomplishments: Experimental procedures were developed using Silicon ranges of 8.5% - 9.5% and Iron levels of 0.7% to 1.0 %. Several alloy heats were produced and the Spectromaxx OES was used to analyze the composition of the alloys. Microstructure refinement of Iron (Fe) and Silicon (Si) were completed to enhance the alloy properties. Additional additions of Manganese (Mn) allowed the formation of the AlFeMn intermetallic formation. This refinement of the Fe phase was made possible by additions of Mn and Strontium (Sr) to the melt. Additional work is still underway for final development using secondary materials for primary applications. (Figure 4)

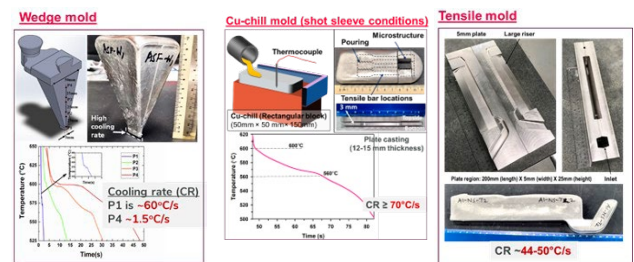


Figure 4 – Experimental Techniques used for the development of alloys using recycled materials to meet the primary alloy requirements.

Project 238: Solder Free Alloys by Optimizing Constitutive Mechanical Behavior (J. Belke – Mercury Castings)

Research Objectives: The goal of this project is to verify the soldering of die cast alloys and subsequent die sticking is controlled by the alloy's constitutive mechanical behavior.

ior. The materials constitutive behavior effect on the die soldering is shown in the denominator of Equation 1 as the strength parameter function, $K(T)$, strain hardening function, $N(T)$, and the strain rate, $M(T)$. The ideal state is to have the denominator as large as possible to minimize the Tresca friction, Tr , which should help prevent soldiering and die sticking.

Key Accomplishments: Work has progressed on this project to develop a working hypothesis and test, to reduce soldering. A356 Alloy was used and Magnesium was added to increase the Magnesium Silicide (Mg_2Si) in the alloy and increase the strength at elevated temperatures and reducing soldering at ejection. (Figure 5)

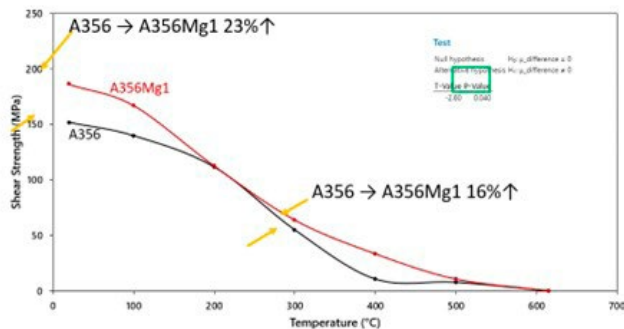


Figure 5 – Magnesium addition to A356 showing the increase in shear strength at various temperatures.

Project 235: Rheocasting with GISS, Corey Vian – Stellantis, Robert Marconi – RCM Industries

Research Objectives: The goal of this project is to utilize a Gas Induced Semi Solid process in several different casting types and determine the application and process improvements that can be achieved using this technology. This will be used on transmission cases and valve bodies using an A380 type die cast material. It will also be used on transmission parts made from a B390 aluminum alloy.

Key Accomplishments: Additional work as completed on the physical application of GISS. The GISS process parameters include the Gas blow time, the metal temperature, the delay and pouring temperature of the material treated with the GISS process. The GISS process controls the temperature of the alloy during injection using the high pressure die casting process. The combination of the GISS process and the Reynolds number, Weber number and the Ohnesorge number are described in a paper by Jarfors et al. stating that the combination of these parameters provides better control of the filling process for low solid fraction semi-solid mixtures. Better control of the semi-solid filling front will reduce air entrapment. (Figure 6)

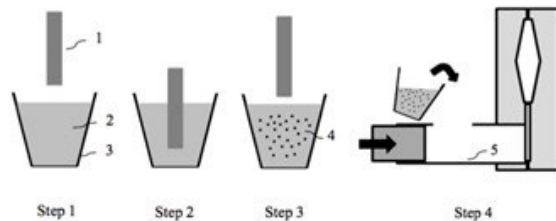


Figure 6 – The traditional operation steps in the GISS process used in the High Pressure Die Cast process.

Project 244: Externally Solidified Crystal (ESC) formation/control in die casting.

Research Objectives: The goal of this project is to simulate the filling (including shot sleeve) during the high pressure die cast process (HPDC). The project will then develop new guidelines on both types of externally solidified crystals formation in HPDC. The guidelines will then be validated casting product in the HPDC machine located at The Ohio State University for both types of externally solidified crystals formation in HPDC.

Key Accomplishments: The project has examined the Externally Solidified Crystal (ESC) formation and has identified two potential sources of ESC formation. The project did both simulation using MAGMA and water analog studies to validate the type I and type II ESC formation. Type I ESC is formed from cooling of molten metal along the shot sleeve walls. Type II ESC is formed during the injection and is a product of the wave formation in the shot sleeve. The next step is to show these two crystal formations in the actual die cast process at OSU. (Figure 7)

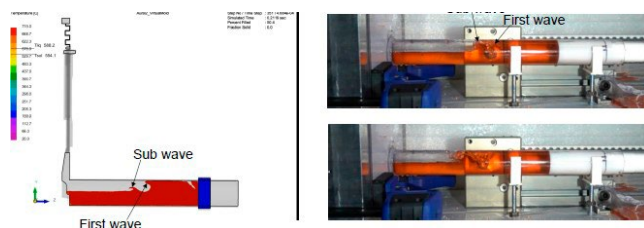


Figure 7 – MAGMA simulation and water analog studies showing the formation of the ESC type II formation in the cold chamber during the injection of molten metal.

Project 245: Characterizing the microstructure, hardness, and aging response of nine compositions of steel die castings.

Research Objectives: The goal of this project is that this proposed work will focus on a characterization of the die castings produced during the five trials at Mercury Marine, specifically to identify differences between

these die castings and alloys produced using conventional wrought processing.

Key Accomplishments: The project was released in the 4th quarter of 2023 and will have updates at the next Die Materials meeting in June of 2024.

Die Materials & Die Surface Engineering

Project 239: High Thermal Conductivity PVD Coated Copper-Alloy Die Inserts (Dr. Corey Vian – Stellantis)

Research Objectives: The objectives of this project is to use a PVD – CrN coating on copper cores to determine the viability of using a highly conductive material that is coated for protection from the molten aluminum alloys being cast.

Key Accomplishments: The project started with a literature review and moved to coating several copper plates using a duplex and additional coating layer then using a PVD coating from Phygen. The adhesion of the coating was difficult until the copper plates were polished to a 4 Ra smoothness and then an adhesion layer was applied prior to a PVD CrN layer. Without the adhesion layer the PVD coating spalled off the coated copper plates. Additional coatings will be trialed and then a Rotation Immersion test(RIT) in molten aluminum will be conducted to determine the viability of coating copper while exposed to molten aluminum. (Figure 8)

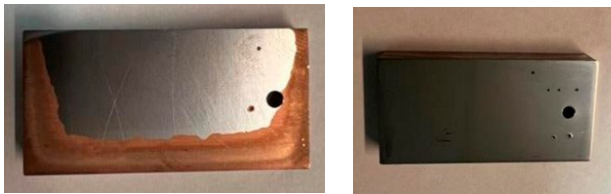


Figure 8 – Phygen – CrN PVD coating on a copper plate without the adhesion layer and with the adhesion Layer. The additional of an adhesion layer prior to the PVD coating makes this a viable coating process.

Project 240: Enhancing performance & longevity of copper plungers for diecast applications through CVD graphene surface coating (Dr. Vikas Berry, UIC)

Research Objectives: The objectives of this project are to extend the lifetime and performance of Beryllium-Copper alloy plunger tips used in diecasting by depositing layer/s of graphene on its surface to form a low friction, low adhesion, high thermal conductivity and high impermeability coating.

Key Accomplishments: This project has started by putting a 5 micron coating of graphene on copper cores. These cores were then tested at the Colorado School of Mines by Dr. Steve Midson. The graphene coated cores did perform better than uncoated cores while submerged in molten aluminum die cast alloy. The project is now moved on to coating of BeCu plunger tips provided by RCM Industries. These will be coated and then tested in the die cast process

to inject molten aluminum into a die cast die. These results will be available mid to late summer of 2024.

Project 243: Modeling Steel High Pressure Die Casting (Danny Portillo – University of Alabama)

Research Objectives: The objective of this project is to model and simulate the Steel High Pressure Die Casting Process.

Key Accomplishments: Project was released in the 4th quarter of 2023. Currently the project is going thru a literature review. The current review is focused on the works of Belov (1964) and Maier (1975). This also used the work from Ohnesorge (1936) to predict the fluid conditions at the gate's exit for steel at different velocities: Continuous flow, disintegrating flow, and atomizing flow. Then he studied the relationship between different casting quality parameters as a function of the gate velocity to finally recommend a gate velocity range for steel HPDC.

Maier's work was based on copper HPDC. In principle, he validated that the results from Ohnesorge do apply to copper. Once this was validated, he determined the optimum filling time (and therefore gate velocity) in order to guarantee an excellent quality casting. The parameter used by Maier was the surface finish.

Design Tools / Computer Modeling

Project 226: Die Casting Manufacturing Analysis Tool (CastView update) (Dr. C. Monroe, UA)

Research Objectives: The goal of this project is to use the initial CastView project and develop an updated version of CastView. This will update the cast view software to a current platform and improve the speed and abilities of the CastView software.

Key Accomplishments: The CastView approach is to identify hotspots in a 3D geometry model. The proposed methodology involves the computation of a distance field using distance transformation, which quantitatively measures the proximity of each point in the 3D space to a specific object or set of objects. The distance field is then utilized to perform a watershed algorithm, which segments the geometry from the deepest areas of the distance field solution. By analyzing the resulting watershed, the casting geometric tool can identify hotspots. Additional features are being added using A.I. to automatically analyze the casting and determine gating locations and the thick and thin sections of the die casting being analyzed.

Process Technologies

Project 223: Die Lube Splash test development – Dr Charlie Monroe – University of Alabama

Research Objectives: Evaluate Die Lubes' performance through casting/die interfacial heat transfer coefficient (IHTC) perspective during die filing stage and early solidification stage.

Key Accomplishments: The splash test is being upgraded to include additional lube testing such as gas generation lubes testing on the plate and possible electrostatic lubes. The gas generation lube has been tested and is currently being evaluated.

Project 241: Properties Versus Section Thickness – High Elongation Structural Alloys - P. Brancaleon, NADCA

Research Objectives: The goal of this project is to establish typical properties for various section thicknesses of production die castings of Structural Alloys. The information gained will be added to the NADCA Product Specification Standards for High Integrity Die Cast Alloys

Key Accomplishments: The first alloy tested was the Aural 2 alloy. The testing was completed in March of 2024. The next alloy being tested is the C611 alloy. The castings selected are being manufactured in 6000 ton to 9000 ton die cast machines. The C611 Alloy is made by Alcoa and is used in the structural high pressure aluminum die cast process. The castings being tested weigh between 87 and 150 lbs as a single die casting. The data and results of the current testing can be found on the NADCA website.

Summary

The portfolio of projects remains balanced and has good support from external as well as NADCA funding. Results and technological advancements from the R&D Program provide many benefits to the die casting industry including enhanced cast part performance, higher productivity, improved process efficiencies, and lower operating costs.

Note: Future project ideas are included in the AMC Metalcasting Industry Roadmap and NADCA has an inventory of new project ideas. However, new project ideas are continually sought and can be submitted to research@diecasting.org for consideration. The AMC Metalcasting industry Roadmap can be found at www.diecasting.org/roadmap.

		Additive Manufacturing
231	NADCA	Failure Analysis of Additively Manufactured Components
242	NADCA	Surface Roughness on the Fatigue Resistance of Die Inserts Additively Manufactured die steel
234	NADCA	Modeling Conformal Cooling of AM Dies
		Cast Materials
237	Remade	Achieving 100% recycled aluminum in Structural Die Casting Applications
235	NADCA	Rheocasting with GISS
238	NADCA	Solder Free Alloys by Optimizing Constitutive Mechanical Behavior
244	NADCA	ESP formation/control in die casting.
245	NADCA	Characterizing the microstructure, hardness, and aging response of nine compositions of steel die castings.
		Die Materials & Surface Engineering
239	NADCA	High Thermal Conductivity PVD Coated Copper-Alloy Die Inserts
240	NADCA	Enhancing performance & longevity of copper plungers for diecast applications through graphene surface coating
243	NADCA	Modeling Steel High Pressure Die Casting
		Design Tools / Computer Modeling
226	NADCA	Die Casting Manufacturability Analysis Tool Cast View
		Process Technologies
223	NADCA	Die Lube Splash Test Development
241	DOD/DLA	Properties Versus Section Thickness for Specifications and Standards and Technology Transfer

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ReMade Funded Project: 237



DIE CASTING CONGRESS & EXPOSITION

SEPTEMBER 30-OCTOBER 2 | INDIANAPOLIS, IN



SPECIAL PREVIEW

Current as of 06/01/24. Subject to change.

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SCHEDULE OF EVENTS

MONDAY SEPTEMBER 30	TUESDAY OCTOBER 1	WEDNESDAY OCTOBER 2
Additive Manufacturing Uses in Die Casting (8:00 – 9:30 am)	Process Controls Through Simulation (8:00 – 9:30 am)	Update on US Government Affairs
Exhibits Open (9:00 am – 5:00 pm)	Exhibits Open (9:00 am – 5:00 pm)	Optimizing Die Casting with Simulation (8:00 – 9:30 am)
Failure and Qualitative Analysis of Additively Manufactured Tooling (9:45 – 11:15 am)	Innovative Die Casting Materials (9:45 – 11:15 am)	North American On-Shoring and Near-Shoring (9:45 – 11:15 am)
	Awards Luncheon (12:15 – 2:00 pm)	Thermally Controlling the Die (9:45 – 11:15 am)
Advanced Tooling Materials and Processes (1:15 – 2:45 pm)		Structural Die Casting Challenges (11:30 am – 1:00 pm)
	Die Casting with Artificial Intelligence (2:00 – 3:30 pm)	
After Hours with the Exhibitors (3:30 – 5:00 pm)	Quality Control using Artificial Intelligence (3:45 – 5:15 pm)	<i>Schedule as of 6/3/24 Subject to change.</i>

SPECIAL COMPLIMENTARY EVENTS

After Hours with the Exhibitors

Monday, September 30
3:30 – 5:00 pm

Having such a good time meeting with exhibitors on the show floor that you wish you had more time? Now you do! Join us for After Hours with the Exhibitors. With more than 150 exhibitors we want to make sure that you have every opportunity to visit the show floor. Kick back and relax with a drink or two all while getting to spend a little extra time learning about all the new technologies and products that the exhibiting companies have to offer. No ticket required.



Die Casting Awards Luncheon

Tuesday, October 1
12:15 – 2:00 pm

Take an afternoon break to converse and network with exhibitors and attendees alike. The following awards will be honored during this special event:

- Herman H. Doehler Award
- Edward A. Kruszynski Supplier Excellence Award
- Nyselius Award
- Gullo & Treiber Award
- Austin T. Lillegren Award
- Committee Member of the Year Award
- Best Congress Paper Award
- Industry Education Award
- International Die Casting Design Competition
- 2023 Safety Awards

GENERAL INFORMATION

Exhibit Hours

Monday, September 30: 10:00 am – 5:00 pm

Tuesday, October 1: 10:00 am – 5:00 pm

Wednesday, October 2: 10:00 am – 5:00 pm

Registration Hours

Saturday, September 28: 3:00 pm – 5:00 pm

Sunday, September 29: 8:00 am – 5:00 pm

Monday, September 30: 8:00 am – 5:00 pm

Tuesday, October 1: 8:00 am – 5:00 pm

Wednesday, October 2: 8:00 am – 2:00 pm

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TAXI

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Additionally, taxi services and rideshare companies operate at the airport, offering passengers the flexibility of door-to-door service. For those seeking a more personalized experience, rental car facilities are also available onsite, allowing travelers to explore the city at their own pace.

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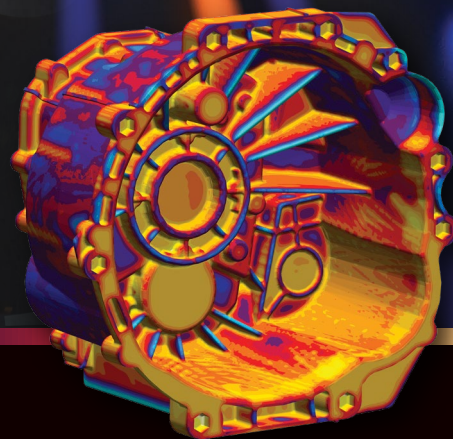
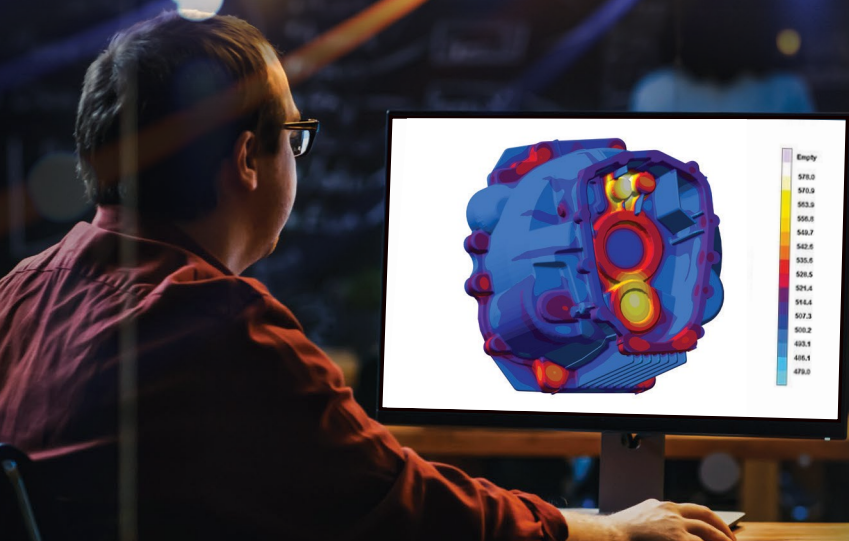




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Eastern Alloys manufactures world-class zinc alloys for the die casting industry using state-of-the-art processing technologies. Zinc alloys are manufactured in Eastern's 100,000-square-foot plant in Maybrook, New York, and as well as our Henderson, Kentucky plant. Eastern Alloys' competitive advantage is our combination of exceptional quality products and unique customer service programs (including defect analysis consultation, training and marketing) to ensure our customers have all the tools needed to manufacture high quality products.

EKK, Inc.**513**

37682 Enterprise Court
Farmington Hills, MI 48331-3440
United States
P: (248) 624-9957
www.ekkinc.com



EKK Inc. is a global supplier of Casting Simulation Software and Consulting Services. The EKKcapcast software suite provides the ability to seamlessly setup and simulate a comprehensive set of casting processes. Finite Element Method (FEM) meshes of your part and mold are automatically created for you for the simulation of the entire process. EKK Inc. also provides engineering consulting services using EKKcapcast. Our experienced engineers help identify problems before they arise and optimize existing processes.

Ellwood Specialty Steel**506**

499 Honey Bee Ln
New Castle, PA 16105
United States
P: (800) 932-2188
www.ess.elwd.com

Fisa North America Inc.**814**

260 Stanley St.
Elk Grove Village, IL 60007
United States
P: (847) 299-8400
www.fisa.com



For over 40 years, and since 2000 in the US, Fisa has been manufacturing and supplying ultrasonic cleaning machines to clean aluminum, zinc and magnesium dies and components.

Using the unsurpassed Magnetostrictive technology, our cleaning method removes soldering, flashes, lubricant build-up, oxides, rust, even calcium build-up from cooling lines.

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Feel free to visit our applications center located in the greater Chicago area and see for yourself by cleaning your own parts with us.

Flow Science**508**

683 Harkle Rd
Santa Fe, NM 87505
United States
P: (505) 982-0088
www.flow3d.com/products/flow-3d-cast

FLOW-3D CAST

FLOW-3D CAST is a state-of-the-art metal casting simulation modeling platform that combines extraordinarily accurate modeling with versatility, ease of use, and high-performance cloud computing capabilities. For every metal casting process, FLOW-3D CAST has a workspace ready to put you on a quick, intuitive path to modeling success. With 11 process workspaces, powerful post-processing, pioneering filling, and solidification and defect analysis, FLOW-3D CAST delivers both the tools and roadmap for designing optimal casting solutions.

Fondarex USA
511

Route Industrielle 13
St-Legier Vaud, 1806
Switzerland
P: (269) 679-7164
www.fondarex.com



With the increasing demand of high quality diecast parts for E-mobility and MEGA / GIGA- Castings, Fondarex created a complete solution for an integrated system, consisting of; Vacuum unit, Squeeze Unit and Jet Cooling System to enhance the quality, reduce costs and expand the range of processable alloys.

