Die Coatings & Surface Treatments | NOVEMBER 2024

DIE CASTING ENGINEER

Official Publication of
THE NORTH AMERICAN DIE CASTING ASSOCIATION (ISSN 0012-253X)

2024 DIE CASTING CONGRESS & EXPOSITION

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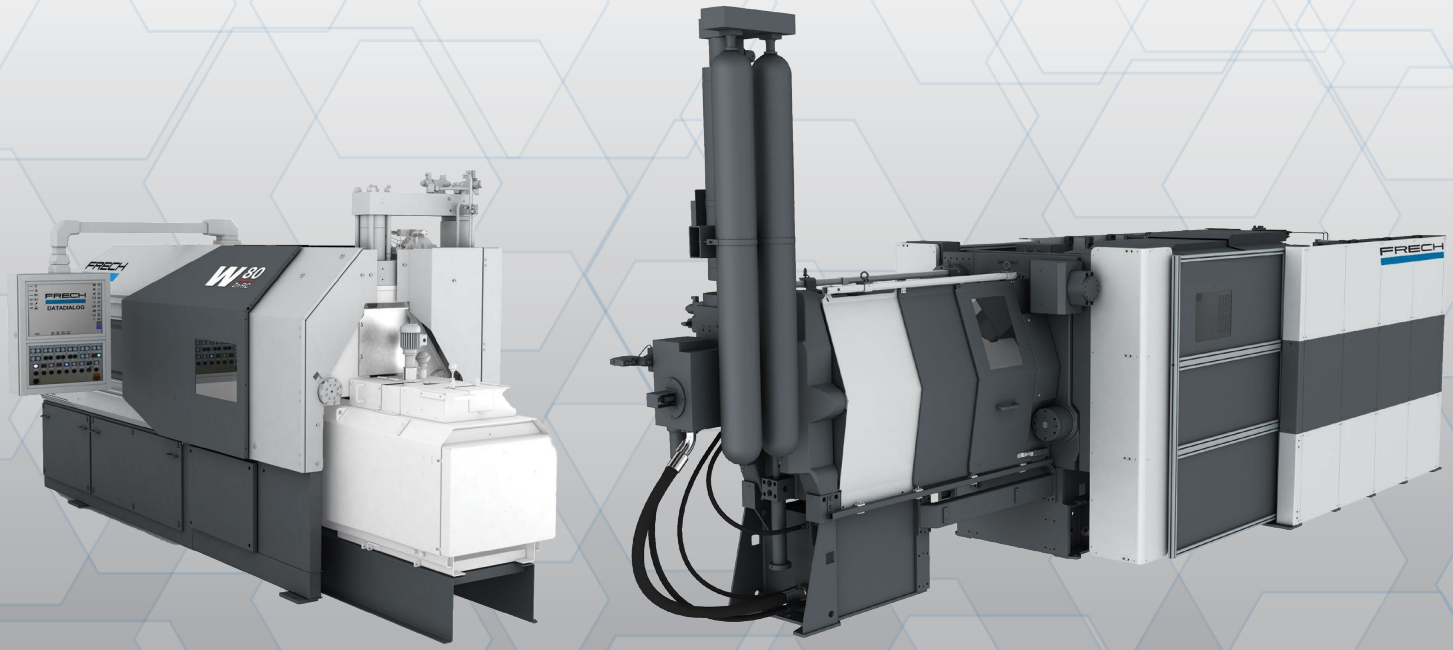

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DIE CASTING ENGINEER
VOLUME 68 NUMBER 6

NADCA
NORTH AMERICAN DIE CASTING ASSOCIATION

NOVEMBER 2024

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Die Casting Engineer (ISSN 012-253X) is published bimonthly, six times per year, by the North American Die Casting Association, 3250 N. Arlington Heights Rd., Suite 101, Arlington Heights, Illinois 60004. Periodicals postage paid at Arlington Heights, Illinois 60004 and at additional mailing office. POSTMASTER: Send address changes to address listed above.

Non-member subscription rates: $80 one year U.S., Canada & Mexico; $150 one year other countries (international airmail). Single copies $15 each, except for Suppliers Directory, $35 (Single issues available in North America only).

Chairman's Note

Reflecting on the 2024 Die Casting Congress & Exposition

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Welcome to the November issue of Die Casting Engineer magazine.

Last month, over 2300 members of the die casting community from around the world had the opportunity to network, gain knowledge on the latest industry developments, and celebrate corporate and individual successes together at our premier industry event - The Die Casting Congress & Exposition. Indianapolis is a wonderful host city, which provides an excellent venue for the event, numerous hotels, and access to a wide range of restaurants within easy walking distance.

With nearly 180 global suppliers displaying at the exposition, most exhibitors had positive feedback regarding the number of new business leads and opportunities they could discover. The attendees were keen on learning more about technologies that will help them to be more competitive in the marketplace using the fresh techniques and technologies displayed by the exhibitors. Whether presented through digital screens, or "hands-on" hardware, the leading technologies from around the world were available to experience.

For exhibitors and attendees alike, the Monday "after hours with exhibitors" on the exhibition floor is always a great time to renew old relationships and develop new industry contacts.

The NADCA awards luncheon was another great networking opportunity as we celebrated industry safety, quality, casting designs, and industry involvement milestones.

The presentation of the die casting industry's highest honor, the Herman H. Doehler Award to Patrick Greene, CEO of Cascade Die Casting Group, was the highlight of the event.

As we continue to improve our vision for NADCA member recognition, future casting awards will be focused on castings manufactured by NADCA member companies.

The Congress sessions are the main differentiators of the NADCA Congress and Expo event from other global die casting exhibitions. Over 40 technical industry-specific presentations were made to standing-room-only crowds, eager to learn of the latest developments on various topics. This year's presentations also included topics that affect our industry such as "Onshoring/Reshoring in North America", and NADCA Washington government affairs update.

The North American die casting industry and our association continue to grow in a competitive global environment. New corporate members were added during the exposition, highlighting the value NADCA brings to industry participants. We were honored to host a large delegation from the foundry industry of India, attending the expo and touring several member facilities.

As chairman of the NADCA organization, I would like to thank the NADCA staff for their efforts in putting together a world-leading die casting industry event.

Most importantly, thank you to the exhibitors and attendees for investing by participating in this event.

This is our organization, and together we can continue to be the worldwide industry leader, developing and providing resources for stimulating continuous improvement in the die casting industry in North America.

"NADCA will continue to improve our vision for member recognition in future shows."

Andrew Ryzner
Editor
North American Die Casting Association

"A 600 horsepower motor is quite a sight to behold!"

A Great Show in Indianapolis

Hello to all readers of Die Casting Engineer magazine and welcome back for those of you who visited us in Indianapolis in late September/early October for the 2024 Die Casting Congress & Exposition. This was once again our big show that runs every three years, so if you were there and you perused the show floor, you had an opportunity to see all the large machinery that was brought in by our wonderful exhibitors. Thank you to all who exhibited, attended and presented at this congress & exposition - we truly could not do this without all of your support. It means a lot to NADCA staff to see faces, old and new, in-person like this.

It is certainly like this every year, but NADCA staff puts a lot of effort into these and as someone who has been to quite a few over the years, I have to say that personally I thought this was one of our best yet in my time at NADCA. I hope you had times to go check out some of the things we put together this year for attendees to see and interact with - such as the VR display that we had going on, and the theater area as well. NADCA put a lot of effort into organizing it all to make it as accessible and intuitive as possible.

The congress papers were also well-attended this year, and having scheduling so many presentations, attendees were sometimes met with a choice to go to one or the other when running concurrently. Do not fret if you were unable to attend something you had wanted to be at - the transactions become available to all who were there shortly after the show.

I would like to extend a special thank you to Buhler for having their hospitality suite going on again, I'm sure many enjoyed that. And I would also like to thank Mercury Marine for that really cool boat motor display that was just outside the exhibit hall. As an infrequent fisherman, when I'm out on a boat I'm used to using a motor that's about 50 HP at best. The 600 HP motor that was on display was a sight to behold.

Thank you for reading and we'll see you back in the new year with our January issue.

Die Castings Included in Critical Goods List

The United States has released its list of critical sectors and goods to be shared with the Indo-Pacific Economic Framework for Prosperity (IPEF) Supply Chain Council, including die castings. The Council, established under the Supply Chain pillar of the agreement, aims to "target critical sectors and key goods to align policies and build initiatives to proactively build resilient, competitive, and diversified supply chains."

NADCA submitted comments to the International Trade Administration (ITA) in June 2024, for consideration in the development of the list of critical sectors and goods, discussing the essential nature of the casting industry. "Die casters are essential to national defense and ensuring a strong and reliable die casting industry has long been a defense and national security priority for the federal government," the comments state. "Due to the essential nature of the casting industry to U.S. national security and defense, the industry should be listed as a critical sector with cast parts included as critical goods."

Some of the critical sectors and goods included on the list the U.S. will be sharing with other members of the IPEF Supply Chain Council include chemicals; critical minerals and mining; transportation and logistics including automotive parts, heavy/medium duty trucks and parts; energy/environmental industries including advanced batteries, solar energy systems, electric grid equipment, and forgings and die castings.

IPEF Supply Chain Council has begun "targeted, action-oriented work to strengthen the supply chains for those sectors and goods most critical to national security, public health, and economic well-being."

The IPEF includes 13 countries in addition to the U.S.: Australia, Brunei, Fiji, India, Indonesia, Japan, South Korea, Malaysia, New Zealand, Philippines, Singapore, Thailand, and Vietnam. As part of the Supply Chain pillar of the agreement, the IPEF Supply Chain Council is developing a list of critical sectors and goods to help "align policies and build initiatives to proactively build resilient, competitive, and diversified supply chains."

Congress Leaves Washington – Legislative Fights Awaits

Members of Congress have officially departed Washington until after the election following the passage of a stop-gap funding bill to avert a government shutdown at the end of the fiscal year. On September 25, 2024, the House and the Senate cleared a short-term continuing resolution (CR) to keep the government funded through December 20, punting the spending fight until after the November elections.

The Senate voted to approve the CR package 78-18, shortly after the House passed the same measure by a 341-82 vote. The mostly clean funding bill passed in the House with Democrats' support after Republican leadership stripped a provision requiring proof of citizenship to register to vote.

Both chambers have now adjourned for a lengthy recess and will not return to Washington until after the November 5 election, on November 12. This gives Congress just five weeks to pass another funding bill.

On the House side, the Appropriations Committee has approved all of the funding measures and 5 of the 12 annual funding bills have passed on the House floor: Defense, Homeland Security, Interior-Environment, Military Construction-Veterans Affairs, and State-Foreign Operations. All of the bills have passed on a mostly party-line vote, with Republicans receiving only a handful of Democratic votes on any of the bills. As was seen last year with the FY24 funding bills, the House has crafted very partisan measures with numerous "poison pill" policy riders that will never get support from across the aisle.

In the Senate, the Appropriations Committee has approved all but one of their funding bills and by an overwhelmingly bipartisan margin. However, none of these bills have advanced through the full Senate.

While Speaker of the House Mike Johnson (R-LA) has stated that he will not allow an omnibus spending package, combining all 12 of the finding measures into one large bill, to pass during the lame-duck session of Congress in December, Congress has several other priorities that need to be completed such as the annual National Defense Authorization Act (NDAA), the Farm Bill, and potential supplemental disaster funding to help with the impacts of Hurricanes Helene and Milton.

The NDAA is a piece of must-pass legislation enacted every year for more than six decades. The House version was passed on the floor in June while the Senate bill was approved by the Senate Armed Services Committee (SASC) in early July. While the SASC version was never considered by the full Senate, SASC Chairman Jack Reed (D-RI) and Ranking Member Roger Wicker (R-MS) along with House Armed Service Committee (HASC) leadership Chairman Mike Rogers (R-AL-03) and Ranking Member Adam Smith (D-WA-09), will negotiate a final NDAA package.

It is also possible that Congress will act on a year-end tax package, potentially attached to a government funding bill, and a China enforcement measures attached to the NDAA.

Proposed Heat Rule Officially Published

The Occupational Safety and Health Administration has officially published a notice of proposed rulemaking (NPRM) to address heat hazards in both indoor and outdoor work environments. The proposed rule was published in the Federal Register on August 30 after being announced by OSHA on July 2, 2024. The rule applies to all indoor workplaces where the heat index hits the "initial heat trigger" of 80˚F, with an exception for workplaces where employee exposure at or above this threshold occurs for short durations, specifically 15 minutes or less per hour.

The proposed standards mandate that all covered employers with more than 10 employees develop a heat injury and illness prevention plan (HIIPP). This plan should detail the policies and procedures necessary to comply with the standard at the worksite. Employers are required to identify areas in the workplace where employees might be exposed to temperatures at or above the initial heat trigger and to monitor the heat index or wet bulb globe temperature as close as possible to those areas.

Upon reaching the initial heat trigger, employers must implement control measures, including providing cool drinking water, break areas with air conditioning or increased air movement, acclimatization for new or returning employees after an absence of more than 14 days, and paid rest breaks if necessary. Additional controls must be implemented for each work area when the initial heat trigger is reached, such as increased air movement (e.g., fans), air conditioning, or other measures to reduce exposure to radiant heat sources.

The proposed standard also includes a "high heat trigger" of a heat index of 90˚F or higher, under which additional control measures would be required. These measures include mandatory rest breaks, continual observation by supervisors or the use of a buddy system for symptoms of heat-related illness, as well as warning signs and an alert system to inform employees of the high heat danger.

NADCA submitted comments as part of the development process of the rule. In comments submitted to OSHA in October 2023, NADCA stated that all members already have procedures in place to maintain a safe work environment that accounts for the heat generated through the manufacturing process. Many members report incorporating procedures related to heat in their formal safety plans.

NADCA believes that a nationwide indoor heat rule is unnecessary for improving the safety of employees in the die casting industry and the agency should exempt industries such as die casting that without heat cannot manufacture a product.

Comments, including requests for a public hearing on the proposed rule, are due to OSHA by December 30, 2024.

DOD Releases Final CMMC 2.0 Rule

In October 2024, the Department of Defense released the final rule for the Cybersecurity Maturity Model Certification (CMMC) 2.0 program, setting updated cyber protection standards for companies in the defense industrial base (DIB). The CMMC is a program that applies to DIB contractors. It is a unifying standard and new certification model to ensure that DoD contractors properly protect sensitive information. The CMMC combines various cybersecurity standards, such as NIST SP 800-171, NIST SP 800-53, ISO 270001, and ISO 2703, as well as best practices and maps these controls and processes across several maturity levels that range from basic cyber hygiene to advanced.

The CMMC 1.0 model was first established under a interim rule in September 2020. In March 2021, the Department initiated an internal review of CMMC's implementation, informed by more than 850 public comments in response to the interim DFARS rule. In November 2021, the Department announced CMMC 2.0, an updated program structure and requirements. CMMC 2.0 builds on and refines the original program requirements by streamlining the model from five to three compliance levels, reducing the assessment costs and adding additional flexibility.

The CMMC program is based on a tiered cybersecurity framework that requires defense contractors working with controlled unclassified information (CUI) or federal contract information (FCI) to meet one of three levels of CMMC compliance, depending on the sensitivity of the information. The CMMC 2.0 model is reduced from the five levels contained in CMMC 1.0 model to three levels, to streamline the compliance process for small and medium-sized contractors. The model contained in the final rule establishes three progressively sophisticated levels, depending on the type of information:

- Level 1 | 15 requirements with annual self-assessment & annual affirmation
- Level 2 | 110 requirements (aligned with NIST SP 800-171) with triennial third-party assessment & annual affirmation (triennial self-assessment & annual affirmation for select programs)
- Level 3 | 110+ requirements (based on NIST SP 800-171 and 800-172) with triennial government-led assessment & annual affirmation

The rule also allows DoD program offices to grant Plans of Action & Milestones (POA&Ms) for contractors that don't meet every required standard to receive a limited conditional certification. DoD says POA&Ms will be granted for "specific requirements as outlined in the rule to allow a business to obtain conditional certification for 180 days while working to meet the NIST standards."

Officially published in the Federal Register on October 15, the final rule is effective December 14, 2024.

Court Blocks FTC Non-Compete Ban

Roughly two weeks before the Federal Trade Commission's (FTC) new rule banning noncompete agreements was set to go into effect, a Texas court blocked the rule. On August 20, 2024, the U.S. District Court for the Northern District of Texas issued a nation-wide block on the Federal Trade Commission's (FTC) rule restricting the use of non-compete, non-disclosure agreements, and non-solicitation agreements in most circumstances.

The FTC rule, which was set to go into effect on September 4, 2024, broadly bans non-compete agreements defining non-competes as any "term or condition of employment that prohibits a worker from, penalizes a worker for, or functions to prevent a worker from (i) seeking or accepting work in the United States with a different person where such work would begin after the conclusion of the employment that includes the term or condition; or (ii) operating a business in the United States after the conclusion of the employment that includes the term or condition." By the FTC's estimates, the rule would impact 30 million workers, or 18 percent of the U.S. workforce.

The Texas judge found that the FTC had "exceeded its statutory authority" and that the agency lacks the authority to issue "substantive rules" related to competition. The Judge went further, stating that even if the FTC had the authority to adopt the rule, the agency did not adequately justify the ban, calling the action, "arbitrary and capricious." The FTC indicated that it intends to challenge the ruling.

Court Upholds Labor Department's Salary Floor for Overtime Exemptions

A federal appeals court has ruled that the Department of Labor (DOL) has the right to set a salary floor when determining eligibility for exemptions from overtime pay. In a decision on September 11, 2024, the U.S. Court of Appeals for the Fifth Circuit held that under the Fair Labor Standards Act (FLSA) DOL has the statuary authority to impose a minimum salary requirement to qualify for the executive, administrative, and professional (EAP) exemptions to overtime pay.

While the FLSA does not expressly mention salary when determining if workers are subject to the exemption, the court held that "setting a minimum salary level for the EAP Exemption is within DOL's power to define and delimit the terms of that Exemption."

The decision by the Fifth Circuit does not address the recent Biden overtime rule, in effect since July 1, 2024, which increased the standard salary level threshold for EAPs to $43,888 per year while the annual compensation threshold for highly compensated employees (HCE) increased to $132,964. A further increase is set for January 1, 2025. Further legal challenges on that rule are still pending.

