DIE CASTING MACHINES & COMPONENTS | JANUARY 2024

DIE CASTING ENGINEER

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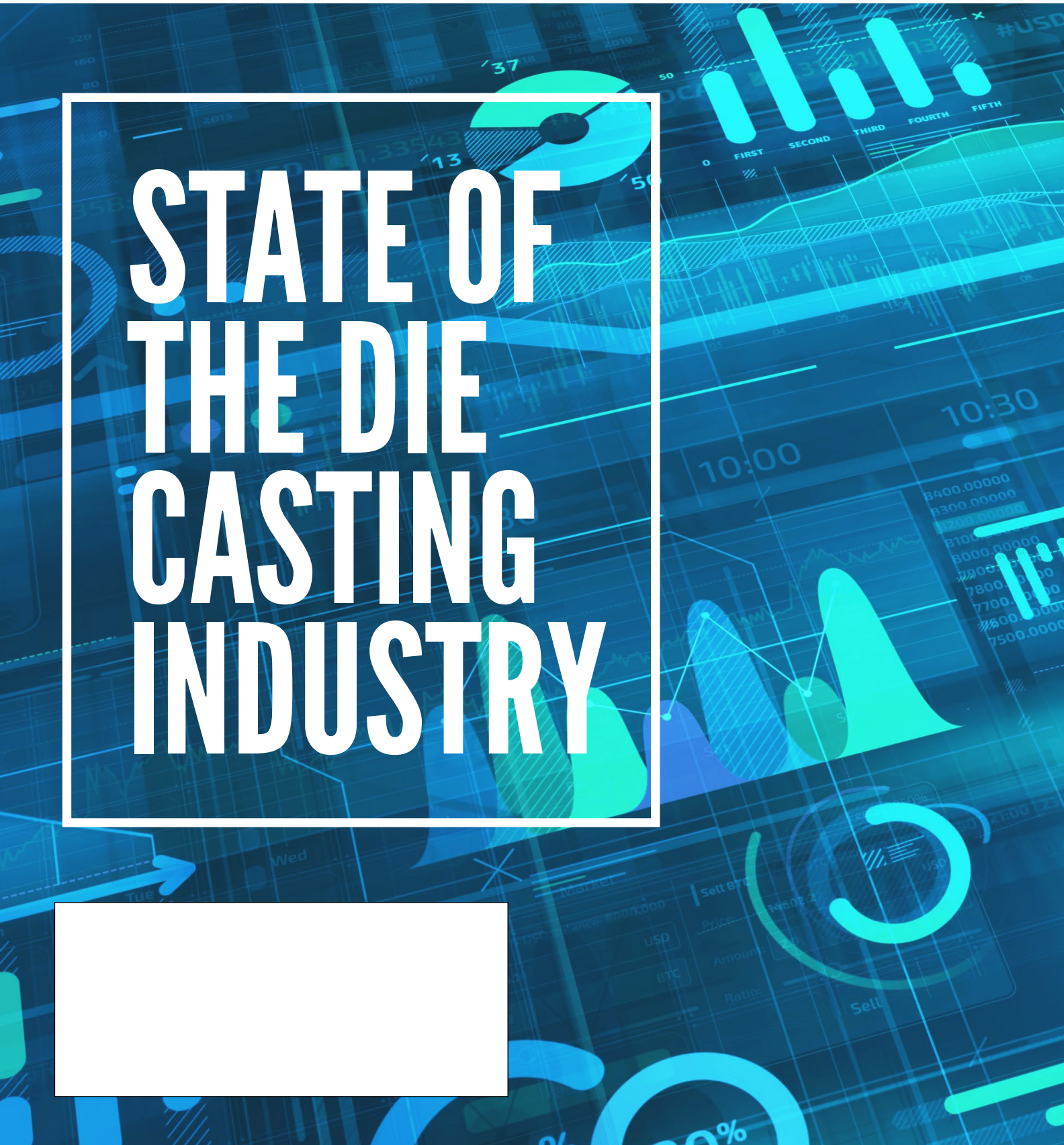


STATE OF THE DIE CASTING INDUSTRY

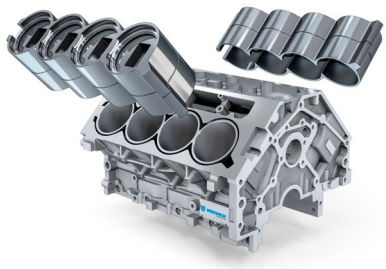
THE BEST OF TWO WORLDS

UDDEHOLM TOOL STEELS AND EIFELER PVD COATINGS

Combining the right Uddeholm tool steel such as Uddeholm Dievar© (≥ 18.4 ft-lbs. toughness value) or Uddeholm Unimax© with a PVD coating from voestalpine eifeler Coatings can increase productivity and achieve higher quality processed components.

FAILURES THAT CAN BE SOLVED BY THE RIGHT STEEL

Gross cracking, heat checking and indentations are failures which can be solved by changing the steel grade or the hardness level.



FAILURES THAT CAN BE SOLVED BY PVD COATING

Erosion, corrosion or soldering problems on cores, ejector pins and cavities (with simple geometry). Abrasive wear in Hot Stamping.

EXAMPLE OF COATINGS FOR HOT WORK STEELS

COATING	COATING TYPE	COLOR	KEY PROPERTIES	THERMAL LIFT
CROSAL®-plus	AlCrN	Slate grey	• High oxidation resistence • Outstanding hot hardness	2012°F (1100°C)
Duplex-TIGRAL®	AlCrTiN	Grey	• High hot hardness • Excellent oxidation resistance • Excellent abrasion resistance	1650°F (900°C)
Duplex-VARIANTIC®	TiAlCN	Old rose	• Good chemical resistance • Low friction • Good oxidation resistance in semi-warm-forming	1470°F (800°C)

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NADCA
NORTH AMERICAN DIE CASTING ASSOCIATION

JANUARY 2024

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Chairman's Note

NADCA Can Help You Make 2024 a Great New Year

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I have the honor and privilege to serve the members of NADCA as Chairman of the Board of Governors this year. Also serving on the executive committee are Joe Vitollo, ABCO Die Casters, Vice Chairman, and Todd Olson, Twin City Die Castings, Secretary-Treasurer.

I would like to thank outgoing Chairman Hal Gerber who has served as chairman for the last two years. His steady leadership through the changes within NADCA over the last two years leaves the organization in a great position to continue to serve and support all the members of NADCA. Hal has had a lifelong commitment to the industry, with a relentless pursuit of expanding die casting opportunities for the industry through promoting new processes and designs. It has been an honor to serve alongside Hal and now follow in his path, supporting our industry association.

Last year was year full of changes within the NADCA organization. President Steve Udvardy retired after 27 years of service to NADCA. The entire die casting community thanks Steve for his tireless service as technical director for 21 years and then serving as NADCA president for the past 6 years! We send Steve our best wishes as he enters the next chapter of life, spending more time with family and honing his already excellent musical skills.

During 2023, the Board of Governors appointed an executive search committee comprised of Pat Greene, Todd Olson, Dan Twarog, Jerry Cegielski, and Mark Los to find the new president for NADCA. After a thorough search, extensive interviews and full Board of Governors' approval, Mike Meyer has accepted this challenge. With Mike's extensive experience in the die casting industry, we look forward to his leadership with the NADCA staff and expanding the activities of our organization in accordance with our strategic plan. Paul Brancaleon's promotion to Executive Director of Research, Education, and Marketing will also be instrumental in providing additional value to our membership.

We enter 2024 with new leadership and new opportunities for our association. One thing remains the same: "The mission of the North American Die Casting Association (NADCA) is to be the worldwide leader of and resources for stimulating continuous improvement in the die casting industry." This is an aggressive goal which cannot be reached by the staff of NADCA alone. The members of this organization are the most critical resources to improve our industry. Get involved in 2024 and take advantage of the opportunities to improve on a personal and business level, as a supplier or die caster.

Join one of the many committees that advance the die cast industry through technology, marketing, education, and government affairs. There are many other options to get involved. Thanks to the many members who invest their time into leading and supporting these various NADCA committees. Check out the NADCA website and learn more about the opportunities where you can get involved locally and nationally.

Attend industry events such as the Executive Conference, Plant Management Conference, Government Affairs/DC Briefing, Indianapolis Congress/Expo, and local chapter meetings.

All are great opportunities to network with industry peers, stay current on industry developments, and shape government policies that impact your business.

My industry story: I joined the die casting industry in 1979 as an employee of Prince Machine and have been able to spend my career in a variety of roles, from technical to management, recently retiring as President/CEO of BuhlerPrince, Inc.