The devices are controlled by a Central Periphery Management System to enhance energy efficiency, process optimization and simplifying maintenance and operation.

Please come and visit Fondarex at the booth 511 during the Die Casting Congress & Exhibition in Indianapolis!

Frech USA Inc.
132

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Michigan City, IN 46360-7757
United States
P: (616) 930-1762
www.frechusa.com



Die casting systems by the Frech Group of companies offer customers improved productivity with the smart application of the die casting industry's leading technologies. Die casting cells are built to last and simple to operate with intuitive controls and flexible interfaces. Frech Group also includes important market brands like Robamat, Meltec, VDS, Spesima and FrechZPF.

Godfrey & Wing
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220 Campus Drive
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United States
P: (330) 562-1440
www.godfreywing.com



Established in 1948, Godfrey & Wing is the longest-serving and largest vacuum impregnation equipment provider in the world. We manufacture and supply equipment, sealants, and services to seal casting porosity. Our systems are engineered to maximize productivity, economize sealant usage, and conserve resources. Godfrey & Wing maintains an extensive network of vacuum impregnation service centers and strategic partners. Global automotive, aerospace, defense, medical, and industrial companies trust Godfrey & Wing to seal their castings.

Hanson International
401

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Saint Joseph, MI 49085-9581
United States
P: (269) 429-5555
www.hansoninternational.com



Hanson International excels in precision mold and high-pressure die cast die design, build, sampling, and inspection, primarily serving the automotive industry. Situated in Saint Joseph, Michigan, Hanson's campus features an office/engineering group, a manufacturing facility, and a die testing facility. Using modern equipment and engineering software, Hanson's experienced workforce ensures top-quality tooling. Hanson's rigorous inspections follow ISO 9001:2015 standards, ensuring excellence from design to delivery with a single-source, single-point-of-contact approach.

Henkel Corporation
807

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United States
P: (866) 332-7024

HERCO, LLC
518

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Auburn Hills, MI 48326
United States
P: (248) 656-5900
www.hercogroup.com



Founded in 2007, HERCO provides service and equipment to the aluminum/magnesium high-pressure die casting industry. HERCO is one of the leading providers for custom capital equipment and services in Tooling, Spray Systems, and Air Filtration. HERCO manufactures a multi-channel MoldFlush Unit, Die Release Mixing Unit, and performs maintenance service, repair, and rebuild to all major-brand TCUs (Temperature Control Units). Stop by booth #518.

High Temperature Systems Inc
309

16755 Park Circle Dr
Chagrin Falls, OH 44023-4562
United States
P: (440) 543-8271
www.hitemp.com



With over 50 years of industry experience, High Temperature Systems, Inc. is a world leader in the innovative design of molten metal circulation, transfer, treatment, and chip submergence solutions. Our standard solutions target the aluminum, zinc, tin, and lead industries while our R&D resources develop unique solutions for specialty high-temperature liquid metal and mineral applications. We take the time to understand your unique challenges and design a solution that provides maximum value.

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1126

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United States
P: (740) 375-5832
www.hildrethmfg.com

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United States
P: (800) 543-0425
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606

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United States
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542

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Kokomo, IN 46901-2220
United States
P: (765) 459-0085
www.idragroup.com

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428

IECI C/o SR Mechanical Llc 3631
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United States
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www.iecionline.com



IECI is an Italian leading company in temperature control solutions for tools in die casting.

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Inductotherm Corp.
913

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United States
P: (609) 267-9000
www.inductotherm.com



Induction can heat and melt aluminum at very high efficiency rates with very low metal losses as compared to gas or oil-fueled furnaces, which can emit a tremendous amount of carbon dioxide. As we go green, we help our customers meet their decarbonization initiatives through our induction furnaces. With over 70 years of experience, we can be your answer to reducing your carbon footprint. Visit Inductotherm.com to learn more.

Industrial Innovations Inc
536

2936 Dormax St SW
Grandville, MI 49418
United States
P: (616) 249-1525
www.industrialinnovations.com



Industrial Innovations provides sustainable lubrication and automation products. Like our PRO-MIX™ proportional mixers ideal for graphite/synthetics, SPRARITE™ application such as automated reciprocator sprayers, and RECLAIM-PRO™ recycling systems. We are a FANUC Authorized System Integrator and produce EOAT items like custom manifolds and spray nozzles. Our Advance™ equipment include automatic ladlers, shot-sleeve reconditioning, tip lubers, and cooling conveyors. Also, consumable products such as shot sleeves, die clamps, ladle cups, hand spray wands, plunger rods/tips.

International Mold Steel
603

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United States
P: (859) 342-6000
www.imsteel.com



Backed by the quality and innovation of Daido Steel in Japan, International Mold Steel (IMS) offers more than raw materials – we provide solutions to all your die cast challenges. When you need toughness through the core, count on DH31EX™, DHA-World™ and AMDAP™ powder to deliver.

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J&S Chemical Corp
802

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Canton, GA 30115-8217
United States
P: (770) 720-8100
www.jschemical.com



USA-based J&S Chemical is a leading manufacturer of specialty lubricants for the die casting industry. J&S Chemical's business philosophy is to create value for their customers by developing high quality, high performing, value added products. Substantial investment in R&D as well as their Technical Service Team, working on-site with their customers, is driving new product developments. Many of their brands are product leaders in the industry such as, TurboCast® (die release agents and liquid plunger lubricants), ShotBeads® (solid plunger lubricants) and TurboTrim™ (trimming fluids).

Lethiguel USA
517

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Rogers, MN 55374-9361
United States
P: (763) 428-4229
www.lethiguelusa.com

Lindberg/MPH
105

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LINDBERG/MPH

Lindberg/MPH is a leading manufacturer of melting and holding furnaces for non-ferrous alloys. In addition to non-ferrous equipment, Lindberg/MPH supplies standard and custom industrial heat treat furnaces, including pit, box, IQ, and belt type for the ferrous markets. Founded in 1912, Lindberg/MPH has more than 75,000 industrial furnace installations worldwide and their equipment is backed by a full range of customer support services, an extensive replacement parts inventory, and a 3-Year warranty on new equipment.

LK World
332

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United States
P: (616) 796-0777
www.lkadventure.com

M & I Machine
1106

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Benton Harbor, MI 49023-1243
United States
P: (269) 849-3624
www.shotendtooling.com



M&I Machine is a supplier of quality shot-end components for the aluminum and magnesium die casting industry. Originally founded in 1980, M&I Machine has experienced significant growth in the North American market through a dedicated approach to service, quality, and on-time delivery. Whether it is new shot sleeves, reconditioned shot sleeves, shot rods, or any other shot end tooling you may need, we guarantee you will not be disappointed with our products and service!

MAGMA Foundry Technologies Inc.
702

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Schaumburg, IL 60173
United States
P: (847) 252-1668
magmaoft.com



MAGMA's product and service portfolio includes the powerful, modular software MAGMASOFT®, with the newest release MAGMASOFT®, as well as engineering services for casting design and optimization. Today, MAGMASOFT® is used throughout the metal casting industry, especially for the robust design and optimization of cast components in automotive and heavy industry applications.

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1101

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Nexthermal Corporation
403

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Battle Creek, MI 49015
United States
P: (269) 964-0271
www.nexthermal.com

NovaCast USA Inc.**817**

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Naperville, IL 60563
United States
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www.novacastusa.com



By inspiration and innovation, NovaCast wants to contribute to a more responsible foundry industry. We focus on technical solutions that reduce the environmental footprint, by guiding customers to analyze, stabilize and optimize the casting process.

We call it the Good Guys' Industry.

We put our hearts and souls into providing the global foundry industry with high-quality, cost-cutting solutions. We offer a selection of user-friendly and extensive casting process simulation programs and metallurgical process control systems.

OEE Companies**318**

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United States
P: (612) 440-5714
www.oecompanies.com



OEE Companies supplies custom inserts, tooling and advanced simulations to high pressure die casters including: custom core pins, chill vents, vacuum systems, jet cool systems, sub-inserts, ejection pins, parting line locks, guide pins and bushings, jet cooled pins and cascades, electric furnaces, multi-slide dies and open close dies.

Phygen Coatings Inc**601**

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United States
P: (612) 767-3242



Phygen is the exclusive provider of FortiPhy XVD, a revolutionary surface enhancement process that far exceeds the performance characteristics of even the best conventional PVD coatings. Tool life and productivity can be increased 3x to 80x due to FortiPhy XVD's nanoprecision process, which eliminates up to 90% of the macro particle defects found in PVD coatings. Benefits include dramatic reductions in soldering, erosive wear, and heat checking. Phygen offers tailored ultra-endurance solutions to meet your most demanding needs and is a proven leader in research and advances in die casting.

Progressive Components**919**

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United States
P: (800) 269-6653
www.procomps.com



Progressive Components is a leading source of high-performing standard products for the die-cast industry. With today's plant managers working to reduce unscheduled production stoppages, Pro has engineered our die-cast line to maximize performance and longevity, and our Black Nitride products are proven to outperform others exponentially. Unlike standard additive process treatments, Pro's Black Nitride is a high-hardness diffusion that won't wear like DLC and other surface coatings and is available on our Pins, Sleeves, Bushings, and more.

Prolong Surface Technologies**420**

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Saint Charles, IL 60174
United States
P: (630) 762-6500
www.prolongtool.com



Prolong Surface Technologies is growing to serve you better. Improving your die-life and reducing maintenance costs of die cast tooling (HPDC) is our only business. We have invested in powerful new PVD technology with the largest PVD Die cast coating machine in USA. Reducing your coating costs and quick turnaround with multiple in house duplex processes such as Solvenite, Maxxshot, along with new emerging PVD coatings. Stop by our booth at NADCA, significant technology upgrade.

Pyrotek Inc**224**

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Pyrotek's foundry team offers process and product solutions designed to increase metal and casting quality, improve process efficiency, reduce energy and replacement costs and optimize performance.

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QuakerHoughton
202

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United States
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www.quakerhoughton.com



With a comprehensive product range and unrivalled process expertise and experience, Quaker Houghton provides the complete solution to improving your die casting performance, including DieCast iQ, an end-to-end intelligent die casting solution. We cover all your die casting needs from die release agents, plunger lubricants, application equipment, quench agents, trim lubricants, and ladle coatings to porosity sealing, metal removal fluids, greases, and fire resistant hydraulic fluids.

Regloplas Corp
503

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United States
P: (269) 769-6441
www.regloplasusa.com



Regloplas is a global leader in the production of temperature control equipment and solutions for the plastics, die casting, food, and other temperature-critical industries. The company is a significant contributor to these industries' continued efficiency and quality advancements. Stringent and diverse customer requirements are met by highly specialized teams in development, production, and international sales. Regloplas owns and runs plants in Switzerland, Germany, France, the United States, and China. Additionally, the company collaborates with a global network of independent representatives in over 50 countries. The company, which was founded in 1961, is family-owned and employs 200 employees worldwide.

Ryoei USA Inc.
1124

5524 Fortune Circle S, Suite F
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United States
P: (317) 912-4498
www.ryoei-usa.com



Ryoei is a full-service industrial automation provider specializing in die-casting that supplies state-of-the-art products and services for OEMs. We provide our customers with die spray systems, inspection systems, sorting equipment, pallet changers, material handling systems, and much more.

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414

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United States
P: (847) 709-7409
www.sappgroup.com

Shibaura Machine Company, America
902

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Elk Grove Village, IL 60007-5031
United States
www.shibaura-machine.com

Sinto America
1133

150 Orchard St.
Grand Ledge, MI 48837
United States
P: (517) 371-2460
www.sintoamerica.com



Sinto Surface Treatment, a division of Sinto America, is a full line shot-blast, shot-peening and surface enhancement machine supplier for the cleaning, deburring and burnishing of aluminum die-cast parts. Sinto offers traditional wire mesh belt, spinner hanger, blast tables and drum machines. Uniquely Sinto, the D-SCC, D- Check and D-Flow processes help improve die surface quality for extending die life. Our DZB safety shot machine offers a safer method to clean aluminum castings. Visit Sinto at booth 1133

Socitec US LLC
110

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United States
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www.vibrodynamics.com



Socitec US - Vibro/Dynamics has been providing an unrivaled range of Elastomeric, Coil Spring and Wire Rope Isolators (WRIs) for shock & vibration isolation of die casting machines, stamping presses and all other types of industrial equipment and military systems for over 60 years. Advanced simulation capabilities (ANSYS, SYMOS) are used to provide the best engineered solution for each application.

Spectro Alloys Corp
1107

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United States
P: (612) 480-6124
www.spectroalloys.com

STOTEK, Inc.**1017**

W233 N2800 Roundy Circle West
Suite 200
Pewaukee, WI 53072
United States
P: (262) 347-0845

StrikoWestofen**740**

1606 Executive Drive
Lagrange, GA 30240
United States
P: (616) 772-3705
www.strikowestofen.com

Swiss Steel USA, Inc.**501**

365 Village Dr
Carol Stream, IL 60188-1828
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P: (800) 323-1233
www.swisssteel-international.us



Swiss Steel USA / Canada, part of Swiss Steel Group, is a leading distributor of quality tooling materials for the Die Casting tooling industry with a wide range of specialty tool, die and mold steels. Hot Work Die Steels include Thermotur® 2344, 2367, E40K, and DC Superior all remelted materials manufactured to the latest Die Casting specifications. Value added services include Vacuum Heat Treatment, full Lab services, CNC machining, and Custom saw cutting at six service centers in North America.

Techmire**317**

185 Voyageur
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Techmire provides cost-effective solutions to manufacturers of die cast components to cast complex parts with faster cycle speed, higher material utilization and superior part quality.

The Schaefer Group Inc**728**

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Dayton, OH 45430
United States
P: (937) 253-3342
www.theschaefergroup.com



Frank W. Schaefer, Inc (FWS) started business as a refractory contractor in 1930, and began designing and manufacturing industrial furnaces in 1945. In the early 1970's, FWS's aluminum furnace business grew large enough that it became necessary to form two divisions within the company: A Refractory Sales and Service Division and an Industrial Furnace Division. In 1998, the Industrial Furnace Division was separated from FWS, Inc to form a new company, Schaefer Furnaces, Inc (SFI). A combining of these two related companies took place in late 2002, forming The Schaefer Group, Inc. Two strong traditions are recombined, with the FWS Division providing exceptional refractory sales and service work and the SFI Division providing the best aluminum furnaces and molten metal delivery systems available.

Uddeholm USA**834**

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www.uddeholm.com/us



Uddeholm specializes in innovative die-casting solutions, prioritizing our clients' productivity. Our flagship product, Uddeholm Dievar, is now available as AM powder or a fully 3D printed insert, boasting exceptional toughness and ductility. Our comprehensive offerings encompass tool and die Steels, PVD coatings, Powders for AM, and 3D Printing, coupled with trusted Technical and Engineering Support. Focal steel options include Uddeholm Dievar® (≥18.4 ft-lbs. toughness value) and Uddeholm Orvar Supreme® (≥12 ft-lbs. toughness value), complemented by advanced PVD Coatings (Duplex-TIGRAL®) and innovative Additive Manufacturing solutions.

Valor Renewables**812**

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Valor Alloys, LLC is a secondary smelter located in Houston Texas producing prime equivalent alloys and secondary alloys that meet or exceed customer specifications for the die casting industry. Valor possesses a rotary furnace and reverberatory furnace and is capable of making ingots and SOWs. Valor is ISO 9001 Certified and a Tier 1 Automotive Supplier. Address 11280 Charles Rd. Houston, TX 77041: sales@valorrenewables.com 713-896-8585

VERSEVO Inc**612**

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Hartland, WI 53029
United States
P: (262) 369-8210
www.versevo.com



VERSEVO is a provider to the cast metals industry, with a focus on product diversity, and mission to become the premier supplier to the metal casting and cast products industries. Offerings include process development engineering, part design, tool design, prototype & production tooling, low pressure aluminum castings, production machining, and foam molding, for High Pressure & Low-Pressure Casting, Trimming, Lost Foam Casting, Permanent & Semi-Permanent Mold Casting, and Vertical & Horizontally parted Sand Casting.

Visi-Trak Worldwide LLC**827**

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United States
P: (216) 524-2363
www.visi-trak.com



Great process with relentless repeatability is the cornerstone of successful die casters. Visi-Trak has been building rugged, upgradable, process monitoring and closed loop hydraulic control systems for 50 years so you can access the process insight you need to control your toughest die casting problems. Today we continue to innovate with human-machine interface (HMI) software (process/casting traceability and production reporting), non-contact die temperature monitoring and web-based access to critical production data. Bring us your biggest challenges today!

voestalpine Additive Manufacturing Centers – North America**834**

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Houston, TX 77066
United States
P: (800) 638-2520
www.voestalpine.com/highperformancemetals/canada/en/services/additive-manufacturing



voestalpine Additive Manufacturing Centers (vAMC) are your premier destination for comprehensive Additive Manufacturing (AM) services specializing in die-cast tooling. We collaborate closely with clients to deliver personalized solutions, employing our optimized design, powder, and printing methods complemented by enhanced services like heat treatment and coating. Merging cutting-edge AM expertise with a wealth of die-casting experience, we offer the optimal tooling solution. Our services encompass conformal cooling design, process simulation & consultation, turn-key tooling manufacturing, and efficient spare management.

voestalpine eifeler Coatings LLC**834**

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voestalpine eifeler Coatings offer PVD coating Services to the North American Die Casting Industry. Our Duplex-TIGRAL® coating, with its high hot hardness characteristics, is a great solution for wear protection, as well as, both chemical resistance and oxidation. Additionally, when subjected to shear loads, the nanostructure properties help to prevent crack propagation, resulting in more production and less downtime. Visit us at www.eifeler.com/northamerica. PVD Coatings: SUBLIME®, Duplex-TIGRAL®, Duplex-VARIANTIC®

voestalpine High Performance Metals**834**

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United States
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www.voestalpine.com/highperformancemetals/usa



voestalpine High Performance Metals is part of voestalpine AG, a leading steel and technology group. Based in Linz Austria, voestalpine is a global partner to the automotive, white goods, and energy industries. Through our various brands, we service the North American Die Casting Industry and global OEM's with tool steel, PVD Coatings, Heat Treatment and Additive Manufacturing. Brands and business units: Uddeholm, BOHLER, eifeler, voestalpine Additive Manufacturing Centers

Wollin USA**240**

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Plymouth, MI 48170
United States
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www.wollinusa.com



Wollin is a global company and the leader in die spraying technology. The patented PowerSpray system allows the maximum in flexibility of spray tool design. Targeted spray agent application, reduction of die release agent, and significantly reduced spray cycles are the main advantages of the Wollin system. The ESM reciprocators come in a variety of models allowing from 4-8 spraying circuits and 2 air blasting circuits depending on the size requirements of the die cast machine and the casting. Wollin offers a variety of spraying technologies to meet your needs.

YIZUMI-HPM Corporation**824**

3424 State Rt 309 PO Box 210
Iberia, OH 43325
United States
P: (740) 382-5600
www.yizumi.com



As a world-leading equipment brand, YIZUMI-HPM was acquired by YIZUMI Corporation in 2011. YIZUMI combines multiple professional capabilities and keeps innovation to meet customers' demands and promote technological progress with global wisdom. YIZUMI not only offers die casting and injection molding machines, but also global sales and after-service in Europe, the US, Brazil, Mexico, India, and SAE. Aiming to provide more advanced molding equipment system solutions with the best ROI, YIZUMI strives to become a world-class enterprise.

Yushiro Manufacturing America, Inc.**310**

783 West Mausoleum Rd.
Shelbyville, IN 46176
United States
P: (317) 398-9862

Zitai USA - Die Casting Equipment Group**1024**

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www.zitai.com



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2344 EFS – H13

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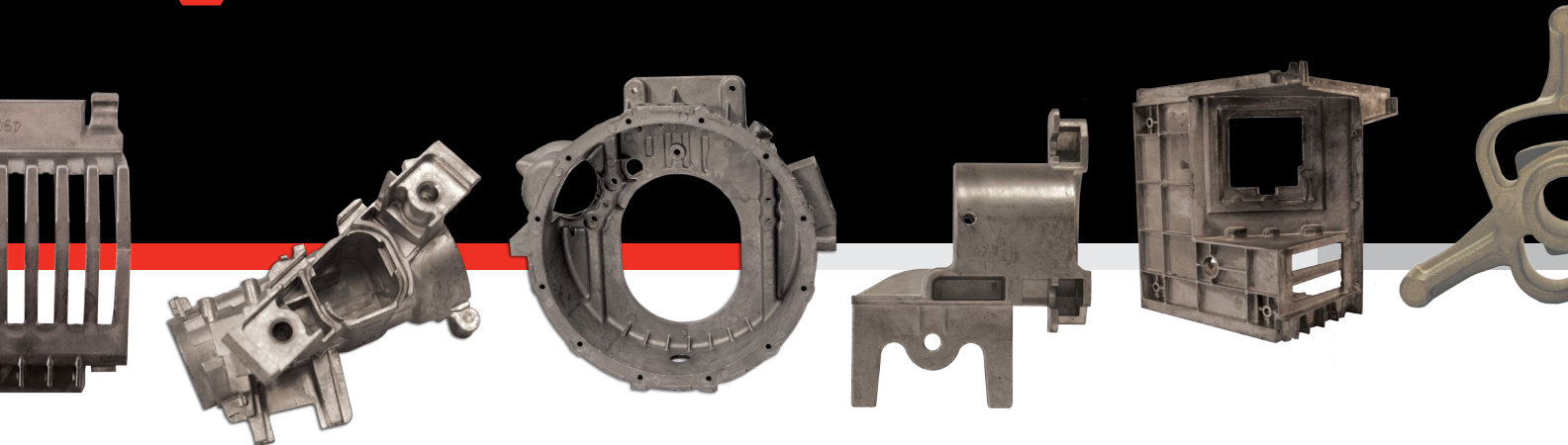
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Corporate Membership

The North American Die Casting Association (NADCA) is the sole trade and professional society of the die casting industry. Membership consists of both corporate and individual members from over 1000 companies located in every geographic region of the United States, Canada and Mexico.