EPA Issues Risk Assessment for Hexavalent Chromium

The Environmental Protection Agency has issued an updated Integrated Risk Information System (IRIS) Assessment for hexavalent chromium [Cr(VI)]. The assessment, released in August 2024, concludes that Cr(VI) is "carcinogenic to humans" via inhalation and "likely to be carcinogenic" via oral exposure. Hexavalent chromium was first deemed carcinogenic to humans via inhalation following an IRIS assessment in 1998. The assessment also found adverse effects to humans, other than cancer, to the gastrointestinal and respiratory systems through oral and inhalation exposure, respectively.

The IRIS human health assessments are risk assessments developed through the evaluation of publicly available scientific study to identify "adverse human health effects and to characterize exposure-response relationships." These assessments can then be used by the EPA when drafting regulations. The EPA's IRIS database contains assessments on over 571 chemicals. For the full toxicological review of hexavalent chromium contained in the assessment visit: https://iris.epa.gov/ChemicalLanding/&substance_nmbr=144

EPA Issues Major Source Reclassification Final Rule

The Environmental Protection Agency (EPA) issued a final rule on September 10, 2024, regulating major sources that are reclassified as area sources under the National Emissions Standards for Hazardous Air Pollutants (NESHAP) program. The "Review of Final Rule Reclassification of Major Sources as Area Sources Under Section 112 of the Clean Air Act" establishes requirements for major sources of hazardous air pollutants (HAPs), those that emit or have the potential to emit 10 tons per year or more of a single HAP or 25 tons per year of a combination of HAPs, to reclassify as area sources emitting below those thresholds.

Under the final rule, any major source emitting one of the "persistent and bioaccumulative" HAPs listed under section 112(c)(6) of the Clean Air Act (CAA) must continue to comply with the major source emissions standards even if they reclassify as area sources. The seven HAPs listed in CAA section 112(c)(6) include alkylated lead compounds, polycyclic organic matter (POM), mercury, hexachlorobenzene, polychlorinated biphenyls(PCB), 2,3,7,8-tetrachlorodibenzofurans (TCDF) and 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD).

This "Major MACT to Area" (MM2A) rule modifies a 2020 file rule that allowed a major source to reclassify to an area source at any time after taking steps to limit emissions, subjecting the reclassified sources to less stringent emissions standards.

Updated Section 301 Tariffs in Effect

The United States Trade Representative (USTR) adopted the proposed modifications to the Section 301 tariffs included in the report issued in May 2024 following the four-year 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.

USTR officially published the final tariff increases on September 18, 2024, with several now in effect as of September 27. The tariff increases impact products from China covered under 382 HTS-8 codes and 7 HTS-10 codes including raising the tariff for electric vehicles to 100 percent and the tariff for steel and aluminum products to 25 percent. Electric vehicle batteries, battery parts, solar panel cells and modules, and certain critical minerals also now are subject to increased tariff rates ranging from 25 to 50 percent.

The finalized modification also includes the establishment of a limited exclusion process for machinery used in domestic manufacturing. Importers of machinery covered under the identified 317 subheadings of HTS Chapters 84 and 85 can apply to temporarily suspend the tariffs. Included on the list of products eligible for an exclusion are Casting machines, of a kind used in metallurgy or in metal foundries (HTS 8454.30.00) and Ingot molds and ladles, of a kind used in metallurgy or in metal foundries (HTS 8454.20.00). Granted exclusions would be effective through May 31, 2025.

Dr. Die Cast

Why Would You Want to Have Your Die Coated?

If you attended the Congress and Expo in Indianapolis, you saw several suppliers who are in the business of applying die coatings. Why would you want to have your die coated? What are some of the benefits? Is it only for high volume projects? Do I have to coat all the die details to see the benefits? Can I apply it to an old die?

This article is not intended to provide a high-level comparison of the various treatments and coatings but to encourage you to apply the technology to improve your operation.

Mark Cohrac, a coworker, performed a test to measure the effectiveness of various die lubricants. He configured a process monitor to measure the peak hydraulic pressure necessary to eject the casting. This same method can measure the reduction of force achieved when applying a coating that makes the die surface slippery.

It is highly recommended that the coating is applied to brand new die steel prior to first shots. However, if you are already knee deep in a problem, the cavities and/or cores can be cleaned up and coated. The die does not have to be a high-volume job. We had a one cavity job that ran around 30,000 pieces per year but was a pain to run. It had deep, low draft ribs that chronically stuck. Half of every run was spent with the die on the bench digging out the stuck pieces and polishing the cavity. We sent the die out for a soft nitride treatment that completely changed the behavior. It ran without sticking and became a profitable job.

Nitriding to create a "case hardened" surface has been used for decades on cold chambers, dies and cores to create a hard, slippery surface. It will reduce ejection force and, in some cases, reduces the amount of die or shot tip lube needed.

There is no substitute for high quality tool steel. Surface treatments and coatings are not intended to replace high quality steel.

Today there are lots of options, titanium nitride, PVD, soft nitriding and other coatings are readily available.

Extend die life by reducing thermal shock. When the casting is easier to eject, you could reduce the amount of die spray. This would reduce the thermal shock and extend die life.

You save at least 2 ways.

1. Less thermal shock, means longer tool life. Some have reported more than 25% longer die life.[1]
2. Reduced die lube consumption.[2] (And less waste from overspray.)

Take your toughest job and start there. You will wonder why you waited so long to try it.

References and further reading:

1. https://phygen.com/wp-content/uploads/2022/12/DieCasting-Mag9_19.pdf
2. https://phygen.com/wp-content/uploads/2022/12/DieCasting-Mag5_19.pdf

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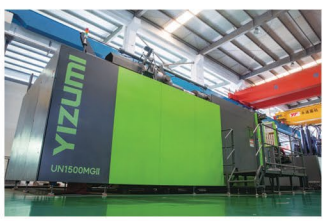

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NADCA Reports

NADCA NEWS

NADCA Unveils 2025 Themes for DCE

Arlington Heights, IL - NADCA has announced the 2024 themes for Die Casting Engineer magazine. DCE's themes are:

- Process Control & Automation; Quality Control
- Cast Materials (Al, Mg, Zn); High Integrity Processes & Alloys; Post Casting/Secondary Operations
- Furnaces; Energy
- Computer Modeling & Simulation; Defects; Computer Design
- Additive Manufacturing; Advanced Technologies
- Die Casting Components & Equipment; Die Casting Machines

To submit your article proposal, please contact Andy Ryzner at ryzner@diecasting.org. If you are interested in advertising email Athena Catlett at catlett@diecasting.org.

UPCOMING EVENTS

Back to the East Coast – Marco Island Welcomes NADCA Execs

Arlington Heights, IL - NADCA is excited to announce that the 2025 Executive Conference will be held at the Hilton Marco Island on February 22-26, 2025 in Marco Island, Florida.

The tentative agenda, housing link and conference registration will be opened later this year. An announcement will be made via email and our newsletter when these items are opened.

Until then, pencil these dates into your calendar!

TOOLS & RESOURCES

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

Arlington Heights, IL - The newest edition of 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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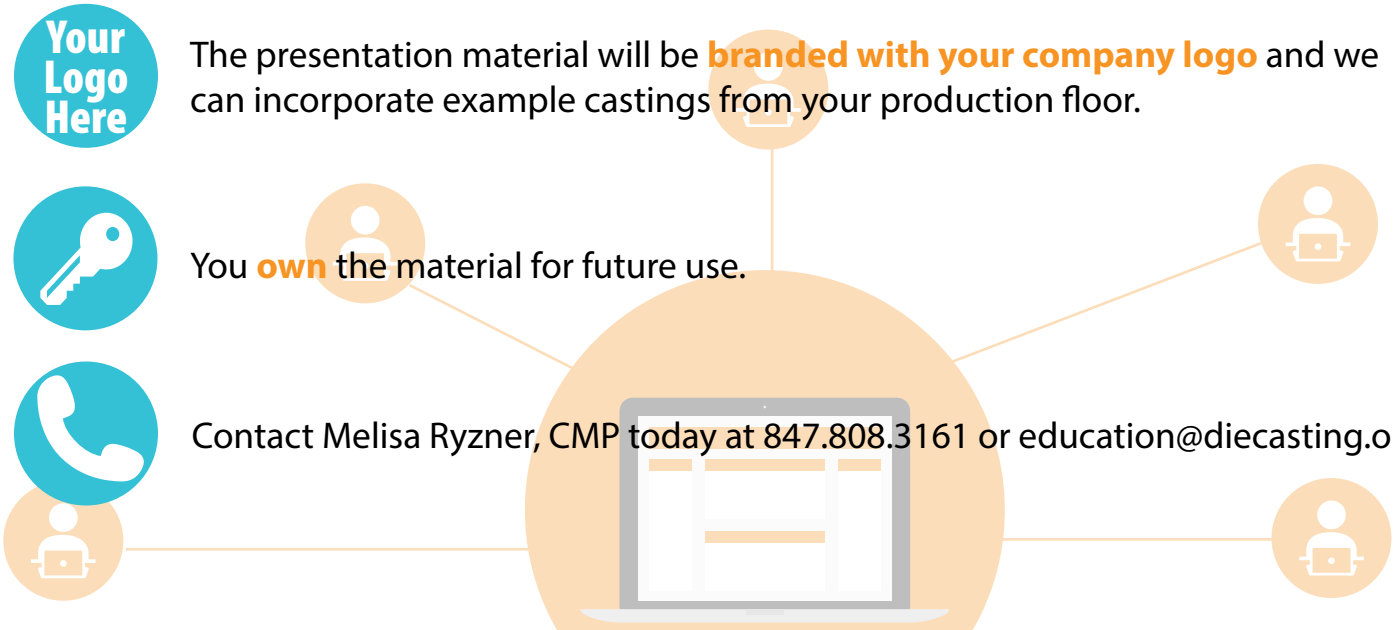

Preparation of a High-Performance Coating Using Cathodic Vacuum Arc Deposition for Die-Casting Molds and Its Characterization

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Abstract

Aluminum die-casting molds must have exceptional soldering and erosion resistance to enhance productivity and maintain product quality. Therefore, various surface treatments have been applied to meet these requirements. The cathodic vacuum arc deposition (CVAD) method has emerged as a promising technique for creating ceramic coatings at low temperatures. Ceramic coatings produced by CVAD are widely used owing to their superior soldering and erosion resistance compared to those achieved through nitriding treatments.

A newly developed AlCrSiN/CrN/TiN multilayer coating for aluminum die-casting molds via CVAD has shown higher wear and heat resistance than traditional ceramic coatings produced using CVAD. Additionally, these coatings demonstrated remarkable properties that make reactions with molten aluminum alloy challenging. Evaluations included aluminum soldering tests with and without mold-release agents, corrosion resistance tests in molten aluminum alloys, friction and wear tests at room and elevated temperatures, and micro-slurry-jet erosion tests. Furthermore, this paper discusses the practical results of applying the AlCrSiN/CrN/TiN multilayer coating to actual aluminum die-casting molds.

Introduction

Aluminum die-casting molds require superior erosion resistance, soldering resistance, and thermal fatigue resistance. Various surface treatments have been applied to these molds to meet these performance requirements[1-7]. Ceramic coatings deposited via chemical vapor deposition (CVD) and physical vapor deposition (PVD) have been widely used owing to their excellent erosion and soldering resistance. However, the high processing temperatures in the CVD method, which can reach approximately 1000 °C, often lead to deformation and dimensional changes in molds. Consequently, while CVD can be used for coating die-casting pins, its application to main molds is challenging. Additionally, although the PVD method is used for die-casting pins and small insert molds owing to its low-temperature processing, its application to main molds with complex shapes is difficult because of poor coating uniformity. Moreover, the PVD method produces film defects such as droplets or pinholes. As a result, thick ceramic coatings using the PVD method are sometimes employed to counteract erosion in aluminum die-casting molds. However, these thick coatings are undesirable for dimensional accuracy, and have issues with toughness such as chipping and cracking.

To address these issues, we developed a new AlCrSiN/CrN/TiN multilayer coating using the cathodic vacuum arc deposition (CVAD) method, which offers excellent film density, wear resistance, heat resistance, and mold releasability. We compared various properties of the AlCrSiN/CrN/TiN multilayer coated specimens with untreated specimens, nitrocarburized specimens, nitrocarburized and oxidized specimens, various ceramic coatings by the PVD method, and VC coatings by the thermo-reactive deposition and diffusion (TRD) method[8]. The evaluation methods included hardness tests, adhesion tests, friction and wear tests at room and elevated temperatures, aluminum soldering tests with and without mold-release agents, corrosion resistance tests in molten aluminum alloys, and micro-slurry-jet erosion tests[9]. Furthermore, comparative practical results were described when the AlCrSiN/CrN/TiN multilayer coating and other surface treatments were applied to actual aluminum die-casting molds.

Experimental

Material

The specimens were prepared from Japanese Industrial Standards (JIS) SKD61 (hot-work tool steel). The chemical composition of SKD61 was 0.40% C, 0.94% Si, 0.42% Mn, 5.11% Cr, 1.22% Mo, and 0.81% V. The SKD61 specimens were quenched at 1020 °C and double-tempered for 120 min at 605 °C in a vacuum furnace before applying surface treatments. The Rockwell hardness (HRC) of the untreated specimen was 48. For crystal structure analyses, hardness tests, adhesion tests, structural observations, friction and wear tests, and micro-slurry-jet erosion tests, the specimens measured 32 mm in diameter and 10 mm in thickness. Specimens for aluminum soldering tests with and without mold-release agents and corrosion resistance tests in molten aluminum alloys measured 12 mm in diameter and 120 mm in length, with a semicircular tip shape used in the soldering and corrosion resistance tests.

Treatment Method

The PVD equipment used in this experiment was a specially modified CVAD system with an added booster mechanism to activate the plasma[10]. This modification

increased the ionization rate, leading to expected improvements in film adhesion, deposition rate, and density. By adjusting the processing conditions, we created a multilayered coating and nanocomposite, resulting in a layered structure that enhances the adhesion and density of even thin films. AlCrSiN/CrN/TiN multilayer coatings were deposited onto steel substrates at 450 ˚C using the CVAD equipment. The lower TiN layer was formed in the multilayer coating, to enhance the adhesion between the substrate and the middle CrN layer. The middle CrN layer was used to improve the adhesion between the lower TiN layer and the upper AlCrSiN layer. The upper AlCrSiN layer, a nanocomposite coating with excellent film density, was optimized for oxidation resistance, wear resistance, mold releasability, and resistance to erosion and soldering with molten aluminum alloy. The total film thickness of the AlCrSiN/CrN/TiN multilayer coating (hereinafter referred to as AlCrTiSiN) was adjusted to 3.7 µm.

For comparison, TiN coatings (3.0 µm), CrN coatings (3.4 µm), TiAlN coatings (1.4 µm), AlCrN coatings (2.3 µm), and TiAlN thick coatings (7.2 µm) were fabricated using a standard CVAD method. Additionally, VC coatings (7.2 µm) were created by the TRD method, gas nitrocarburized products (nitride compound layer: 6.5 µm), and gas nitrocarburized + oxidized products (nitride compound layer: 4.1 µm, oxide layer: 2.1 µm) were prepared for the comparison of various characteristics.

Evaluation Method

The multilayer coatings were analyzed using scanning electron microscopy (SEM), X-ray diffraction (XRD), and glow discharge optical emission spectroscopy (GDOS). The hardness of these coatings was measured with a nanoindentation hardness tester under the following conditions: maximum indentation load of 25 mN, loading time of 10 s, no holding time, unloading time of 10 s, and a Berkovich indenter tip. Adhesion was evaluated using the Rockwell C adhesion test. Friction and wear tests were performed on a ball-on-disk CSM tribometer (Anton-Paar) at room and elevated temperatures (500 ˚C). The room temperature test was performed without lubrication at 25 ˚C and 40% relative humidity, with sliding speeds of 50 and 100 mm/s, sliding distance of 500 m, and loads of 1, 5, and 10 N.

The balls used were made of cemented carbide (WC-Co, diameter, 6 mm), bearing steel (JIS-SUJ2, diameter 6 mm), aluminum (JIS-A1070, diameter 6 mm), and Al2O3 (diameter 6 mm). The surface roughness of the disk specimens was reduced to Ra = 0.1 µm or less by lapping with diamond-paste.

The micro-slurry-jet erosion tests were conducted using the following system: polygonal alumina particles (size 1.2 µm) were mixed with water to create a slurry, which was circulated through the system. This fluid control allowed for precise slurry management. The slurry was introduced into the injection gun, instantly mixed and accelerated with compressed air, then sprayed onto the specimen surface in a mist form. Although the cutting force of each particle was minute, the cumulative effect of numerous particles colliding with the surface resulted in nanometer-sized wear. Water was used to cool and clean the specimen. The TiAlN coating thickness used in this test was 3.5 µm.

The aluminum soldering resistance tests were conducted by immersing the specimens to a depth of 70 mm in a molten aluminum die-casting alloy (JIS-ADC12: Al-Cu-Si based alloy) bath at 700 ˚C for 5 min, then pulling them out. The aluminum alloy soldered to the specimen was gently wiped off with a rag. The weight of each specimen was measured before and after the test using an electronic balance to calculate the amount of soldered aluminum alloy.

For the aluminum soldering resistance tests with mold-release agents, the specimens were preheated in a furnace to 200 ˚C. The preheated specimens were manually sprayed with an aqueous mold-release agent (AZ7150W, Yushiro Chemical Industry Co., Ltd.). The cooled specimens were reheated in the furnace at 200 ˚C. Subsequently, they were immersed up to a depth of 70 mm in the molten aluminum die-casting alloy for 5 s at 600 ˚C. After pulling the specimens out of the molten aluminum alloy, they were cooled to approximately 30 - 40 ˚C using an air blow. The aluminum alloy soldered to the specimen was gently wiped off with a rag. This procedure was repeated four times, and the weight of each specimen before and after the test was measured with an electronic balance to calculate the amount of soldered aluminum alloy. The TiAlN coating thickness used in this test was 3.5 µm.