I have been active in NADCA since its inception in 1989, serving on local and national committees, and having served multiple terms on the Board of Governors. The relationships and friendships formed within this industry have shaped my career.

I look forward to supporting our association this year and would welcome any feedback you may have regarding how best to serve your needs in this exciting industry!

"We enter 2024 with new leadership and new opportunities for our association."

Guest Editorial

Mike Meyer
President
North American Die Casting Association

"It truly is an honor to be working with this team and with our industry."

To say that I am humbled to be leading the North American Die Casting Association would be a huge understatement. Our association has had two outstanding leaders - Dan Twarog and Steve Udvardy - over the last 30+ years. My sincere desire is to carry on the excellent work that Dan and Steve and the NADCA team (Andy, Athena, Beau, Donna, Julie, Melisa, Paul, and Trish) have accomplished. It truly is an honor to be working with this team and with our industry. It will be exciting to see what we can all accomplish together. I am looking forward to meeting with as many of you as possible, and NADCA will be traveling to all 12 Chapters in 2024, so that we can hear firsthand what we can do to assist you and your business. We are excited to explain our education portfolio (which is massive!), our work in research and development, and other pertinent topics in the industry.

Our recent Board and Business Barometers indicate that there is a softening in sales as compared to 6 or 9 months ago. Consumers are still spending money, but are generally more concerned about our economy. Business leaders (reported by NAM) are also growing more cautious. In our global landscape, there is simply more nervousness. Wars in the Ukraine and the Middle East do not appear to be coming to an end, there is still pessimism about the economy of China, interest rates continue to remain much higher than normal, US politicians continue to get little done, and there is apathy over the 2024 presidential race (which appears to be a repeat of 2020). Most reports indicate our economy will be flat through Q2 of 2024, before modest growth occurs in the latter half of 2024.

It's exciting to share that NADCA will be starting a YPO (Young Professional Organization). This organization will be open to those who work in our industry and are under 40 years old. Getting young people into our industry has been identified as a top priority by nearly every one of our NADCA members. We are holding our first meeting for these professionals in conjunction with our Executive Conference in Scottsdale, Arizona in February 2024. This group will have a separate venue to hear from our keynote speaker, be introduced to our mentors, and most importantly, have time to network amongst themselves. After this initial meeting, the YPO will get together again in May or June, and then again at our Expo in Indianapolis (late September/early October). By the end of 2024, the goal is for the YPO to have a charter and mission and vision statements. Because this is such an important initiative, NADCA will significantly subsidize these two events. We believe this to be a good investment, as our youth are our future.

There is little doubt that 2024 will be a dynamic year for all of us. I look forward to working with and learning from you all. As always, if you need anything, please reach out to our team – we are here to assist.

NADCA Reports

NADCA NEWS

Safety Award Program Open for Applications on February 1

Arlington Heights, IL - NADCA's annual Safety Award Program is accepting applications starting February 1. Only NADCA Corporate Members are eligible for this program. Awards are given for Perfect and Outstanding Safety Records for die casting companies and suppliers to the industry. NADCA has also developed the Progress Award for Safety Improvements for any company that has shown a 25% improvement in safety standard as compared to the previous year.

Applications are accepted through the end of the month, and companies will be notified of their award status in March. Winning companies are highlighted in Die Casting Engineer magazine and recognized at this year's Die Casting Congress & Exposition, September 30-Octiber 2, 2024, in Indianapolis,IN.

Applications must be received by midnight on February 28, so gather those records and apply soon! To find the program criteria and entry form, please visit: www.diecasting.org/safety/award.

Die Casting Internship Opportunities for Engineering Students

Arlington Heights, IL - NADCA's David Laine Scholarship & Intern Program strives to provide students with hands-on experience in the industry and is currently gathering resumes for the intern program. Students that wish to be considered for an internship in the die casting industry should send their resumes to intern@diecasting.org with a general letter of interest (PDF documents preferred). Applicants should note a geographic area of interest to work (around school, around home or if willing to re-locate for the summer in cover letter). Materials are due January 31, 2024, though we will continue to post resumes as they are received. Interested companies will contact students directly.

The David Laine Scholarship awards scholarships to college students that have interned with die casting companies/companies that are suppliers to the die casting industry. Students that receive internships are not required to apply for the scholarship and scholarship applicants do NOT have to have their die casting internship sourced through NADCA to be eligible to apply. The deadline for the scholarship program is in the fall; more information may be found at: www.diecasting.org/scholarship.

UPCOMING EVENTS

Sliding Into the West Coast – Execs Take Scottsdale

Arlington Heights, IL - NADCA is excited to announce that the 2024 Executive Conference will be held at the Fairmont Scottsdale Princess February 18-21, 2024 in Scottsdale, Arizona.

The Die Casting Executive Conference is an annual event that provides timely information on marketplace, government, industry and business trends that impact the die casting industry. Leaders and executives from die shops have an opportunity to gain insights that can help improve operations and profitability as well as benefit from networking with peers.

For more infomation or to register visit: www.diecasting.org/meetings/exec.

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

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

In addition to the Congress sessions, this exposition show will feature more than 120 exhibitors, the International Die Casting Design Competition and the Die Casting Industry Awards Luncheon. Attendee registration will open in the summer of 2024.

Save the date! We hope to see you there! For more information please visit: www.diecasting.org/congress.

NADCA Government Affairs

Delay to Phase 3 Truck Rule Expected

The Environmental Protection Agency's (EPA) timeline for releasing the "phase 3" greenhouse gas emission standards for heavy-duty trucks is expected to be delayed, according to sources familiar with the agency's development of the rule.

The proposed rule was first issued in April after the EPA abandoned a plan to issue a supplemental GHG proposal for medium- and heavy-duty trucks for MY27-29 to consider stronger GHG standards in response to the passage of truck electrification incentives in the Inflation Reduction Act (IRA). The draft phase 3 GHG rule, which would impose more stringent greenhouse gas emissions standards on trucks, such as delivery vehicles, school buses, dump trucks, and tractor trailers, was released along with a proposed rule covering passenger cars, light trucks, and some medium-duty vehicles setting new multi-pollutant standards for model years (MY) 2027 to 2032. The phase 3 rule starts with revisions to certain MY27 standards, while also issuing new standards for MY28-32.

While the phase 3 regulation was expected to be finalized by the end of the year, EPA officials are now aiming at issuing the rule sometime in March 2024. This delay could allow the truck GHG and light-duty rules to be issued simultaneously.

EPA to Tighten PM2.5 Limits

The Environmental Protection Agency (EPA) is on track to unveil a final rule likely tightening the national ambient air quality standards (NAAQS) for fine particulate matter (PM2.5) by the year-end, despite opposition from industry stakeholders and more than 70 Republican members of the House of Representatives. The White House Office of Management and Budget's (OMB) Office of Information and Regulatory Affairs (OIRA) received the regulation titled "Reconsideration of the National Ambient Air Quality Standards for Particulate Matter" on September 22, 2023. The review process typically takes up to 90 days, but the timeline can vary depending on the specific action.

On January 5, 2023, the Environmental Protection Agency (EPA) proposed to strengthen the National Ambient Air Quality Standards (NAAQS) for fine particulate matter (PM2.5) or soot. PM2.5 is a fine inhalable particle resulting from chemical reactions emitted from manufacturing facilities, power plants, and automobiles that are generally 2.5 micrometers and smaller – typically thirty times smaller than a human hair. EPA first established NAAQS for particulate matter in 1971 and has since set and revised standards numerous times for fine particles (PM2.5) and coarse particles (PM10).

In a proposed rule EPA suggested lowering the annual standard from its current level of 12 micrograms per cubic meter ($\mu g/m^3$) to within the range of 9 – 10 $\mu g/m^3$. The EPA also proposed to retain all other PM standards, including the primary (health-based) and secondary (welfare-based) 24-hour PM2.5 standard at the level of 35 $\mu g/m^3$, the secondary annual PM2.5 standard at the level of 15 $\mu g/m^3$ and the primary and secondary 24-hour PM10 standards at the level of 150 $\mu g/m^3$.

In a November 14, 2023, letter sent to EPA Administrator Michael Regan, the 70 Republican lawmakers, led by House Energy & Commerce Committee Chairwoman Cathy McMorris Rodgers (R-WA) and Environment, Manufacturing, & Critical Materials Subcommittee Chairman Bill Johnson (R-OH), argued that the agency should follow the Obama administration's example and halt the "discretionary" rulemaking due to its "stifling costs."