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- To Stay Current on News/Technology
- Training/Education
- Networking Opportunities
- Retain Competitive Edge
- Visibility to OEMs
- Inclusion in R&D Projects
- Access Member-only Information
- Recognition
- Source Staff
- Save Money on Conferences/Shows/Advertising/Training



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SUPPLIERS DIRECTORY

2024

✓ Current as of 06/01/24



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Companies Listed
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Section 2

Companies Listed by
Product or Service
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Section 3

Manufacturers, Distributors,
Reps. & Sales Offices
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Product & Service Categories

Alloys

Aluminum
Copper
Magnesium
Metal Matrix/Ceramic Composite
Semi-Solid
Structural Aluminum
Zinc-Aluminum (ZA)
Zinc

DCM Cell Ancillary Equipment

Aluminum Melting Furnaces
Auto Pour Furnaces
Automation Equipment
Chillers
Collaborative Robots (Cobots)
Die Spraying Equipment & Supplies
Die Spray Systems
Die Temperature Control Systems
Electric Furnaces
Electric Launder Systems
Extractors
Furnace Feeders
Furnace Rebuilding/Repair
Gas Furnaces
Heat Treating Furnaces
Holding Furnaces
Hydraulic Filtration Systems
Lubrication Central Proportioning Systems
Magnesium Melting Furnaces
Molten Metal Filtration Systems
Molten Metal Pumps
Process Control Systems
Quench & Cooling Equipment
Die Spray Systems
Robots
Secondary Machining Equipment
Trim Presses
Used Machinery
Vacuum Systems
Zinc Furnaces

Die Builders, Materials & Coatings

Core Pins
Die Bases
Die Casting Die Builders
Die Cavity Sets
Die Coatings
Die Maintenance/Repair
Die Steels
Die Stress Relieving
Dies Parts and Supplies
Trim Dies
Unit Dies

Die Casting Machines

Cold Chamber
Hot Chamber
Low Pressure
Maintenance & Repair
Multiple Slide
Remanufacturing
Rheocasting
Semi-Solid Molding
Squeeze
Vertical
Thixocasting
Used Die Casting Machines

Plant Equipment

Air Filtration Systems
CAD/CAM equipment
Casting Impregnation Equipment
CNC Machines
Combustion & Control Systems
Deburring Equipment
Degassing Equipment
Dross Recovery Systems
Finishing Equipment
Inspection Equipment
Material Handling Equipment
Parts Cleaners
Safety Equipment & Supplies
Shot Blast Equipment
Spectrometers
Waste Treatment Equipment
Used Machinery

Process Materials

Abrasives & Shot Blast Media
Adhesives
Alloying Additives
Die Lubricants
Fluxes
Greases
Heat Transfer Fluids
Hydraulic Fluids
Ladle Coatings
Machine Coolants
Plunger Lubricants
Quench Agents
Refractories
Rust/Oxidation Preventatives
Sealants
Welding Supplies

Replacement Parts

Automatic Pouring Ladles
Ceramic Ladles
Crucibles
Goosenecks
Hand Ladles
Heaters
Hydraulic Filters
Hydraulic Valves
Ladle Cups
Molten Metal Filters
Nozzles & Noses
Plungers & Parts
Shot End Systems & Components
Shot Sleeves & Products
Thermocouples
Tie Bars
Transfer Ladles

Services & Consultants

Additive Manufacturing
Anodizing
CAD/CAM Services
Casting Impregnation Service & Supplies
Consulting Services
Degating Services
Die Casting Design
Energy Products & Services
Environmental Products and Services
Finishing Services
Heat Treating Services
Hydraulic Valve Repair
Laboratory Services
Leak Testing & Equipment
Non-Destructive Testing
Parts Cleaning Services
Powder Coating
Rapid / Prototyping services Safety Services
Scrap Recycling Services
Secondary Machining Services
Tolling Services
Training
Waste Treatment Services
Welding Services

Software & Monitoring

Clamp Force Monitoring
Design Software
Gating Software
Information Management Software
Modeling & Simulation Software
Shot Monitoring
Thermal Analysis Software
Tie Bar Monitoring

SECTION ONE

Companies Listed Alphabetically

1

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bhoward@shapirometals.com
www.shapirosales.com

**Shibaura Machine Company,
America**
755 Greenleaf Ave
Elk Grove Village, IL 60007
United States
Phone: (847) 709-7400
dc-sales@shibaura-machine.com
shibaura-machine.com

Shippo Molds Mexico, S.A. DE C.V.
Av. Mina De Guadalupe #902 Parque
Industrial Santa Fe IV, C.P.
Silao, Guanajuato 36275, Mexico
Phone: +52 472 7 48 93 90
sales@dmsmoldes.com.mx

SIJ Metal Ravne - SIJ Americas
331 Newman Springs Rd. Suite 104
Red Bank, NJ 07701 United States
Phone: (732) 203-1505
brigita.rataj@metalaravne.com
si-j.metalravne.com/sl

SINC Thermal
9550 True Drive
Saint Louis, MO 63132 United States
jms@sinthermal.com

Sinto America
150 Orchard St
Grand Ledge, MI 48837-1210
United States
Phone: (517) 371-2460
sales@sintoamerica.com
www.sintoamerica.com

Socitec US LLC
2443 Braga Drive
Broadview, IL 60155 United States
Phone: (800) 842-7668
mikeyoung@vibroynamics.com
vibroynamics.com

South Haven Finishing, Inc.
1610 Stieve Dr.
South Haven, MI 49090 United States
Phone: (269) 637-2047
andy@southhavenfinishing.com
www.southhavenfinishing.com

Spectro Alloys Corp.
13220 Doyle Path E
Rosemount, MN 55068 United States
Phone: (651) 437-2815
agergen@spectroalloys.com
www.spectroalloys.com

Standard Tool & Die
2950 Johnson Road PO Box 608
Stevensville, MI 49127 United States
Phone: (269) 465-6004
info@standardtool.net
www.standardtool.net

Stanton A Moss Inc
PO Box 896
Bryn Mawr, PA 19010 United States
Phone: (215) 877-8200
stephen@stantonamoss.com
www.stantonamoss.com

State Metal Industries Inc
941 S Second Street PO BOX 1407
Camden, NJ 08101 United States
Phone: (856) 964-1510
macgrace@smialum.com
statemetalindustries.com

Stotek Inc.
W233 N2800 Roundy Circle West,
Suite 200
Pewaukee, WI 53072 United States
Phone: (262) 347-0845
sales@stotek.com
www.stotek.com



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and Aftermarket Solutions**

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strikowestofen.com

StrikoWestofen America
1606 Executive Drive
Lagrange, GA 30240 United States
Phone: (616) 772-3705
striko.sales.na@noricangroup.com
www.strikowestofen.com/

Strohwig Industries
3285 Industrial Rd PO Box 38
Richfield, WI 53076 United States
Phone: (262) 628-4477
dglass@strohwig.com
www.strohwig.com

Stucchi USA
1105 Windham Parkway
Romeoville, IL 60446 United States
Phone: (847) 956-9720

Sun Metalon
One Broadway, 14th Floor
Cambridge, MA 02142 United States
Phone: (617) 682-3624
mark.cook@sunmetalon.com
sunmetalon.com

Sun Steel Treating, Inc.
550 N. Mill Street Box 759
South Lyon, MI 48178 United States
Phone: (877) 471-0840
asmith@sunsteeltreating.com
www.sunsteeltreating.com

Sunocs LLC
5907 Murvihill Road
Valparaiso, IN 46383 United States
Phone: 219-881-8060
contact@sunocs.com
www.sunocs.com

Superior Aluminum Alloys
14214 Edgerton Rd PO Box 678
New Haven, IN 46774 United States
Phone: (260) 749-7599 x7810
pccarlin@saalloys.com
saalloys.com

Swiss Steel Canada, Inc.
6350 Vipond Dr
Mississauga, ON L5T 1G2 Canada
Phone: (416) 675-5941 x2366
peter.tuomi@swisssteelgroup.com
www.swisssteel-international.ca

Swiss Steel USA, Inc.
365 Village Dr
Carol Stream, IL 60188-1828
United States
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J.Stocker@swisssteelgroup.com
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T

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- Training & Maintenance
- Tooling design and building

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Pointe-Claire, QC H9R6B2
Canada
Phone: (514) 694-4110
info@techmire.com
www.techmire.com

Tempel Steel Company
5500 N Wolcott Ave
Chicago, IL 60640 United States
Phone: (773) 342-7400
drivera@tempel.com
www.tempelsteel.com

The Folk Group
410 Church Street, Suite 204
Bangor, PA 18013 United States
Phone: (215) 353-8105
jfolk@folkgroup.com
www.folkgroup.com

The Foundry Way
5100 River Valley Rd
Milford, OH 45150 United States
Phone: (513) 831-8777
dave@foundryway.com

The Midson Group Inc
1353 South Gaylord St
Denver, CO 80210 United States
Phone: (303) 778-0271
steve@themidsongroup.com
www.themidsongroup.com

The Schaefer Group, Inc.
1300 Grange Hall Road
Beavercreek, OH 45430 United States
Phone: (937) 253-3342
bill.marshall@theschaefergroup.com
www.theschaefergroup.com

Thermal-Tec Roofing
13801 Francis Way
Cedar Springs, MI 49319 United States
Phone: (800) 531-9798
info@thermal-tec.com

Therm-Tech of Waukesha
301 Travis Ln
Waukesha, WI 53189 United States
Phone: (262) 549-1878
sales@thermtech.net
thermtech.net

THT Presses Inc
7475 Webster St
Dayton, OH 45414 United States
Phone: (937) 898-2012
sales@thtpresses.com
www.THTPresses.com

Tiocco-Filmax, a Division of Filmax, LLC
6775 Corporate Park Dr
Loudon, TN 37774 United States
Phone: (800) 321-3895
tiocco-filmax@filmaxinc.com
filmaxinc.com

Titus Group / Titus Technologies
900 W. Connexion Way
Columbia City, IN 46725 United States
Phone: (425) 746-2080
usa@titusplus.com
www.titusplus.com

Tool-Temp US, Inc.
7148 Weddington Road NW
Suite180
Concord, NC 28027 United States
Phone: (704) 918-4402
info@tool-temp.com
tool-temp.com

TOTALL Metal Recycling
2700 Missouri Avenue
Granite City, IL 62040 United States
Phone: (618) 877-0585
info@tmrusa.com
www.tmrusa.com

Towa America, Inc.
2083 Ivy Ridge Dr
Hoffman Estates, IL 60192 United States
Phone: (847) 628-6282
info@towa-america.com
towa-america.com

TOYO Machine America, LLC
3431 Wise Way
The Villages, FL 32163 United States
Phone: (614) 551-1225
rob@toyocast.com
www.toyocast.com

TRANSVALOR AMERICAS Corp.
405 W Superior Street Suite 601
Chicago, IL 60654 United States
Phone: 312-219-6029
nicolas.poulain@transvalor.com
transvalor.com

Trialco Aluminum LLC
900 E 14th Street
Chicago Heights, IL 60411 United States
Phone: (708) 757-4200
armstrong@trialco.net
www.trialco.net

Turn Key Tool & Die
8 Progress Parkway
Union, MO 63084 United States
Phone: (636) 583-4505
bstockhorst@tktool.net

Tvarit GmbH
1121 Meadowview Lane
Ottawa, IL 61350 United States
Phone: (815) 405-1213
patel@tvarit.com
tvarit.com

U

Uddeholm USA
2505 Millennium Drive
Elgin, IL 60124 United States
Phone: (800) 638-2520
sales.usa@uddeholm.com
www.uddeholm.com/us


Ultraseal America Inc.
PO Box 2120
Ann Arbor, MI 48106 United States
bremler@ultrasealamerica.com
www.ultraseal-impregnation.com/us

Unifrax, LLC
600 Riverwalk Parkway Suite 120
Tonawanda, NY 14150 United States
Phone: (716) 768-6500
sharon.darlington@unifrax.com

United Surface Preparation
900 Lund Blvd
Anoka, MN 55303 United States
rylie.dierich@unitedsurfprep.com

V

Valmont/Applied Coating Technology Inc.
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Alloys include but not limited to: A304, A380, A356.1, A356.2, A365, A319...etc.

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Valor Alloys, LLC
11250 Charles Road
Houston, TX 77041 United States
Phone: (713) 896-8585
khami@valorrenewables.com
www.valorrenewables.com

VERSEVO Inc.
1055 Cottonwood Ave
Hartland, WI 53029 United States
Phone: (262) 369-8210
tmooon@versevo.com
versevo.com

Viami International Inc.
267 Alice Carriere
Beaconsfield, QC H9W 6E6 Canada
Phone: (514) 426-1814
martin.hartlieb@viami.ca

Vinet Micro-Technologies Inc.
1099 Lotbiniere, Unit #403
Vaudreuil-Dorion, QC J7V 0H5 Canada
Phone: (450) 424-5039
alain.vinet@videotron.ca
www.vinetmicrotechnologies.ca

Visi-Trak Worldwide, LLC
8400 Sweet Valley Dr Suite 406
Valley View, OH 44125 United States
Phone: (216) 524-2363
sales@visi-trak.com
www.visi-trak.com

Voestalpine Additive Manufacturing Centre Ltd.
2595 Meadowvale Blvd
Mississauga, ON L5N 7Y3 Canada
Phone: (800) 665-8335
Sami.arsan@voestalpine.com
www.voestalpine.com/highperformancemetals/canada/en/services/additive-manufacturing/

Voestalpine Eifeler Coatings
2475 Millennium Drive
Elgin, IL 60124 United States
Phone: (630) 587-1220
sales.usa@eifeler.com
www.eifeler.com/northamerica/en/

Voestalpine High Performance Metals - USA
2505 Millennium Drive
Elgin, IL 60124 United States
Phone: (630) 883-3000
hpm-sales.usa@voestalpine.com
www.voestalpine.com/highperformancemetals/usa/en/

W

Wheelabrator Group
1606 Executive Drive
LaGrange, GA 30240 United States
Phone: (800) 544-4144
wheelabrator.sales.na@norican-group.com
www.wheelabratorgroup.com

Willer Tool Corporation
PO Box 169
Jackson, WI 53037 United States
Phone: (262) 677-6000
jwiller@willer.com
www.willer.com

Wirth Tool & Die
W212 N7250 Dudovick Drive
Lannon, WI 53046 United States
Phone: (262) 251-8630
randy@bizwi.r.com
www.wirthtoolanddie.com

Wollin USA
44250 Plymouth Oaks Blvd
Plymouth, MI 48170 United States
Phone: (800) 245-9232
john_goode@wollinUSA.com
www.wollinusa.com

X

XL Technologies Inc
1501 NORMAN DRIVE
Darien, IL 60561 United States
Phone: (630) 435-5469
zackli@xlti.com

Y

YAC Robot Systems Inc.
11 Kiesland Court
Hamilton, OH 45015 United States
Phone: (513) 874-9670
wkeesee@yac-robot.com

YIZUMI-HPM Corporation
3424 State Rt 309 PO Box 210
Iberia, OH 43325 United States
Phone: (740) 382-5600
sburkett@yizumi-hpm.com
www.yizumi-hpm.com

Yushiro Manufacturing America, Inc.
783 West Mausoleum Road
Shelbyville, IN 46176 United States
Phone: (317) 398-9862
lhether@yushirousa.com
yushirousa.com

Z

Zitai USA - Die Casting Equipment Group
1191 Hilary Lane
Highland Park, IL 60035 United States
Phone: (847) 441-8500
rjaffe@diecastequipmentgroup.com
www.diecastequipmentgroup.com

SECTION TWO

Companies Listed by Product or Service

ALLOYS

Aluminum

Alcoa USA Corp.
Alcoa, TN USA

Allied Metal Company
Chicago, IL USA

Audubon Metals LLC
Henderson, KY USA

Bob McClintic & Associates
Grand Rapids, MI USA

BuhlerPrince, Inc.
Holland, MI USA

Canmet MATERIALS - Natural
Resources Canada
Hamilton, ON Canada

Carpenter Brothers Inc.
Mequon, WI USA

Conticast Hormesa LLC
Weston, FL USA

Custom Alloy Sales, Inc.
La Puente, CA USA

D and S Consulting LLC
Springboro, OH USA

Die Cast Date Screws
Dayton, OH USA
Die Cast Services LLC
Corona, CA USA

DISA Group
LaGrange, GA USA

DTP Diecast Solutions LLC
Florence, AL USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Eastern Alloys Inc.
Maybrook, NY USA

EDRO Specialty Steels
Ellwood City, PA USA

Ellwood Specialty Steel
New Castle, PA USA

Fondarex USA
Elgin, IL USA

Foundry Supply Source Inc.
Milton, ON Canada

Frech USA
Michigan City, IN USA
Gefran Inc.
North Andover, MA USA

General Die & Engineering Inc.
Grand Rapids, MI USA

HERCO, LLC
Auburn Hills, MI USA

High Temperature Systems Inc
Chagrin Falls, OH USA

Imperial Zinc Corp & Imperial
Aluminum Corp
Chicago, IL USA

ItalPresseGauss
Lagrange, GA USA

J. Solotken & Company Inc.
Indianapolis, IN USA

Klockowski & Associates Inc
Elgin, IL USA

Midland Industries, Inc.
Chicago, IL USA

Norican Group
LaGrange, GA USA

Refractory Engineers, Inc.
Indianapolis, IN USA

Ritchey Metals Company Inc
Canonsburg, PA USA

Rochester Aluminum Smelting
Canada Ltd.
Concord, ON Canada

SAPP Inc.
Edinburgh, IN USA

Sceptor Inc.
Waverly, TN USA

SINC Thermal
Saint Louis, MO USA

Spectro Alloys Corp.
Rosemount, MN USA

State Metal Industries Inc
Camden, NJ USA


StrikoWestofen America
Lagrange, GA USA

Superior Aluminum Alloys
New Haven, IN USA

The Schaefer Group, Inc.
Beavercreek, OH USA


TRANSVALOR AMERICAS Corp.
Chicago, IL USA

Trialco Aluminum LLC
Chicago Heights, IL USA



Valor Alloys, LLC
Secondary Aluminum Smelter
Producing Ingot and SOWs Like Prime!

SOW's and Ingots made and shipped to custom specifications



Alloys include but not limited to: A304, A380, A356.1, A356.2, A365, A319...etc.