The corrosion resistance of each specimen was assessed by immersing them in the molten aluminum die-casting alloy at 700 ˚C to a depth of 70 mm. During the corrosion resistance tests, the specimens were immersed in the molten aluminum alloy for a specified duration. They were then cleaned in a NaOH solution to remove most of the soldered aluminum alloy from their surfaces. The corrosion loss of the specimens was measured using an electronic balance. This procedure of immersing the specimens in the molten aluminum alloy was repeated five times, with a total immersion time of 540 min.

Results and Discussion

Morphology of Cross-Sections

Figure 1 shows a cross-sectional SEM image of the AlCrTiSiN multilayer coating deposited by CVAD. The cross-sections of the TiN and CrN coatings prepared by CVAD exhibited columnar structures. The upper AlCrSiN coating in the AlCrTiSiN multilayer coating displayed a dense structure. The AlCrSiN coating is presumed to have a nanocomposite structure, where crystalline and amorphous phases are mixed.

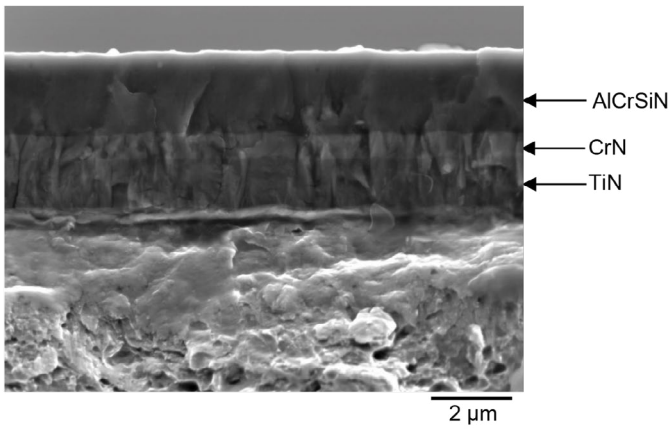

***Figure 1** – Cross-sectional SEM image of the AlCrTiSiN multilayer coating deposited by CVAD.*

Compositional and Structural Analyses

Figure 2 shows the GDOS concentration depth profiles for each element in the AlCrTiSiN multilayer coating. Based on the concentration distributions of Al, Cr, Ti, Si, and N, we confirmed that the coating consisted of three layers. Figure 3 shows the XRD pattern of the AlCrTiSiN multilayer coatings. With the X-ray incident angle set at 0.5 degrees, the outermost AlCrSiN layer was assumed to be analyzed. The diffraction peak suggests that an AlCrSiN-based composite nitride was formed in the outermost layer.

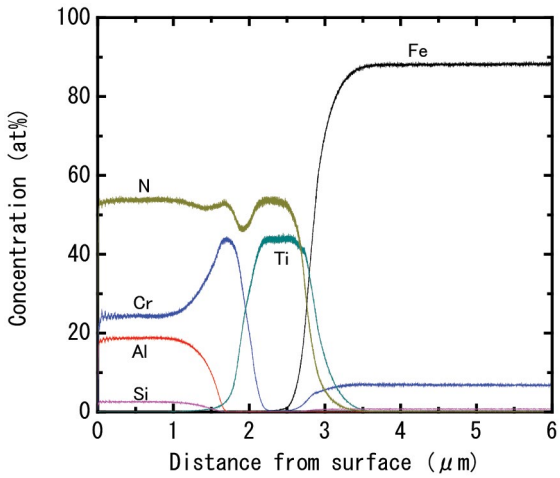

***Figure 2** – GDOS concentration depth profiles for each element in the AlCrTiSiN multilayer coating.*

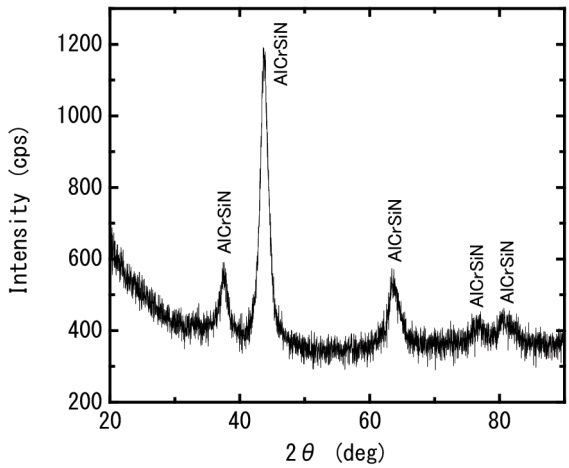

***Figure 3** – XRD pattern of the AlCrTiSiN multilayer coating. (Cu-Kα; 40kV, 44 mA; incident angle, 0.5 degree)*

Surface Hardness and Adhesion

Figure 4 shows the load versus displacement curves obtained using the nanoindentation method for each coating produced by the PVD method.

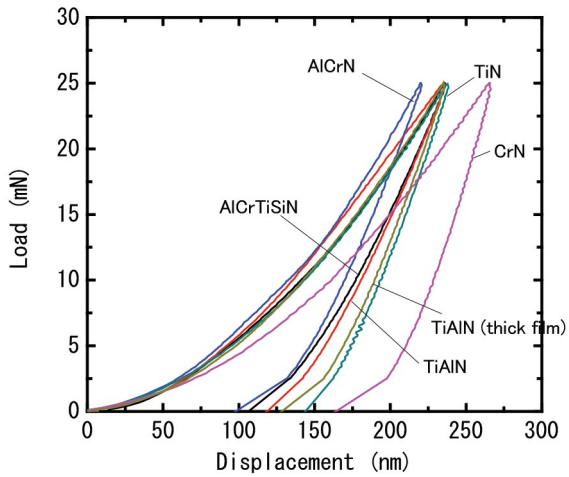

***Figure 4** – Load versus displacement curves obtained using the nanoindentation method for each coating produced by the PVD method.*

***Table 1** – Nanoindentation hardness (HI), reduced modulus (Er), HI/Er, and HI3/Er2 for each coating.*

	HI (GPa)	Er (GPa)	HI/Er	HI3/Er2
ArCrTiSiN	30.5	281.0	0.108	0.359
TiAlN	29.5	294.0	0.100	0.297
AlCrN	32.9	336.9	0.097	0.313
TiN	26.3	340.6	0.074	0.139
CrN	18.0	358.1	0.050	0.045
TiAlN (thick film)	26.3	338.1	0.077	0.159

Table 1 presents the nanoindentation hardness (HI), reduced modulus (Er), HI/Er, and HI^3/Er^2 for each coating. The Er value represents the combined elastic deformations

of the sample material and the indenter. The HI of AlCrTiSiN was 30.5 GPa, which is higher than that of TiN, CrN, TiAlN, and TiAlN (thick film) and slightly lower than AlCrN. Additionally, the HI/Er of AlCrTiSiN was 0.108, higher than any other coating tested. Furthermore, the HI^3/Er^2 of AlCrTiSiN was 0.359, surpassing the other coatings tested. This indicates that AlCrTiSiN has high resistance to elastic and plastic deformations, enhancing its wear resistance.

Figure 5 shows HRC indentation photographs of each coating in the Rockwell C adhesion test. TiN and CrN exhibited minimal film delamination around the indentations and small cracks. TiAlN, being harder than TiN, displayed concentric cracks characteristic of hard films, with less film delamination. The TiAlN (thick film) showed small cracks and significant film delamination, likely owing to its large thickness. Similar to AlCrN, AlCrTiSiN exhibited little delamination but had large cracks typical of hard films around the indentations. Thus, the film adhesion of AlCrTiSiN is considered good.

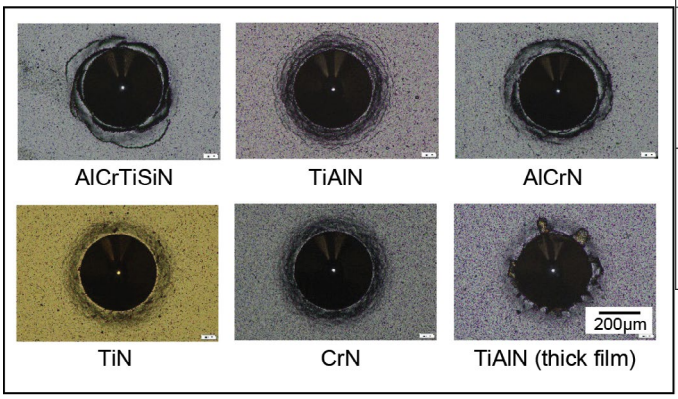

***Figure 5** – HRC indentation photographs of each coating in the Rockwell C adhesion test.*

Tribological Properties

Figure 6 shows the friction coefficient measurements of each coating with a WC-Co ball using a ball-on-disk tribometer.

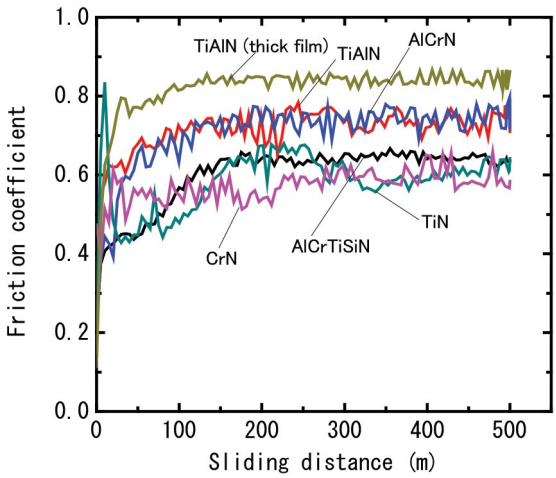

***Figure 6** – Friction coefficient measurements of each coating with a WC-Co ball. (ball, WC-Co; load, 10 N; sliding speed, 100 mm/s; unlubricated condition).*

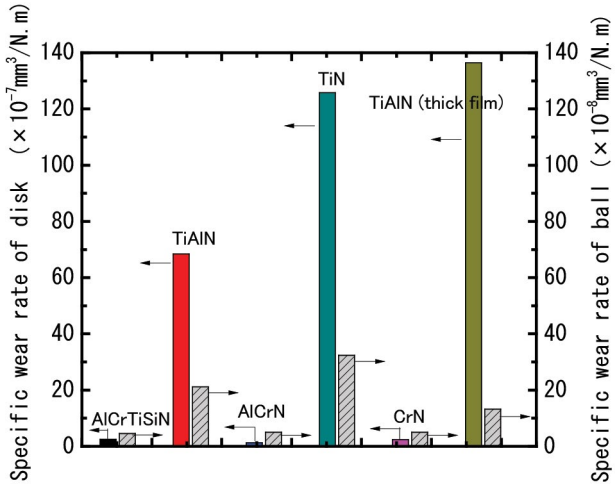

***Figure 7** – Specific wear rates of the disk and ball of each coating with the WC-Co ball.*

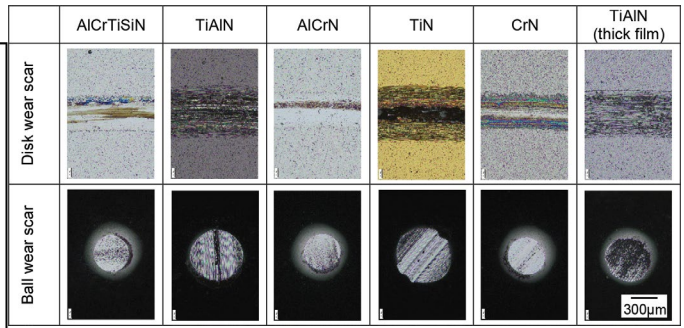

***Figure 8** – Wear scars on the disk and ball of each coating after the tests with the WC-Co ball.*

Figure 7 shows the specific wear rates of the disk and ball, while Figure 8 shows photographs of the wear scars on the disk and ball after the test. The friction coefficients near the sliding distance of 500 m were approximately 0.84 for TiAlN (thick film), 0.76 for TiAlN, 0.76 for AlCrN, 0.64 for AlCrTiSiN, 0.63 for TiN, and 0.63 for CrN. Harder films such as TiAlN (thick film), TiAlN, and AlCrN showed higher friction coefficients than TiN and CrN, with TiAlN (thick film) having the highest friction coefficient. Although AlCrTiSiN is a hard coating, it exhibited a low friction coefficient similar to softer coatings such as TiN and CrN. The disk specific wear rate was highest for TiAlN (thick film), and the order of specific wear rates for each coating was as follows: TiAlN (thick film) > TiN > TiAlN > CrN = AlCrTiSiN > AlCrN. The order of ball specific wear rates was: TiN > TiAlN > TiAlN (thick film) > CrN = AlCrN > AlCrTiSiN. The disk wear scars after the wear test of AlCrTiSiN showed less adhesion and oxidation than other coatings, similar to AlCrN. These results show that AlCrTiSiN is a coating with high wear resistance comparable to AlCrN and low aggressiveness toward the counterpart material (WC-Co).

Figure 9 shows friction coefficient measurements of each coating with the SUJ2 ball. The friction coefficients near the sliding distance of 500 m were approximately 0.54 for TiAlN, 0.52 for TiN, 0.47 for TiAlN (thick film), 0.27 for AlCrN, and 0.19 for CrN and AlCrTiSiN. This indicates that AlCrTiSiN has a low friction coefficient even against steel materials like SUJ2. Figure 10 shows friction coef-

ficient measurements of each coating with the Al ball. The friction coefficients near the sliding distance of 500 m were approximately 0.85 for TiN, 0.52 for TiAlN and TiAlN (thick film), 0.31 for AlCrN, 0.18 for AlCrTiSiN, and 0.13 for CrN. This shows that AlCrTiSiN maintains a low friction coefficient even against soft and easily adhesive aluminum materials such as A1070. Figure 11 shows the friction coefficients of AlCrTiSiN and TiAlN with the Al_2O_3 ball at 500 °C.

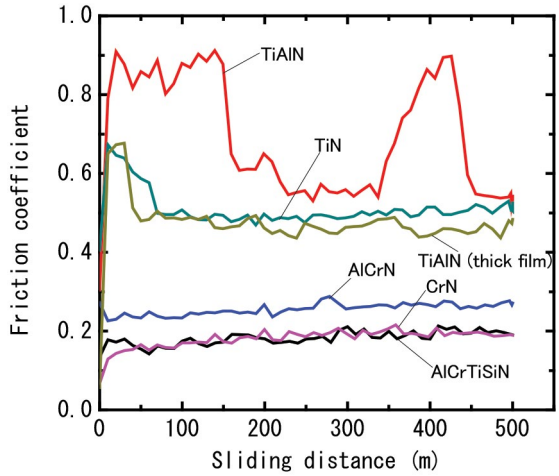

***Figure 9** – Friction coefficient measurements of each coating with the SUJ2 ball. (ball, SUJ2; load, 5 N; sliding speed, 100 mm/s; unlubricated condition).*

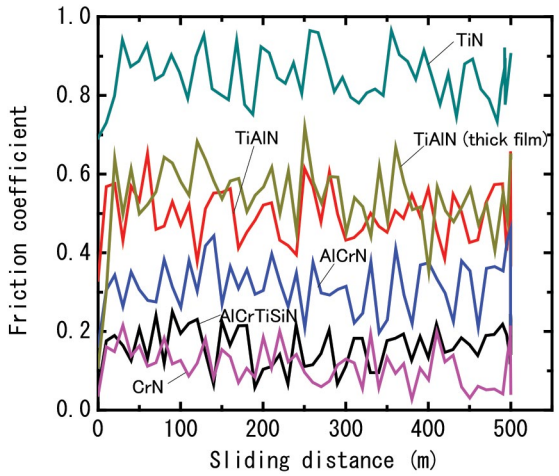

***Figure 10** – Friction coefficient measurements of each coating with the A1070 ball. (ball, A1070; load, 1 N; sliding speed, 50 mm/s; unlubricated condition).*

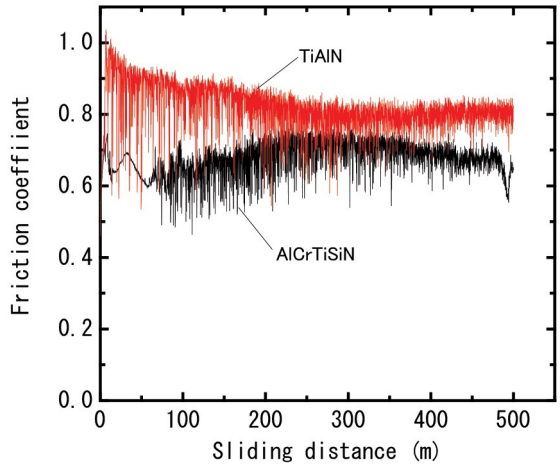

***Figure 11** – Friction coefficients of AlCrTiSiN and TiAlN with the Al2O3 ball at 500 °C. (ball, Al2O3; load, 5N; sliding speed, 100 mm/s; unlubricated condition).*

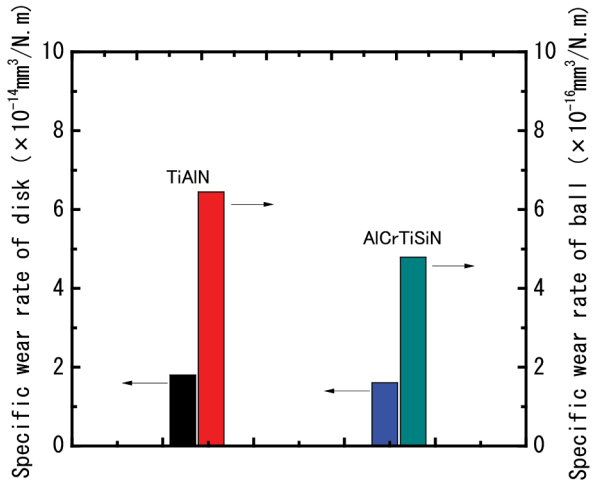

***Figure 12** – Specific wear rates of the disk and ball for both coatings with the Al_2O_3 ball at 500 °C.*

Figure 12 shows the specific wear rates of the disk and ball for both coatings at 500 °C. AlCrTiSiN had a lower friction coefficient than TiAlN at 500 °C, and its disk and ball wear rates were also lower.

Erosion Resistance

Figure 13 shows the relationship between erosion depth and erosion rate for AlCrTiSiN and TiAlN. The erosion rate (μm/g) is calculated by dividing the erosion depth (μm) by the particle projection amount (g). It was demonstrated that AlCrTiSiN has superior erosion resistance compared to TiAlN. Consequently, AlCrTiSiN can be expected to exhibit excellent erosion resistance even with a thin coating, eliminating the need for a thicker application.