While the EPA accepted public comments on revising the standards to as low as 8.0 $\mu g/m^3$ or up to 11.0 $\mu g/m^3$, sources suggest that the EPA will finalize the standard at the limit of 9 ug/m^3.

New EU Carbon Border Tariff System Launched

On October 1, 2023, the European Union (EU) launched the initial phase of its new Carbon Border Adjustment Mechanism (CBAM) to impose CO2 emissions tariffs on imported steel, cement, and other goods. While tariffs will not be collected until 2026, this initial transitional phase requires importers to report the greenhouse gas emissions embedded during the production of certain goods.

Initially, the CBAM covers specified goods in the carbon-intensive sectors of cement, electricity, fertilizers, aluminum, iron, steel, and hydrogen. Beginning with the fourth quarter of 2023, importers will be required to report the imported quantity of CBAM goods and the direct and indirect greenhouse gas emissions that occur in the course of the production process of those imported goods. The first reports are due by January 31, 2023.

Once the permanent CBAM system is in place on January 1, 2026, certificate trading will begin. Importers will be required to purchase and then turn over "CBAM certificates" to offset emissions from imported goods.

EU, U.S. Unlikely to Reach Green Steel, Aluminum Agreement

Reports from both Washington, D.C. and Brussels indicate that the United States and European Union are unlikely to reach a green steel and aluminum agreement, known as the Global Arrangement on Sustainable Steel and Aluminum, which was expected to be finalized in December. The U.S. is moving forward with a two-year extension of the Tariff Rate Quota system, which allows a set amount of steel and aluminum products from specific countries to enter the U.S. tariff-free.

The Global Arrangement, a collaborative effort initiated by the U.S. and the EU in October 2021, is focused on addressing concerns related to carbon intensity and global overcapacity. It also aims to discourage the trade of steel and aluminum products with high emissions. As part of the ongoing negotiations, the U.S. submitted a concept paper to the EU in December 2022, proposing the establishment of a green steel club with defined "emissions intensity" standards for steel and aluminum production. The proposal also included the possibility of implementing carbon-based tariffs for products that exceed these standards.

While the U.S. replaced the 232 steel and aluminum tariffs on EU imports with the Tariff Rate Quota system on the condition of reaching an agreement, the U.S. has indicated that it will not reimpose those tariffs on the EU at the end of 2023 even if the sides cannot agree.

Senate Republicans Offer Carbon Border 'Fee' Legislation

As the U.S. continues to negotiate towards some sort of deal that encourages trade in steel and aluminum made in more environmentally friendly ways to combat climate change, Senate Republicans have introduced a bill to impose import fees on foreign polluters. The "Foreign Pollution Fee Act" would assess tariffs based on the greenhouse gas intensity of a category of imports as compared to U.S. emissions for the same product. Imports from countries that are within 10 percentage points of U.S. emissions would pay no charges, while the levies would grow the more a given country exceeds the U.S. baseline.

The legislation, introduced by Senators Bill Cassidy (R-LA), Lindsey Graham (R-SC) and Roger Wicker (R-MS), aims to shift the production of certain products to domestic sources or cleaner foreign producers with the fee rate set to ensure the imports of a given product are initially, on average, no more than 50 percent more pollution-intense than the U.S. This pollution intensity difference ramps down to no more than 25% and then 10 percent over time. The bill also includes a mechanism for U.S. trade officials to strike partnerships with individual countries under certain conditions.

Covered sectors include aluminum; biofuels; cement; crude oil; glass; hydrogen, methanol and ammonia; iron and steel; lithium-ion batteries; minerals; natural gas; petrochemicals; plastics; pulp and paper; refined petroleum products; solar cells and panels; and wind turbines.

USITC to Investigate USMCA Rules of Origin Impacts

The U.S. International Trade Commission has launched an investigation into the "economic impact and operation" of the automotive rules of origin within the U.S.-Mexico-Canada Agreement (USMCA). This investigation is part of a series of five reports mandated by the USMCA implementing legislation. The report is expected to be finalized and submitted to the President, the House Committee on Ways and Means, and the Senate Committee on Finance by July 1, 2025. This second report follows the release of the initial report in June 2023. The subsequent three reports are slated for 2027, 2029, and 2031.

The focus of the investigation lies in evaluating the economic repercussions of the rules of origin (ROOs) on key factors such as GDP, imports and exports, employment, production, investment, and profit levels within the automotive industry. The U.S. International Trade Commission (ITC) is particularly keen on understanding "the operation of the ROOs and their effects on the competitiveness of the United States in terms of production and trade in automotive goods." Additionally, the ITC aims to determine whether these rules remain relevant considering technological advancements.

The commission will conduct a survey as well as hold a public hearing and accept written submissions for the record.

OMB Proposes Changes to Cost-Benefit Guidance

On November 9, 2023, the Office of Management and Budget (OMB) issued final revisions to the government-wide guidance on regulatory analysis, including cost-benefit analysis. OMB released proposed revisions to the Circular A-4 guidance in April 2023, following a Presidential Memorandum issued by President Biden in January 2021 directing OMB to consider steps to update regulatory guidelines for conducting benefit-cost analyses of federal regulations to "reflect new developments in scientific and economic understanding."

The updated Circular A-4 introduces a significant adjustment by lowering the discount rate applied to estimate the value of future benefits. OMB's document urges regulators to utilize a single 2 percent discount rate for projecting costs and benefits from the present to three decades into the future. This marks a departure from the previous two-tier discount rate schedule of 3 and 7 percent, which had been in effect since 2003.

Additionally, the revised guidance places heightened emphasis on the global implications of certain regulations, stating that while "in many instances" primary analysis of rules should focus on the effects of regulations "experienced by citizens and residents" of the United States, there is a range of reasons for also considering impacts on "noncitizens residing abroad."

The new guidance will apply to all draft proposals submitted after February. 29, 2024, and for draft final rules submitted after December 21, 2024, according to OMB.

EPA Releases Trichloroethylene Proposal

The Environmental Protection Agency (EPA) has published a proposed rule regulating trichloroethylene (TCE) under the Toxic Substances Control Act (TSCA). The proposed rule would effectively ban TCE by prohibiting the manufacture or import, processing, and distribution in commerce of TCE for all uses including as a solvent in industrial cleaning and degreasing.

The proposed rule would phase out most uses of TCE within one year while a small set of critical uses would be subject to longer compliance timeframes and workplace controls. These uses include the use by Federal agencies in making rocket booster nozzles, battery separator manufacturing, and the "critical" degreasing of military vehicles.

For the limited continued use, the proposed rule would require a workplace chemical protection program (WCPP) including inhalation exposure monitoring and limits, dermal protection, recordkeeping, and downstream notification requirements.

The TCE proposal is EPA's fourth under TSCA for a halogenated solvent this year, following methylene chloride, perchloroethylene (PCE), and carbon tetrachloride (CTC).

PFAS Reporting Rule Issued

The Environmental Protection Agency (EPA) has released a final Toxics Release Inventory (TRI) rule which would expand the reporting requirements for per- and polyfluoroalkyl substances (PFAS). The "Changes to Reporting Requirements for Per- and Polyfluoroalkyl Substances [(PFAS)] and to Supplier Notifications for Chemicals of Special Concern; Community Right-to-Know Toxic Chemical Release Reporting" rule was announced by the EPA on October 20, 2023.

Under TRI reporting, facilities are required to report annually on covered PFAS if they manufacture, process, or otherwise use more than 100 pounds of the substance. Prompted by requirements under the fiscal year 2020 National Defense Authorization Act (NDAA), EPA added 172 PFAS to the TRI, and has since added additional PFAS. For Reporting Year (RY) 2022, 180 PFAS are reportable, while for RY 2023, nine additional PFAS were added to the list.

The rule designates PFAS as chemicals of special concern (CSC) for TRI-reporting purposes which eliminates a Trump-era reporting exemption for de minimis amounts of TRI-listed PFAS. The final rule also makes the de minimis exemption unavailable for purposes of supplier notification requirements to downstream facilities for all chemicals deemed CSC, beyond just PFAS, such as lead, mercury, and dioxins. The new requirements under the rule will apply for the reporting year beginning Jan. 1, 2024.

The final rule also comes on the heels of EPA issuing a final Toxic Substances Control Act (TSCA) reporting rule that requires industry to report information on uses, production volumes, disposal, exposures, and hazards related to the chemicals dating back to 2011. Companies have until November 2024 to file the one-time report for each year dating back to 2011.