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www.valorrenewables.com
Phone: 713-896-8585

Valor Alloys, LLC
Houston, TX USA

VERSEVO Inc.
Hartland, WI USA

Viami International Inc.
Beaconsfield,, QC Canada

Vinet Micro-Technologies Inc.
Vaudreuil-Dorion, QC Canada

YIZUMI-HPM Corporation
Iberia, OH USA

Copper

BuhlerPrince, Inc.
Holland, MI USA

Carpenter Brothers Inc.
Mequon, WI USA

Conticast Hormesa LLC
Weston, FL USA

EDRO Specialty Steels
Ellwood City, PA USA

Gefran Inc.
North Andover, MA USA

J. Solotken & Company Inc.
Indianapolis, IN USA

Materion Brush Beryllium & Com-
posites
Elmore, OH USA

Refractory Engineers, Inc.
Indianapolis, IN USA

Spectro Alloys Corp.
Rosemount, MN USA

TRANSVALOR AMERICAS Corp.
Chicago, IL USA

Magnesium

Bob McClintic & Associates
Grand Rapids, MI USA

BuhlerPrince, Inc.
Holland, MI USA

Canmet MATERIALS - Natural
Resources Canada
Hamilton, ON Canada

Carpenter Brothers Inc.
Mequon, WI USA

DieKast, Inc.
Holland, MI USA

DTP Diecast Solutions LLC
Florence, AL USA

Fondarex USA
Elgin, IL USA

Frech USA
Michigan City, IN USA

General Die & Engineering Inc.
Grand Rapids, MI USA

High Temperature Systems Inc
Chagrin Falls, OH USA

IDRA North America Inc.
Kokomo, IN USA
ItalPresseGauss
Lagrange, GA USA

Refractory Engineers, Inc.
Indianapolis, IN USA

SAPP Inc.
Edinburgh, IN USA

StrikoWestofen America
Lagrange, GA USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Vinet Micro-Technologies Inc.
Vaudreuil-Dorion, QC Canada

YIZUMI-HPM Corporation
Iberia, OH USA

Metal Matrix/Ceramic Composite

Allied Mineral Products Inc
Columbus, OH USA

Anviloy By Astaras Inc.
Largo, FL USA

Carpenter Brothers Inc.
Mequon, WI USA

Plansee Se USA LLC
Franklin, MA USA

Semi-Solid

BuhlerPrince, Inc.
Holland, MI USA

Gefran Inc.
North Andover, MA USA

Viami International Inc.
Beaconsfield,, QC Canada

YIZUMI-HPM Corporation
Iberia, OH USA

Structural Aluminum

Alcoa USA Corp.
Alcoa, TN USA

BuhlerPrince, Inc.
Holland, MI USA

Carpenter Brothers Inc.
Mequon, WI USA

Conticast Hormesa LLC
Weston, FL USA

Custom Alloy Sales, Inc.
La Puente, CA USA

Die Cast Date Screws
Dayton, OH USA

Fondarex USA
Elgin, IL USA

Frech USA
Michigan City, IN USA

General Die & Engineering Inc.
Grand Rapids, MI USA

Integrity Light Metals LLC
Elgin, IL USA

ItalPresseGauss
Lagrange, GA USA

NCC Die Casting LLC
Haltom City, TX USA

Norican Group
LaGrange, GA USA

Spectro Alloys Corp.
Rosemount, MN USA

Trialco Aluminum LLC
Chicago Heights, IL USA

Viami International Inc.
Beaconsfield,, QC Canada

YIZUMI-HPM Corporation
Iberia, OH USA

Zinc-Aluminum (ZA)

Allied Metal Company Chicago, IL USA

Bob McClintic & Associates
Grand Rapids, MI USA

BuhlerPrince, Inc. Holland, MI USA

Carpenter Brothers Inc.
Mequon, WI USA

Custom Alloy Sales, Inc. La Puente, CA USA

Eastern Alloys Inc. Maybrook, NY USA

Fondarex USA Elgin, IL USA

High Temperature Systems Inc Chagrin Falls, OH USA

ItalPresseGauss Lagrange, GA USA

Klockowski & Associates Inc
Elgin, IL USA

Midland Industries, Inc.
Chicago, IL USA

Rochester Aluminum Smelting Canada Ltd. Concord, ON Canada

SAPP Inc. Edinburgh, IN USA

Spectro Alloys Corp. Rosemount, MN USA

StrikoWestofen America Lagrange, GA USA

The Schaefer Group, Inc. Beavercreek, OH USA

Titus Group / Titus Technologies Columbia City, IN USA

Zinc

Allied Metal Company Chicago, IL USA

Bob McClintic & Associates
Grand Rapids, MI USA

BuhlerPrince, Inc. Holland, MI USA

Carpenter Brothers Inc.
Mequon, WI USA

Custom Alloy Sales, Inc. La Puente, CA USA

Die Cast Services LLC
Corona, CA USA

DTP Diecast Solutions LLC Florence, AL USA

Eastern Alloys Inc. Maybrook, NY USA

Fondarex USA Elgin, IL USA

High Temperature Systems Inc Chagrin Falls, OH USA

Imperial Zinc Corp & Imperial Aluminum Corp Chicago, IL USA

ItalPresseGauss Lagrange, GA USA

J. Solotken & Company Inc.
Indianapolis, IN USA

Klockowski & Associates Inc
Elgin, IL USA

Midland Industries, Inc.
Chicago, IL USA

Odyssey Manufacturing Solutions,
LLC
Lexington, NC USA

Ritchey Metals Company Inc
Canonsburg, PA USA

Rochester Aluminum Smelting Canada Ltd. Concord, ON Canada

Spectro Alloys Corp. Rosemount, MN USA

StrikoWestofen America Lagrange, GA USA

The Schaefer Group, Inc. Beavercreek, OH USA

Titus Group / Titus Technologies Columbia City, IN USA

Vinet Micro-Technologies Inc.
Vaudreuil-Dorion, QC Canada

YIZUMI-HPM Corporation Iberia, OH USA

DCM CELL ANCILLARY EQUIPMENT

Aluminum Melting Furnaces

Beta Die Casting Equipment
Cambridge, ON Canada

Carpenter Brothers Inc.
Mequon, WI USA

Conticast Hormesa LLC Weston, FL USA

Craft Cast Engineering Inc.
Georgetown, ON Canada

D and S Consulting LLC
Springboro, OH USA

Daiichi Jitsugyo (America) Inc. Wood Dale, IL USA

Die Cast Machinery LLC
Waukegan, IL USA

Die Cast Services LLC
Corona, CA USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Dynamo Furnaces
Cambridge, ON Canada

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Foundry Supply Source Inc.
Milton, ON Canada

Frech USA Michigan City, IN USA

Gefran Inc.
North Andover, MA USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

Inductotherm Corp. Rancocas, NJ USA

ItalPresseGauss Lagrange, GA USA

Klockowski & Associates Inc
Elgin, IL USA

Lethiguel USA
Rogers, MN USA

Lindberg MPH
Riverside, MI USA

LK World
Edinburgh, IN USA

Norican Group
LaGrange, GA USA

Refractory Engineers, Inc.
Indianapolis, IN USA



SINC Thermal
Saint Louis, MO USA

State Metal Industries Inc
Camden, NJ USA

StrikoWestofen America
Lagrange, GA USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Valor Alloys, LLC
Houston, TX USA

Zitai USA - Die Casting Equipment Group
Highland Park, IL USA

Auto Pour Furnaces

Carpenter Brothers Inc.
Mequon, WI USA

Conticast Hormesa LLC
Weston, FL USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Machinery LLC
Waukegan, IL USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Foundry Supply Source Inc.
Milton, ON Canada

Frech USA
Michigan City, IN USA

Gefran Inc.
North Andover, MA USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

Inductotherm Corp.
Rancocas, NJ USA

ItalPresseGauss
Lagrange, GA USA

Klockowski & Associates Inc
Elgin, IL USA

Lindberg MPH
Riverside, MI USA

Norican Group
LaGrange, GA USA

Refractory Engineers, Inc.
Indianapolis, IN USA

SINC Thermal
Saint Louis, MO USA

StrikoWestofen America
Lagrange, GA USA

Zitai USA - Die Casting Equipment Group
Highland Park, IL USA

Automation Equipment

Automation Systems & Design (ASD)
Dayton, OH USA

Bedford Machine & Tool Inc.
Bedford, IN USA

Beta Die Casting Equipment
Cambridge, ON Canada

BuhlerPrince, Inc.
Holland, MI USA

Burkert Fluid Control Systems
Huntersville, NC USA

Carpenter Brothers Inc.
Mequon, WI USA

Colosio USA Inc.
Minneapolis, MN USA

Combined Technologies Group Inc
Dayton, OH USA

Conticast Hormesa LLC
Weston, FL USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Date Screws
Dayton, OH USA

Die Cast Machinery LLC
Waukegan, IL USA

Die Cast Services LLC
Corona, CA USA

DieKast, Inc.
Holland, MI USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Frech USA
Michigan City, IN USA

Gefran Inc.
North Andover, MA USA

HERCO, LLC
Auburn Hills, MI USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

Industrial Innovations Inc.
Grandville, MI USA

ItalPresseGauss
Lagrange, GA USA

Klockowski & Associates Inc
Elgin, IL USA

LiCON MT LP
Dexter, MI USA

Lincoln Electric Automation
Columbus, OH USA

LK World
Edinburgh, IN USA

MetalPress Machinery
Cambridge,, Canada

Odyssey Manufacturing Solutions, LLC
Lexington, NC USA

OEE Companies
Saint Paul, MN USA

Pascal Engineering
Arlington Heights, IL USA

Quaker Houghton
Conshohocken, PA USA

Rosler Metal Finishing USA LLC
Battle Creek, MI USA

Ryoei USA Inc.
Indianapolis, IN USA

**Shibaura Machine Company,
America**
Elk Grove Village, IL USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Titus Group / Titus Technologies
Columbia City, IN USA

TOYO Machine America, LLC
The Villages, FL USA

Wheelabrator Group
LaGrange, GA USA

**Zitai USA - Die Casting Equipment
Group**
Highland Park, IL USA

Chillers

Carpenter Brothers Inc.
Mequon, WI USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Machinery LLC
Waukegan, IL USA

Die Cast Services LLC
Corona, CA USA

DME Company LLC
Madison Hts, MI USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Gefran Inc.
North Andover, MA USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

IECI S.r.l.
Bedford, IN USA

Klockowski & Associates Inc
Elgin, IL USA

Lethiguel USA
Rogers, MN USA

LK World
Edinburgh, IN USA

Mokon
Buffalo, NY USA

Odyssey Manufacturing Solutions, LLC
Lexington, NC USA

OEE Companies
Saint Paul, MN USA

Regloplas Corporation
Sodus, MI USA

Collaborative Robots (Cobots)

Carpenter Brothers Inc.
Mequon, WI USA

Conticast Hormesa LLC
Weston, FL USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Services LLC
Corona, CA USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Gefran Inc.
North Andover, MA USA

HERCO, LLC
Auburn Hills, MI USA

Klockowski & Associates Inc
Elgin, IL USA

Lincoln Electric Automation
Columbus, OH USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Die Spraying Equipment & Supplies

Applied Material Solutions, Inc. (AMS)
Elkhorn, WI USA

BuhlerPrince, Inc.
Holland, MI USA

Carpenter Brothers Inc.
Mequon, WI USA

Colosio USA Inc.
Minneapolis, MN USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Machinery LLC
Waukegan, IL USA

Die Cast Services LLC
Corona, CA USA

DieKast, Inc.
Holland, MI USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Frech USA
Michigan City, IN USA

Gokoh Corporation
Troy, OH USA

HERCO, LLC
Auburn Hills, MI USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

HTS International Corporation
Knoxville, TN USA

Industrial Innovations Inc.
Grandville, MI USA

ItalPresseGauss
Lagrange, GA USA

J&S Chemical Corp.
Canton, GA USA

Klockowski & Associates Inc
Elgin, IL USA

Lincoln Electric Automation
Columbus, OH USA

MORESCO USA Inc.
Simpsonville, SC USA

OEE Companies
Saint Paul, MN USA

Quaker Houghton
Conshohocken, PA USA

Ryoei USA Inc.
Indianapolis, IN USA

Shibaura Machine Company, America
Elk Grove Village, IL USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Towa America, Inc.
Hoffman Estates, IL USA

TOYO Machine America, LLC
The Villages, FL USA

Ultraseal America Inc.
Ann Arbor, MI USA

Wollin USA
Plymouth, MI USA

Yushiro Manufacturing America, Inc.
Shelbyville, IN USA

Zitai USA - Die Casting Equipment Group
Highland Park, IL USA

Die Temperature Control Systems

Anviloy By Astaras Inc.
Largo, FL USA

Beta Die Casting Equipment
Cambridge, ON Canada

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Machinery LLC
Waukegan, IL USA

Die-Pro LLC
Sheboygan Falls, WI USA

Dynamo Inc.
La Grange, IL USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Frech USA
Michigan City, IN USA

Gefran Inc.
North Andover, MA USA

HERCO, LLC
Auburn Hills, MI USA

Hildreth Manufacturing LLC
Marion, OH USA

HTS International Corporation
Knoxville, TN USA

IECI S.r.l.
Bedford, IN USA

ItalPresseGauss
Lagrange, GA USA

Klockowski & Associates Inc
Elgin, IL USA

Lethiguel USA
Rogers, MN USA

LK World
Edinburgh, IN USA

MetalPress Machinery
Cambridge,, Canada

Mokon
Buffalo, NY USA

Odyssey Manufacturing Solutions, LLC
Lexington, NC USA

OEE Companies
Saint Paul, MN USA

Pyrotek Inc.
Spokane, WA USA



Regloplas Corporation
Sodus, MI USA

Ryoei USA Inc.
Indianapolis, IN USA

Shibaura Machine Company, America
Elk Grove Village, IL USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Zitai USA - Die Casting Equipment Group
Highland Park, IL USA

Electric Furnaces

Beta Die Casting Equipment
Cambridge, ON Canada

Carpenter Brothers Inc.
Mequon, WI USA

Conticast Hormesa LLC
Weston, FL USA

Craft Cast Engineering Inc.
Georgetown, ON Canada

D and S Consulting LLC
Springboro, OH USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Machinery LLC
Waukegan, IL USA

Die Cast Services LLC
Corona, CA USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Dynamo Furnaces
Cambridge, ON Canada

Ferrell Metalcasting Solutions
Cedarburg, WI USA
Foundry Supply Source Inc.
Milton, ON Canada

Frech USA
Michigan City, IN USA

Gefran Inc.
North Andover, MA USA

HeatTek Inc.
Ixonia, WI USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

Inductotherm Corp.
Rancocas, NJ USA

ItalPresseGauss
Lagrange, GA USA

Klockowski & Associates Inc
Elgin, IL USA

Lethiguel USA
Rogers, MN USA

Lindberg MPH
Riverside, MI USA

LK World
Edinburgh, IN USA

Norican Group
LaGrange, GA USA

Pyrotek Inc.
Spokane, WA USA

Refractory Engineers, Inc.
Indianapolis, IN USA

SINC Thermal
Saint Louis, MO USA

StrikoWestofen America
Lagrange, GA USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Zitai USA - Die Casting Equipment
Group
Highland Park, IL USA

Electric Launder Systems

Beta Die Casting Equipment
Cambridge, ON Canada

Carpenter Brothers Inc.
Mequon, WI USA

D and S Consulting LLC
Springboro, OH USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Machinery LLC
Waukegan, IL USA

Dynamo Furnaces
Cambridge, ON Canada

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Frech USA
Michigan City, IN USA

Gefran Inc.
North Andover, MA USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

ItalPresseGauss
Lagrange, GA USA

Lethiguel USA
Rogers, MN USA

Lindberg MPH
Riverside, MI USA

Pyrotek Inc.
Spokane, WA USA

Refractory Engineers, Inc.
Indianapolis, IN USA

SINC Thermal
Saint Louis, MO USA

StrikoWestofen America
Lagrange, GA USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Extractors

Automation Systems & Design (ASD)
Dayton, OH USA

Beta Die Casting Equipment
Cambridge, ON Canada

BuhlerPrince, Inc.
Holland, MI USA

Carpenter Brothers Inc.
Mequon, WI USA

Colosio USA Inc.
Minneapolis, MN USA

Combined Technologies Group Inc
Dayton, OH USA

Conticast Hormesa LLC
Weston, FL USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Machinery LLC
Waukegan, IL USA

Die Cast Services LLC
Corona, CA USA

DieKast, Inc.
Holland, MI USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Frech USA
Michigan City, IN USA

Gefran Inc.
North Andover, MA USA

HERCO, LLC
Auburn Hills, MI USA

Industrial Innovations Inc.
Grandville, MI USA

ItalPresseGauss
Lagrange, GA USA

Klockowski & Associates Inc
Elgin, IL USA

Lincoln Electric Automation
Columbus, OH USA

LK World
Edinburgh, IN USA

Ryoei USA Inc.
Indianapolis, IN USA

Shibaura Machine Company,
America
Elk Grove Village, IL USA

The Schaefer Group, Inc.
Beavercreek, OH USA

VERSEVO Inc.
Hartland, WI USA

Zitai USA - Die Casting
Equipment Group
Highland Park, IL USA

Furnace Feeders

Beta Die Casting Equipment
Cambridge, ON Canada

Carpenter Brothers Inc.
Mequon, WI USA

Conticast Hormesa LLC
Weston, FL USA

D and S Consulting LLC
Springboro, OH USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Dynamo Furnaces
Cambridge, ON Canada

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Gefran Inc.
North Andover, MA USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

ItalPresseGauss
Lagrange, GA USA

Norican Group
LaGrange, GA USA

Refractory Engineers, Inc.
Indianapolis, IN USA

StrikoWestofen America
Lagrange, GA USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Furnace Rebuilding/Repair

Conticast Hormesa LLC
Weston, FL USA

D and S Consulting LLC
Springboro, OH USA

Die Cast Services LLC
Corona, CA USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Dynamo Furnaces
Cambridge, ON Canada

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Frech USA
Michigan City, IN USA

Gefran Inc.
North Andover, MA USA

HeatTek Inc.
Ixonla, WI USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

Inductotherm Corp.
Rancocas, NJ USA

ItalPresseGauss
Lagrange, GA USA

Lethiguel USA
Rogers, MN USA

Lindberg MPH
Riverside, MI USA

Norican Group
LaGrange, GA USA

Pyrotek Inc.
Spokane, WA USA

Refractory Engineers, Inc.
Indianapolis, IN USA

StrikoWestofen America
Lagrange, GA USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Gas Furnaces

Carpenter Brothers Inc.
Mequon, WI USA

Conticast Hormesa LLC
Weston, FL USA

Craft Cast Engineering Inc.
Georgetown, ON Canada

D and S Consulting LLC
Springboro, OH USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Machinery LLC
Waukegan, IL USA

Die Cast Services LLC
Corona, CA USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Dynamo Furnaces
Cambridge, ON Canada

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Foundry Supply Source Inc.
Milton, ON Canada
Gefran Inc.
North Andover, MA USA

HeatTek Inc.
Ixonla, WI USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

ItalPresseGauss
Lagrange, GA USA

Klockowski & Associates Inc
Elgin, IL USA

Lindberg MPH
Riverside, MI USA

LK World
Edinburgh, IN USA

Refractory Engineers, Inc.
Indianapolis, IN USA

SINC Thermal
Saint Louis, MO USA

StrikoWestofen America
Lagrange, GA USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Zitai USA - Die Casting Equipment
Group
Highland Park, IL USA

Heat Treating Furnaces

Beta Die Casting Equipment
Cambridge, ON Canada

Bodycote Thermal Processing Inc.
Sturtevant, WI USA

Carpenter Brothers Inc.
Mequon, WI USA

Conticast Hormesa LLC
Weston, FL USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Machinery LLC
Waukegan, IL USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Fondarex USA
Elgin, IL USA

Gefran Inc.
North Andover, MA USA

HeatTek Inc.
Ixonla, WI USA

Lindberg MPH
Riverside, MI USA

Refractory Engineers, Inc.
Indianapolis, IN USA

SINC Thermal
Saint Louis, MO USA

StrikoWestofen America
Lagrange, GA USA

Holding Furnaces

Beta Die Casting Equipment
Cambridge, ON Canada

Carpenter Brothers Inc.
Mequon, WI USA

Conticast Hormesa LLC
Weston, FL USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Machinery LLC
Waukegan, IL USA

Die Cast Services LLC
Corona, CA USA

Dynamo Furnaces
Cambridge, ON Canada

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Frech USA
Michigan City, IN USA

Gefran Inc.
North Andover, MA USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

Inductotherm Corp.
Rancocas, NJ USA

ItalPresseGauss
Lagrange, GA USA

Klockowski & Associates Inc
Elgin, IL USA

Lethiguel USA
Rogers, MN USA

Lindberg MPH
Riverside, MI USA

LK World
Edinburgh, IN USA

Norican Group
LaGrange, GA USA

Pyrotek Inc.
Spokane, WA USA

Refractory Engineers, Inc.
Indianapolis, IN USA

SINC Thermal
Saint Louis, MO USA

StrikoWestofen America
Lagrange, GA USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Zitai USA - Die Casting Equipment Group
Highland Park, IL USA

Hydraulic Filtration Systems

BuhlerPrince, Inc.
Holland, MI USA

Conticast Hormesa LLC
Weston, FL USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Services LLC
Corona, CA USA

Gefran Inc.
North Andover, MA USA

HERCO, LLC
Auburn Hills, MI USA

Hill and Griffith Company
Cincinnati, OH USA

Klockowski & Associates Inc
Elgin, IL USA

Tiocco-Filmax, a Division of Filmax, LLC
Loudon, TN USA

Lubrication Central
Proportioning Systems

Applied Material Solutions, Inc. (AMS)
Elkhorn, WI USA

Craft Cast Engineering Inc.
Georgetown, ON Canada

Die Cast Services LLC
Corona, CA USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

HERCO, LLC
Auburn Hills, MI USA

Hill and Griffith Company
Cincinnati, OH USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

Industrial Innovations Inc.
Grandville, MI USA

J&S Chemical Corp.
Canton, GA USA

Klockowski & Associates Inc
Elgin, IL USA

Lincoln Electric Automation
Columbus, OH USA

LK World
Edinburgh, IN USA

Regloplas Corporation
Sodus, MI USA

Magnesium Melting Furnaces

Beta Die Casting Equipment
Cambridge, ON Canada

Carpenter Brothers Inc.
Mequon, WI USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Machinery LLC
Waukegan, IL USA

Dynamo Furnaces
Cambridge, ON Canada

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Frech USA
Michigan City, IN USA

Gefran Inc.
North Andover, MA USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