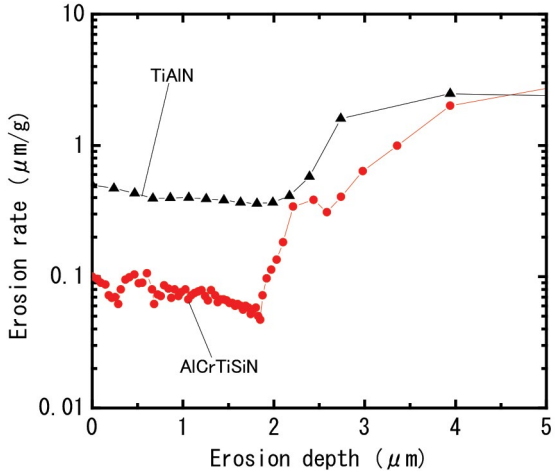

***Figure 13** – Relationship between erosion depth and erosion rate for AlCrTiSiN and TiAlN.*

Soldering Resistance

Figure 14 shows the aluminum soldering rate of various specimens after being immersed in molten aluminum alloy at 700 °C for 5 min. Figure 15 shows the appearance of the specimens after immersion in molten aluminum alloy for 5 min and subsequent withdrawal. AlCrTiSiN exhibited the lowest amount of soldered aluminum and the best soldering resistance among the tested specimens. This is attributed to the upper layer AlCrSiN coating's low reactivity with molten aluminum alloy, poor wettability, and excellent mold-release properties.

Figure 16 shows the aluminum soldering rates for each specimen in the soldering resistance test conducted with a mold-release agent. AlCrTiSiN had the lowest aluminum soldering rate among the specimens tested. Thus, AlCrTiSiN is compatible with mold-release agents and can improve aluminum soldering resistance.

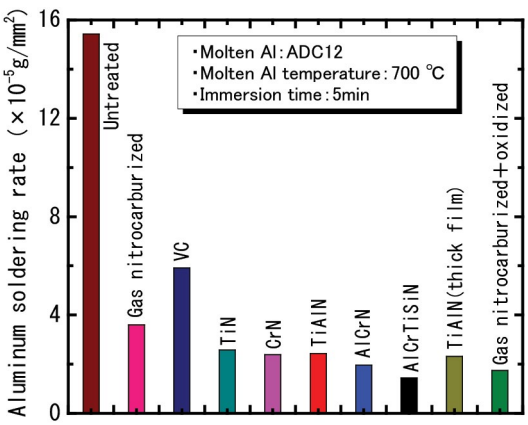

***Figure 14** – Aluminum soldering rate of various specimens after being immersed in molten aluminum alloy at 700 °C for 5 min.*

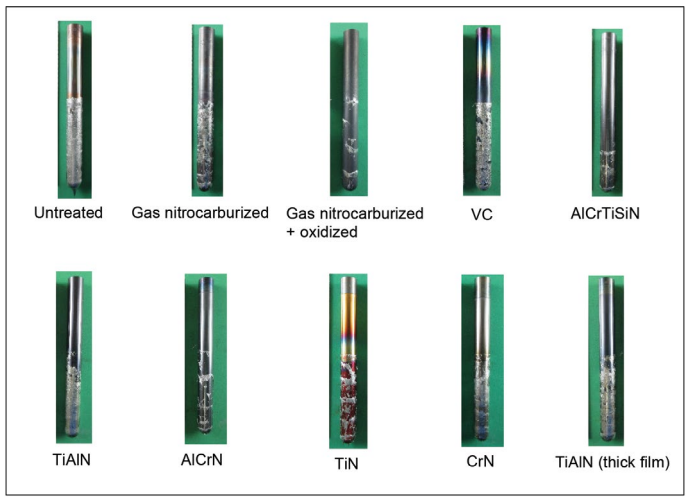

***Figure 15** – Appearance of the specimen after immersion in molten aluminum alloy for 5 min and subsequent withdrawal.*

Corrosion Resistance

Figure 17 shows the relationship between immersion time and corrosion rate for each specimen in molten aluminum alloy at 700 °C. The order of the corrosion rates was: TiAlN > untreated = gas nitrocarburized > AlCrN > gas nitrocarburized + oxidized > TiN > VC > CrN > TiAlN (thick film) > AlCrTiSiN. AlCrTiSiN demonstrated superior corrosion resistance in molten aluminum alloy compared to thick films such as TiAlN (thick film) and VC.

Application

Table 2 shows application examples of AlCrTiSiN. In application example 1, the AlCrTiSiN-treated product required less maintenance and was more durable than nitrided or TiAlN-treated products. In application example 2, the AlCrTiSiN-treated product required less frequent maintenance and demonstrated improved durability compared to the VC (TRD)-treated product. In application example 3, the AlCrTiSiN-treated product needed less maintenance and had inhanced durability compared to the AlCrTiN composite-treated product. Besides these examples, AlCrTiSiN has already been applied to aluminum die-casting pins and molds.

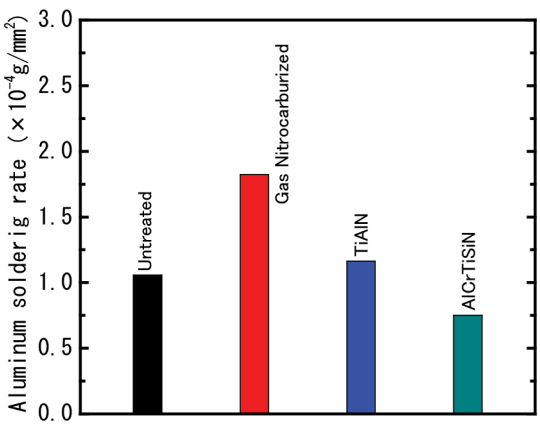

***Figure 16** – Aluminum soldering rates for each specimen in the soldering resistance test conducted with a mold-release agent.*

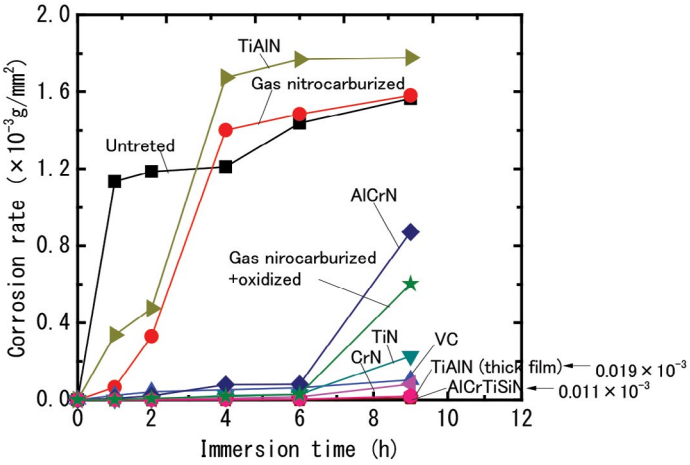

***Figure 17** - Relationship between immersion time and corrosion rate for each specimen in molten aluminum alloy at 700 °C.*

Conclusions

The following conclusions were derived from these experiments:

1. The cross-section of the upper AlCrSiN coating in the AlCrTiSiN multilayer coating prepared by CVAD displayed a dense structure.
2. GDOS analysis revealed that AlCrTiSiN was a three-layer coating consisting of AlCrSiN/CrN/TiN. Grazing incidence XRD analysis inferred that the top layer was an AlCrSiN composite nitride.
3. The nanoindentation hardness (HI) of AlCrTiSiN was 30.5 GPa, higher than those of TiN, CrN, TiAlN, and TiAlN (thick film), and slightly lower than that of AlCrN. The HI/Er and HI3/Er2 values of AlCrTiSiN were higher than any other coating tested. Additionally, HRC indentation tests showed that AlCrTiSiN had good film adhesion.
4. AlCrTiSiN exhibited excellent tribological properties against various counterpart materials at room temperature and demonstrated superior wear resistance compared to the TiAlN coating in high-temperature wear tests at 500 °C.
5. In the micro-slurry-jet erosion test, AlCrTiSiN demonstrated superior erosion resistance than TiAlN.
6. AlCrTiSiN exhibited the highest corrosion and soldering resistance with and without a release agent among the specimens tested in molten aluminum alloy.
7. AlCrTiSiN has already been applied to aluminum die-casting pins and molds.

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***Table 2** – Application examples of ArCrTiSiN.*

Application Example 1	
· Mold Material: HAP40(P/M high speed tool steel, 40HRC)	
· Molten metal: JIS-ADC12(Al-Cu-Si based alloy, 680 °C)	
· Mold clamping force: 350 ton	
· Products: automobile parts	
· Problem: Soldering often occurs on pins that are in positions where the release-agent does not reach easily. This results in frequent maintenance.	
Maintenance frequency (out of 20 days of operation)	· Nitriding: 160 times · TiAlN(thick film): 60 times · AlCrTiSiN: 10 times
Number of shots until tool replacement	· TiAlN(thick film): 11,200 shots · AlCrTiSiN: No abnormalities were found after 24,000 shots, so production is continuing.
Application Example 2	
· Mold Material: JIS-SKD61(hot-work tool steel, 48HRC)	
· Molten metal: JIS-ADC12(Al-Cu-Si based alloy, 680 °C)	
· Mold clamping force: 250 ton	
· Products: automobile parts	
· Problem: Too many mold polishings due to soldering	
Number of shots until maintenance	· VC(TRD): 3,000 shots · AlCrTiSiN: 10,000 shots
Number of shots until tool replacement	· VC(TRD): 10,000 shots · AlCrTiSiN: 16,350 shots
Application example 3	
· Mold Material: JIS-SKD61(hot-work tool steel, 48HRC)	
· Molten metal: JIS-ADC12(Al-Cu-Si based alloy, 680 °C)	
· Mold clamping force: 800 ton	
· Products: automobile parts	
· Problem: Too many mold polishings due to soldering	
Number of shots until maintenance	· Plasma nitriding+fine particle peening+ AlCrTiN: 2,500 shots · AlCrTiSiN: 30,000 shots
Number of shots until tool replacement	· Plasma nitriding+fine particle peening+ AlCrTiN: 30,000 shots · AlCrTiSiN: 35,364 shots

More Zinc Castings for Automotive Applications

Martin Gagné
ZELIXIR Inc.
Toronto, Canada

Introduction

The automotive industry has always been a leader for improving the integrity of its supply chains, from product quality and cost through resilience, traceability and now sustainability.

Die cast zinc metal parts have kept pace with the increasing quality and cost requirements, consistently and economically delivering excellent mechanical properties (high strength, good elongation), physical properties (thermal and electrical conductivity) easy castability, long-life tooling and a wide choice of surface finishes available for zinc die castings.[1]

The high-pressure zinc die casting process also continues to evolve with improved process controls, low carbon technologies, and waste reduction further driving down the carbon footprint of zinc products.

Surface Finishing

Zinc provides the best foundation for the high quality surface finishes demanded by the automotive industry. The Wilkast company has won multiple awards producing high visibility components for the Harley Davidson Motorcycle company, from handlebar mounts[2] to headlamp visors[3] and instrument consoles[4]. These are fully exposed locations for the castings, which must not have any visible imperfections. Harley Davidson has reduced cost and part inventory numbers by combining the functionality of multiple parts into one zinc die casting, while maintaining very high cosmetic standards.

Figure 1 shows the Cateye Console. This functional casting, made with the Zamak 3 alloy, is highly decorative, requiring an excellent surface finish, tight tolerances to form fit to the contoured gas tank, and with multiple openings trimmed to the exact size and shape to fit the indicator lights in three openings. The casting process is closely monitored and controlled to produce castings with a surface quality necessary for accepting highly cosmetic finishes.

***Figure 1** – Cateye console installed.*

Another example is a headlamp visor, cast in ZA8 alloy, which plays a key functional role in the motorcycle's handlebar assembly. Taking advantage of zinc's strength and dimensional stability, the design offers adjustability for each individual rider's comfort while maintaining safety standards and standing out as one of the most visible features of the motorcycle.

***Figure 2** – Headlamp visor.*

High Strength

Automotive parts designers have always been able to rely on the excellent product attributes of zinc die castings, including high strength. As shown in Figure 3, all the zinc die casting alloys have higher yield strengths than engineered plastics and other non-ferrous casting alloys. Some of the zinc alloys, notably the ZA alloys and EZAC have higher yield strength than ductile iron.

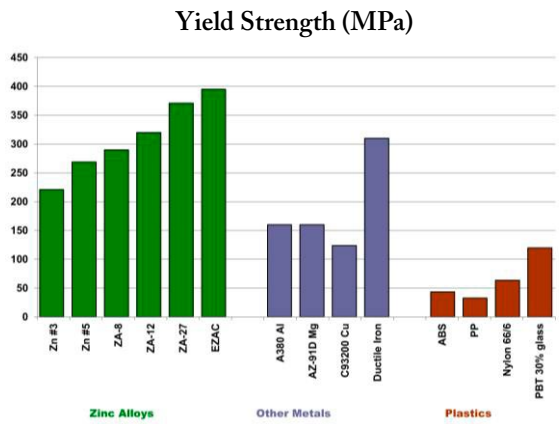

***Figure 3** – Yield strength of selected materials. [Source: INTERZINC]*

Automobile safety components take advantage of the high strength of zinc die castings. A steering wheel and ignition lock housing, shown in Figure 4, is a safety-critical component of the automotive steering column produced in Zamak 5 alloy by Dynacast[5]. This is a complex casting with features aligned in multiple axes. It keeps the steering wheel locked until the car is ready to start and drive.

The near net shape zinc casting streamlined the production of the part, which resulted in large cost savings by reducing steps and time associated with secondary operations. By reducing machining steps, there was a productivity boost of almost 70%, and a cost savings of 80% over previous production.

Another critical automotive safety component is the three-point restraint seatbelt system[6]. Figure 5 shows a pretensioner in a seat belt assembly, shown installed at the base of the seatbelt clasp.

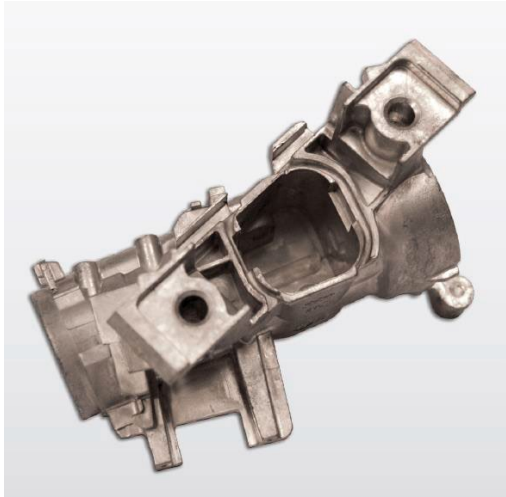

***Figure 4** – Wheel and ignition lock housing.*

The casting takes advantage of the strength and ductility of zinc to allow assembly without fasteners, along with a unique casting process to improve productivity.

The casting, in Zamak 5 alloy, was designed with steel shut-offs in the mold which allows it to shear into two separate parts from the original cast component. Because the "two components" were already aligned via a cast in dovetail, the part is easily assembled by robots and orbitally riveted in location. Zinc high pressure die casting allowed for a significant reduction in component cost while maintaining strength and repeatability. The proprietary casting process easily keeps up with the quality and production demands of the automotive industry.

***Figure 5** – Seat belt pretensioner installed.*

Net Shape Casting

The excellent fluidity and castability of all the zinc die casting alloys allows for net shape casting. As-cast parts, direct from the machine, are ready to use without any subsequent trimming, reaming or machining operations. Complex geometries can be cast to final size and shape thereby eliminating the cost of machining and improving productivity to meet production demands of the automotive industry.

Figure 6 shows a shift lever, which connects the shifter and the gear in ZF automotive gearboxes. This part was originally cast in aluminum but required tapping and other secondary operations to meet the tight tolerance specifications. The part was redesigned and optimized for high pressure zinc die casting in Zamak 5 alloy by Adolf Föhl[7].

Figure 6 – *Shift lever.*

The redesign is net shape cast and does not require any secondary machining operations to achieve the tolerances. Having a lower melting temperature, the zinc casting process has a shorter casting cycle, which improves productivity. Being less aggressive towards the tool steel, the die has a 10x longer tool life compared to casting in aluminum. All of these benefits led to a reduction in cost of 30% for this part along with a total weight reduction of 5%.

Surface finish is just as important inside the vehicle and combined with net shape casting provides a real competitive advantage.

With the electrification of all driving actions, the controls for many functions, such as drive by wire, are being located to the steering wheel.

Bruschi S.P.A made an award-winning aesthetic bezel for a steering wheel cover with hollows for multifunctional switches in Zamak 5 alloy[8]. Zinc die casting provides the required stiffness which increased safety due to the stability provided. The zinc casting provided the haptic properties of a metal touch feeling, and easy coating options for painting or plating for the high-level aesthetic requirement.

Zamak 5 alloy was chosen for the shift paddles of a Porsche automobile[9]. This award-winning part is shown in Figure 7. The paddles are attached to both sides of the back of the steering wheel and are therefore easy to operate. The simple design of the side contours and the component shape however, require a complex slide geometry and design of the ejector system in the casting tool. Due to the tactile surface requirements a precise fit and component surface is required. The economic benefits of high productivity net shape zinc die casting assisted in keeping costs low for a part which is finished by hand.

Figure 7 – *Porsche shift paddles.*

High pressure zinc die casting was used to produce a drive-by-wire control knob with the required haptic properties, which fully incorporated the complex geometry of the part[10]. The net shape casting in Zamak 3 alloy eliminated the need for trimming and associated machine tooling costs, which substantially lowered the cost of the part.

Thermal and Electrical Conductivity

All the zinc die casting alloys have excellent electrical and thermal conductivity which exceeds the conductivity of other casting metals and engineering plastics. The combination of good thermal and electrical conductivity properties provides exceptional heat dissipation performance, along with shielding capability for electromagnetic and radiofrequency interference which is important for many automotive electronics and sensor housing applications.

The automotive connector shown in Figure 8 is used in an assembly for high-speed data communication and requires thin walls (0.33 mm) and tight tolerances[11].