Dr. Die Cast

Machine Components: Tiny Particles Mean a Lot

When it comes to industrial machines, a die casting machine is totally reliant on hydraulics and pneumatics to operate. And one thing that can stop hydraulics quicker than anything is dirty fluid. Contaminants, both physical objects/contaminants and chemical, such as polluted hydraulic fluid will stop a machine in its tracks.

How small is small? When it comes to jamming any of the directional valves, proportional-valves, or servo valves it only takes 1-23 microns or 0.00004 to 0.000906 inches. When asked to explain the cause of machine down time you will typically get the response of: "The intensifier, die close, shot, pump unload directional valve(s) or P.O. check 'jammed' or a blown pump, O-ring leaked, etc." What you will not hear in most cases is the "root cause" - that is - dirty or contaminated fluid hydraulic fluid. People are not withholding information; they are simply answering the question you asked. What we as managers must do is ask the deeper questions. For example: "When was the last time the filters were replaced or cleaned?" Are we maintaining scheduled hydraulic fluid chemical and filtration analysis? (Your hydraulic fluid supplier needs to be doing this as part of their service). There should be an ISO (hydraulic fluid cleanliness) code standard for every machine.

How small is small: white blood cells are 25 micron. Red blood cells are 8 microns. Imagine your filters small enough to filter out white blood cells. That is exactly the type of cleanliness that will extend the life of your hydraulic components.

I was at a die casting operation once that was replacing the shot pump every month on every machine! The hydraulic fluid had never been analyzed. And the filters had never been changed. In addition, all the heat exchangers were plugged resulting in overheated fluids. Water glycol hydraulic fluid is particularly sensitive to excessive operating temperature. The combination of dirty fluid and overheating was ruining the hydraulic system. We had all the fluids analyzed and several of the machine's fluid was so far out of tolerance that they had to be replaced with new fluid. Due to the excessive operating temperature of the water glycol, much of the water had evaporated, leaving a fluid that was thick and syrupy. This added to the friction of the directional valve spools. The excessive force required to energize the solenoids to shift the spools in the directional valves resulted in burned-out solid-state circuit boards that powered the solenoids. Added together, the monthly down time was equivalent to an entire shift.

It may seem like a costly investment but the benefit of reduced down time in this case was the ability to run in 2 shifts what used to take 3.

Who's Dr. Die Cast?
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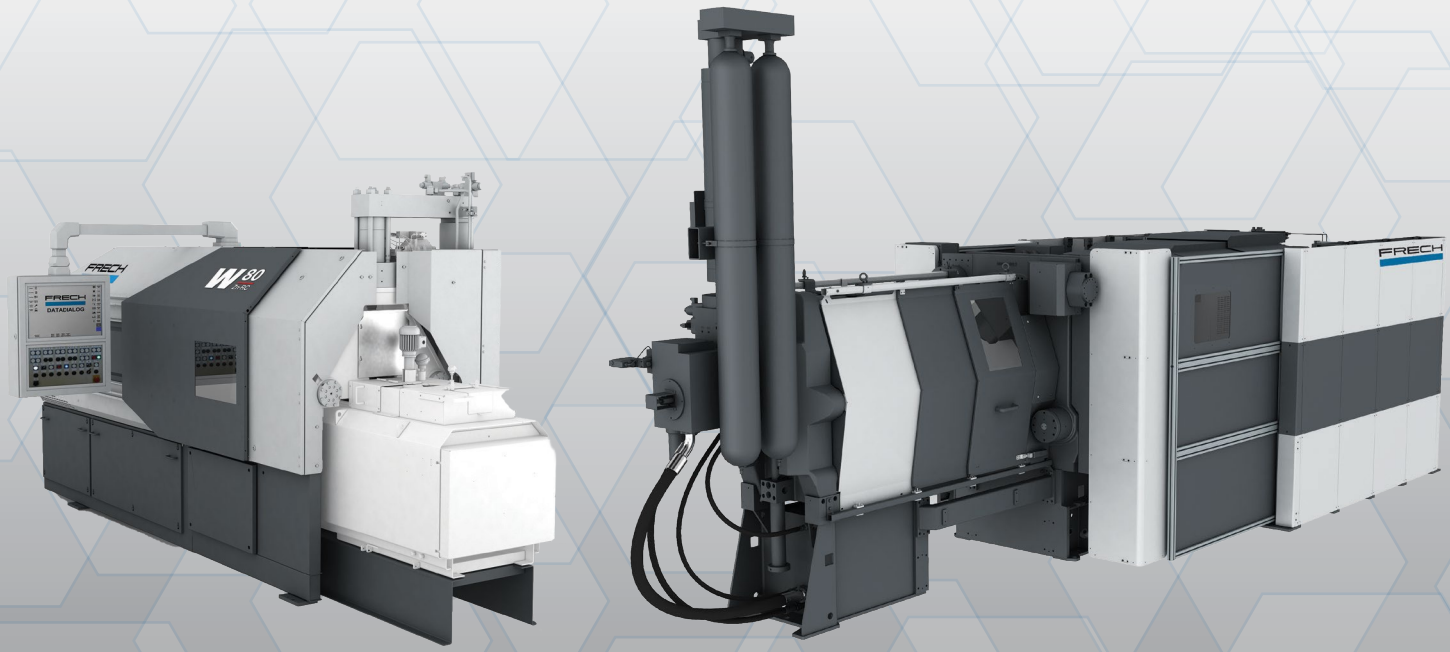

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2023 State of the Die Casting Industry

Mike Meyer
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Arlington Heights, Illinois

Introduction

As we leave 2023 and enter 2024, there are reasons to be cautious from an economic standpoint. The Russia/Ukraine Conflict is still lingering on, and the conflict in the Middle East continues with no apparent quick ending. Interest rates continue to be high, but housing starts appear to be holding strong. Our industry, and the rest of the US economy, has softened slightly from historical highs. Throw in a presidential election in 2024, that appears to be identical to 2020, and most citizens are less optimistic than a year ago. With all that said, most believe our economy will remain relatively stable in the first two quarters of 2024, and then start to tick up in Q3.

The Biden Administration

As we near the end of Biden's term in the presidency, the top priorities as of November 2023 include:

- Control Covid 19
- Economic Relief
- Climate Change
- Immigration Reform
- Racial Equity
- Infrastructure
- Health Care
- Restoring America's Global Standing

Climate change priorities in more detail include the pushing of electric vehicles, have a 100% clean energy economy, and reach net-zero emissions by the year 2050. Infrastructure has a focus of $2 billion targeting a climate-focused plan, an overhaul of green energy, new roads and bridges and expanding broadband.

The administration has listed its accomplishments as follows:

- More Americans working than ever before
- Lowering costs of families' everyday expenses
- Making more in America
- Rescued our Economy
- Changed the course of the Pandemic
- Protected Marriage for LGBTQI+
- Rallied the World to support Ukraine
- Successful missions against ISIS & Al Qaeda

***Figure 1** – President Biden signing legislation into law.*

Overtime Proposed Rule

The overtime proposed rule expansion update public comment period closed on November 7, 2023. Once the Labor Department issues a final rule, it will take effect after 60 days time. The proposed rule increases time and a half eligibility for salaried EAPs from $35,568 to $55,068. The final rule could increase that threshold to $60,209.

1. **What are the estimated costs, benefits, and transfers of the proposed rule?**
   The Department estimates that in year 1, the proposed rule would impose $1.2 billion of direct costs on employers, including $427.2 million in regulatory familiarization costs, $240.8 million in adjustment costs, and $539.9 million in managerial costs. The Department estimated that the proposed rule would result in year 1 income transfer of $1.2 billion from employers to employees, predominantly from new overtime premiums, or pay raises to maintain the exempt status of some affected employees. Beyond these wage transfers, the proposal could reduce the risk of misclassification, increase worker productivity, reduce employee turnover, and increase personal time for workers.

2. **How many employees would be impacted by the proposed salary level increase?**
   In the first year, the Department estimates that 3.4 million workers exempt under the current regulations who earn at least the current weekly salary level of $684, but less than the proposed salary level of $1,059 would, without some intervening action by their employers, become newly entitled to overtime protection under the FLSA.

Similarly, the Department estimates that an additional 248,900 workers who earn at least $107,432 per year (the current HCE total annual compensation level) and who meet the minimal HCE duties test but not the standard duties test, would, without some intervening action by employers, become eligible for overtime if the HCE total annual compensation level were increased to the proposed level of $143,988 per year.

The proposed guidance explains the legal standards and employer liability applicable to harassment claims under the federal employment discrimination laws enforced by the EEOC. These laws protect covered employees from harassment based on race, color, religion, sex (including sexual orientation, transgender status, and pregnancy), national origin, disability, age (40 and older) or genetic information.