Inductotherm Corp.
Rancocas, NJ USA

ItalPresseGauss
Lagrange, GA USA

Lethiguel USA
Rogers, MN USA

Lindberg MPH
Riverside, MI USA

Refractory Engineers, Inc.
Indianapolis, IN USA

StrikoWestofen America
Lagrange, GA USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Molten Metal Filtration
Systems

Carpenter Brothers Inc.
Mequon, WI USA

Conticast Hormesa LLC
Weston, FL USA

D and S Consulting LLC
Springboro, OH USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Foundry Supply Source Inc.
Milton, ON Canada

Gefran Inc.
North Andover, MA USA

Pyrotek Inc.
Spokane, WA USA

Refractory Engineers, Inc.
Indianapolis, IN USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Molten Metal Pumps

Carpenter Brothers Inc.
Mequon, WI USA

Conticast Hormesa LLC
Weston, FL USA

D and S Consulting LLC
Springboro, OH USA

Die Cast Machinery LLC
Waukegan, IL USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Frech USA
Michigan City, IN USA

Gefran Inc.
North Andover, MA USA

Gokoh Corporation
Troy, OH USA

High Temperature Systems Inc
Chagrin Falls, OH USA

ItalPresseGauss
Lagrange, GA USA

Pyrotek Inc.
Spokane, WA USA

Refractory Engineers, Inc.
Indianapolis, IN USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Process Control Systems

BuhlerPrince, Inc.
Holland, MI USA

Castool Tooling Systems
Uxbridge, ON Canada

Conticast Hormesa LLC
Weston, FL USA

Die Cast Date Screws
Dayton, OH USA

Die Cast Machinery LLC
Waukegan, IL USA

Die-Pro LLC
Sheboygan Falls, WI USA

DieKast, Inc.
Holland, MI USA

Frech USA
Michigan City, IN USA

Gefran Inc.
North Andover, MA USA

HERCO, LLC
Auburn Hills, MI USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

IECI S.r.l.
Bedford, IN USA

ItalPresseGauss
Lagrange, GA USA

Lethiguel USA
Rogers, MN USA

LiCON MT LP
Dexter, MI USA

LK World
Edinburgh, IN USA

Mokon
Buffalo, NY USA

Regloplas Corporation
Sodus, MI USA

TOYO Machine America, LLC
The Villages, FL USA

Visi-Trak Worldwide, LLC
Valley View, OH USA

Quench and Cooling
Equipment

Automation Systems & Design
(ASD)
Dayton, OH USA

Beta Die Casting Equipment
Cambridge, ON Canada

BuhlerPrince, Inc.
Holland, MI USA

Combined Technologies Group Inc
Dayton, OH USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Machinery LLC
Waukegan, IL USA

DieKast, Inc.
Holland, MI USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Frech USA
Michigan City, IN USA

Gefran Inc.
North Andover, MA USA

HeatTek Inc.
Ixonla, WI USA

HERCO, LLC
Auburn Hills, MI USA

Hill and Griffith Company
Cincinnati, OH USA

IECI S.r.l.
Bedford, IN USA

Industrial Innovations Inc.
Grandville, MI USA

ItalPresseGauss
Lagrange, GA USA

Lincoln Electric Automation
Columbus, OH USA

Lindberg MPH
Riverside, MI USA

LK World
Edinburgh, IN USA

Regloplas Corporation
Sodus, MI USA

Reciprocating Die Spray Systems

Beta Die Casting Equipment
Cambridge, ON Canada

BuhlerPrince, Inc.
Holland, MI USA

Carpenter Brothers Inc.
Mequon, WI USA

Colosio USA Inc.
Minneapolis, MN USA

Combined Technologies Group Inc
Dayton, OH USA

Craft Cast Engineering Inc.
Georgetown, ON Canada

Die Cast Machinery LLC
Waukegan, IL USA

Die Cast Services LLC
Corona, CA USA

DieKast, Inc.
Holland, MI USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Frech USA
Michigan City, IN USA

HERCO, LLC
Auburn Hills, MI USA

Hill and Griffith Company
Cincinnati, OH USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

HTS International Corporation
Knoxville, TN USA

Industrial Innovations Inc.
Grandville, MI USA

ItalPresseGauss
Lagrange, GA USA

Klockowski & Associates Inc
Elgin, IL USA

Lincoln Electric Automation
Columbus, OH USA

OEE Companies
Saint Paul, MN USA

Quaker Houghton
Conshohocken, PA USA

Ryoei USA Inc.
Indianapolis, IN USA

Shibaura Machine Company,
America
Elk Grove Village, IL USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Towa America, Inc.
Hoffman Estates, IL USA

TOYO Machine America, LLC
The Villages, FL USA

Ultraseal America Inc.
Ann Arbor, MI USA

**Zitai USA - Die Casting Equipment
Group**
Highland Park, IL USA

Robots

Automation Systems & Design (ASD)
Dayton, OH USA

Beta Die Casting Equipment
Cambridge, ON Canada

BuhlerPrince, Inc.
Holland, MI USA

Carpenter Brothers Inc.
Mequon, WI USA

Colosio USA Inc.
Minneapolis, MN USA

Combined Technologies Group Inc
Dayton, OH USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Machinery LLC
Waukegan, IL USA

Die Cast Services LLC
Corona, CA USA

DieKast, Inc.
Holland, MI USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Frech USA
Michigan City, IN USA

HERCO, LLC
Auburn Hills, MI USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

Industrial Innovations Inc.
Grandville, MI USA

ItalPresseGauss
Lagrange, GA USA

Klockowski & Associates Inc
Elgin, IL USA

LiCON MT LP
Dexter, MI USA

Lincoln Electric Automation
Columbus, OH USA

LK World
Edinburgh, IN USA

Shibaura Machine Company, America
Elk Grove Village, IL USA

Sinto America
Grand Ledge, MI USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Zitai USA - Die Casting Equipment Group
Highland Park, IL USA

Secondary Machining Equipment

Automation Systems & Design (ASD)
Dayton, OH USA

Bedford Machine & Tool Inc.
Bedford, IN USA

Die Cast Machinery LLC
Waukegan, IL USA

Die Cast Services LLC
Corona, CA USA

Klockowski & Associates Inc
Elgin, IL USA

Lion Tool & Die Co
Algonquin, IL USA

LK World
Edinburgh, IN USA

VERSEVO Inc.
Hartland, WI USA

Used Machinery

Automation Systems & Design (ASD)
Dayton, OH USA

Beta Die Casting Equipment
Cambridge, ON Canada

BuhlerPrince, Inc.
Holland, MI USA

Carpenter Brothers Inc.
Mequon, WI USA

Colosio USA Inc.
Minneapolis, MN USA

Conticast Hormesa LLC
Weston, FL USA

Die Cast Machinery LLC
Waukegan, IL USA

DieKast, Inc.
Holland, MI USA

DTP Diecast Solutions LLC
Florence, AL USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Foundry Supply Source Inc.
Milton, ON Canada

Frech USA
Michigan City, IN USA

HERCO, LLC
Auburn Hills, MI USA

Industrial Innovations Inc.
Grandville, MI USA

ItalPresseGauss
Lagrange, GA USA

Lincoln Electric Automation
Columbus, OH USA

Regloplas Corporation
Sodus, MI USA

StrikoWestofen America
Lagrange, GA USA

Techmire
Pointe-Claire, QC Canada

YIZUMI-HPM Corporation
Iberia, OH USA

Vacuum Systems

Carpenter Brothers Inc.
Mequon, WI USA

Castool Tooling Systems
Uxbridge, ON Canada

Conticast Hormesa LLC
Weston, FL USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Machinery LLC
Waukegan, IL USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Fondarex USA
Elgin, IL USA



Frech USA
Michigan City, IN USA

HERCO, LLC
Auburn Hills, MI USA

Hildreth Manufacturing LLC
Marion, OH USA

Inductotherm Corp.
Rancocas, NJ USA

Integrity Light Metals LLC
Elgin, IL USA

Klockowski & Associates Inc
Elgin, IL USA

Lethiguel USA
Rogers, MN USA

Lincoln Electric Automation
Columbus, OH USA

OEE Companies
Saint Paul, MN USA

Shibaura Machine Company, America
Elk Grove Village, IL USA

Viami International Inc.
Beaconsfield,, QC Canada

Zinc Furnaces

Beta Die Casting Equipment
Cambridge, ON Canada

Carpenter Brothers Inc.
Mequon, WI USA

D and S Consulting LLC
Springboro, OH USA

Die Cast Machinery LLC
Waukegan, IL USA

Die Cast Services LLC
Corona, CA USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Dynamo Furnaces
Cambridge, ON Canada

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Foundry Supply Source Inc.
Milton, ON Canada

Frech USA
Michigan City, IN USA

Inductotherm Corp.
Rancocas, NJ USA

Klockowski & Associates Inc
Elgin, IL USA

Lethiguel USA
Rogers, MN USA

Lindberg MPH
Riverside, MI USA

LK World
Edinburgh, IN USA

Refractory Engineers, Inc.
Indianapolis, IN USA

SINC Thermal
Saint Louis, MO USA

StrikoWestofen America
Lagrange, GA USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Zitai USA - Die Casting Equipment Group
Highland Park, IL USA

DIE BUILDERS, **MATERIALS & COATINGS**

Core Pins

AarKel Tool & Die Inc.
Wallaceburg, ON Canada

Anviloy By Astaras Inc.
Largo, FL USA

BOHLER Special Steels, EDRO
Specialty Steels
Schaumburg, IL USA

Carpenter Brothers Inc.
Mequon, WI USA

Castec Corporation
Indianapolis, IN USA

Castool Tooling Systems
Uxbridge, ON Canada

Davis Tool & Die
Fenton, MO USA

Die Cast Date Screws
Dayton, OH USA

Die Cast Services LLC
Corona, CA USA

Die-Pro LLC
Sheboygan Falls, WI USA

DieTech & Engineering Inc.
Grand Rapids, MI USA

DTP Diecast Solutions LLC
Florence, AL USA

Dynamo Inc.
La Grange, IL USA

Ellwood Specialty Steel
New Castle, PA USA

Exco Engineering
Newmarket, ON Canada

Foundry Supply Source Inc.
Milton, ON Canada

Fremar Industries
Brunswick, OH USA

Gokoh Corporation
Troy, OH USA

HERCO, LLC
Auburn Hills, MI USA

Hildreth Manufacturing LLC
Marion, OH USA

HTS International Corporation
Knoxville, TN USA

ItalPresseGauss
Lagrange, GA USA

Klockowski & Associates Inc
Elgin, IL USA

Lethiguel USA
Rogers, MN USA

LK World
Edinburgh, IN USA

Materion Brush Beryllium & Composites
Elmore, OH USA

Midwest Die Corporation
Baroda, MI USA

Odyssey Manufacturing Solutions, LLC
Lexington, NC USA

OEE Companies
Saint Paul, MN USA

Oerlikon Balzers Coating USA Inc.
Rock Hill, SC USA

P M Mold Co
Schaumburg, IL USA

PCS Company
Fraser, MI USA

Progressive Components
Wauconda, IL USA

Prolong Tool / Prolong Surface Technologies
Saint Charles, IL USA

SAPP Inc.
Edinburgh, IN USA

VERSEVO Inc.
Hartland, WI USA

Willer Tool Corporation
Jackson, WI USA

Die Bases

AarKel Tool & Die Inc. **Wallaceburg, ON Canada**

Accu Die & Mold Inc
Stevensville, MI USA

Bedford Machine & Tool Inc. **Bedford, IN USA**

Davis Tool & Die
Fenton, MO USA

Die Cast Machinery LLC
Waukegan, IL USA

Die Cast Services LLC
Corona, CA USA

DTP Diecast Solutions LLC **Florence, AL USA**

Dynamo Inc. **La Grange, IL USA**

Ellwood Specialty Steel **New Castle, PA USA**

Exco Engineering **Newmarket, ON Canada**

Foundry Supply Source Inc.
Milton, ON Canada

Fremar Industries **Brunswick, OH USA**

Hanson International **Saint Joseph, MI USA**

Integrity Light Metals LLC
Elgin, IL USA

Klockowski & Associates Inc
Elgin, IL USA

LK World **Edinburgh, IN USA**

Midwest Die Corporation
Baroda, MI USA

Mo-Tech Corp
Oakdale, MN USA

Oerlikon Balzers Coating USA Inc. **Rock Hill, SC USA**

Prolong Tool / Prolong Surface **Technologies** **Saint Charles, IL USA**

SAPP Inc. **Edinburgh, IN USA**

Technmire **Pointe-Claire, QC Canada**

VERSEVO Inc. **Hartland, WI USA**

Willer Tool Corporation
Jackson, WI USA

Die Casting Die Builders

AarKel Tool & Die Inc. **Wallaceburg, ON Canada**

Accu Die & Mold Inc
Stevensville, MI USA

Bedford Machine & Tool Inc. **Bedford, IN USA**

Davis Tool & Die
Fenton, MO USA

Delaware Dynamics
Muncie, IN USA

Die Cast Date Screws
Dayton, OH USA

Die Cast Services LLC
Corona, CA USA

DieKast, Inc.
Holland, MI USA

DieTech & Engineering Inc. **Grand Rapids, MI USA**

DTP Diecast Solutions LLC **Florence, AL USA**

Dynamo Inc. **La Grange, IL USA**

Exco Engineering **Newmarket, ON Canada**

Frech USA **Michigan City, IN USA**

Gefran Inc.
North Andover, MA USA

GH Tool & Mold
Washington, MO USA

Hanson International **Saint Joseph, MI USA**

HERCO, LLC **Auburn Hills, MI USA**

IDRA North America Inc. **Kokomo, IN USA**

Integrity Light Metals LLC
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Lagrange, GA USA

Parts Cleaners

Badger Metal Tech Inc.
Jackson, WI USA

Beta Die Casting Equipment
Cambridge, ON Canada

Consultant Lubricants Inc
St. Charles, MO USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Fisa North America Inc.
Elk Grove Village, IL USA

Foundry Supply Source Inc.
Milton, ON Canada

Gokoh Corporation
Troy, OH USA

Hill and Griffith Company
Cincinnati, OH USA

J&S Chemical Corp.
Canton, GA USA

Microfinish
St. Louis, MO USA

Norican Group
LaGrange, GA USA

Rosler Metal Finishing USA LLC
Battle Creek, MI USA

Ryoei USA Inc.
Indianapolis, IN USA

Sinto America
Grand Ledge, MI USA

Safety Equipment & Supplies

BuhlerPrince, Inc.
Holland, MI USA

Carpenter Brothers Inc.
Mequon, WI USA

Conticast Hormesa LLC
Weston, FL USA

Die Cast Services LLC
Corona, CA USA

DieKast, Inc.
Holland, MI USA

DME Company LLC
Madison Hts, MI USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Foundry Supply Source Inc.
Milton, ON Canada

Gokoh Corporation
Troy, OH USA

ItalPresseGauss
Lagrange, GA USA

Lincoln Electric Automation
Columbus, OH USAs

Pascal Engineering
Arlington Heights, IL USA

Pyrotek Inc.
Spokane, WA USA

Shot Blast Equipment

Badger Metal Tech Inc.
Jackson, WI USA

Beta Die Casting Equipment
Cambridge, ON Canada

Carpenter Brothers Inc.
Mequon, WI USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Machinery LLC
Waukegan, IL USA

Foundry Supply Source Inc.
Milton, ON Canada

Klockowski & Associates Inc
Elgin, IL USA

Microfinish
St. Louis, MO USA

Norican Group
LaGrange, GA USA

Pyrotek Inc.
Spokane, WA USA

Rosler Metal Finishing USA LLC
Battle Creek, MI USA

Sinto America
Grand Ledge, MI USA

Wheelabrator Group
LaGrange, GA USA

Spectrometers

Allied Metal Company
Chicago, IL USA

Carpenter Brothers Inc.
Mequon, WI USA

Conticast Hormesa LLC
Weston, FL USA

Die Cast Machinery LLC
Waukegan, IL USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Used Machinery

Automation Systems & Design (ASD)
Dayton, OH USA

Beta Die Casting Equipment
Cambridge, ON Canada

BuhlerPrince, Inc.
Holland, MI USA

Carpenter Brothers Inc.
Mequon, WI USA

Colosio USA Inc.
Minneapolis, MN USA

Conticast Hormesa LLC
Weston, FL USA

Die Cast Machinery LLC
Waukegan, IL USA

DieKast, Inc.
Holland, MI USA

DTP Diecast Solutions LLC
Florence, AL USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Foundry Supply Source Inc.
Milton, ON Canada

Frech USA
Michigan City, IN USA

HERCO, LLC
Auburn Hills, MI USA

Industrial Innovations Inc.
Grandville, MI USA

ItalPresseGauss
Lagrange, GA USA

Lincoln Electric Automation
Columbus, OH USA

Regloplas Corporation
Sodus, MI USA

Rosler Metal Finishing USA LLC
Battle Creek, MI USA

StrikoWestofen America
Lagrange, GA USA

Technimire
Pointe-Claire, QC Canada

YIZUMI-HPM Corporation
Iberia, OH USA

Waste Treatment Equipment

Carpenter Brothers Inc.
Mequon, WI USA

Conticast Hormesa LLC
Weston, FL USA

Die Cast Machinery LLC
Waukegan, IL USA

Die Cast Services LLC
Corona, CA USA

Klockowski & Associates Inc
Elgin, IL USA

Meitler Consulting Inc.
Tonganoxie, KS USA

Rosler Metal Finishing USA LLC
Battle Creek, MI USA

PROCESS MATERIALS

Abrasives & Shot Blast Media

Carpenter Brothers Inc.
Mequon, WI USA

Die Cast Services LLC
Corona, CA USA

Foundry Supply Source Inc.
Milton, ON Canada

Gefran Inc.
North Andover, MA USA

Gokoh Corporation
Troy, OH USA

Klockowski & Associates Inc
Elgin, IL USA

Microfinish
St. Louis, MO USA

Sinto America
Grand Ledge, MI USA

Wheelabrator Group
LaGrange, GA USA

Adhesives

Carpenter Brothers Inc.
Mequon, WI USA

DME Company LLC
Madison Hts, MI USA

Foundry Supply Source Inc.
Milton, ON Canada

Gefran Inc.
North Andover, MA USA

Alloying Additives

Carpenter Brothers Inc.
Mequon, WI USA

Gefran Inc.
North Andover, MA USA

Materion Brush Beryllium & Composites
Elmore, OH USA

Pyrotek Inc.
Spokane, WA USA

Trialco Aluminum LLC
Chicago Heights, IL USA

Valor Alloys, LLC
Houston, TX USA

Die Lubricants

Applied Material Solutions, Inc.
(AMS)
Elkhorn, WI USA

Beta Die Casting Equipment
Cambridge, ON Canada

Castool Tooling Systems
Uxbridge, ON Canada

Chem-Trend, LP
Howell, MI USA

Consultant Lubricants Inc
St. Charles, MO USA

Craft Cast Engineering Inc.
Georgetown, ON Canada

Die Cast Services LLC
Corona, CA USA

DME Company LLC
Madison Hts, MI USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Foundry Supply Source Inc.
Milton, ON Canada

Gefran Inc.
North Andover, MA USA

Gokoh Corporation
Troy, OH USA

Hill and Griffith Company
Cincinnati, OH USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

HTS International Corporation
Knoxville, TN USA

J&S Chemical Corp.
Canton, GA USA

Klockowski & Associates Inc
Elgin, IL USA

LaFrance Manufacturing Co.
Maryland Heights, MO USA

MORESCO USA Inc.
Simpsonville, SC USA

Quaker Houghton
Conshohocken, PA USA

Ryoei USA Inc.
Indianapolis, IN USA

Towa America, Inc.
Hoffman Estates, IL USA

Ultraseal America Inc.
Ann Arbor, MI USA

Viami International Inc.
Beaconsfield,, QC Canada

Yushiro Manufacturing America, Inc.
Shelbyville, IN USA

Fluxes

American Metal Chemical Corp
(AMCOR)
Chicago, IL USA

Carpenter Brothers Inc.
Mequon, WI USA

Craft Cast Engineering Inc.
Georgetown, ON Canada

D and S Consulting LLC
Springboro, OH USA

Die Cast Services LLC
Corona, CA USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Foundry Supply Source Inc.
Milton, ON Canada

Gefran Inc.
North Andover, MA USA

Gokoh Corporation
Troy, OH USA

HA International, LLC
Westmont, IL USA

Hill and Griffith Company
Cincinnati, OH USA

Klockowski & Associates Inc
Elgin, IL USA

LaFrance Manufacturing Co.
Maryland Heights, MO USA

Pyrotek Inc.
Spokane, WA USA

Refractory Engineers, Inc.
Indianapolis, IN USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Valor Alloys, LLC
Houston, TX USA

Greases

Consultant Lubricants Inc
St. Charles, MO USA

Die Cast Services LLC
Corona, CA USA

DME Company LLC
Madison Hts, MI USA

Foundry Supply Source Inc.
Milton, ON Canada

Gefran Inc.
North Andover, MA USA

Gokoh Corporation
Troy, OH USA

Hill and Griffith Company
Cincinnati, OH USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