Figure 8 – *Automotive connector installed.*

Requirements for the part included dimensional accuracy, repeatability, quality of the knurl, and good ductility to allow cold-forming or staking. Zinc die casting in Zamak 3 alloy met all the requirements along with a cost savings of 30%.

Dynacast produced two award winning zinc die cast components to support and cool a dashboard display projector[12]. Both the backplate, which supports and connects

the printed circuit board to the projector, and the heat sink, which draws heat away from the projector were cast in Zamak 3 alloy.

Both parts were cast with all the mounting features in place. The zinc backplate had higher strength than the steel stamping it replaced, while the heat sink was a single piece component that outperformed the machined aluminum extrusion assembly previously used. As well, lot traceability was an important requirement for both components.

Improving Sustainability

With low melting point alloys, zinc die casting already has low energy consumption compared to other casting metals. Combined with high fluidity enabling thin wall casting capability and net shape casting, these material savings contribute to the sustainability of die cast zinc products.

Process monitoring tools further improve the environmental performance of zinc products by determining the die casting machine efficiency, improving product quality and reducing waste[13]. Cavity fill times are on the order of milliseconds while the complete process cycle is only a few seconds long. Computer controlled measuring systems are required for data visualization, diagnostic services and machine monitoring, to automatically ensure repeatability and detect variations. Process variation creates variations in quality, which can lead to rejected parts and rework. Consistent performance is the key to producing successful products and reducing energy consumption and scrap production.

Hot runner technology is now available for zinc die casting. Figure 9 shows that conventional sprue and runner feed systems can be eliminated, so that molten zinc can be directly or indirectly injected into a single cavity or multiple cavities in the die. There are multiple process and environmental benefits from removing the sprue and runner system[14]. Managing and remelting of process scrap is significantly reduced or eliminated. With less metal in the die to cool, process cycle times are decreased. The die can contain more cavities, increasing productivity. All of these benefits lower the overall carbon footprint of the die casting operation.

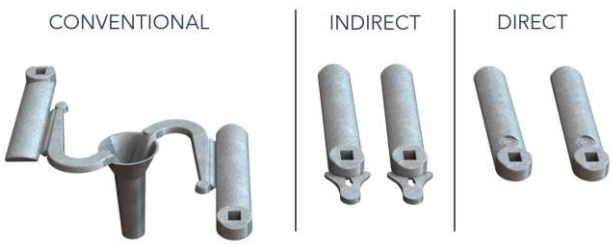

Figure 9 – *Elimination of conventional sprue and runner systems with hot runner technology.*

An important technology development for the decarbonization of the die casting industry is the electric die casting machine[15]. Compared to hydraulic machines, electric die casting machines have a more compact structure and reduced operating noise for improved working conditions. Fewer components translate into less maintenance and lower energy consumption since there is no hydraulic oil cooling system.

Conclusion

Zinc die castings have high strength, good elongation, thermal and electrical conductivity, high fluidity for thin wall casting, dimensional stability, and superior surface finish. Along with the process benefits of long-life tooling with net shape casting and lot traceability, makes designing in zinc an attractive option for automotive components. New machines, process control and waste reduction technology adds to the sustainability benefit of zinc die casting.

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2024 SHOW WRAP

The 2024 Die Casting Congress & Exposition was a tremendous success! Rebounding to pre-covid numbers, the show welcomed roughly 2200 attendees featuring over 670 unique companies. Indianapolis, the home of the Expo, offered something for everyone. Some of those that arrived early got to experience a Colts victory live from Lucas Oil Stadium, w hich set the pace for a truly great week. From September 30 - October 2 over 170 exhibitors were on display – machines, robots, degassing equipment, riveting presentation, virtual reality simulations and so much more. Concurrent congress sessions really bulked up the content being presented and allowed attendees so many topics to choose from.

I received favorable comments from several exhibitors about the quality and level of traffic on the show floor, as well as comments from many of those who attended the technical congress sessions.

"The 2024 Die Casting Congress & Exposition held in Indianapolis attracted nearly 2200 attendees, and over 170 exhibitors. It was wonderful to see this level of attendance, as it illustrates the value this event provides for the attendees and exhibitors. An abundance of information was transferred through the presentations and exhibits. The Awards Luncheon recognized the safety, die casting competition, technical and educational award winners and featured our most prestigious honor, the Doehler Award. This event, while taking the time to honor our award recipients, also provided a special networking opportunity. I received favorable comments from several exhibitors about the quality and level of traffic on the show floor, as well as comments from many of those who attended the technical congress

This has to be one of the best group of visitors we ever experienced. There is a real need and interest for new technology and solutions to die casting industry.

sessions. The host city of Indianapolis entertained our guests superbly. From the many great hotels and restaurants, to the Colts football game, the city was electric," said NADCA President Mike Meyer.

NADCA staff were out and about on the show floor and in the congress sessions, taking the pulse of our attendees to assess the quality of the event as well as gather feedback and suggestions. There was quite a bit of commentary on the post show survey as well about how the show went. Here are some comments we received.

"The vibe on the floor felt was more intense, more positive/hopeful for future business. Felt more contacts were made as an exhibitor. The app VERY useful! The checklist for uploading/completing documentation was useful. Delivery, set-up, breakdown all good; no damages. Check-in was smooth onsite and friendly," said Amy Bachulis, Sales/HR, HERCO.

"After being present to many Die Casting Congress & Expos over years, this has to be one of the best group of visitors we ever experienced. There is a real need and interest for new technology and solutions to die casting industry. Many thanks to the companies to let their employees explore new solutions for their plants," said Kevin Van Damme, AarKel Tool and Die Inc.

"This was the best networking show I have ever attended. Great discussions about keeping manufacturing strong in the U.S.," said Scott Donahue, Mo-Tech Corp.

'This year's show was exceptional. Great variety of Congress topics, and having dual sessions gave people an opportunity to customize their Congress experience. Floor was awesome, lots of amazing demos even going so far as casting actual zinc parts," added Jeremy DeHoff, Cascade Die Casting.

More options meant more attendees. Congress sessions took it up a notch by offering over 41 technical sessions and 2 special topic sessions. With over 70 attendees in each room, sessions peaked at a whopping 140 attendees.

"The 2024 NADCA Die Casting Congress provided a forum for the presentation of 41 technical papers. Average attendance for the presentations was 70. Having 5 simultaneous sessions did mean some attendees had to make a choice, but the high quality of the presentations meant that no matter which they chose, all received information relevant to the industry. Omar Nashashibi (Inside Beltway) provided a great presentation on how government is affecting manufacturing in the United States, while Paul Brancaleon (NADCA) gave an insightful presentation on on-shoring and near-shoring. Both presentations received very positive feedback for the information they contained. The quantity and quality of the papers presented at the 2024 NADCA Die Casting Congress shows that the industry continues to be dedicated to improving the technology and processes that make die casting such a widely used manufacturing method," said NADCA Project Manager, Beau Glim.

"I came to the Exposition so that I could learn more about die casting since I am relatively new to designing parts for the process. With that background, the best part of the Exposition was that the exhibitors were willing to share information about die casting and introduce me to their piece of the process even though I'm not a directly paying customer for their business. I thought that the support of the die casting industry in general was outstanding. The venue was also excellent - getting in and out was low-stress," said Bryan Drummond, Franklin Electric.

YOUNG PROFESSIONALS GATHER TOGETHER

This year also featured a very special session that brought together the newly formed NADCA Young Professionals Organization.

This group (Chaired by Spencer Schultze, Cascade Die Casting and supported by Education Chair RJ Fryan, Kind Alloys and Social Events Chair, Mindi Pagel, Spectro Alloys) met on Monday, September 30 for a networking/mentoring event. During this time the group worked on zoning in and defining the organization and what they hope to accomplish.

Later during the meeting, they broke up into smaller groups to get more help from our esteemed mentors. Industry leaders helped navigate hot topic questions and dug deeper into problem solving with our up-and-coming leaders. Special thanks to our mentors:

- Elizabeth Gubrud-Howe - CEO, Pacific Die Casting Corporation
- Mark Los - Senior Advisor, Special Projects, Buhler Prince, Inc.
- Steve Jacobson - President/CEO, BuhlerPrince, Inc.
- Tim Fenner - Regional Sales Manager & Business Development Manager, Shibaura Machine Company, America
- Robert DeNeff - Casting Engineer, TOYO Machine America, LLC
- Frank Sant - President, Falcon Lakeside Manufacturing

The best part of the Exposition was that the exhibitors were willing to share information about die casting and introduce me to their piece of the process.

NETWORKING OPPORTUNITIES AND SPECIAL EVENTS

It wasn't only the IDRA booth that was pumping bass through the show floor. The Welcome Party, held Monday, September 30, pumped energy onto the show floor and provided attendees a laidback way to mix and mingle. Maybe you snacked on some chicken and waffles, grabbed a beverage with your favorite supplier or enjoyed some tunes mixed by our DJ in the Frech booth. Regardless of what you did, we know you were in great company.

DIE CASTING INDUSTRY AWARDS PRESENTATION

On Tuesday, October 1 we honored those that have been major contributors to our industry. The following awards were presented during this special event:

- Doehler Award - Patrick (Pat) Greene, Cascade Die Casting Group, Inc.
- Nyselius Award – Alex Monroe, SpaceX
- Committee Member of the Year Award – Patricia Miller, Uddeholm North America

• Best Congress Paper Award - Preparation of a High Performance Coating Using Cathodic Vacuum Arc Deposition for Die Casting Molds and its Characterization

• Emphasis on Education Recognition Award – TESLA

• International Die Casting Design Competition

• 2023 Safety Awards

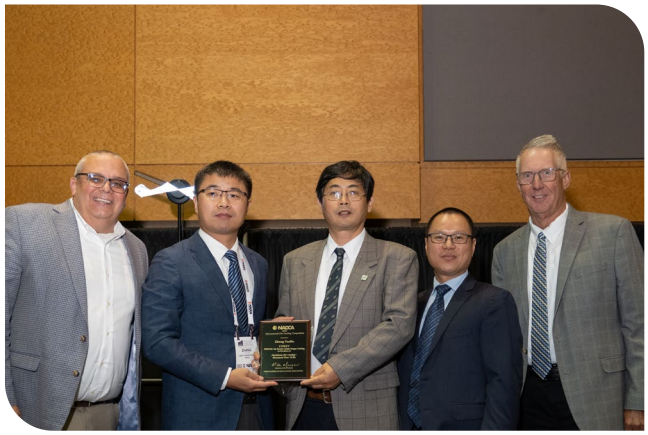
2024 INTERNATIONAL DIE CASTING DESIGN AWARDS

The winners of the International Die Casting Design Competition were on display on the show floor. Video looping details on the winners spun overhead and attendees were able to walk around each casting, investigating the intricate work and advanced design they offered.

Aluminum – Under 1 lb
General Die Casers
Caster Award Nominee: John Quitter & Tim Tennant
Customer: Flex N Gate

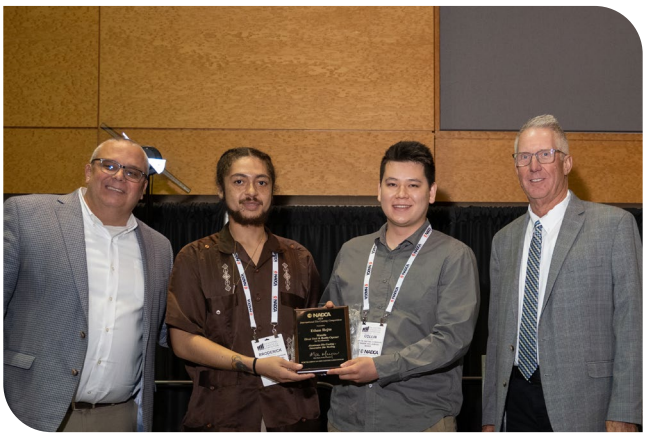
Aluminum – 1 to 10 lbs
Benda Tool & Model Works
Caster Award Nominee: Ryszard Urbaniak, Dan Jacks, & Ricardo Paniagua
Customer: Datron World Communications, Inc

Structural Aluminum – Over 10lbs
Xpeng inc., Alcoa Corp and Csmet
Caster Award Nominees: Luo WenZhi (XPENG), Xinyan Yan (Alcoa), Zhang YueBo (CSMET)
Customer: XPENG Inc.



Structural Aluminum – Under 10lbs
IKD Co., DN Automotive, & General Motors
Caster Award Nominees: Xiaokang Liang (IKD), Hugh Leitch (DN Automotive), Sam Jomaa, Wojtek Suchta, & Frank Risko (General Motors)
Customer: General Motors

Aluminum - Innovative Die Tooling
Benda Tool & Model Works
Caster Award Nominee: Collin Elmer & Broderick Gillard
Customer: Benda Tool & Model Works / A&B Die Casting Division



Magnesium - Over .5 lbs
Meridian Lightweight Technologies
Customer: Advanced Filtration Systems, Inc

Zinc – Under 6oz
Lakeside Casting Solutions
Caster Award Nominee: Dennis Lehenbauer
Customer: Utility Solutions Group

"The North American Die Casting 2024 International Die Casting Design Competition awards were presented in Indianapolis, Indiana. This casting competition featured castings made from Structural Aluminum, High Pressure Die Cast Aluminum & Magnesium, and Zinc alloys. Entries were submitted by automotive and non-automotive die casting companies represented from North America, Europe, and China. There were seven unique categories, showcasing a wide range of castings varying in size and finish, from under 6 ounces to over 86 lbs. This year we had a new category for a casting made from a completely 3D printed die cast cavity by Benda Tool and Model Works. This is a unique application and definitely the future of 3D printing applications for high pressure die casting. The winners of this year's competition demonstrated exceptional skill in each category, making them the best in the world for 2024. Congratulations to all the winning die casters on their outstanding achievements," said NADCA Executive Director of Research, Education & Marketing, Paul Brancaleon.

COMMITTEE MEMBER OF THE YEAR

Patricia Miller was awarded the Technical Committee Member of the Year Award. The person chosen for NADCA's Technical Committee Member of the Year award is subject to several sets of criteria. The award, chosen by NADCA's technical staff and Technical Committee Chairmen, is given based on participation in committees, contribution to committee/task force, and applicability of efforts to industry.

Patricia Miller is the Director of Technical Services for Uddeholm North America, a division of voestalpine High Performance Metals. Her current role is to support the technical needs of salesforce, customer base, and end users in the United States and Canada in the area of tooling materials. This entails using knowledge of best practices across the wide spectrum of applications where our materials are used, the goal being their proper and successful implementation. It also involves the development of training programs using the latest digital tools.

In support of these activities, she is currently involved in a number of industry associations. Since a large focus of the organization is the use of their steel, heat treatment, and surface protection for the die casting industry, Patricia have been a member of the North American Die Casting Association for many years, helping to establish the NADCA 207 specification for die materials and heat treatment, and supporting the special materials, coatings, and welding committees as well.

Past job responsibilities have been support of aerospace, oil and gas, and quality related steel development which was possible because of a solid education aided by being a co-op at Armco Steel Research and Plant Floor Operations where many developments learned there are still in industry use today.

Patricia graduated with a B.S. and M.S. in Metallurgical Engineering from the University of Illinois, Champaign/Urbana, and an MBA with emphasis on Operations Management from the University of Chicago. Having worked with IBM supporting Engineering Platforms in the Chicago area, she was introduced to many engineering and office software developments.

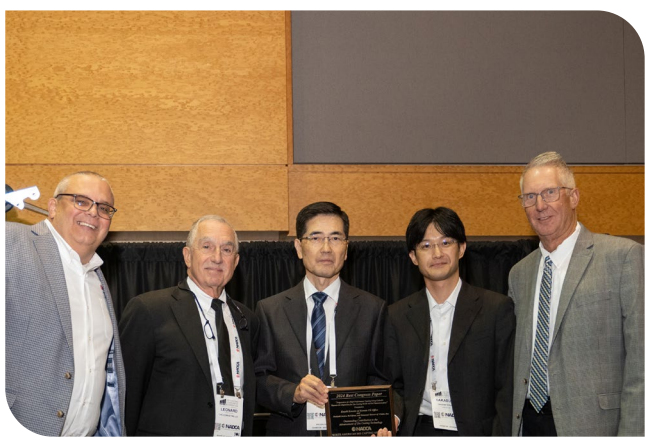
Recent awards have been the 2022 Uddeholm Technician of the Year, and nominated and awarded as one of the Plastics News' Women Breaking the Mold class of 2024.

Patricia is passionate about the arts and history, and enjoys documentaries. In addition, she likes to travel and when she does, she searches for children's books of different countries and share them with her children and grandchildren. One of her earliest was introducing the very first book of Harry Potter to her son Joe when he was 6 years old and finding Platform 9 ¾ at King's Cross Station in London (they have upped their marketing since she was last there). Her latest book is Tove Jansson's Moomin, a mystical creature from Moominvalley. She was thrilled when her granddaughter Maeve took the book she gave her to her day care and the class sat mesmerized while it was read to them. And when she can she tries to golf with her husband at Medinah Country Club and looks forward to playing the new Course 3.

BEST CONGRESS PAPER AWARD

Dr. Kazuki Kawata, Noriyuki Inatsu, Rai Iijima and Takasumi Tatsuno were presented with the award for Best Congress Paper. The Best Congress Paper is selected by paper reviewers and session chairpersons from NADCA's International Technical Council and NADCA's Technical Staff. Papers that are chosen demonstrate a high degree of technical achievement and excellence in the advancement of die casting.

Dr. Kazuki Kawata received his PhD from Nagoya University, Japan, and his MS and BS from Kansai University, Japan. For the past 41 years, he worked for Oriental Engineering Co., Ltd., which manufactures



heat-treatment furnaces and offers contract heat-treatment services. For the last eight years, he served as the CEO of this company. He currently runs a consultancy office that focuses on heat-treatment and surface-techniques. For many years, he has applied plasma nitridation in conjunction with ceramic coating to die-casting molds using mass-production-type PECVD equipment, achieving good results. Recently, he has focused on developing new PVD coatings and has applied these coatings to various molds.