Specifically, it provides numerous updated examples to reflect a wide range of scenarios, incorporates updates throughout on current case law on workplace harassment, and addresses the proliferation of digital technology and how social media postings and other online content can contribute to a hostile work environment.

Tariffs and Trade

Section 232 Tariffs
Japan and the UK have a tariff rate quota system in place - no tariffs until a quota is reached. The frequency is semiannual for aluminum and quarterly for steel. The EU has a quota deal it is working on to replace with a carbon-based tariff. The US and EU are likely imposing tariffs on excess steel and aluminum imports from non-market economies such as China.

Carbon-based Tariffs
The US wants to impose tariffs on carbon-intense imports as the EU Carbon Border Adjustment Mechanism repoting started on October 1, 2023. US talks with the EU could potentially lead to a 2024 carbon tariff start date.

Section 301 China Tariffs
There is a 25% tariff on over 6,800 Chinese imports; and 10% on 3,200 imports remain. The Biden administration should be concluding their review of tariff policy by December 31, 2023. It is unlikely that all tariffs are lifted, but they could allow for an exclusion process for some imports.

Heat Rule is Coming

Another thing we do know is that a heat rule is coming. An emphasis program already exists, adding to that will be a written heat injury and illness prevention program. Heat hazards must be identified for employees, a cool down area and provisions for drinking water and rest breaks, and acclimatization rules. Supervisors and employees should be trained, and have a designated individual to oversee and implement the HIIPP.

Five SBAR (Small Business Advocacy Review) Panels included participants from: foundries, roofers, cemeteries, restaurants, line workers, landscapers, water parks, and so on. The most comment statement from each is: "We are already addressing this, do not create a blanket rule." The rule is likely to have more direction by the end of the year.

Monthly US Exports

Exports from the United States increased by $4.1 billion over a month to $256 billion in August 2023, the highest level in five months, boosted by a $3.1 rise in goods sales. Shipments of industrial supplies and materials increased $2.7 billion, mostly crude oil (up $1.5 billion) and fuel oil (up $0.5 billion). Meanwhile, capital goods exports surged by $1.1 billion, driven by increased shipments of computer accessories (up by $0.5 billion) and semiconductors (up by $0.3 billion). Consumer goods exports saw a $1.0 billion rise, with pharmaceutical preparations increasing $0.4 billion. Overseas sales of automotive vehicles, parts, and engines saw a decline of $1.4 billion, with passenger cars dropping by $0.8 billion, and trucks, buses, and special

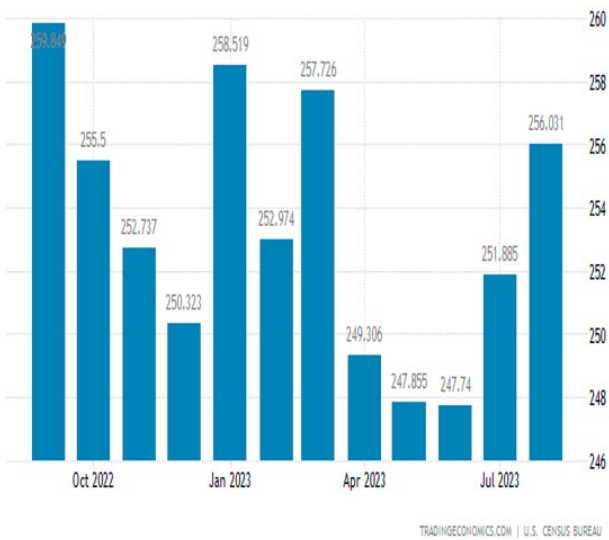

***Figure 1** - Monthly US exports - September 2022-August 2023.*

purpose vehicles decreasing by $0.5 billion.

Macro-Economics & Manufacturing

Economic Challenges

Manufacturing activity remains robust, especially demand, with the U.S. and global economy continuing to rebound from the sizable declines in spring 2020. Real GDP and manufacturing production now exceed pre-pandemic levels, which is encouraging. And yet, significant challenges remain, including supply chain disruptions, worker shortages and soaring costs. In addition, the delta variant of COVID-19 is spreading rapidly in many markets,

resulting in renewed restrictions and dampening activity, particularly in the hard-hit service sector, which is struggling to regain a sense of normalcy and recovery. There have been many challenges posed by the pandemic. We will look at some of the impact COVID-19 has had on the economy, manufacturers and the die casting industry.

Supply chain problems persist, factory floor capacity remains diminished, consumer needs and spending patterns have changed, and the biggest factor—a once-in-a-century pandemic—remains a potent global force whose resurgence is uncertain and one whose remaining effects have yet to be realized.

Geopolitical concerns such as climate-related events, the Russia/Ukraine conflict, the ramp up to the US presidential race, attacks in the middle east, and so on, have the ability to affect the US and global economy.

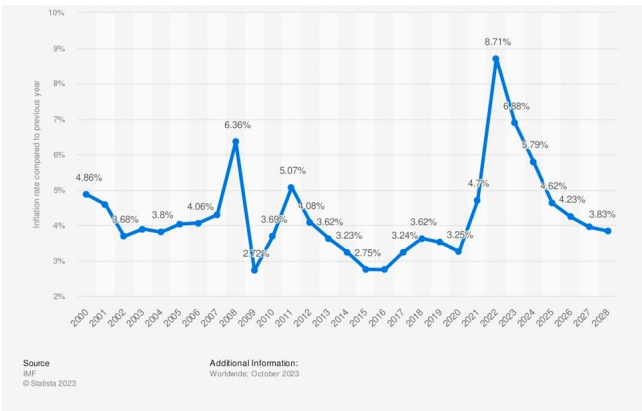

***Figure 2** - Global inflation rate from 2000-2022, with forecasts until 2028. (Percent change from previous year.)*

The US economy expanded an annualized 4.9% in the third quarter of 2023, the most since the last quarter of 2021, above market forecasts of 4.3% and a 2.1% expansion in Q2, the advance estimate showed. Consumer spending rose 4%, the most since Q4 2021 (vs 0.8% in Q2 2023), led by consumption of housing and utilities, health care, financial services and insurance, food services and accommodations and nondurable goods (led by prescription drugs), recreational goods and vehicles.

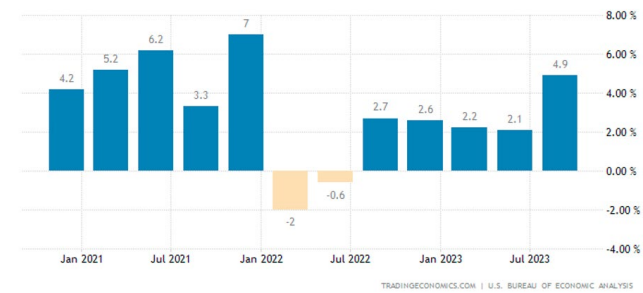

***Figure 3** - US GDP growth rate.*

GDP Annual Growth Rate in the United States is expected to be 0.30 percent by the end of this quarter, according to Trading Economics global macro models and analysts expectations. In the long-term, the United States GDP Annual Growth Rate is projected to trend around 0.10 percent in 2024 and 1.10 percent in 2025, according to our econometric models.

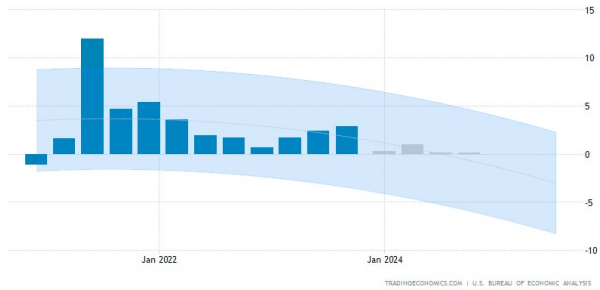

***Figure 4** - US GDP forecast.*

The Gross Domestic Product (GDP) in Canada expanded 1.12 percent in the second quarter of 2023 over the same quarter of the previous year. GDP Annual Growth Rate in Canada averaged 3.04 percent from 1962 until 2023, reaching an all time high of 12.10 percent in the second quarter of 2021 and a record low of -12.20 percent in the second quarter of 2020.