LaFrance Manufacturing Co.
Maryland Heights, MO USA

MORESCO USA Inc.
Simpsonville, SC USA

PCS Company
Fraser, MI USA

Quaker Houghton
Conshohocken, PA USA

Heat Transfer Fluids

Beta Die Casting Equipment
Cambridge, ON Canada

DME Company LLC
Madison Hts, MI USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Gefran Inc.
North Andover, MA USA

Hill and Griffith Company
Cincinnati, OH USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

J&S Chemical Corp.
Canton, GA USA

LaFrance Manufacturing Co.
Maryland Heights, MO USA

Mokon
Buffalo, NY USA

MultiTherm LLC
Pottstown, PA USA

Quaker Houghton
Conshohocken, PA USA

Regloplas Corporation
Sodus, MI USA

Yushiro Manufacturing America, Inc.
Shelbyville, IN USA

Hydraulic Fluids

Applied Material Solutions, Inc.
(AMS)
Elkhorn, WI USA

Castool Tooling Systems
Uxbridge, ON Canada

Chem-Trend, LP
Howell, MI USA

Consultant Lubricants Inc
St. Charles, MO USA

Conticast Hormesa LLC
Weston, FL USA

Die Cast Services LLC
Corona, CA USA

DME Company LLC
Madison Hts, MI USA

Gefran Inc.
North Andover, MA USA

Hill and Griffith Company
Cincinnati, OH USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

J&S Chemical Corp.
Canton, GA USA

Klockowski & Associates Inc
Elgin, IL USA

MORESCO USA Inc.
Simpsonville, SC USA

Non-Haz Hydraulic Fluids, LLC
Jackson, MI USA

Quaker Houghton
Conshohocken, PA USA

Ladle Coatings

Allied Mineral Products Inc
Columbus, OH USA

Beta Die Casting Equipment
Cambridge, ON Canada

Carpenter Brothers Inc.
Mequon, WI USA

Chem-Trend, LP
Howell, MI USA

Consultant Lubricants Inc
St. Charles, MO USA

Conticast Hormesa LLC
Weston, FL USA

Craft Cast Engineering Inc.
Georgetown, ON Canada

Die Cast Services LLC
Corona, CA USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Foundry Supply Source Inc.
Milton, ON Canada

Gokoh Corporation
Troy, OH USA

HA International, LLC
Westmont, IL USA

Hill and Griffith Company
Cincinnati, OH USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

J&S Chemical Corp.
Canton, GA USA

Klockowski & Associates Inc
Elgin, IL USA

LaFrance Manufacturing Co.
Maryland Heights, MO USA

MORESCO USA Inc.
Simpsonville, SC USA

Pyrotek Inc.
Spokane, WA USA

Quaker Houghton
Conshohocken, PA USA

Refractory Engineers, Inc.
Indianapolis, IN USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Machine Coolants

Consultant Lubricants Inc
St. Charles, MO USA

Die Cast Services LLC
Corona, CA USA

Fondarex USA
Elgin, IL USA

Foundry Supply Source Inc.
Milton, ON Canada

Hill and Griffith Company
Cincinnati, OH USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

J&S Chemical Corp.
Canton, GA USA

Klockowski & Associates Inc
Elgin, IL USA

LaFrance Manufacturing Co.
Maryland Heights, MO USA

Quaker Houghton
Conshohocken, PA USA

Yushiro Manufacturing America,
Inc.
Shelbyville, IN USA

Plunger Lubricants

Applied Material Solutions, Inc.
(AMS)
Elkhorn, WI USA

Castool Tooling Systems
Uxbridge, ON Canada

Chem-Trend, LP
Howell, MI USA

Consultant Lubricants Inc
St. Charles, MO USA

Craft Cast Engineering Inc.
Georgetown, ON Canada

Die Cast Services LLC
Corona, CA USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Foundry Supply Source Inc.
Milton, ON Canada

Gokoh Corporation
Troy, OH USA

Hill and Griffith Company
Cincinnati, OH USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

HTS International Corporation
Knoxville, TN USA

J&S Chemical Corp.
Canton, GA USA

Klockowski & Associates Inc
Elgin, IL USA

LaFrance Manufacturing Co.
Maryland Heights, MO USA

MORESCO USA Inc.
Simpsonville, SC USA

NCC Die Casting LLC
Haltom City, TX USA

Quaker Houghton
Conshohocken, PA USA

Viami International Inc.
Beaconsfield,, QC Canada

Yushiro Manufacturing America, Inc.
Shelbyville, IN USA

Quench Agents

Carpenter Brothers Inc.
Mequon, WI USA

Chem-Trend, LP
Howell, MI USA

Hill and Griffith Company
Cincinnati, OH USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

J&S Chemical Corp.
Canton, GA USA

LaFrance Manufacturing Co.
Maryland Heights, MO USA

Quaker Houghton
Conshohocken, PA USA

Yushiro Manufacturing America, Inc.
Shelbyville, IN USA

Refractories

Allied Mineral Products Inc
Columbus, OH USA

Carpenter Brothers Inc.
Mequon, WI USA

Conticast Hormesa LLC
Weston, FL USA

D and S Consulting LLC
Springboro, OH USA

Dynamo Furnaces
Cambridge, ON Canada

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Foundry Supply Source Inc.
Milton, ON Canada

Gokoh Corporation
Troy, OH USA

High Temperature Systems Inc
Chagrin Falls, OH USA

Hill and Griffith Company
Cincinnati, OH USA

Lethiguel USA
Rogers, MN USA

Plansee Se USA LLC
Franklin, MA USA

Pyrotek Inc.
Spokane, WA USA

Refractory Engineers, Inc.
Indianapolis, IN USA

SINC Thermal
Saint Louis, MO USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Rust/Oxidation Preventatives

Carpenter Brothers Inc.
Mequon, WI USA

DME Company LLC
Madison Hts, MI USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Gokoh Corporation
Troy, OH USA

Hill and Griffith Company
Cincinnati, OH USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

J&S Chemical Corp.
Canton, GA USA

MORESCO USA Inc.
Simpsonville, SC USA

Oerlikon Balzers Coating USA Inc.
Rock Hill, SC USA

PCS Company
Fraser, MI USA

Quaker Houghton
Conshohocken, PA USA

Ryoei USA Inc.
Indianapolis, IN USA

Yushiro Manufacturing America, Inc.
Shelbyville, IN USA

Sealants

Foundry Supply Source Inc.
Milton, ON Canada

Quaker Houghton
Conshohocken, PA USA

Ultraseal America Inc.
Ann Arbor, MI USA

Welding Supplies

Lincoln Electric Automation
Columbus, OH USA

REPLACEMENT PARTS

Automatic Pouring Ladles

Automation Systems & Design
(ASD)
Dayton, OH USA

Beta Die Casting Equipment
Cambridge, ON Canada

Carpenter Brothers Inc.
Mequon, WI USA

Combined Technologies Group Inc
Dayton, OH USA

Conticast Hormesa LLC
Weston, FL USA

Craft Cast Engineering Inc.
Georgetown, ON Canada

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Machinery LLC
Waukegan, IL USA

Die Cast Services LLC
Corona, CA USA

DieKast, Inc.
Holland, MI USA

Dynamo Furnaces
Cambridge, ON Canada

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Foundry Supply Source Inc.
Milton, ON Canada

Frech USA
Michigan City, IN USA

Gefran Inc.
North Andover, MA USA

HERCO, LLC
Auburn Hills, MI USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

Industrial Innovations Inc.
Grandville, MI USA

ItalPresseGauss
Lagrange, GA USA

Klockowski & Associates Inc
Elgin, IL USA

Lincoln Electric Automation
Columbus, OH USA

LK World
Edinburgh, IN USA

Pyrotek Inc.
Spokane, WA USA

Refractory Engineers, Inc.
Indianapolis, IN USA

**Shibaura Machine Company,
America
Elk Grove Village, IL USA**

**TOYO Machine America, LLC
The Villages, FL USA**

Ceramic Ladles

Carpenter Brothers Inc.
Mequon, WI USA

**Conticast Hormesa LLC
Weston, FL USA**

Craft Cast Engineering Inc.
Georgetown, ON Canada

**Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA**

Die Cast Services LLC
Corona, CA USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Foundry Supply Source Inc.
Milton, ON Canada

**Frech USA
Michigan City, IN USA**

Gefran Inc.
North Andover, MA USA

Gokoh Corporation
Troy, OH USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

**Industrial Innovations Inc.
Grandville, MI USA**

Klockowski & Associates Inc
Elgin, IL USA

**Lincoln Electric Automation
Columbus, OH USA**

**Pyrotek Inc.
Spokane, WA USA**

Refractory Engineers, Inc.
Indianapolis, IN USA

**Zitai USA - Die Casting Equipment
Group**

Highland Park, IL USA

Crucibles

Allied Mineral Products Inc
Columbus, OH USA

Beta Die Casting Equipment
Cambridge, ON Canada

Carpenter Brothers Inc.
Mequon, WI USA

**Conticast Hormesa LLC
Weston, FL USA**

Craft Cast Engineering Inc.
Georgetown, ON Canada

Die Cast Services LLC
Corona, CA USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Foundry Supply Source Inc.
Milton, ON Canada

**Frech USA
Michigan City, IN USA**

Gefran Inc.
North Andover, MA USA

Gokoh Corporation
Troy, OH USA

Klockowski & Associates Inc
Elgin, IL USA

**Lindberg MPH
Riverside, MI USA**

**Pyrotek Inc.
Spokane, WA USA**

Refractory Engineers, Inc.
Indianapolis, IN USA

**StrikoWestofen America
Lagrange, GA USA**

**Technmire
Pointe-Claire, QC Canada**

**The Schaefer Group, Inc.
Beavercreek, OH USA**

Goosenecks

Beta Die Casting Equipment
Cambridge, ON Canada

**Brach Machine
Rochester, NY USA**

**Brondolin North America
Benton Harbor, MI USA**

**BuhlerPrince, Inc.
Holland, MI USA**

Craft Cast Engineering Inc.
Georgetown, ON Canada

Die Cast Services LLC
Corona, CA USA

**Frech USA
Michigan City, IN USA**

Gefran Inc.
North Andover, MA USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

Klockowski & Associates Inc
Elgin, IL USA

**LK World
Edinburgh, IN USA**

**OEE Companies
Saint Paul, MN USA**

**Pyrotek Inc.
Spokane, WA USA**

**Technmire
Pointe-Claire, QC Canada**

**Titus Group / Titus Technologies
Columbia City, IN USA**

**Zitai USA - Die Casting Equipment
Group
Highland Park, IL USA**

Hand Ladles

Beta Die Casting Equipment
Cambridge, ON Canada

Carpenter Brothers Inc.
Mequon, WI USA

**Conticast Hormesa LLC
Weston, FL USA**

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Dalton Electric Heating Co. Inc.
Ipswich, MA USA

Die Cast Machinery LLC
Waukegan, IL USA

DME Company LLC
Madison Hts, MI USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Gefran Inc.
North Andover, MA USA

Gokoh Corporation
Troy, OH USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

Klockowski & Associates Inc
Elgin, IL USA

Lethiguel USA
Rogers, MN USA

Lindberg MPH
Riverside, MI USA

LK World
Edinburgh, IN USA

Odyssey Manufacturing Solutions, LLC
Lexington, NC USA

PCS Company
Fraser, MI USA

Pyrotek Inc.
Spokane, WA USA

Regloplas Corporation
Sodus, MI USA

StrikoWestofen America
Lagrange, GA USA

Techmire
Pointe-Claire, QC Canada

Heaters

Beta Die Casting Equipment
Cambridge, ON Canada

Carpenter Brothers Inc.
Mequon, WI USA

Conticast Hormesa LLC
Weston, FL USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Dalton Electric Heating Co. Inc.
Ipswich, MA USA

Die Cast Machinery LLC
Waukegan, IL USA

DME Company LLC
Madison Hts, MI USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Gefran Inc.
North Andover, MA USA

Gokoh Corporation
Troy, OH USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

Klockowski & Associates Inc
Elgin, IL USA

Lethiguel USA
Rogers, MN USA

Lindberg MPH
Riverside, MI USA

LK World
Edinburgh, IN USA

Odyssey Manufacturing Solutions, LLC
Lexington, NC USA

PCS Company
Fraser, MI USA

Pyrotek Inc.
Spokane, WA USA

Regloplas Corporation
Sodus, MI USA

StrikoWestofen America
Lagrange, GA USA

Techmire
Pointe-Claire, QC Canada

Hydraulic Filters

Conticast Hormesa LLC
Weston, FL USA

Die Cast Services LLC
Corona, CA USA

Gefran Inc.
North Andover, MA USA

HERCO, LLC
Auburn Hills, MI USA

Hill and Griffith Company
Cincinnati, OH USA

Klockowski & Associates Inc
Elgin, IL USA

LK World
Edinburgh, IN USA

Metal Mechanics Inc.
Schoolcraft, MI USA

OEE Companies
Saint Paul, MN USA

Shibaura Machine Company,
America
Elk Grove Village, IL USA

Tiocco-Filmax, a Division of Filmax, LLC
Loudon, TN USA

Visi-Trak Worldwide, LLC
Valley View, OH USA

YIZUMI-HPM Corporation
Iberia, OH USA

Hydraulic Valves

BuhlerPrince, Inc.
Holland, MI USA

DieKast, Inc.
Holland, MI USA

Fondarex USA
Elgin, IL USA

Foundry Supply Source Inc.
Milton, ON Canada

IDRA North America Inc.
Kokomo, IN USA

LK World
Edinburgh, IN USA

Metal Mechanics Inc.
Schoolcraft, MI USA

Visi-Trak Worldwide, LLC
Valley View, OH USA

YIZUMI-HPM Corporation
Iberia, OH USA

Ladle Cups

Beta Die Casting Equipment
Cambridge, ON Canada

Carpenter Brothers Inc.
Mequon, WI USA

Craft Cast Engineering Inc.
Georgetown, ON Canada

Die Cast Services LLC
Corona, CA USA

DieKast, Inc.
Holland, MI USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Foundry Supply Source Inc.
Milton, ON Canada

Gokoh Corporation
Troy, OH USA

Hill and Griffith Company
Cincinnati, OH USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

Industrial Innovations Inc.
Grandville, MI USA

Klockowski & Associates Inc
Elgin, IL USA

Lincoln Electric Automation
Columbus, OH USA

LK World
Edinburgh, IN USA

Pyrotek Inc.
Spokane, WA USA

Refractory Engineers, Inc.
Indianapolis, IN USA

Shibaura Machine Company,
America
Elk Grove Village, IL USA

Zitai USA - Die Casting Equipment
Group
Highland Park, IL USA

Molten Metal Filters

Carpenter Brothers Inc.
Mequon, WI USA

Conticast Hormesa LLC
Weston, FL USA

Craft Cast Engineering Inc.
Georgetown, ON Canada

D and S Consulting LLC
Springboro, OH USA

Dynamo Furnaces
Cambridge, ON Canada

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Foundry Supply Source Inc.
Milton, ON Canada

Gefran Inc.
North Andover, MA USA

Gokoh Corporation
Troy, OH USA

Hill and Griffith Company
Cincinnati, OH USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

Pyrotek Inc.
Spokane, WA USA

Refractory Engineers, Inc.
Indianapolis, IN USA

StrikoWestofen America
Lagrange, GA USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Nozzles & Noses

Brach Machine
Rochester, NY USA

Brondolin North America
Benton Harbor, MI USA

Carpenter Brothers Inc.
Mequon, WI USA

Die Cast Services LLC
Corona, CA USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Ellwood Specialty Steel
New Castle, PA USA

Foundry Supply Source Inc.
Milton, ON Canada

Frech USA
Michigan City, IN USA

Hildreth Manufacturing LLC
Marion, OH USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

HTS International Corporation
Knoxville, TN USA

Industrial Innovations Inc.
Grandville, MI USA

Klockowski & Associates Inc
Elgin, IL USA

Lincoln Electric Automation
Columbus, OH USA

LK World
Edinburgh, IN USA

M & I Machine
Benton Harbor, MI USA

Midwest Die Corporation
Baroda, MI USA

OEE Companies
Saint Paul, MN USA

PCS Company
Fraser, MI USA

Refractory Engineers, Inc.
Indianapolis, IN USA

Techmire
Pointe-Claire, QC Canada

Titus Group / Titus Technologies
Columbia City, IN USA

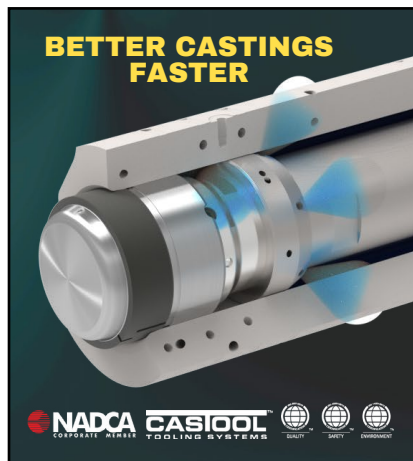
Plungers & Parts

Anviloy By Astaras Inc.
Largo, FL USA

Beta Die Casting Equipment
Cambridge, ON Canada

Brach Machine
Rochester, NY USA

Brondolin North America
Benton Harbor, MI USA



Castool Tooling Systems
Uxbridge, ON Canada

Craft Cast Engineering Inc.
Georgetown, ON Canada

Die Cast Services LLC
Corona, CA USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Foundry Supply Source Inc.
Milton, ON Canada

Frech USA
Michigan City, IN USA

Gokoh Corporation
Troy, OH USA

HERCO, LLC
Auburn Hills, MI USA

Hildreth Manufacturing LLC
Marion, OH USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

HTS International Corporation
Knoxville, TN USA

Industrial Innovations Inc.
Grandville, MI USA

Klockowski & Associates Inc
Elgin, IL USA

LK World
Edinburgh, IN USA

M & I Machine
Benton Harbor, MI USA

Materion Brush Beryllium & Composites
Elmore, OH USA

NCC Die Casting LLC
Haltom City, TX USA

OEE Companies
Saint Paul, MN USA

Techmire
Pointe-Claire, QC Canada

Titus Group / Titus Technologies
Columbia City, IN USA

Viami International Inc.
Beaconsfield,, QC Canada

YIZUMI-HPM Corporation
Iberia, OH USA

Zitai USA - Die Casting Equipment Group
Highland Park, IL USA

Shot End Systems & Components

Brach Machine
Rochester, NY USA

BuhlerPrince, Inc.
Holland, MI USA

Carpenter Brothers Inc.
Mequon, WI USA

Castool Tooling Systems
Uxbridge, ON Canada

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

DieKast, Inc.
Holland, MI USA

Ellwood Specialty Steel
New Castle, PA USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Frech USA
Michigan City, IN USA

Gefran Inc.
North Andover, MA USA

Gokoh Corporation
Troy, OH USA

Hildreth Manufacturing LLC
Marion, OH USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

HTS International Corporation
Knoxville, TN USA

Klockowski & Associates Inc
Elgin, IL USA

Lethiguel USA
Rogers, MN USA

LK World
Edinburgh, IN USA

M & I Machine
Benton Harbor, MI USA

NCC Die Casting LLC
Haltom City, TX USA

Norican Group
LaGrange, GA USA

OEE Companies
Saint Paul, MN USA

Progressive Components
Wauconda, IL USA

Shibaura Machine Company, America
Elk Grove Village, IL USA

Titus Group / Titus Technologies
Columbia City, IN USA

TOYO Machine America, LLC
The Villages, FL USA

Visi-Trak Worldwide, LLC
Valley View, OH USA

Wheelabrator Group
LaGrange, GA USA

YIZUMI-HPM Corporation
Iberia, OH USA

Zitai USA - Die Casting Equipment Group
Highland Park, IL USA

Shot Sleeves & Products

Anviloy By Astaras Inc.
Largo, FL USA

Beta Die Casting Equipment
Cambridge, ON Canada

Brach Machine
Rochester, NY USA

Brondolin North America
Benton Harbor, MI USA

BuhlerPrince, Inc.
Holland, MI USA

Castool Tooling Systems
Uxbridge, ON Canada

Die Cast Services LLC
Corona, CA USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Ellwood Specialty Steel
New Castle, PA USA

Frech USA
Michigan City, IN USA

Gefran Inc.
North Andover, MA USA

Gokoh Corporation
Troy, OH USA

HERCO, LLC
Auburn Hills, MI USA

Hildreth Manufacturing LLC
Marion, OH USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

HTS International Corporation
Knoxville, TN USA

Industrial Innovations Inc.
Grandville, MI USA

ItalPresseGauss
Lagrange, GA USA

Klockowski & Associates Inc
Elgin, IL USA

Lethiguel USA
Rogers, MN USA

Lindberg MPH
Riverside, MI USA

LK World
Edinburgh, IN USA

M & I Machine
Benton Harbor, MI USA

NCC Die Casting LLC
Haltom City, TX USA

Phygen Coatings Inc.
Minneapolis, MN USA

Progressive Components
Wauconda, IL USA

Pyrotek Inc.
Spokane, WA USA

Techmire
Pointe-Claire, QC Canada

Titus Group / Titus Technologies
Columbia City, IN USA

Thermocouples

Allied Mineral Products Inc
Columbus, OH USA

Beta Die Casting Equipment
Cambridge, ON Canada

Carpenter Brothers Inc.
Mequon, WI USA

Castool Tooling Systems
Uxbridge, ON Canada

Conticast Hormesa LLC
Weston, FL USA

Craft Cast Engineering Inc.
Georgetown, ON Canada

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Services LLC
Corona, CA USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Foundry Supply Source Inc.
Milton, ON Canada