Noriyuki Inatsu received his Bachelor's degree in Systems Engineering from the Nippon Institute of Technology (NIT). He then joined Castec Inc., where he brought the company's heat treatment and surface treatment operations in-house. He was also a key figure in the company's production engineering and production management for heat treatment and surface treatment. After that, he established the Engineering Service Department, a division aimed at solving problems such as early life extension and life extension of die components such as cast pins and inserts. Currently, as manager of the Engineering Service Department, he is active in solving problems of die components for customers.

Rai Iijima has been involved in the die casting industry for more than 25 years after joining Castec Inc., a manufacturer of core pins and inserts for die casting molds, where he currently serves as the company's CEO. Castec has been exhibiting at NADCA exhibitions since 1995, and its subsidiary Castec Corp, established in Indiana in 1997, is a NADCA member.

Takasumi Tatsuno received his Bachelor's degree in Mechanical Engineering from the Nippon Institute of Technology (NIT). He then joined Castec Inc., where he worked for four years as a production engineer in the machining department. Currently, he serves as a specialist in the Engineering Services Department, where he is active in solving problems such as early life and part life extension for die components such as cast pins and inserts from the perspective of machining technology.

Their paper, Preparation of a High-Performance Coating Using Cathodic Vacuum Arc Deposition for Die Casting Molds and Its Characterization, can be read on page 12 of this publication.

EMPHASIS ON EDUCATION RECOGNITION AWARD

TESLA was presented with the Emphasis on Education Recognition Award recognizes a die casting company that has had a specific focus on die casting education and training for their workforce. The award is chosen by NADCA Education Staff and Educational Committee Chairman. The selection criteria for outstanding contribution to the promotion of die casting education includes the number of NADCA courses held over the past year, the total number of employees exposed to the courses, and consistency in offering courses over the past three years.

Tesla's mission statement is to accelerate the world's transition to sustainable energy by creating products that help reduce emissions and replace some of the planet's biggest polluters. Tesla's products include all-electric vehicles, solar energy, and batteries for storing clean energy. Tesla is leading a revolution to transform the automotive industry with zero-emissions technology and reminding drivers why they love their cars in the process. Tesla focuses on utilizing manufacturing processes that are lean and environmentally sustainable. Embracing this approach, they are reinventing the manufacturing process with first principles approach.

NYSELIUS AWARD

Alex Monroe was presented with the Nyselius Award. This award is given in recognition of exceptional technical contributions to the industry. The award was established in 1965 by the Nyselius Foundation.

Alex holds both a Bachelor's and Master's in Mechanical Engineering from the University of Iowa, and a PhD in Materials Engineering from Michigan Technological University. Throughout his career, he has made contributions to the field, particularly in the areas of soldering in aluminum die castings and the simulation of shrinkage in die castings. Alex held roles at NADCA, MAGMA Foundry Technologies, Mercury Marine, and currently serves as a Lead Engineer at SpaceX. With over five patents and numerous publications, Alex is a recognized contributor in the die casting field, having received several industry awards, including the prestigious NADCA Best Paper award.

HERMAN H. DOEHLER AWARD

Patrick (Pat) Greene was awarded our industry's top honor, the Herman H. Doehler Award. This award is given in recognition of outstanding contributions to the advancement of the die casting industry or to the art of die casting.

Technical Achievement – as measured by significant scientific contributions of a metallurgical or engineering nature relating to the die casting process, including casting alloys, die steels and die practices, finishing methods, machine design and related subjects.

Advancement in Plant Operations – of a management or administrative nature and related to the operational phases of the industry safety procedures, devices and techniques, practical mechanical advances and other accomplishments directly related to efficiency, economy and safety of plant operations.

Other Activities – not primarily of a scientific nature or operational nature that result in the enhancement of the reputation and acceptability of die castings. All contributions to the progress of the art of die casting and advancement of the industry are to be evaluated on the applicability of the contribution to the die casting industry as a whole.

Greene has been the CEO of Cascade Die Casting Group, Inc. since 2009. Prior to becoming CEO, Pat served as Vice President – Finance of Cascade Die Casting Group, while also holding finance positions at several affiliated companies including GR Spring & Stamping, Inc. since 1992. Cascade Die Casting Group is a $120 million die casting manufacturer that produces castings used in automotive, appliance, consumer products, and

transportation industries. Founded in 1978 by Ted Hohman, Cascade remains a privately owned company today with manufacturing locations in Michigan and North Carolina, employing a total of 450 team members. Cascade is committed to improving the lives of their team members, including creating a positive work environment, encouraging growth and investing in employee development. They have been recognized as one of the National Best and Brightest Companies to Work For in 2023 and 2024. Members of the Cascade team have been involved in NADCA committee and chapter activities including R&D, Safety, Government Affairs, Scholarships and Die Materials, and have served on the local NADCA chapter boards.

Pat has been an active leader in the industry for the last 15 years, participating as a member of the Board of Governors and Executive Council of NADCA. He served as NADCA's Chairman in 2020 and 2021. He also serves on the Board of Directors of The Right Place, a Michigan based regional economic development organization. Additionally, he is the past chairman of West Michigan Manufacturers Council and continues to serve on the executive committee. Pat is deeply involved in the Jandernoa Entrepreneurial Mentorship (JEM) program, a West Michigan initiative that mentors business entrepreneurs to help them develop as leaders and navigate the challenges they face in their businesses. Over the past 35 years, he has contributed his time to numerous other trade and community boards.

Pat graduated from Michigan State University in 1983 with a bachelor's degree in finance. He became a licensed CPA and spent eight years at Coopers and Lybrand (a predecessor to Pricewaterhouse Coopers) where he met his wife Julie. He joined Cascade in 1992.

Pat and his wife Julie have been married for 35 years and reside in Grand Rapids. They enjoy traveling, hiking, golf and spending time with family. They have two sons, Michael and John, and two daughters in law, Betsy and Lidia.

SAFETY AWARDS

NADCA also acknowledged the 2023 Safety Awards Winners. These awards recognize companies within the die casting community that have exceeded or met the industry criteria to operate a safe working environment for their employees. Only NADCA Corporate Members in North America are eligible. There are two award levels: the Perfect Award recognizes the facilities that operated all of 2023 without a reportable injury or illness, and the Outstanding Award honors operations whose reportable injury or illness level was below the national average for all manufacturing of 2.2%.

In addition, the NADCA Progress Award for Safety Improvements recognizes companies with a recorded safety DART improvement of 25% or more as compared to the prior year. NADCA is pleased to recognize all of these award-winning companies.

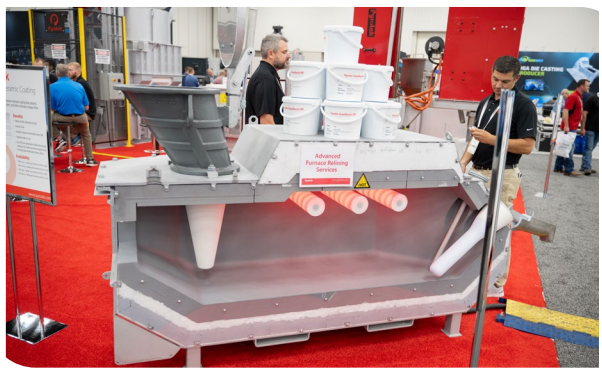
Interested in viewing a pretty slick site with information on all of our award winners? Visit: www.nadcaawards.com

OUR SINCEREST THANK YOU

Phew! That was a whirlwind of an event. We would like to thank all of those that attended, making this event one for the books – our largest and most successful event in years. No one can predict what the world will throw at them, but the resiliency and comradery we see in this industry is unmatched.

A special shout out to our exhibitors, authors, and sponsors: voestalpine, ItalPresseGauss, Flow-3D, Techmire, BuhlerPrince, Yizumi HMP, Auburn FilterSense, Magma, Automated System & Design, Plansee, StrikoWestofen, Quaker Houghton and Frech USA.

Did someone say breweries and cheese curds? That's right, we are headed to Milwaukee, WI in 2025. The Die Casting Congress & Tabletop will take place October 7-9 at the Baird Center. We hope to see you there, but until then, don't be a stranger.



Want more photos?

To view all photos available from the show, please visit NADCA's Facebook page at:
www.diecasting.org/facebook

Photos by: Antonio Chapital
chapitalphoto@gmail.com

NADCA Welcomes Its Newest Corporate Members

HF Manufacturing

67 Hi-Line Drive
Union, MO 63084
P: 314.581.9537
E: JasonH@hfmanufacturingusa.com
W: HFManufacturingUSA.com

HF Manufacturing focuses on multi slide zinc die casting and production CNC milling/turning. HF strives to bring quality, delivery and value for every customer. Joining NADCA as a new business was an easy decision. NADCA unites the die casting community to improve the nation's manufacturing knowledge and expertise. NADCA provides an excellent education system for employees, and brings a universal standard for an industry of competing businesses.

LEECH Industries

13144 Dickson Road
Meadville, PA 16335
P: 814.336.2141
E: leechind@leechind.com
W: leechind.com

Leech Industries is a one-stop manufacturing company located in Meadville, PA. With more than 75 years of manufacturing experience, Leech offers a range of capabilities, including high-volume plastic injection molding, metal stamping, and zinc die casting, as well as low-volume, high-mix machining services.

With an expert team of engineers equipped to guide design and prototyping, Leech facilitates projects from conception through production and assembly. As an AS9100 and ISO-certified supplier, the Leech team adheres to quality standards required by challenging industries, including aerospace and medical.

Leech Industries joined NADCA to expand its network and gain more exposure as a die casting supplier. Additionally, the Leech team will leverage NADCA's extensive training resources and job tool kits to build upon their current knowledge base.

United Tool and Mold

106 Financial Blvd.
Liberty, SC 29657
P: 864.859.8300
E: Heath.Cassell@utminc.com
W: www.utminc.com

Since its founding in 1995, United Tool and Mold focuses and works hard to keep the manufacturing industry running. UTM has rapidly grown with the success of completing engineering changes, refurbishments, repairs, and emergency repairs. With the "Charge forward attitude of a Rhinoceros" UTM has been able to remain a top performer in the repair industry.

UTM continually sets itself apart by keeping up with industry changes and demands of new technologies. The company is equipped with multiple 5-axis CNC machines and EDMs that can handle large dies. UTM is also equipped with a 500T spotting press capable of holding 170,000 lbs, and crane capacity up to 50T.

The company diversely works on die cast, plastic injection, blow molds, stamping dies , and forming dies. Thanks to a big diversity in work, no job comes as a surprise with the amount of knowledge and skill that they possess. United Tool and Mold stays ready to take on any job, at any time, to keep the manufacturing industry running.

Zeman Tool & MFG

W228 N575 Westmound Drive
Waukesha, WI 53186
P: 262.549.4400
E: sschreindl@zemantool.com
W: zemantool.com

Since 1966, Zeman Tool & Mfg. has empowered die casters with industry-leading fixturing solutions. Their team of specialists leverages extensive experience to design and manufacture custom fixtures renowned for unparalleled precision and durability.

Understanding the critical demands of die casting – tight tolerances, intricate components, and relentless production schedules – Zeman prioritizes meticulous engineering. Their fixtures optimize part handling, minimize distortion, and ensure unwavering quality across high-volume runs.

Zeman's commitment to rigorous testing procedures guarantees exceptional performance and reliability. From manual solutions to fully automated systems, they offer a comprehensive suite of options designed to streamline your die casting process and maximize Overall Equipment Effectiveness.

Zeman works with casting companies that also provide secondary services such as machining. Its partnerships improve part design, machining and inspection fixtures.

2024 Corporate Members

CORPORATE DIE CASTERS

A

A & B Die Casting, a division of Benda Tool & Model Works, Inc.
Hercules, CA

AAM - American Axle & Manufacturing
Detroit, MI

ABCO Die Casters Inc.
Newark, NJ

ACE Precision International, LLC
Marshalltown, IA

Acme Alliance LLC
Northbrook, IL

ADC Aerospace
Buena Park, CA

Advance Die Cast LLC
Milwaukee, WI

Ahresty Wilmington Corp.
Wilmington, OH

Aludyne - Pierceton Plant
Pierceton, IN

Alupress LLC
Laurens, SC

Anderson Die Casting Co.
Englewood, CO

Anderton Castings De Monterrey
Apodaca NL

Anderton Castings LLC
Troy, TX

Apex Aluminum Die Casting Co.
Piqua, OH

Astronics PECO Inc.
Clackamas, OR

Auto Cast Inc.
Grandville, MI

B

Blue Ridge Pressure Castings
Lehighton, PA

Bocar US, Inc.
Huntsville, AL

Boyd Allenton, LLC
Allenton, WI

Bridgeport Fittings, LLC a Division of NSI Industries
Stratford, CT

C

C Palmer Die Casting Inc.
Oakland, MD

Caldwell Casting Company
Cambridge, MD

California Die Casting Inc.
Ontario, CA

Canimex Incorporated
Drummondville, QC, Canada

Cascade Die Casting Group - Atlantic
High Point, NC

Cascade Die Casting Group - Great Lakes
Sparta, MI

Cascade Die Casting Group - Group Services/ Corp. HQ
Grand Rapids, MI

Cascade Die Casting Group Inc. - Mid-State
Grand Rapids, MI

Cast Products Inc.
Norridge, IL

Cast Specialties Inc.
Warrensville Heights, OH

Centracore de Mexico
Guanjuato, Mexico

Centrifugal Castings*
Milwaukee, WI

Chicago White Metal Casting Inc.
Bensenville, IL

CMP Group Ltd.
Delta, BC, Canada

CompX Security Products
Grayslake, IL

Consolidated Metco Inc.
Clackamas, OR

Cosma Casting Michigan, Cosma International, Magna International
Battle Creek, MI

D

Dalite*
Troy, MI

Dart Casting, Inc.
Alsip, IL

DeCardy Diecasting Co.
Chicago, IL

Deco Products Co.
Decorah, IA

DyCast Specialties Corp.
Starbuck, MN

Dyersville Die Cast
Dyersville, IA

Dynacast International, LLC - Elgin Plant
Elgin, IL

Dynacast International, LLC - Germantown Plant
Germantown, WI

Dynacast International, LLC - Global Headquarters
Charlotte, NC

Dynacast International, LLC - Lake Forest Plant
Lake Forest, CA

Dynacast Limited
Peterborough, ON, Canada

Dynacast Mexico SA De CV
Obispo, Cuautitlan, Mexico

E

Empire Die Casting
Macedonia, OH

F

FabCast Solutions SRL De CV *
San Luis Potosí Mexico

Falcon Lakeside Manufacturing
Eau Claire, MI

FCA Canada, Inc. - Etobicoke Casting Plant
Toronto, ON, Canada

Fielding Mfg.-Zinc Diecasting Inc.
Cranston, RI

Fort Recovery Industries Inc.
Fort Recovery, OH

FT Precision
Fredericktown, OH

G

G & M Die Casting Co. Inc.
Wood Dale, IL

General Die Casters Inc.
Twinsburg, OH

General Motors Corporation - Bedford Casting Operations
Bedford, IN

General Motors Corporation - R&D Technical Center
Warren, MI

Gibbs Die Casting Corporation
Henderson, KY

Gnutti Carlo Canada Ltd. - Light Metals Div.
Ljunghall, Canada

Greenfield Industries Inc.
Freeport, NY

H

Heritage Die Casting Co.
Denver, CO

HF Manufacturing*
Union, MO

Honda De Mexico - Celaya Engine Plant
Celaya, Mexico

Honda De Mexico - Transmissions
Celaya, Mexico

Honda Development Manufacturing of America - Alabama Auto Plant - ALDC
Lincoln, AL

Honda Development Manufacturing of America - Anna Engine Plant: ALDC
Anna, OH

Honda Development Manufacturing of America - Auto Development Center: Aluminum Division
Raymond, OH

Honda Development Manufacturing of America - Production Engineering
Anna, OH

Honda Development Manufacturing of America - TMPG: ALDC
Tallapoosa, GA

Honda Development Manufacturing of America - TMPO: ALDC
Russells Point, OH

Honda North America - Purchasing
Marysville, OH

Honda of Canada Mfg. Inc. - Engine Plant: ALDC
Alliston, ON, Canada

Honda Power Equipment - Aluminum Die Cast
Swepsonville, NC

Hyatt Die Cast & Engineering Corporation
Cypress, CA

J

J&M Precision Die Casting
Elyria, OH

JTEKT Automotive*
White Pine, TN

K

Kamtek Casting, Inc. - a Division of Magna International
Birmingham, AL

Kason Industries Inc.
Shenandoah, GA

Kobelt Manufacturing Company Limited
Surrey, BC, Canada

Kwikset Corporation
Denison, TX

L

Lakeside Casting Solutions
Monroe City, MO

Lamar Tool & Die Casting Inc.*
Modesto, CA

Le Sueur Incorporated
Le Sueur, MN

Leech Industries - Division of Leech Holdings, LLC*
Meadville, PA

Linamar Light Metals - Mills River (LLM-MR)
Arden, NC

M

Madison Precision Products
Madison, IN

Madison-Kipp Corp.
Madison, WI

Madison-Kipp Corp. - Richmond
Richmond, IN

Mag-Tec Casting Corp.
Jackson, MI

Marchesi Light Alloy
Jalisco, Mexico

Mercury Castings - Div. of Mercury Marine, WI
Fond Du Lac, WI

Meridian Lightweight Technologies Corporate Head Office
Plymouth, MI

Meridian Lightweight Technologies Inc. - GTC
Strathroy, ON, Canada

Meridian Technologies Inc. - Magnesium Products of America
Eaton Rapids, MI

Meridian Technologies Mexico
Ramos Arizpe, Coahuila, Mexico

Michigan Automotive Compressor, Inc.
Parma, MI

Michigan Die Casting LLC
Dowagiac, MI

Midwest Die Casting Corp.
Milwaukee, WI

Millison Casting Technology LLC*
Sallisaw, OK

Miniature Casting Corp.
Cranston, RI

Mumford Companies - Metal Casting Division
Chicago, IL

N

Nebraska Aluminum Castings Inc.
Hastings, NE

Nemak Alabama
Sylacauga, AL

Nemak Kentucky*
Glasgow, KY

Nemak Wisconsin
Sheboygan, WI

New GLDC LLC
Muskegon, MI

Northern Iowa Die Casting Inc.
Lake Park, IA

O

Omni Die Casting Inc.
Massillon, OH

Ozark Die Casting Co.
Saint Clair, MO

P

Pace Industries, Cambridge
North Billerica, MA

Pace Industries, Chihuahua
Chihuahua, Mexico

Pace Industries, Corporate Headquarters
Rochester, MI

Pace Industries, Grafton
Grafton, WI

Pace Industries, Harrison Aluminum
Harrison, AR

Pace Industries, Harrison Zinc
Harrison, AR

Pace Industries, Jackson
Jackson, TN

Pace Industries, Latrobe
Loyalhanna, PA

Pace Industries, Maple Lake
Maple Lake, MN

Pace Industries, Port City
Muskegon, MI

Pace Industries, Saltillo
Saltillo, Mexico

Pacific Die Casting Corporation
Vancouver, WA

PHB - Die Casting Div.
Fairview, PA

PIAD Precision Casting Corporation*
Greensburg, PA

Polaris Inc. *
Monticello, MN

Prestige Casting Inc.
Englewood, CO

Production Castings Inc.
Fenton, MO

Promatek Research Center - a Division of Cosma Part of Magna Intl.
Brampton, ON Canada