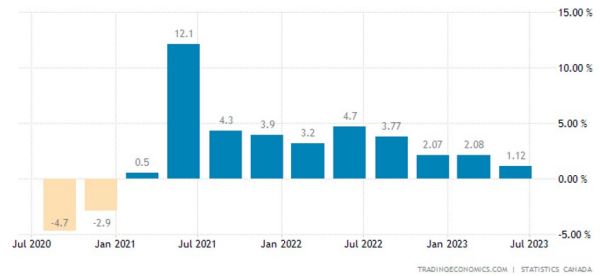

***Figure 5** - Canada GDP growth rate.*

GDP Annual Growth Rate in Canada is expected to be 0.80 percent by the end of this quarter, according to Trading Economics global macro models and analysts expectations. In the long-term, the Canada GDP Annual Growth Rate is projected to trend around 0.30 percent in 2024 and 2.00 percent in 2025, according to our econometric models.

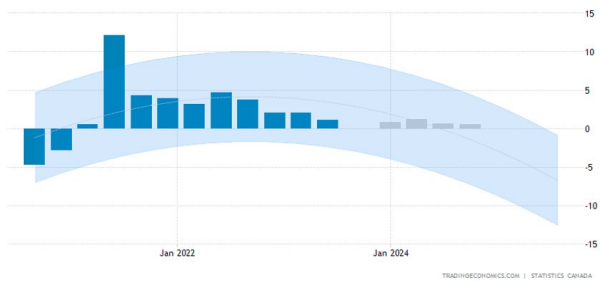

***Figure 6** - Canada GDP forecast.*

Mexico's gross domestic product expanded by 3.3% from a year earlier in the third quarter of 2023, beating market expectations of 3.2% and notching ten consecutive quarters of positive yearly growth, following the 3.6% expansion from the earlier quarter.

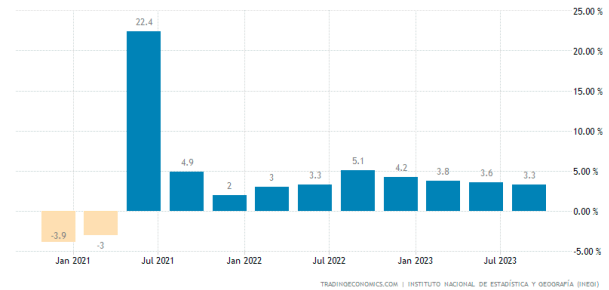

***Figure 7** - Mexico GDP growth rate.*

GDP growth rate in Mexico is expected to be 0.40 percent by the end of this quarter, according to Trading Economics global macro models and analysts' expectations. In the long-term, the Mexico GDP Growth Rate is projected to trend around 0.50 percent in 2023, according to our econometric models.

In the long-term, the Mexico GDP Annual Growth Rate is projected to trend around 1.60 percent in 2024 and 1.80 percent in 2025, according to our econometric models.

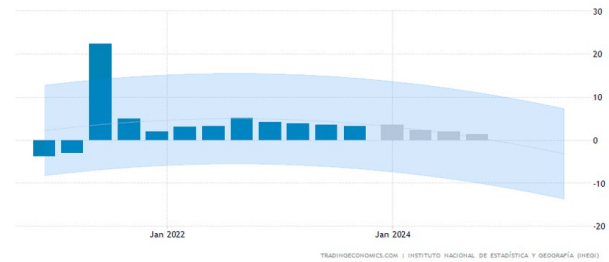

***Figure 8** - Mexico GDP forecast.*

Short-run and long-run expectations for economic conditions remained relatively flat, and consumers remain relatively tentative about the trajectory of the economy.

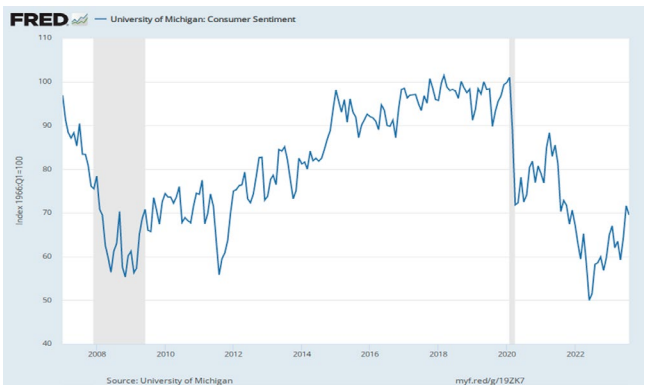

***Figure 9** - Consumer sentiment dropping.*

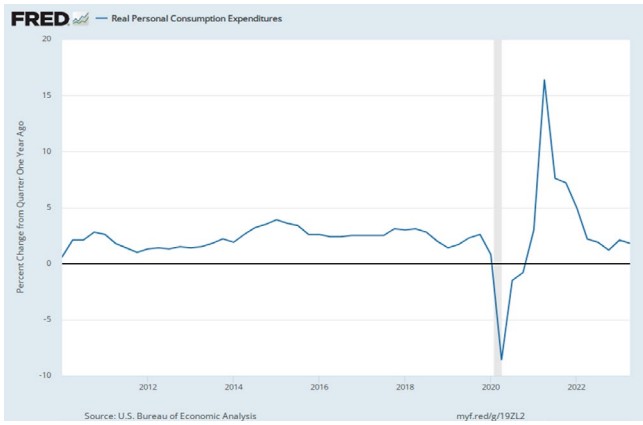

***Figure 10** - Personal consumption remains somewhat positive, but not at 2021 levels.*

Overall employment in late 2019 was a 50-year record low of 3.5% Feb'20. COVID-19 caused an increase to 14.8% in April 2020 impacting millions of workers. After the sharp rise in April 2020, unemployment declined to 6.3% in January '21, 5.9% in October '21 and 4.0% in January 2022. U.S. Unemployment rate is 3.9% as of October 2023. The unemployment rate reaches 4.1 percent by the end of 2023 and 4.7 percent by the end of 2024 before falling slightly. (Knoema.com)

***Figure 11** - October 2023 unemployment at 3.9%.*

Capacity had changed from 79.57% in November 2018 to 75.56% in February 2020. Falling to 60.96% in April 2020, capacity increased to 75.8% in Jan 2021 and is trending down to 77.88% for September 2023.

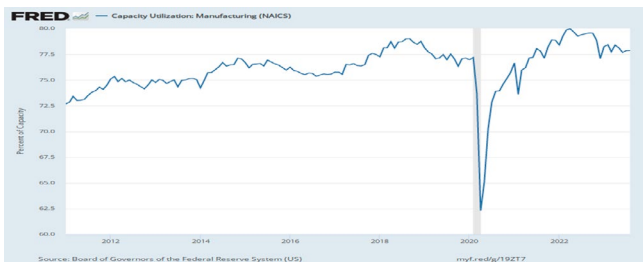

***Figure 12** - Manufacturing capacity use at 77.88%.*

NAM Manufacturing CEO Outlook

The NAM manufacturing business outlook by quarter has been somewhat consistent in 2023, but not at 2021 and early 2022 levels.

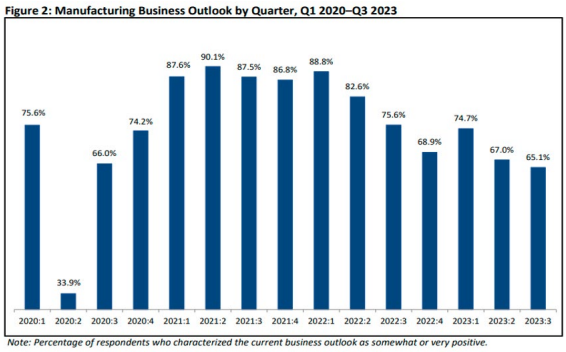

***Figure 13** – Business outlook by quarter, percentage characterized current business as somewhat or very positive.*

When asked if the US will experience a recession in the next 12 months, 42.2% of respondents said yes, 30.3% were uncertain, and 27.5% said no.

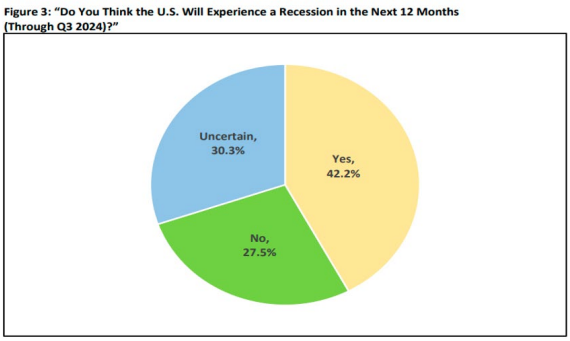

***Figure 14** – NAM: Will the US economy sink into a recession?*

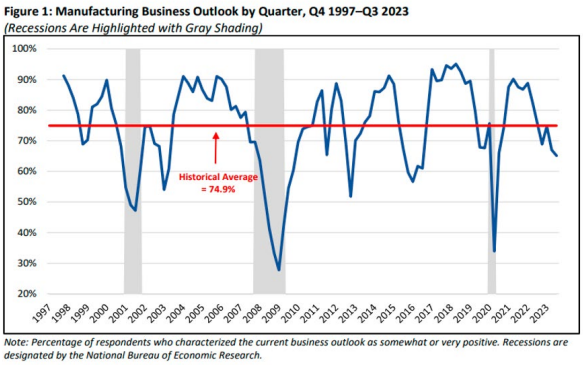

***Figure 15** – Recessions are highlighted in gray shading.*

Manufacturing CEOs were also asked about their challenges as of Q3 of 2023. Some of the usual answers showed up as most popular, including: attracting and retaining a quality workforce, weaker domestic economy and sales for our products, rising healthcare & insurance costs, and an unfavorable business climate.