Gefran Inc.
North Andover, MA USA

Gokoh Corporation
Troy, OH USA

High Temperature Systems Inc
Chagrin Falls, OH USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

ItalPresseGauss
Lagrange, GA USA

Klockowski & Associates Inc
Elgin, IL USA

Lethiguel USA
Rogers, MN USA

Lindberg MPH
Riverside, MI USA

LK World
Edinburgh, IN USA

PCS Company
Fraser, MI USA

Pyrotek Inc.
Spokane, WA USA

Refractory Engineers, Inc.
Indianapolis, IN USA

Regloplas Corporation
Sodus, MI USA

SINC Thermal
Saint Louis, MO USA

StrikoWestofen America
Lagrange, GA USA

Techmire
Pointe-Claire, QC Canada

The Schaefer Group, Inc.
Beavercreek, OH USA

Zitai USA - Die Casting Equipment Group
Highland Park, IL USA

Tie Bars

A Plus Machine LLC
Cornell, WI USA

Beta Die Casting Equipment
Cambridge, ON Canada

Brach Machine
Rochester, NY USA

BuhlerPrince, Inc.
Holland, MI USA

Castool Tooling Systems
Uxbridge, ON Canada

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Machinery LLC
Waukegan, IL USA

DieKast, Inc.
Holland, MI USA

DTP Diecast Solutions LLC
Florence, AL USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Frech USA
Michigan City, IN USA

Gefran Inc.
North Andover, MA USA

ItalPresseGauss
Lagrange, GA USA

LK World
Edinburgh, IN USA

Metal Mechanics Inc.
Schoolcraft, MI USA

Shibaura Machine Company,
America
Elk Grove Village, IL USA

TOYO Machine America, LLC
The Villages, FL USA

YIZUMI-HPM Corporation
Iberia, OH USA

Zitai USA - Die Casting Equipment
Group
Highland Park, IL USA

Transfer Ladles

Allied Mineral Products Inc
Columbus, OH USA

Beta Die Casting Equipment
Cambridge, ON Canada

Carpenter Brothers Inc.
Mequon, WI USA

Conticast Hormesa LLC
Weston, FL USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Machinery LLC
Waukegan, IL USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Foundry Supply Source Inc.
Milton, ON Canada

Frech USA
Michigan City, IN USA

Gokoh Corporation
Troy, OH USA

Hill and Griffith Company
Cincinnati, OH USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

Lethiguel USA
Rogers, MN USA

Lincoln Electric Automation
Columbus, OH USA

Lindberg MPH
Riverside, MI USA

Pyrotek Inc.
Spokane, WA USA

Refractory Engineers, Inc.
Indianapolis, IN USA

Shibaura Machine Company,
America
Elk Grove Village, IL USA

SINC Thermal
Saint Louis, MO USA

StrikoWestofen America
Lagrange, GA USA

The Schaefer Group, Inc.
Beavercreek, OH USA

SERVICES & **CONSULTANTS**

Additive Manufacturing

AarKel Tool & Die Inc.
Wallaceburg, ON Canada

BOHLER Special Steels, EDRO
Specialty Steels
Schaumburg, IL USA

Carpenter Brothers Inc.
Mequon, WI USA

Delaware Dynamics
Muncie, IN USA

Die Cast Date Screws
Dayton, OH USA

DME Company LLC
Madison Hts, MI USA

Dynamo Inc.
La Grange, IL USA

EDRO Specialty Steels
Ellwood City, PA USA

Exco Engineering
Newmarket, ON Canada

Frech USA
Michigan City, IN USA

Gefran Inc.
North Andover, MA USA

Hanson International
Saint Joseph, MI USA

HERCO, LLC
Auburn Hills, MI USA

HTS International Corporation
Knoxville, TN USA

Lincoln Electric Automation
Columbus, OH USA

Metal Marks Consulting LLC
Traverse City, MI USA

Midwest Die Corporation
Baroda, MI USA

Next Chapter Manufacturing
Grand Rapids, MI USA

Oerlikon Balzers Coating USA Inc.
Rock Hill, SC USA

TRANSVALOR AMERICAS Corp.
Chicago, IL USA

Uddeholm USA
Elgin, IL USA

VERSEVO Inc.
Hartland, WI USA

Viami International Inc.
Beaconsfield,, QC Canada

**Voestalpine Additive Manufactur-
ing Centre Ltd.**
Mississauga, ON Canada

Anodizing

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Gefran Inc
North Andover, MA USA

Luke Engineering & Manufacturing Co.
Wadsworth, OH USA

CAD/CAM Services

Accu Die & Mold Inc
Stevensville, MI USA

Badger Metal Tech Inc.
Jackson, WI USA

Bedford Machine & Tool Inc.
Bedford, IN USA

Davis Tool & Die
Fenton, MO USA

DieTech & Engineering Inc.
Grand Rapids, MI USA

Fremar Industries
Brunswick, OH USA

General Die & Engineering Inc.
Grand Rapids, MI USA

Global Tool & Die Inc.
Elk Grove Village, IL USA

Hanson International
Saint Joseph, MI USA

HTS International Corporation
Knoxville, TN USA

Lethiguel USA
Rogers, MN USA

Lion Tool & Die Co
Algonquin, IL USA

Midwest Die Corporation
Baroda, MI USA

OEE Companies
Saint Paul, MN USA

P M Mold Co
Schaumburg, IL USA

SAPP Inc.
Edinburgh, IN USA

Swiss Steel Canada, Inc.
Mississauga, ON Canada

VERSEVO Inc.
Hartland, WI USA

Willer Tool Corporation
Jackson, WI USA

Consulting Services

Alcoa USA Corp.
Alcoa, TN USA

Allied Metal Company
Chicago, IL USA

**Automation Systems & Design
(ASD)**
Dayton, OH USA

B&L Information Systems, Inc.
Bridgman, MI USA

Badger Metal Tech Inc.
Jackson, WI USA

Bob McClintic & Associates
Grand Rapids, MI USA

BuhlerPrince, Inc.
Holland, MI USA

**Canmet MATERIALS - Natural
Resources Canada**
Hamilton, ON Canada

Carpenter Brothers Inc.
Mequon, WI USA

Conticast Hormesa LLC
Weston, FL USA

Craft Cast Engineering Inc.
Georgetown, ON Canada

D and S Consulting LLC
Springboro, OH USA

Delaware Dynamics
Muncie, IN USA

Die Cast Machinery LLC
Waukegan, IL USA

Die-Pro LLC
Sheboygan Falls, WI USA

DieKast, Inc.
Holland, MI USA

DME Company LLC
Madison Hts, MI USA

DTP Diecast Solutions LLC
Florence, AL USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Eastern Alloys Inc.
Maybrook, NY USA

EKK, Inc.
Southfield, MI USA

Gefran Inc.
North Andover, MA USA

GH Tool & Mold
Washington, MO USA

Global Tool & Die Inc.
Elk Grove Village, IL USA

H Gerber Consulting
Evanston, IL USA

HERCO, LLC
Auburn Hills, MI USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

HTS International Corporation
Knoxville, TN USA

Integrity Light Metals LLC
Elgin, IL USA

ItalPresseGauss
Lagrange, GA USA

LaFrance Manufacturing Co.
Maryland Heights, MO USA

Lethiguel USA
Rogers, MN USA

Lincoln Electric Automation
Columbus, OH USA

LK World
Edinburgh, IN USA

Long View Business Partners
Maple Lake, MN USA

Meitler Consulting Inc.
Tonganoxie, KS USA

Metal Marks Consulting LLC
Traverse City, MI USA

OEE Companies
Saint Paul, MN USA

Phygen Coatings Inc.
Minneapolis, MN USA

Pyrotek Inc.
Spokane, WA USA

SINC Thermal
Saint Louis, MO USA

StrikoWestofen America
Lagrange, GA USA

Techmire
Pointe-Claire, QC Canada

Therm-Tech of Waukesha
Waukesha, WI USA

TRANSVALOR AMERICAS Corp.
Chicago, IL USA

VERSEVO Inc.
Hartland, WI USA

Viami International Inc.
Beaconsfield, QC Canada

Wheelabrator Group
LaGrange, GA USA

YIZUMI-HPM Corporation
Iberia, OH USA

Zitai USA - Die Casting Equipment Group
Highland Park, IL USA

Degating Services

Automation Systems & Design (ASD)
Dayton, OH USA

Combined Technologies Group Inc
Dayton, OH USA

DME Company LLC
Madison Hts, MI USA

Gokoh Corporation
Troy, OH USA

Lincoln Electric Automation
Columbus, OH USA

Odyssey Manufacturing Solutions, LLC
Lexington, NC USA

VERSEVO Inc.
Hartland, WI USA

Die Casting Design

AarKel Tool & Die Inc.
Wallaceburg, ON Canada

Badger Metal Tech Inc.
Jackson, WI USA

Bob McClintic & Associates
Grand Rapids, MI USA

BuhlerPrince, Inc.
Holland, MI USA

Canmet MATERIALS - Natural Resources Canada
Hamilton, ON Canada

Conticast Hormesa LLC
Weston, FL USA

Davis Tool & Die
Fenton, MO USA

Delaware Dynamics
Muncie, IN USA

Die Cast Date Screws
Dayton, OH USA

Die Cast Services LLC
Corona, CA USA

DieTech & Engineering Inc.
Grand Rapids, MI USA

DTP Diecast Solutions LLC
Florence, AL USA

Dynamo Inc.
La Grange, IL USA

EKK, Inc.
Southfield, MI USA

Exco Engineering
Newmarket, ON Canada

Flow Science Inc.
Santa Fe, NM USA

Frech USA
Michigan City, IN USA

Fremar Industries
Brunswick, OH USA

Gefran Inc.
North Andover, MA USA

GH Tool & Mold
Washington, MO USA

Hanson International
Saint Joseph, MI USA

HERCO, LLC
Auburn Hills, MI USA

HTS International Corporation
Knoxville, TN USA

Integrity Light Metals LLC
Elgin, IL USA

ItalPresseGauss
Lagrange, GA USA

Klockowski & Associates Inc
Elgin, IL USA

Lethiguel USA
Rogers, MN USA

LK World
Edinburgh, IN USA

Midwest Die Corporation
Baroda, MI USA

Mo-Tech Corp
Oakdale, MN USA

OEE Companies
Saint Paul, MN USA

P M Mold Co
Schaumburg, IL USA

Patterson Mold & Tool
Saint Charles, MO USA

Sanji Industries, LLC
Celina, OH USA

SAPP Inc.
Edinburgh, IN USA

Strohwig Industries
Richfield, WI USA

TRANSVALOR AMERICAS Corp.
Chicago, IL USA

VERSEVO Inc.
Hartland, WI USA

Viami International Inc.
Beaconsfield,, QC Canada

Vinet Micro-Technologies Inc.
Vaudreuil-Dorion, QC Canada

Willer Tool Corporation
Jackson, WI USA

YIZUMI-HPM Corporation
Iberia, OH USA

Zitai USA - Die Casting Equipment Group
Highland Park, IL USA

Energy Products & Services

BuhlerPrince, Inc.
Holland, MI USA

Conticast Hormesa LLC
Weston, FL USA

D and S Consulting LLC
Springboro, OH USA

Gefran Inc.
North Andover, MA USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

ItalPresseGauss
Lagrange, GA USA

Lethiguel USA
Rogers, MN USA

LK World
Edinburgh, IN USA

Metal Mechanics Inc.
Schoolcraft, MI USA

StrikoWestofen America
Lagrange, GA USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Environmental Products and Services

Carpenter Brothers Inc.
Mequon, WI USA

Conticast Hormesa LLC
Weston, FL USA

D and S Consulting LLC
Springboro, OH USA

Die Cast Machinery LLC
Waukegan, IL USA

Die Cast Services LLC
Corona, CA USA

Gefran Inc.
North Andover, MA USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

Industrial Innovations Inc.
Grandville, MI USA

Meitler Consulting Inc.
Tonganoxie, KS USA

Rosler Metal Finishing USA LLC
Battle Creek, MI USA

Viami International Inc.
Beaconsfield,, QC Canada

Finishing Services

Automation Systems & Design (ASD)
Dayton, OH USA

Badger Metal Tech Inc.
Jackson, WI USA

Conticast Hormesa LLC
Weston, FL USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Services LLC
Corona, CA USA

DTP Diecast Solutions LLC
Florence, AL USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Gefran Inc.
North Andover, MA USA

Klockowski & Associates Inc
Elgin, IL USA

KVF
Elk Grove Village, IL USA

Luke Engineering & Manufacturing Co.
Wadsworth, OH USA

Microfinish
St. Louis, MO USA

New Brunswick Plating Inc.
New Brunswick, NJ USA

Oerlikon Balzers Coating USA Inc.
Rock Hill, SC USA

Paulo
Saint Louis, MO USA

Sinto America
Grand Ledge, MI USA

VERSEVO Inc.
Hartland, WI USA

Wheelabrator Group
LaGrange, GA USA

Heat Treating Services

Badger Metal Tech Inc.
Jackson, WI USA

Bodycote Thermal Processing
Canada Inc.
Burlington, ON Canada

Bodycote Thermal Processing Inc.
Sturtevant, WI USA

Century Sun Metal Treating
Traverse City, MI USA

Conticast Hormesa LLC
Weston, FL USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Services LLC
Corona, CA USA

Dynamic Surface Technologies
Canton, MI USA

Gefran Inc.
North Andover, MA USA

HTS International Corporation
Knoxville, TN USA

Klockowski & Associates Inc
Elgin, IL USA

Metal Marks Consulting LLC
Traverse City, MI USA

Paulo
Saint Louis, MO USA

SAPP Inc.
Edinburgh, IN USA

Swiss Steel Canada, Inc.
Mississauga, ON Canada

Swiss Steel USA, Inc.
Carol Stream, IL USA

Therm-Tech of Waukesha
Waukesha, WI USA

Uddeholm USA
Elgin, IL USA

Voestalpine High Performance
Metals - USA
Elgin, IL USA

Hydraulic Valve Repair

BuhlerPrince, Inc.
Holland, MI USA

DieKast, Inc.
Holland, MI USA

HERCO, LLC
Auburn Hills, MI USA

YIZUMI-HPM Corporation
Iberia, OH USA

Laboratory Services

Alcoa USA Corp.
Alcoa, TN USA

Allied Metal Company
Chicago, IL USA

Badger Metal Tech Inc.
Jackson, WI USA

Conticast Hormesa LLC
Weston, FL USA

Element Materials Technology
Glendale Heights, IL USA

Foundry Supply Source Inc.
Milton, ON Canada

HeatTek Inc.
Ixonia, WI USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

HTS International Corporation
Knoxville, TN USA

LaFrance Manufacturing Co.
Maryland Heights, MO USA

Metal Marks Consulting LLC
Traverse City, MI USA

Phygen Coatings Inc.
Minneapolis, MN USA

TRANSVALOR AMERICAS Corp.
Chicago, IL USA

Yushiro Manufacturing America,
Inc.
Shelbyville, IN USA

Leak Testing & Equipment

Automation Systems & Design (ASD)
Dayton, OH USA

Bedford Machine & Tool Inc.
Bedford, IN USA

Carpenter Brothers Inc.
Mequon, WI USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Die Cast Services LLC
Corona, CA USA

Fondarex USA
Elgin, IL USA

Gefran Inc.
North Andover, MA USA

Global Tool & Die Inc.
Elk Grove Village, IL USA

HERCO, LLC
Auburn Hills, MI USA

Intertech Development Company
Skokie, IL USA

Klockowski & Associates Inc
Elgin, IL USA

Lincoln Electric Automation
Columbus, OH USA

Odyssey Manufacturing Solutions, LLC
Lexington, NC USA

VERSEVO Inc.
Hartland, WI USA

Non-Destructive Testing

Carpenter Brothers Inc.
Mequon, WI USA

Gefran Inc.
North Andover, MA USA

Hill and Griffith Company
Cincinnati, OH USA

Intertech Development Company
Skokie, IL USA

Phygen Coatings Inc.
Minneapolis, MN USA

Sinto America
Grand Ledge, MI USA

Parts Cleaning Services

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

DME Company LLC
Madison Hts, MI USA

KVF
Elk Grove Village, IL USA

Phygen Coatings Inc.
Minneapolis, MN USA

Sinto America
Grand Ledge, MI USA

VERSEVO Inc.
Hartland, WI USA

Wheelabrator Group
LaGrange, GA USA

Yushiro Manufacturing America, Inc.
Shelbyville, IN USA

Powder Coating

Bedford Machine & Tool Inc.
Bedford, IN USA

Carpenter Brothers Inc.
Mequon, WI USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

EDRO Specialty Steels
Ellwood City, PA USA

Prototyping Services

Conticast Hormesa LLC
Weston, FL USA

Die Cast Date Screws
Dayton, OH USA

DieTech & Engineering Inc.
Grand Rapids, MI USA

Exco Engineering
Newmarket, ON Canada

General Die & Engineering Inc.
Grand Rapids, MI USA

Integrity Light Metals LLC
Elgin, IL USA

VERSEVO Inc.
Hartland, WI USA

Safety Services

Conticast Hormesa LLC
Weston, FL USA

D and S Consulting LLC
Springboro, OH USA

HERCO, LLC
Auburn Hills, MI USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Scrap Recycling Services

Conticast Hormesa LLC
Weston, FL USA

Custom Alloy Sales, Inc.
La Puente, CA USA

DY-KAST Supply and Equipment Inc
Avon, OH USA

Frech USA
Michigan City, IN USA

**Imperial Zinc Corp & Imperial
Aluminum Corp**
Chicago, IL USA

J. Solotken & Company Inc.
Indianapolis, IN USA

Metal Conversions Ltd.
Mansfield, OH USA

Midland Industries, Inc.
Chicago, IL USA

Spectro Alloys Corp.
Rosemount, MN USA

State Metal Industries Inc
Camden, NJ USA

StrikoWestofen America
Lagrange, GA USA

Secondary Machining Services

Bedford Machine & Tool Inc.
Bedford, IN USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

DTP Diecast Solutions LLC
Florence, AL USA

Klockowski & Associates Inc
Elgin, IL USA

Lethiguel USA
Rogers, MN USA



Onsite Machining, Inc.
Alma, MI USA

SAPP Inc.
Edinburgh, IN USA

VERSEVO Inc.
Hartland, WI USA

Tolling Services

Badger Metal Tech Inc.
Jackson, WI USA

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

DTP Diecast Solutions LLC
Florence, AL USA

Eastern Alloys Inc.
Maybrook, NY USA

NCC Die Casting LLC
Haltom City, TX USA

**Rochester Aluminum Smelting
Canada Ltd.**
Concord, ON Canada

Spectro Alloys Corp.
Rosemount, MN USA

Superior Aluminum Alloys
New Haven, IN USA

Training

B&L Information Systems, Inc.
Bridgman, MI USA

Bob McClintic & Associates
Grand Rapids, MI USA

Bodycote Thermal Processing Inc.
Sturtevant, WI USA

BuhlerPrince, Inc.
Holland, MI USA

Castool Tooling Systems
Uxbridge, ON Canada

Conticast Hormesa LLC
Weston, FL USA

DieKast, Inc.
Holland, MI USA

Frech USA
Michigan City, IN USA

Gefran Inc.
North Andover, MA USA

HERCO, LLC
Auburn Hills, MI USA

Integrity Light Metals LLC
Elgin, IL USA

Lincoln Electric Automation
Columbus, OH USA

LK World
Edinburgh, IN USA

Meitler Consulting Inc.
Tonganoxie, KS USA

OEE Companies
Saint Paul, MN USA

Pyrotek Inc.
Spokane, WA USA

Sinto America
Grand Ledge, MI USA

Spectro Alloys Corp.
Rosemount, MN USA

StrikoWestofen America
Lagrange, GA USA

Techmire
Pointe-Claire, QC Canada
The Schaefer Group, Inc.
Beavercreek, OH USA

Viami International Inc.
Beaconsfield,, QC Canada

Vinet Micro-Technologies Inc.
Vaudreuil-Dorion, QC Canada

Visi-Trak Worldwide, LLC
Valley View, OH USA

Wheelabrator Group
LaGrange, GA USA

YIZUMI-HPM Corporation
Iberia, OH USA

Yushiro Manufacturing America, Inc.
Shelbyville, IN USA

Zitai USA - Die Casting Equipment Group
Highland Park, IL USA

Waste Treatment Services

Carpenter Brothers Inc
Mequon, WI USA

Conticast Hormesa LLC
Weston, FL USA

Die Cast Services LLC
Corona, CA USA

Klockowski & Associates Inc
Elgin, IL USA

Meitler Consulting Inc.
Tonganoxie, KS USA

Welding Services

Accu Die & Mold Inc
Stevensville, MI USA

Automation Systems & Design (ASD)
Dayton, OH USA

Bedford Machine & Tool Inc.
Bedford, IN USA

BuhlerPrince, Inc.
Holland, MI USA

Castool Tooling Systems
Uxbridge, ON Canada

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL USA

Davis Tool & Die
Fenton, MO USA

Delaware Dynamics
Muncie, IN USA

DieKast, Inc.
Holland, MI USA

Global Tool & Die Inc.
Elk Grove Village, IL USA

Onsite Machining, Inc.
Alma, MI USA

SAPP Inc.
Edinburgh, IN USA

VERSEVO Inc.
Hartland, WI USA

SOFTWARE & MONITORING

Clamp Force Monitoring

BuhlerPrince, Inc.
Holland, MI USA

Carpenter Brothers Inc.
Mequon, WI USA

DieKast, Inc.
Holland, MI USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