R

RCM Industries Inc. - Aallied Die Casting Co. of Franklin Park
Franklin Park, IL

RCM Industries Inc. - Aallied Die Casting Co. of NC
Rutherfordton, NC

RCM Industries Inc. -Corporate Headquarters
Franklin Park, IL

RCM Industries Inc. - Imperial Die Casting Co.
Liberty, SC

RCM Industries Inc. - Inland Die Casting Co.
Wheeling, IL

Rheocast Company, A Division of The Fall River Group, Inc.
Germantown, WI

Ryobi Die Casting Mexico
Irapuato, Guanajuato, Mexico

Ryobi Die Casting USA Inc.
Shelbyville, IN

S

Schlage De Mexico
Baja California, Mexico

SDC Incorporated
Sullivan, MO

Shawnee Specialties Incorporated
Eau Claire, MI

Simalex Manufacturing Company Ltd.
Langley, BC, Canada

SKS Die Casting & Machining Inc.
Alameda, CA

Soldy Manufacturing Company
Schiller Park, IL

SpaceX
Hawthorne, CA

Spartan Light Metal Products Inc.
Sparta, IL

Spartan Light Metal Products LLC
Hannibal, MO

Spartan Light Metal Products -Corporate Office
Hannibal, MO

Spartan Light Metal Products LLC
Mexico, MO

Spartan Light Metal Products - LMP Plant
Mexico, MO

Stellantis - Kokomo Casting Plant
Yorktown, IN

STRATTEC Component Solutions
Milwaukee, WI

Sundaram - Clayton Limited
Deerfield, IN

T

TAC Manufacturing Incorporated
Jackson, MI

Team Industries - Detroit Lakes
Detroit Lakes, MN

Technical Die-Casting Inc.
Winona, MN

TESLA Motors
Lathrop, CA

Top Die Casting Company
South Beloit, IL

Troy Design & Manufacturing*
Plymouth, MI

TRU Die Cast Corp.
New Troy, MI

TVT Die Casting Die Casting & Manufacturing
Portland, OR

Twin City Die Castings Co.
Minneapolis, MN

Twin City Die Castings Co.
Monticello, MN

Twin City Die Castings Co.
Watertown, SD

Twinsburg Manufacturing Facility, a Division of AAM
Twinsburg, OH

W

Walker Die Casting
Lewisburg, TN

Whitehead Die Casting Inc.
Gainesville, GA

Y

Yamada North America
South Charleston, OH

CORPORATE SUPPLIERS

A

AarKel Tool & Die Inc.
Wallaceburg, ON, Canada

Absolute Machinery Corporation
Worcester, MA

Alcoa USA Corp.
Alcoa, TN

Allied Metal Co.
Chicago, IL

Anviloy By Astaras Inc.
Largo, FL

Audubon Metals LLC
Henderson, KY

Automation Systems & Design
Dayton, OH

B

B & L Information Systems Inc.
Bridgman, MI

Badger Metal Tech Inc.
Jackson, WI

Bedford Machine & Tool Inc.
Bedford, IN

BGH Specialty Steel*
Macedonia, OH

Bholster Tech*
Toronto, ON, Canada

Blue Ridge Community College
Flat Rock, NC

Bodycote Thermal Processing Inc.
Sturtevant, WI

BOHLER
Walnut, CA

Brach Machine
Batavia, NY

Brondolin North America
Benton Harbor, MI

BuhlerPrince Inc.
Holland, MI

C

Cal-Miser Aluminum Systems Inc.
Rock Island, IL

Canmet MATERIALS - Natural Resources Canada
Hamilton, ON, Canada

Castec Corporation
Indianapolis, IN

Castool Heat Treat
Newmarket, ON, Canada

Castool Tooling Systems
Uxbridge, ON, Canada

Chem-Trend Ltd. Partnership
Howell, MI

Colosio Die-Casting Machines & Accessories
Minneapolis, MN

Conticast Hormesa LLC
Weston, FL

Cottingham & Butler
Dubuque, IA

Custom Alloy Sales, Inc.
City of Industry, CA

D

Daido Steel Co. Ltd.
Hebron, KY

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL

Delaware Dynamics LLC*
Muncie, IN

Die Cast Press Manufacturing Co.
Paw Paw, MI

Diehl Tool Steel
Cincinnati, OH

Die-Pro LLC
Sheboygan Falls, WI

DieTech & Engineering Inc.
Grand Rapids, MI

DISA Group
LaGrange, GA

DME Company
Madison Heights, MI

DTP Diecast Solutions LLC
Florence, AL

Dynamo Inc.
LaGrange, IL

E

Eastern Alloys Inc.
Maybrook, NY

EcoShot, Inc.
Indianapolis, IN

EKK, Inc.
Farmington Hills, MI

Ellwood Specialty Steel
New Castle, PA

Exco Engineering
Newmarket, ON, Canada

F

Finkl Steel
Chicago, IL

Finkl Steel - Sorel
St-Joseph-De-Sorel, QC, Canada

Fisa North America Inc.
Elk Grove Village, IL

Flow Science
Santa Fe, NM

FONDAREX USA
Schoolcraft, MI

Frech USA Inc.
Michigan City, IN

Fremar Industries
Brunswick, OH

G

Godfrey & Wing Inc.
Aurora, OH

H

HA International, LLC
Westmont, IL

Hanson International *
Saint Joseph, MI

H Gerber Consulting
Evanston, IL

Henkel Corporation
Madison Heights, MI

Herco, LLC
Auburn Hills, MI

High Temperature Systems Inc.
Chagrin Falls, OH

Hildreth Mfg LLC
Marion, OH

Hill & Griffith Co.
Cincinnati, OH

HTS International Corporation
Knoxville, TN

I

IDRA North America
Kokomo, IN

IECI Srl
Pine Brook, NJ

Imperial Zinc Corp. & Imperial Aluminum Corp.
Chicago, IL

Inductotherm Corp.
Rancocas, NJ

Industrial Innovations
Grandville, MI

Italpresse Gauss
Lagrange, GA

J

J&S Chemical Corp.
Canton, GA

K

Kind Specialty Alloys LLC
Youngstown, OH

Kirby Metal Recycling
Clinton, MD

L

LaFrance Manufacturing Co.
Maryland Heights, MO

LK World
Edinburgh, IN

Lethiguel USA
Rogers, MN

LiCON Mt LP
Dexter, MI

LIFT - American Lightweight Materials Manufacturing Innovation Institute*
Detroit, MI

Lincoln Electric Automation
Columbus, OH

Lindberg MPH
Riverside, MI

Luke Engineering & Manufacturing Co.
Wadsworth, OH

M

M & I Machine
Benton Harbor, MI

MAGMA Foundry Technologies Inc.
Schaumburg, IL

Mangas-AarKel Tool and Engineering Inc.
Muscle Shoals, AL

Meitler Consulting Inc.
Tonganoxie, KS

Metal Conversions Ltd.
Mansfield, OH

Metal Mechanics Inc.
Schoolcraft, MI

Metalworks Recycle-Reload, LLC
Bowling Green, KY

Mokon
Buffalo, NY

MORESCO USA Inc.
Fountain Inn, SC

N

New Brunswick Plating Inc.
New Brunswick, NJ

Nexthermal Corporation
Battle Creek, MI

Norican Group
LaGrange, GA

Novacast Solutions USA Inc.
Naperville, IL

O

OEE Companies
North Oaks, MN

Oerlikon Balzers Coating USA
Rock Hill, SC

P

Pascal Engineering
Arlington Heights, IL

Patterson Mold & Tool
Saint Charles, MO

Paulo
Saint Louis, MO

PCS Company
Fraser, MI

Phygen Coatings Inc.
Minneapolis, MN

Progressive Components
Wauconda, IL

Prolong Surface Technologies
West Chicago, IL

Pyrotek Inc.
Columbia City, IN

Q

Quaker Houghton
Dayton, OH

R

Regloplas Corporation
Sodus, MI

Rochester Aluminum Smelting Canada Ltd.
Concord, ON, Canada

Rosler Metal Finishing USA LLC*
Battle Creek, MI

S

Sandvik Machining Solutions AB*
Mebane, NC

Sanji Industries
Celina, OH

Sanyo Special Steel USA Inc.
New York, NY

SAPP Inc.
Edinburgh, IN

The Schaefer Group Inc.
Dayton, OH

Shibaura Machine Company, America
Elk Grove Village, IL

SIJ Metal Ravne - SIJ Americas
Hazlet, NJ

Sinto America
Grand Ledge, MI

Socitec US LLC*
Broadview, IL

Spectro Alloys Corp.
Rosemount, MN

Stotek Inc. *
Pewaukee, WI

StrikoWestofen America
Kalamazoo, MI

Sun Metalon
Cambridge, MA

Sun Steel Treating, Inc.
South Lyon, MI

Superior Aluminum Alloys
New Haven, IN

Swiss Steel Canada, Inc.
Mississauga, ON, Canada

Swiss Steel USA, Inc.
Carol Stream, IL

T

Techmire
Pointe-Claire, QC, Canada

Therm-Tech of Waukesha
Waukesha, WI

Titus Group / Titus Technologies*
Columbia City, IN

TOYO Machine America, LLC
The Villages, FL

Transmet Corporation*
Columbus, OH

Transvalor Americas Corp.*
Chicago, IL

Tvarit GmbH *
Ottawa, IL

U

UBE Machinery Inc.
Ann Arbor, MI

Uddeholm USA
Elgin, IL

Ultraseal America Inc.
Ann Arbor, MI

United Tool and Mold*
Liberty, SC

V

Valor Alloys, LLC
Houston, TX

VERSEVO Inc.
Hartland, WI

Visi-Trak Worldwide LLC
Valley View, OH

voestalpine Additive Manufacturing Centre Ltd.
Mississauga, ON, Canada

voestalpine Eifeler Coatings Technology
Saint Charles, IL

voestalpine High Performance Metals Corp.
Elgin, IL

W

Wheelabrator Group
LaGrange, GA

Wollin USA
Plymouth, MI

Y

YIZUMI-HPM Corp.
Iberia, OH

Yushiro Manufacturing America, Inc.
Shelbyville, IN

Z

Zeman Tool & MFG*
Waukesha, WI

Zitai USA - Die Casting Equipment Group
Highland Park, IL

*New Corporate Member Companies

Chapter News & New Members

Chapter 3 - Michigan

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

New Members: *Joe Beuker, Al Bowlson, both with Auto Cast Inc.; William Garvey, Cosma Casting Michigan, Cosma International, Magna International; Cesar Grajeda, Pace Industries, Corporate Headquarters; Tim Hardimon, Unifrax - Thermbond Refractory Solutions; Andrea Hill, Cosma Casting Michigan, Cosma International, Magna International; Michael Kehn, Tonci Kovac, both with Ford Motor Company; David Miller, Ionbond US - Madison Heights; Robert Monroe, Social Experiment, LLC; Zachary Reed, Michigan Technological University; Ian Saum, Ford Motor Company; Parveen Singh, DENSO; Robbie Stacey, Delaware Dynamics*

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: *Luke Badger, RCM Industries Inc. - Corporate Headquarters; Tony Bourassa, Nelson Lopez, both with Fisa North America Inc.; Alex Matviko, Trialco Aluminum LLC; Tak Miyabayashi, Brother International Corporation; Ernesto Vega Gonzalez, Vega Industries; Henry Vogel, DeCardy Diecasting Company; Tao Wang, PSW Group*

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: *Angela Bontrager, Leech Industries Division of Leech Holdings, LLC; Brandon Filaseta, Diehl Tool Steel; Shane Gallagher, Leech Industries Division of Leech Holdings, LLC; Leo Ku, MagReTech, LLC; Mian Liang, Visi-Trak Worldwide, LLC; Chris Mazeika, Real Alloy; Philip Medsger, BMO Bank, N.A.; Tyler Modjeska, MagReTech, LLC; Martin Rieth, J&M Precision Die Casting; Steven Sobol, Tiffin Foundry & Machine, Inc.; Alex Stitzel, PIAD Precision Casting Corporation; Daniel Vergara, Twinsburg Manufacturing Facility, a Division of AAM*

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: *Benjamin Clinton, Huntington Ingalls Industries; Vishwas Danthi Shivaram, Indo-MIM Inc.; Kevin M. Learn, Leech Industries Division of Leech Holdings, LLC; Nanjunda Lingsetty, Humanscale; Jeff Silver, Unifrax - Thermbond Refractory Solutions*

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: *Nathan Carroll, Five Star Tool & Die Ltd.; Doug Daniels, Mitchell Goldman, Dale Keefe, Stan Marchalewicz, all with Accurcast Inc.; Megan McGee, Five Star Tool & Die Ltd.; Richard R. Myers, 1 Source Design Ltd. / MS-2; Deepak Saran Nagaraj, Accurcast Inc.; Jean-Benoit Neron, Sotrem-Maltech; Todd Sharpless, Accurcast Inc.; Tom Waizmann, Armada Toolworks Limited*

Chapter 12 - Wisconsin

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

New Members: *John E. Allen, Quaker Houghton; David Campbell, Fire Brick Engineers Company; Jamie Gresk, Doug Johnson, Craig Schreindl, Spencer Schreindl, all with Zeman Tool & MFG; William Johnson, Carpenter Brothers Inc.; Chris D. Konzak, Pace Industries, Maple Lake*

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: *Elias Aboujaoude, Andrea Aboujaoude, both with Deban Enterprises, Inc.; Tom Bametzrieder, Diehl Tool Steel; Buwei Chen, The Ohio State University; Brian Collins, Dave Jenkins, Jose Legaspi, all with FT Precision; Alan Luo, Lightweight Materials and Manufacturing Research Lab The Ohio State University; Paul Daniel Shull, Transmet Corpora-*

tion; Tyler S. Treiber, Basic Aluminum Castings Corporation; Jon Washington, The Innvovation Garage; Jianyue Zhang , Ohio State University

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: *Brian Beckham, Trace Die Cast Incorporated; Eleonora Bettini, Sandvik Machining Solutions AB; Roberto Boeker, ALUMAG Automotive LLC; Patrick Brisson, Heath Cassell, Scott Phipps, Chad LaMance, all with United Tool and Mold; Greg Comoglio, SUS Cast Products Incorporated; Faraz Deirmina, Sandvik Machining Solutions AB; Brandon Lloyd, Atotech USA LLC; Caleb Mandile, SUS Cast Products Incorporated; Travis Mummert, Robert Bosch LLC; Kevin Sandoval, ABB Motors and Mechanical Inc.*

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: *Casey Arends, Scott A. Olson, both with Twin City Die Castings Company - Watertown; Angelo Bruna, ABC LLC; Bruce Robert Burley, Kurt Manufacturing Company; Rob Curry, Dave Honer, both with Twin City Die Castings Company - Monticello; Madelyn DeMotts, Arrow Finishing, Inc.; Jeremy Larson, Johnson Outdoors Marine Electronics; Cameron Sucik, Pace Industries, Maple Lake*

Chapter 17 - St. Louis

Greetings from St. Louis! October 15/16 were wonderful days for Chapter 17!! We started the day with Educational Seminar Machine Maintenance: Hydraulics presented by NADCA's Paul Brancaleon. Fifteen die cast industry professionals attended the two day class. Reports of the first day's proceedings were very positive, and I'm certain day two was just as good. We appreciate Paul's time and effort very much, and "thank you" to Kevin Voss – Hellebusch Tool and Die for his legwork to make it happen.

We hosted a Membership meeting the evening of the 15th featuring Chris Berry and Doug Green from Oerlikon Balzers discussing various surface treatments for die cast die cores, cavities and components. Thanks to Chris and Doug for their informative presentation. "Good Job" Kayla Barrett – Ozark Diecasting for her efforts to make the meeting happen.

***Chapter 17** - Chris Berry, Oerlikon Balzers at the Chapter 17 Membership meeting October 15, 2024.*

***Chapter 17** - NADCA National's Paul Brancaleon presenting EC Machine Maintenance: Hydraulics to Chapter 17.*

There's plenty of opportunities upcoming to network with Die Cast industry professionals, so please watch your email for details and to sign up to attend.

We hope to see you!