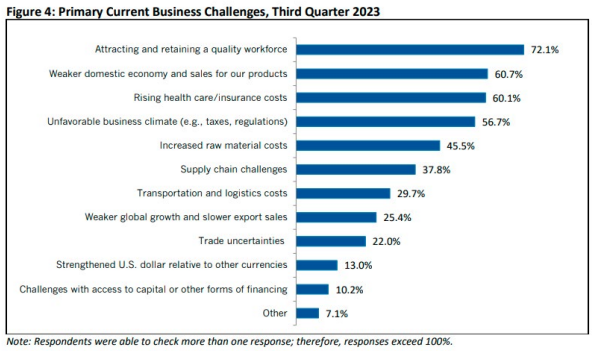

***Figure 16** – Manufacturing CEOs rate challenges, Q3 2023.*

When asked about labor disputes and contract negotiations impacting business, there is a sentiment of at the very least mild concern for this.

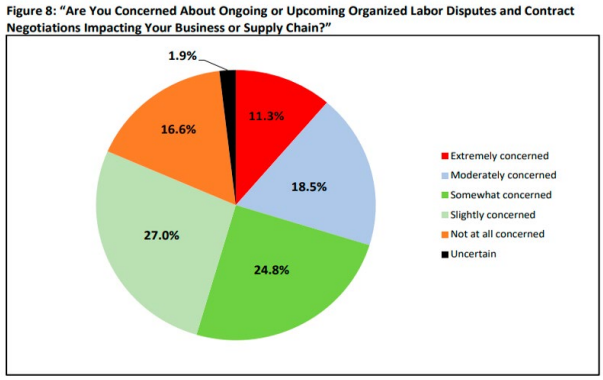

***Figure 17** – CEOs asked about strikes and their potential effect on business.*

Expected growth was slightly up from Q2 2023 to Q3 2023 but not by much. We are still off from 2022 levels as can be seen in the next graphic.

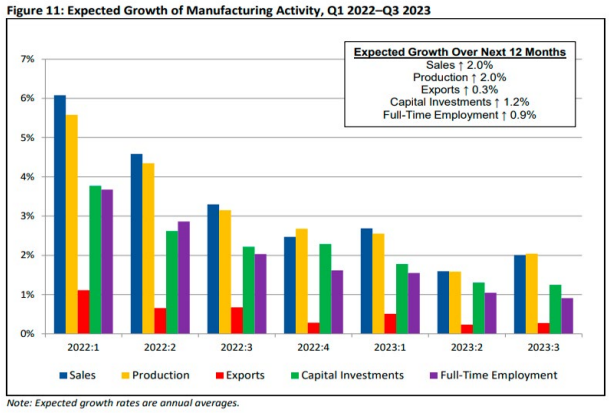

***Figure 18** – Expected growth rates are annual averages.*

An overall summary of the outlook survey can be seen in the next figure.

NAM MANUFACTURERS' OUTLOOK SURVEY
THIRD QUARTER 2023

Sept. 13, 2023

By Chad Moutray and Mary Frances Holland[1]

Percentage of Respondents Positive About Their Own Company's Outlook 65.1% – Lowest Since Q2 2020 (or Q3 2016 Excluding the Pandemic) *(June: 67.0%)* Small Manufacturers: 63.6% *(June: 67.2%)* Medium-Sized Manufacturers: 62.9% *(June: 68.6%)* Large Manufacturers: 68.3% *(June: 64.8%)*	**Overall Facts About the Survey** Number of Responses: 323* In the Field: Aug. 17–31, 2023 Small Manufacturers: 53 responses (16.4%) Medium-Sized Manufacturers: 143 responses (44.3%) Large Manufacturers: 126 responses (39.0%) ** One respondent did not state firm size.* **NAM Manufacturing Outlook Index**[2] 43.3 *(June: 44.6 – Revised)*
Expected Growth Rate for SALES Over the Next 12 Months ↑ 2.0% *(June: ↑ 1.6%)*	**Expected Growth Rate for PRODUCTION Over the Next 12 Months** ↑ 2.0% *(June: ↑ 1.6%)*
Expected Growth Rate for FULL-TIME EMPLOYMENT Over the Next 12 Months ↑ 0.9% – Lowest Since Q3 2020 (or Q4 2019 Excluding the Pandemic) *(June: ↑ 1.0%)*	**Expected Growth Rate for EMPLOYEE WAGES Over the Next 12 Months** ↑ 2.7% – Lowest Since Q1 2021 *(June: ↑ 2.9%)*
Expected Growth Rate for CAPITAL INVESTMENTS Over the Next 12 Months ↑ 1.2% – Lowest Since Q3 2020 (or Q4 2019 Excluding the Pandemic) *(June: ↑ 1.3%)*	**Expected Growth Rate for EXPORTS Over the Next 12 Months** ↑ 0.3% *(June: ↑ 0.2%)*
Expected Growth Rate for PRICES OF COMPANY'S PRODUCTS Over the Next 12 Months ↑ 1.7% – Lowest Since Q3 2020 *(June: ↑ 1.9%)*	**Expected Growth Rate for RAW MATERIAL PRICES AND OTHER INPUT COSTS Over the Next 12 Months** ↑ 2.1% – Remaining the Lowest Since Q3 2020 *(June: ↑ 2.1%)*
Expected Growth Rate for INVENTORIES Over the Next 12 Months ↓ 1.8% *(June: ↓ 2.0%)*	**Expected Growth Rate for HEALTH INSURANCE COSTS Over the Next 12 Months** ↑ 7.2% *(June: ↑ 7.0%)*

***Figure 19** – Summary of the NAM manufacturers' outlook survey.*

End Market Analysis

There are several markets served by die casting. For several years, end markets have included lawn and garden equipment, hand and power tools, telecommunication devices, computers and business equipment, plumbing, medical devices, sports and recreation equipment, aerospace, and others. More recently, opportunities to serve the robotics and the renewable energy industries have increased. However, for several years, the top 2 markets, comprising about 75% of all shipments, have remained the automotive market and the housing market. At approximately 68% of the shipments, automotive is the top market for aluminum die casting followed by housing at approximately 9% of shipments.

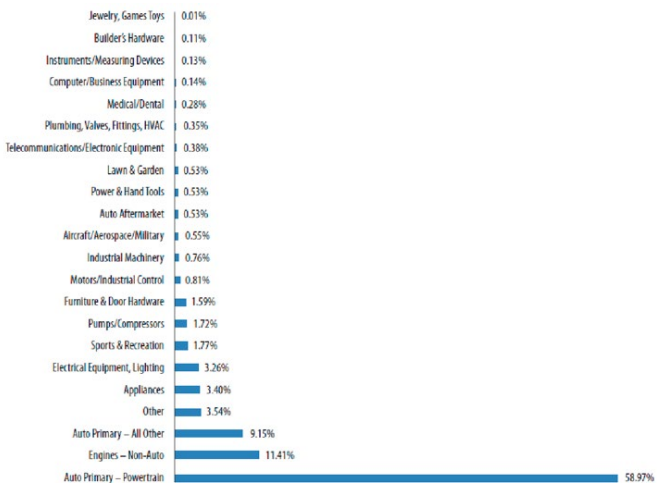

***Figure 20** – Automotive and housing remain the top 2 aluminum markets.*

At approximately 45% of shipments, housing is the top market for zinc die casting followed by automotive at about 26% of the shipments. With automotive and housing comprising the bulk of all die casting shipments, the sales and sales forecast information below is focused on these two markets.