Frech USA
Michigan City, IN USA

Gefran Inc.
North Andover, MA USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

LK World
Edinburgh, IN USA

StrikoWestofen America
Lagrange, GA USA

YIZUMI-HPM Corporation
Iberia, OH USA

Design Software

Badger Metal Tech Inc.
Jackson, WI USA

Bob McClintic & Associates
Grand Rapids, MI USA

BuhlerPrince, Inc.
Holland, MI USA

Conticast Hormesa LLC
Weston, FL USA

EKK, Inc.
Southfield, MI USA

Fondarex USA
Elgin, IL USA

MAGMA Foundry Technologies Inc.
Schaumburg, IL USA

TRANSVALOR AMERICAS Corp.
Chicago, IL USA

VERSEVO Inc.
Hartland, WI USA

Gating Software

Conticast Hormesa LLC
Weston, FL USA

EKK, Inc.
Southfield, MI USA

Gefran Inc.
North Andover, MA USA

MAGMA Foundry Technologies Inc.
Schaumburg, IL USA

TRANSVALOR AMERICAS Corp.
Chicago, IL USA

VERSEVO Inc.
Hartland, WI USA

Information Management Software

B&L Information Systems, Inc.
Bridgman, MI USA

BuhlerPrince, Inc.
Holland, MI USA

Castool Tooling Systems
Uxbridge, ON Canada

DISA Group
LaGrange, GA USA

Ferrell Metalcasting Solutions
Cedarburg, WI USA

ItalPresseGauss
Lagrange, GA USA

Shibaura Machine Company, America
Elk Grove Village, IL USA

StrikoWestofen America
Lagrange, GA USA

The Schaefer Group, Inc.
Beavercreek, OH USA

Visi-Trak Worldwide, LLC
Valley View, OH USA

YIZUMI-HPM Corporation
Iberia, OH USA

Modeling & Simulation Software

BuhlerPrince, Inc.
Holland, MI USA

Conticast Hormesa LLC
Weston, FL USA

EKK, Inc.
Southfield, MI USA

Flow Science Inc.
Santa Fe, NM USA

Fondarex USA
Elgin, IL USA

Hanson International
Saint Joseph, MI USA

HTS International Corporation
Knoxville, TN USA

ItalPresseGauss
Lagrange, GA USA

Lethiguel USA
Rogers, MN USA

MAGMA Foundry Technologies Inc.
Schaumburg, IL USA

Ryoei USA Inc.
Indianapolis, IN USA

StrikoWestofen America
Lagrange, GA USA

TRANSVALOR AMERICAS Corp.
Chicago, IL USA

VERSEVO Inc.
Hartland, WI USA

Shot Monitoring

Bob McClintic & Associates
Grand Rapids, MI USA

BuhlerPrince, Inc.
Holland, MI USA

Castool Tooling Systems
Uxbridge, ON Canada

Ferrell Metalcasting Solutions
Cedarburg WI USA

Frech USA
Michigan City, IN USA

Hill Casting Equipment and Supplies
Brush Prairie, WA USA

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SEPTEMBER 10-11

Die Control & Monitoring

OCTOBER 29-30

Machine Maintenance: Hydraulics

UPDATED!

NOVEMBER 7

Die Casting Defects

NOVEMBER 19-20

Operator Training



NADCA

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Chapter News & New Members

Chapter 3 - Michigan

Chapter 3 is pleased to announce its second round of scholarships for 2024. Through our efforts and programs, we are able to provide scholarships for the 2024 school and make a contribution to the NADCA Chapter 3 Endowment at Western Michigan University. In total, Chapter 3 was able to provide \$15,000 for the scholarships, and \$5,000 for the Endowment program. We thank all our members who attend our Annual Golf Outing (Aug 16th 2024), and sponsor our yearly member directory as these activities fund the programs.



Chapter 3 - Harris Spungen (top), Erickson Carpenter (left) and Brennan Neitzel (right) received scholarships from NADCA Chapter 3.

On April 18th, Chapter 3 hosted its third and final dinner meeting of the year in magnificent Grand Rapids. The dinner was generously sponsored by Die Therm and had over 55 members in attendance. After great food, libations, and some networking at Peppino's Pizzeria and Sports Grille, the revelry moved next door to Western Michigan University's Applied Manufacturing Partnership (AMP) Lab. Scott Kirkman from Die Therm was the key note speaker and provided an excellent presentation on Best Practices for Process Optimization with Thermal Design and Control. Chapter 3's next open meeting is our famous Golf Outing at Saskatoon Golf Club on August 16th and Vender night on August 15th at Gippers Sports Bar. Please

visit our website (nadchapter3.org) to register and view other upcoming events. If you would like to sponsor or present at one of our dinner meetings, please reach out to Scheduling Chair Steve Quirk (squirk@cascade-cdc.com).



Chapter 3 - Dinner and attitude adjustment before presentation.



Chapter 3 - Scott Kirkman of Die Therm presenting.



CHAPTER NEWS & NEW MEMBERS

Chapter 3 held its first class of the year on May 16th. The class was presented by Paul Brancleon of NADCA and had a full roster of 17 students. The subject of the class was Die Casting Defects (NADCA EC-515) and held at Cascade Die Casting group in Sparta, MI in a one day class. Please be on the lookout for additional classes through the rest of the year. For additional information or to request a specific class please contact Education Chair Don Tory (dtorrey@hillandgriffith.com)



Chapter 3 – Paul leading the class on an in-depth discussion on Casting Defects.

New Members: Debbie Aliya, Aliya Analytical, Inc.; Arthur Bush, Cascade Die Casting Group – Group Services/Corporate Headquarters; Christina Galecki, PCS Company; Benny Jones, Michigan Die Casting LLC; Erika Kaye, Troy Design & Manufacturing; Nicholas Larsen, Parker Hannifin Corporation Pneumatic Division NA; Ante Lausic, General Motors Corporation – R&D Technical Center; Christine Longroy, LIFT – American Lightweight Materials Manufacturing Innovation Institute; Swapnil Jotiram Salokhe, ESI Group North America; Jason Steven, Michigan Die Casting LLC; Andrea Strand, Lindberg MPH; Jason Sutter, Parker Hannifin Corporation Pneumatic Division NA; Ezhil Viswanathan, FPT North America

Chapter 5 - Chicago

Please visit www.diecasting.org and click on Chapters under the Become a Member tab for details on upcoming events.

New Members: Alfonso Barrios, Serv-All Die & Tool Company; Jonathan Egan, FabCast Solutions SRL De CV; Romain Luzoir, Fondarex USA; Mike Young, Socitec US LLC

Chapter 6 - Cleveland

Please visit www.diecasting.org and click on Chapters under the Become a Member tab for details on upcoming events.

New Members: Russell Diefenbach, Hypertherm, Inc.; Dan Irvin, Godfrey & Wing LLC; Marissa Miller, Copeland

Chapter 7 - New York

Please visit www.diecasting.org and click on Chapters under the Become a Member tab for details on upcoming events.

New Members: Annika Neudecker, Quaker Houghton; Christopher A. Stevens, Dalton Electric Heating Co. Inc

Chapter 10 - Ontario

Please visit www.diecasting.org and click on Chapters under the Become a Member tab for details on upcoming events.

New Members: Jack Iwanski, Dynamo Furnaces; Jack Iwanski, MetalPress Machinery; Jose J. Puthenparampil, Rochester Aluminum Smelting Canada Ltd.

Chapter 12 - Wisconsin

In April, Chapter 12 hosted the Spring Member Meeting at Delafield Brewhaus. The speaker was Mr. Jeff Uitenbroek, a Toyota Kata Coach. Jeff discussed lean and continuous improvement using Toyota kata methodologies to the NADCA Chapter. It was a good spring meeting for Chapter 12.

Next on the agenda is the 2024 Annual Dave Williams Classic golf outing that will be on Friday, June 14th. Registration for this event and details of all Chapter 12 events can be found at: www.nadca12.org.



Chapter 12 – Jeff Uitenbroek was the speaker for the Spring Member meeting for Chapter 12. He talked about lean and continuous improvement following Toyota kata methodologies.

New Members: Aaron Kostuch, StrikoWestofen America; Storm Damien Phenix, Harley-Davidson, Mark Westol, Godfrey & Wing LLC

Chapter 14 - S. Ohio

Please visit www.diecasting.org and click on Chapters under the Become a Member tab for details on upcoming events.

New Members: Jake Clark, Quaker Houghton; Bill Metzner, THK Manufacturing of America

Chapter 15 - Southeastern

Please visit www.diecasting.org and click on Chapters under the Become a Member tab for details on upcoming events.

New Members: Ruben Berlanga, Robert Gary Feagain, Jr., Jesus Flores, George Muallem, all with Bocar US, Inc.; Matthew Cambre, Scojet; Joe Everett, Wheelabrator Group

Chapter 16 - Minnesota

Please visit www.diecasting.org and click on Chapters under the Become a Member tab for details on upcoming events.

New Members: Olayinka Sakiru Ayorinde, student; Bright Osagie Eze, South Dakota School of Mines and Technology; Gabe Glowatsky, Cody Hoeft, Jeremy Nothnagel, Jon Resech, all with Polaris Inc.; Amanda Kiehl, Team Industries; Jeffrey Rivers, Long View Business Partners

Chapter 17 - St. Louis

Greetings from St. Louis. Chapter 17 is amid our customary summer hiatus. When we get back to business, we'll hold our annual Alan Loeffelman Memorial Golf Outing on Friday September 20, 2024 at Crescent Farms Golf Club in Eureka, MO. On October 15/16, we'll sponsor the Educational Seminar Hydraulics. There will be a Membership meeting the evening of October 15th and dinner will be provided for those attending the Hydraulics seminar. Please watch your email for invitations to upcoming events and plan to join us.

New Members: Mike Fabrion, Jayant Gupta, Jrgen Schmiezek, all with Tvarit GmbH

Chapter 25 - Indiana

Please visit www.diecasting.org and click on Chapters under the Become a Member tab for details on upcoming events.

New Members: Erik Alamillo, Castec Corporation; Jodie Day, Rodney Hardesty, Matthew Hurley, Adam Sauers, all with Titus Group / Titus Technologies; Carl Holmberg, General Motors Corporation – Bedford Casting Operations; Xiaoming Wang, Purdue University

Chapter 30 - Los Angeles

Please visit www.diecasting.org and click on Chapters under the Become a Member tab for details on upcoming events.

New Members: Kayla Gupta, Jeffrey Jones, II, Paul Schreiner, all with Astronics PECO Inc.

International Members: A Yohanes Teguh P, PT. Mattel Indonesia; Roy Wang; Heiner Fuchs, Martinrea-Honsel Germany GmbH; Ashwindran Nagandran; Jiachen Pang; Hyungsop Yoon



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FabCast Solutions SRL de CV is the first vertically-integrated contract manufacturing die casting shop to open up in Mexico to cater solely to U.S. mid cap companies! FabCast is a one-stop shop for companies who want to NearShore their castings out of the far east.

FabCast's secondary processes include machining, polish and buff, ecoat, wet coat and powder coating that are all under one roof! For Phase 1, the company is bringing 2 x 850T and 1 x 580T presses. For bespoke projects FabCast is willing to bring in new machines.

FabCast joined NADCA to avail of workforce training and fantastic networking opportunities.

Current product lines are mirror brackets, air horns, lighting fixtures and castings for appliances, and end customers are in transportation equipment, marine, appliances and fixtures.

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With 200 employees in Europe, US, and China, LiCON is perfectly sized to lead in technology and be a flexible partner to its customers worldwide.



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With a focus on advancing the metalcasting sector, Transvalor Americas offers tailored solutions that help businesses streamline operations, reduce time-to-market, and achieve superior product quality through precise simulation and analysis. Transvalor has a worldwide presence with local technical support to assist our users across the world.

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RYOBI INVESTS USD\$50 MILLION AT ITS MEXICO FACILITY

Shelbyville, IN - Ryobi Die Casting announced plans for a USD\$50 million investment at its Irapuato, Mexico aluminum die casting facility. This investment adds additional capacity to support the anticipated future demand for the electric vehicle market. Construction is expected to begin in June 2024, and is scheduled for completion in April 2025. The expansion includes an additional 91,500 square feet of manufacturing space with five new large high-pressure die cast machines. We anticipate the need for an additional 124 new jobs.

"This marks another significant milestone for Ryobi in North America," said Ryan Willhelm, President and COO, at Ryobi Die Casting (USA), Inc. "Ryobi's decision to expand its operations in Irapuato is a testament to the hard-working men and women there who have earned a reputation for high quality work as an automotive supplier. This is a very exciting time for us and we are very pleased to be able grow together with our government and private sector partners in the state of Guanajuato."

GF TO BUILD \$184M HPDC PLANT

Augusta, GA - GF Casting Solutions will return to the U.S. market with a new high-pressure diecasting operation in Augusta, GA, to start production by 2027. The reported \$184 million operation was announced by the Georgia Department of Economic Development, which sponsoring an incentives package to the metalcaster estimated at \$28 million. The plant will produce cast aluminum parts "with a special focus on aluminum focus on large structural components for the automotive industry."

According to the state's announcement, the plant will employ 350 people.

"Building a high-pressure diecasting facility is a very long-term investment," stated GF Casting Solutions president Carlos Vasto. "The new facility will complete our footprint to become truly global in the e-mobility market."

"We are looking forward to bringing leading technology to the U.S. and to creating advanced manufacturing jobs for several generations in Georgia. The location is ideal for addressing the thriving automotive industry in the region."

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Versevo's New 3D Sand Printing Technology Reduces Time and Cost to Make Cores and Molds



Versevo has expanded its capabilities in the development of complex cores and molds used by metal casters and foundries, with the addition of 3D sand printing technology. The company is well known industry-wide for its high-quality tools, dies, molds, patterns & coreboxes, and molds with complex geometries, but the 3D sand printing capabilities provide a faster and less expensive solution to making early development, low volume, and production sand cores.

"3D Sand printing allows us to deliver molds and cores faster using the same raw materials and chemicals as is used in current production core making processes" says Terry Moon, President, and CEO at Versevo. "This process lowers costs for customers because the automated system eliminates the need for labor, reduces scrap, and is printed directly from 3D CAD data, therefore eliminating the need for physical tooling and core assembly operations."

To provide these "digital" capabilities, Versevo invested in an ExOne S-Max Pro binder jet 3D sand printer, which features a large 1260-liter (44 Cu Ft) build volume, a max build rate up to 125 liters (132 quarts) per hour, and layer height from 0.2mm (.008") to 0.5 mm (.020"). Using the 3D sand printing process to make complex cores is superior to traditional sand core blowing because it permits

the opportunity to consolidate cores, eliminating expensive assembly operations, reducing labor and considerably minimizing process-related defects. The company plans to quickly scale its 3D sand printing capabilities to meet customer demand as the metalcasting industry goes digital.

Nimble design

For metal casters and OEMs producing aluminum castings with complex shapes, the tool-less digital environment of 3D sand printing allows for fast iterative design changes. Molds & cores can be reprinted, and the casting can be poured within days versus physically modifying traditional hard tooling, which can take weeks or months. This quick turnaround can be essential to high value parts for the automotive, aerospace, military, marine, recreational, heavy truck industries, among others.

For more information, please contact bob@cultivate-communications.com.

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www.rosler.com/en/news/detail/rosler-powerline-valve-the-first-blast-media-flow-control-based-on-ai.

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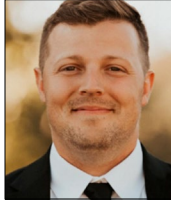
Chris Westra

*Regional Sales Manager,
FRECH USA*

Chris is a business manager with a keen focus on customer satisfaction. He comes to Frech USA with over 7 years of residential real-estate experience. He has successfully completed Frech's 6-week Technical Sales training program including courses at Frech's headquarters in Schorndorf Germany and its subsidiary businesses – Robamat, Meltec, VDS and ZPF. He is well prepared to support Frech USA's customers in North America.

"Sales is customer service. In the end, customers need an advocate to listen, match technology to their needs and deliver results. I look forward to this new challenge at Frech USA." Chris Westra Chris lives in Grand Rapids, Michigan with his wife Lauren and their one-year-old daughter, Blake. He is a devout fan of the Detroit Lions and enjoys golf, pickleball and backyard football in his spare time.

Frech USA is the North American subsidiary of Oskar Frech, Schnorndorf Germany. Beyond die casting machines, the Frech Group companies also include important market Brands like Robamat, Meltec, VDS and Spesima. www.frechusa.com



Greg Hansen

President, Twin City Die Casting

Effective May 1, 2024, Greg Hansen assumed a part-time senior advisory role for the organization while he moves into



full-time retirement in the oncoming year. As a third-generation employee of the company, Greg has dedicated his career to TCDC with an impressive 47-year tenure. He has held a number of senior management positions in operations, sales and marketing, and since 2011 as the company's President.

Tony Varitz

Director of Business Development, Twin City Die Casting

Tony has 12 years of die casting experience. Previous roles have included CAD Designer, Account Manager, Project Manager, and Engineering Manager. He has an AAS degree in Product Design & Engineering Technology, Northwest Technical Institute.



Kevin Weast

Director of Engineering, Twin City Die Casting

Kevin has over 40 years experience in the die casting industry. Kevin rejoined TCDC in March of 2014 as Senior Tooling/Casting Engineer. Shortly after that, Kevin was promoted to Chief Casting Engineer where he successfully managed the development of new technology and suppliers that enabled TCDC to maintain a competitive edge. Kevin has degree's in Machine Technology, Tool and Die Making, Mini-Master's of Lean, and Mini-MBA.



Nic George

Vice President of Operations, Twin City Die Casting

Nic's career with TCDC has included roles in Administration, Information Technology, and Director of Operations prior to being promoted to Vice President of Operations. Bachelor's Degree in Computer/Information Technology Administration and Management, Associates degrees in Computer Science. Certification in Lean Operations from Kellogg Executive Education.



Marty Syverson

Minneapolis Plant Manager, Twin City Die Casting

Marty joined TCDC in 2001. He has served as Production Manager and was promoted to Plant Manager in 2016, spending time at both Minneapolis and Monticello divisions.



Rob Curry

Monticello Plant Manager, Twin City Die Casting

Rob joined TCDC in 2018, as CNC Department Manager. Previously Rob has held Plant Management positions in the fabrications industry, and has a degree from the Minneapolis Technical College.



**Kyle Nylander**

Director of Human Resources, Twin City Die Casting



Kyle most recently led the regional Human Resources functions in Minnesota and Wisconsin for ICU Medical, a medical device manufacturer with multiple locations and 460 employees under his oversight. Kyle joins TCDC with more than 11 years of experience in Human Resources with expertise in talent management, recruiting, and enhancing company culture. Kyle holds a bachelor's degree in business administration from the University of Minnesota Duluth and a master's degree in organizational leadership from Northwestern University. ing, and since 2011 as the company's President.

Jeff Somers

Account Manager – Minneapolis r, Twin City Die Casting



Jeff joined TCDC in April, 2024 as Minneapolis Account Manager. Prior to TCDC, Jeff was employed at Water Gremlin Co. as a Key Account Specialist, and Sales Representative; and previously held roles in Account Management and manufacturing Sales. Jeff has a bachelor's degree from the University of St. Thomas.

Andrea Mudrey

Administrative Support Specialist, Twin City Die Casting



Andrea has been employed at TCDC since 2010. She was originally hired as Marketing Coordinator, and most recently held the position as Minneapolis Account Manager. Prior to TCDC, Andrea's experience has been in Marketing and Administration in the manufacturing and facility services industries. Andrea is the NADCA Minnesota Chapter 16 Secretary, and has a BS Degree from the University of Minnesota, as well as a Mini-Masters in Marketing Management from the University of St. Thomas.

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Do you have some interesting industry news or promotions within your company that you would like to announce?

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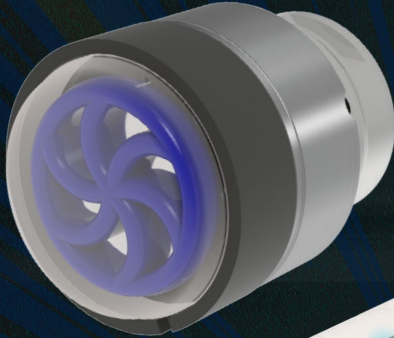
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