New Members: *Srikanth Badrinarayanan, Rivian Automotive, LLC; Michael Burgess, Millison Casting Technology LLC; Chris Cline, Kawasaki Tennessee Incorporated; Matt Crum, Denso Manufacturing Tennessee Inc.; Chris Daniels, Rivian Automotive, LLC; Veronica Decker, SDC of Indiana, LLC; Jonathan Eads, Briggs & Stratton Corp - Poplar Bluff; Justin Freund, HF Manufacturing; John Garner, Nissan Powertrain Decherd; Loren Graber, SDC of Indiana, LLC; Jason Hussey, HF Manufacturing; Gokul Kanike, Rivian Automotive, LLC; Matt Koble, SDC of Indiana, LLC; Kevin*

O'Brien, Viking Corporation; Brandon Tapp, Pace Industries, Jackson; Michael Werner, Superior Die Cast LLC; Jeff Whittaker, Kawasaki Tennessee Incorporated; Greg Will, Hydro-Gear; Wiliam Zielske, REAZN

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: *Brian Backus, Bill Blumer, David Clark, Dan T. Moore, all with Delaware Dynamics LLC; Erin Blanford, Riteway Machining Inc.; Rusty Chapman, Denso Manufacturing Tennessee Inc.; Jason William Dotson, Paul A Osborne, Steve Schuyler, all with Hitachi Astemo Greenfield, LLC; Bryan Drummond, Franklin Elelectric; Brad Fix, Fix Consulting Services LLC; Tom Follis, David Wayne McGaughey, both with Five Star Hydraulics; Kent Guthrie, Steven Vittitoe, both with Trace Die Cast Incorporated; Kathryn Jackson, Denso Manufacturing Tennessee Inc.; Tim Johnson, Kenneth Merlau, both with S.U.S. Cast Products, Inc.; Gerald King, King Commercial Capital; James Lu, GSO LLC; Nicholas Allen Richter, Oak Ridge National Laboratory; Chad Stephenson, Refractory Engineers, Inc.; Ryan Stumler, Toyota; Kenji Takahashi, Allison Transmission*

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: *Telmo Agirrezabalaga, Fagor Ederlan Mexico; Anton E. Check, Hill Casting Equipment and Supplies; Jose M. De La Garza, Distributor; Cesar Daniel García Hidalgo, KHA DIE CASTING; Kyle Harris, Ambrit Industries Inc.; Saumyadeep Jana, Pacific Northwest National Laboratory; Shian Jia, RIVIAN AUTOMOTIVE; Larry Snoreen, Lamar Tool & Die Casting Inc.*

International Members: *Massimo Bettineschi, LUCCHINI RS; Yufei Chen, Sciveda Technology Co., LTD; Nilesh Dahanukar, Om Sai Moulds & Plastics; Ernest Eu, Mold Asia Group; Daniel Frie, Deutsche Edelstahlwerke; Ping Gong , Kejia Mold Asia Group; Ajitha Prabu Gunthu Nathan, Kriatec Services Private Limited; Marek Kania; Thomas Li, Shenzhen Camel Die Ltd.; Rohit Ramchandani, Lubrikote Specialities Private Ltd.; Bakul Shah, BMway Auto Components; Sang Soo Shin, Ohsung Tech; Girish Vispute, Furnteck Engineers Pvt. Ltd.; Zac Wang*

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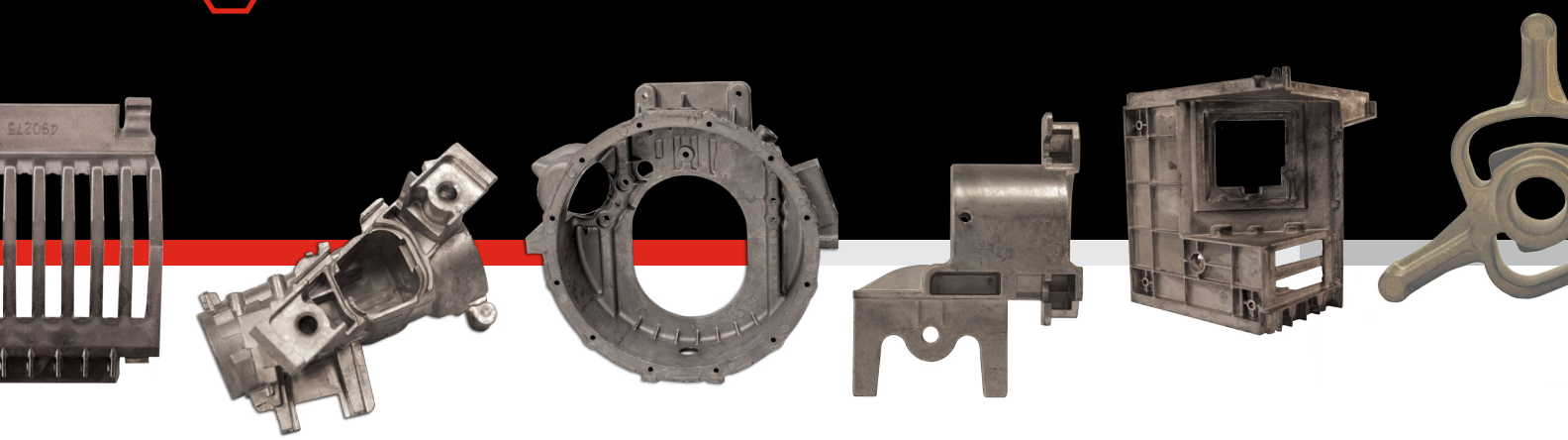

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Corporate Membership

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Industry News

HONDA INSTALLS NEW DIE CAST UNIT IN OHIO

Marysville, OH - Honda's EV Hub in Ohio will have flexibility to produce petrol, hybrid electric and battery electric vehicles on the same manufacturing line.

The first EV will made at the Marysville Auto Plant late in 2025.

Honda said it was using the retooling of the Marysville Auto Plant, the East Liberty Auto Plant and the Anna Engine Plant to "reimagine" its approach to vehicle production, "focusing on human-friendly and environmentally responsible manufacturing layouts, processes and materials that will also achieve the highest level of quality, efficiency and value to customers".

Retooling efforts included the installation of the first of six 6,000 ton high pressure die cast machines at the engine plant for megacasting the cases for the intelligent power unit (IPU), which houses the EV battery and serves as part of the vehicle platform. The cases being developed are much larger than anything Honda has die cast before, with megacasting representing a new capability for the automaker worldwide.

After consolidating two vehicle production lines into one to begin the transition to the flexible production line that will build petrol, hybrid and EVs while also maintaining current ICE and hybrid production, the auto plant is now preparing for an all new capability, the sub assembly of the IPU.

Workers at the auto plant will combine the battery modules from L-H Battery, the Honda-LG Energy Solution joint venture EV battery plant being constructed in Ohio, with the IPU case made at the engine plant to produce mid- and large-size IPUs for the different vehicles to be made at the Marysville and East Liberty Auto Plants in Ohio.

The automaker is changing the production environment by reducing complexity on the main production line which enables process layouts which reduce walking required for associates. By changing the flow of certain installation processes, the team is increasing the space allotted for parts delivery and staging to create an optimised, worker friendly environment.

"By optimising the flow of processes we're also making it easier for workers to achieve the highest level of quality, efficiency and value for our customers," the automaker said.

Honda is spending US$700m on retooling in Ohio while the automaker and LG Energy Solution have committed $3.5bn for the new JV battery facility, with the overall investment projected to reach $4.4bn. The facility is scheduled to be completed by the end of 2024, with annual capacity of approximately 40GWh.

Even as it accelerates preparation for EV production, the automaker plans to sustain current ICE and hybrid electric vehicle production in order to meet continued strong demand. The sustained success of ICE and hybrid electric vehicle sales also will support the required investment in the electrified future.

YIZUMI-HPM: EXPANDING FACILITY FOR NORTH AMERICAN GROWTH

Iberia, OH - On October 10th, local time, YIZUMI-HPM holds a grand ceremony for the new facility expansion at its Ohio factory, as well as an open house event. This move comes after the opening of YIZUMI's subsidiaries in Thailand and Mexico earlier this year, marking another significant milestone in the company's global layout.

Mr. Richard Yan highlights that with well-known brand HPM, YIZUMI has strengthened its global market presence, expanded into strategic markets, and achieved new milestones overseas, thereby elevating its brand's international profile.

And he introduces the expansion project of the Ohio factory. He noted that the expansion project, with a total investment of over $11 million, is one of YIZUMI's largest investment projects in North America and globally in recent years. This project will significantly enhance

YIZUMI's position in the North American and global markets, providing strong support for achieving the strategic goal of "becoming a world-class enterprise in the field of molding equipment." In the future, the company is expected to further accelerate its response to the southern U.S. market and consider launching a second construction project to continue promoting YIZUMI's expansion in the global market.

SHELBYVILLE COMMON COUNCIL APPROVES TAX ABATEMENT FOR RYOBI DIE CASTING

Shelbyville, IN - Ryobi Die Casting is investing in its Shelbyville facility that potentially could grow to more than 1,000 employees in 2025.

On Monday at the City of Shelbyville's Common Council meeting, Ryobi received a 10-year tax abatement on a $6.87 million purchase of new manufacturing equipment that will include a new die cast machine.

Ryobi, with its principal office at 800 W. Mausoleum Road in Shelbyville, develops and produces state-of-the-art cast aluminum parts for the automotive industry. Ryobi is a Tier I supplier to automakers located in North America.

The project, which is expected to add three employees at an average hourly rate of $24.56, is expected to be completed in the third quarter of 2024.

People in Die Casting

Mark Kaszer

President of Ellwood Specialty Metals

Mark Kaszer has been named the new president of Ellwood Specialty Metals, effective Jan. 1, 2025.

Kaszer will succeed outgoing president Judy Shaffer, who earlier announced she would retire at the end of the year.

"We are thankful to Judy for her leadership, and we are proud of Mark as this promotion is a recognition of his hard work and his numerous successes during his time with Ellwood," said Ben Huffman, Ellwood Group president and CEO. "Mark and Judy have worked together to expand ESM's product and service offering, and we are excited for the future of the company."

Kaszer has worked at Ellwood for 16 years. He joined Ellwood City Forge in 2008 as a product specialist. He was named the director of sales for ESM in 2011 and helped to develop and grow ESM's aluminum offering in the United States, Canada and Mexico.

ESM is a distributor of tool steels and aluminum for plastic molds, die casting, forging dies and other tooling applications. ESM has operations in Pennsylvania, Ohio, Michigan, Canada and Mexico.

Kaszer was named vice president of sales for ESM in 2021 and was a key leader in the start-up of the ESM Mexico facility, assisting with the hiring of the leadership and sales team and building inventory to increase sales volume.

Shaffer started at Ellwood Crankshaft and Machine in 1993 as a quality assurance manager, and she has served as president of ESM since 2019.

NADCA Remembers

Robert H. Walker

1926 - 2024

Robert Hardison "Bobby" Walker, 97, of Lewisburg, TN, passed away peacefully on Monday, June 17, 2024.

Mr. Walker is best known as the longtime president of Walker Die Casting, Inc., which he founded in 1958 and presided over for many years.

Mr. Walker was born on September 13, 1926, in Martinsville, Virginia, to John Robert and Edith Hardison Walker. He attended schools in Martinsville, and upon graduating in 1944, attended Virginia Military Institute (VMI). He was soon called to service and arrived in Europe in February 1945. He served in the 42nd Infantry Division, U.S. Army, and then with the Occupation Forces in Austria, returning to the U.S. in October 1946.

Upon his return, Mr. Walker attended the University of Virginia and then came to Lewisburg, where he worked at his grandfather's store, W.H. Hardison Hardware. He was also in the U.S. Army Reserve and in 1950, Mr. Walker was called to active duty. He served in the U.S. Army in Korea from September 1950 to October 1951.

Upon his return from the war in Korea, Mr. Walker resumed work in Lewisburg, TN, and later became a traveling salesman for Shapleigh Hardware.

In June of 1958, he started Walker Metal Products. It began with one die cast machine and three employees, housed in the basement of Kuhn's Variety store in downtown Lewisburg. (This is where First Horizon Bank currently stands.)

Walker Metal's first product was zinc stay nut castings. The company quickly succeeded and outgrew its downtown location and moved to an unused airport hangar on Spring Place Road. That plant was destroyed by fire in 1965. Walker Metal resumed operations at a secondary location in Lewisburg until a new facility could be built in the Industrial Park in 1967.

Walker Metal Products continued producing zinc die castings and then expanded into the production of aluminum die castings. The company was renamed Walker Die Casting, Inc. in 1974.

Walker Die Casting, Inc. became known throughout the industry for its dedication to quality and meeting commitments.

Mr. Walker was well known for hosting a Tuesday night bluegrass picking session in the front lobby at Walker Die Casting. Many times, customers, sales people, vendors, and other interested persons scheduled their visits to Walker so that they could listen or participate in the weekly event. Many good times were had by all.

New Products, Services & Solutions

QUAKER HOUGHTON LAUNCHES DIGITAL FLUID OPTIMIZATION PLATFORM

Quaker Houghton, the global leader in industrial process fluids, has launched a new platform that allows manufacturers to measure, control and optimize the performance of their process fluids and improve processes to achieve greater levels of efficiency.

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For more information about QH FLUID INTELLIGENCE™, visit: https://home.quakerhoughton.com/qhfluidintelligence.

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The annual subscription rate for U.S. nonmembers is $100. The general business offices of the publisher are located at 3250 N Arlington Heights Rd - Suite 101, Arlington Heights, IL 60004. The names and addresses of the publisher and editor are: Publisher, North American Die Casting Association, 3250 N Arlington Heights Rd - Suite 101, Arlington Heights, IL 60004; Editor, Andrew Ryzner, 3250 N Arlington Heights Rd - Suite 101, Arlington Heights, IL 60004. Stockholders owning one or more percent of the total amount of the stock: none. Known bondholders, mortgages, and other security holders owning one or more percent of the total amounts of bonds, mortgages, or other securities: none. The purpose, function and nonprofit status of this organization and the exempt status for federal income tax purposes has not changed during the preceding 12 months. The average number of copies each issue during the preceding 12 months are: (a) Total number of copies (net press run): 2080. (b) Paid/requested circulation: (1) outsidecounty mail subscriptions: 1754; (2) incounty subscriptions: 120; (3) sales through dealers and carriers, street vendors, counter sales and other non-USPS paid distribution: 104; (4) other classes mailed through USPS: 0. (c) Total paid and/or requested circulation: 1978. (d) Free distribution by mail: (1) outside-county: 20; (2) in-county: 5; (3) other classes mailed through the USPS: 10. (e) Free distribution outside the mail: 25 (f) Total free distribution: 60. (g) Total distribution: 2038. (h) Copies not distributed: 42 (i) Total: 2080. (j) Percent paid and/or requested circulation: 97%. The number of copies of single issue published nearest the filing date are: (a) Total number of copies (net press run): 2467. (b) Paid/requested circulation: (1) outside county-mail subscriptions 1879; (2) in-county subscriptions: 109; (3) sales through dealers and carriers, street vendors, counter sales, and other non-USPS paid distribution: 99, (4) other classes mailed through the USPS: 0. (c) Total paid and/or requested circulation: 2078. (d) Free distribution by mail: (1) outsidecounty: 45; (2) in-county: 12; (3) other classes mailed through the USPS: 7. (e) Free distribution outside the mail: 200. (f) Total free distribution: 309. (g) Total distribution: 2387. (h) Copies not distributed: 80. (i) Total: 2467. (j) Percent paid and/or requested circulation: 87%. I certify that all the above information is true and complete. (signed) Athena Catlett, Sept. 30th, 2024.

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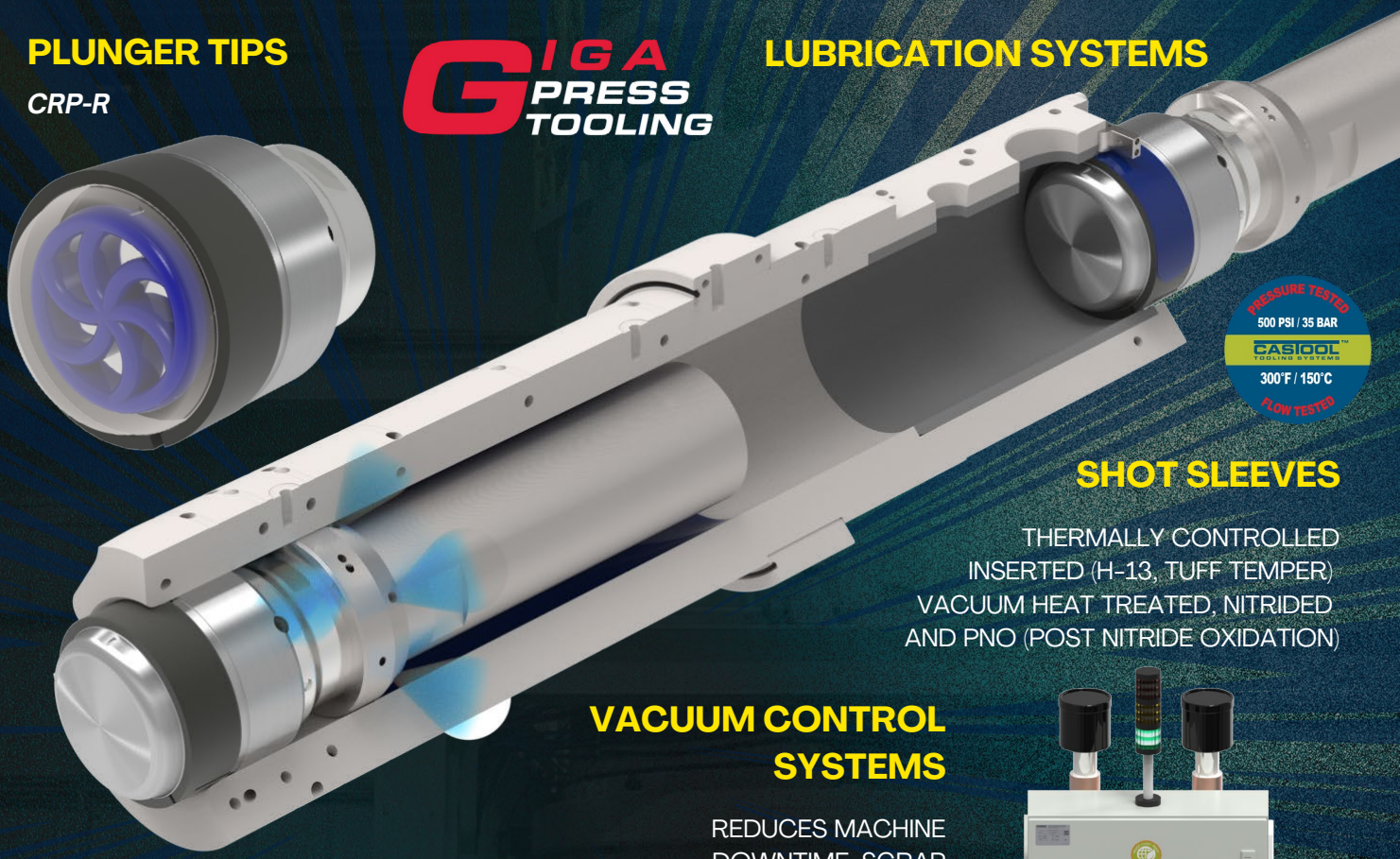

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