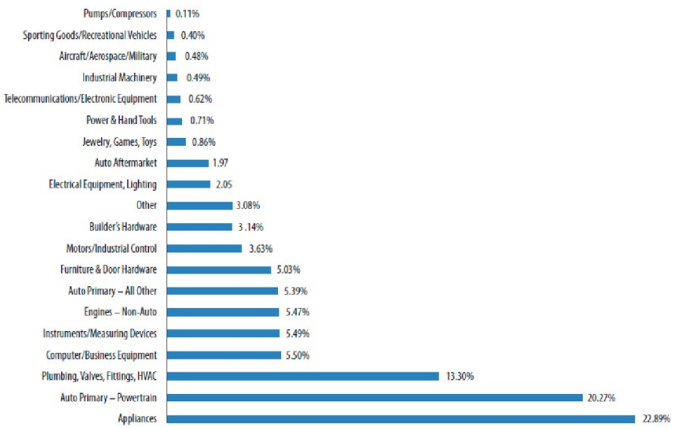

***Figure 21** – The top market for zinc is housing.*

Monthly SAAR Light Vehicle Sales

October's results were below expectations, apparently due to weakness at the end of the month. Most automakers finished below mid-month projections for each, thus the industry's overall weaker results can't be blamed on underestimating the impacts to Ford, GM and Stellantis from the strike-related plant shutdowns. The results also show that other automakers did not benefit from losses at the Detroit 3. Still, most manufacturers recorded year-over-year gains and the industry posted its 14th straight increase.

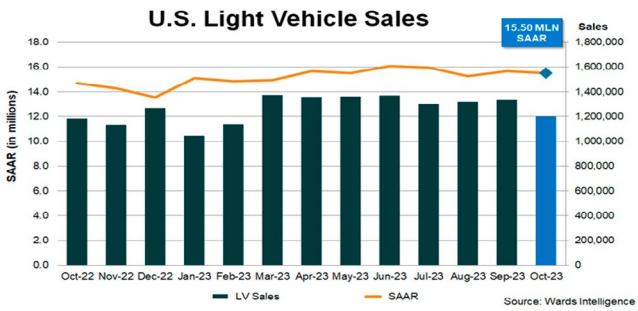

***Figure 22** – Light vehicle sales Oct 2022 – Oct 2023.*

Monthly SAAR New Privately-Owned Housing Starts

Housing starts in the US surged 9.8% from a month earlier to a seasonally adjusted annualized rate of 1.45 million in February of 2023, the highest in five months, and way above market forecasts of 1.31 million, in a sign that some confidence may have returned to the housing market, although mortgage rates and inflation remain elevated. Single-family housing starts were up 1.1% to 830 thousand and starts for units in buildings with five units or more surged 24.1% to 608 thousand, the highest since April last year. Starts soared in the Midwest (70.3% to 201 thousand), the West (16.8% to 347 thousand), and the South (2.2% to 796 thousand) but fell in the Northeast (-16.5% to 106 thousand). Compared to February 2022 however, housing starts were 18.4% lower. In January, housing starts were revised higher to 1.321 million from an early estimate of 1.309 million, but remaining the lowest since June of 2020. (Source: U.S. Census Bureau)

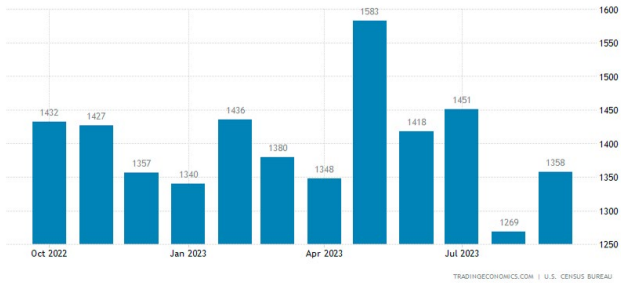

***Figure 23** – Housing starts in the US rose by 7% month-over-month to a seasonally adjusted annualized rate of 1.36 million in September of 2023, rebounding from the upwardly revised, three-year low of 1.27 million from the previous month, but missing estimates of a sharper 1.38 million starts.*

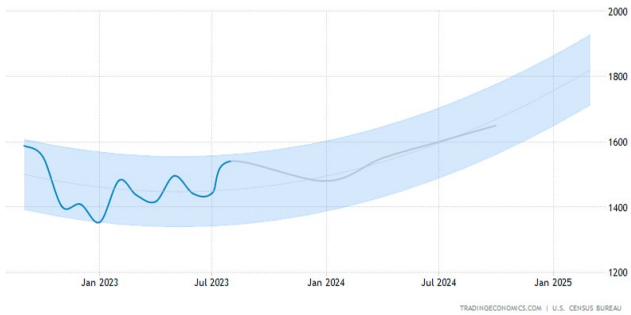

***Figure 24**– Strong housing starts are forecasted.*

NADCA's Most Recent Board Barometer

The following questions were asked to NADCA's board and answered as seen in the following figures.

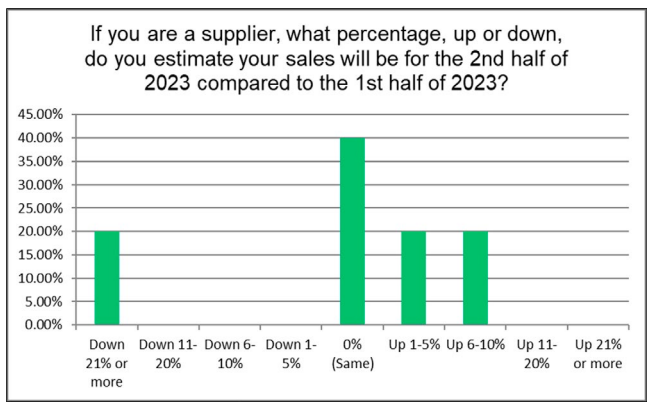

***Figure 25** – Suppliers comparing sales estimates from the first and second halves of 2023.*

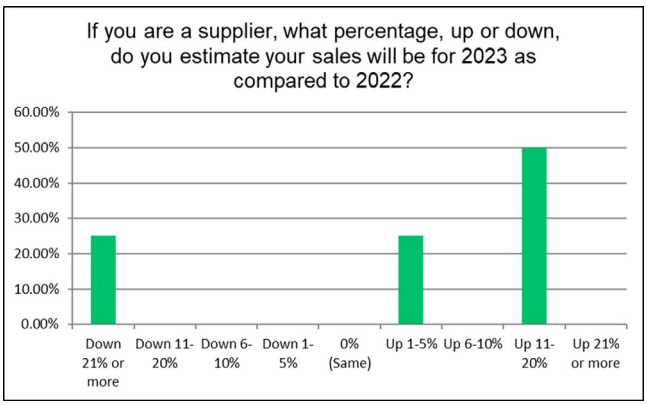

***Figure 26** – Suppliers comparing sales from all of 2022 vs 2023.*

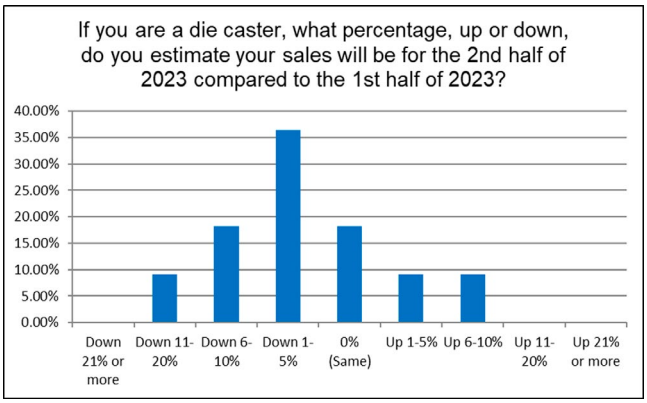

***Figure 27** – Die casters comparing sales estimates from the first and second halves of 2023.*

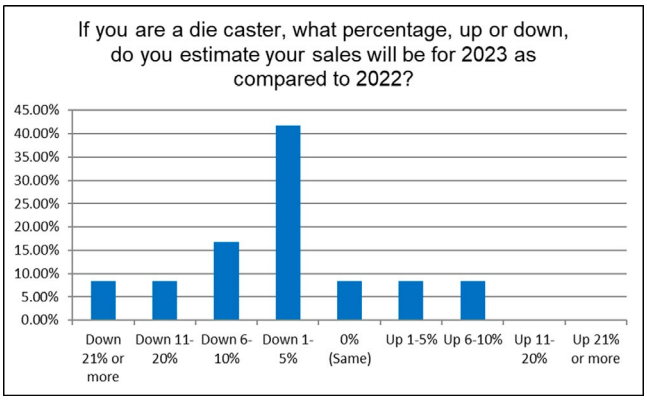

***Figure 28** – Die casters comparing sales from all of 2022 vs 2023.*

NADCA's Most Recent Business Barometer

NADCA asked companies some of the following questions in its most recent business barometer survey.

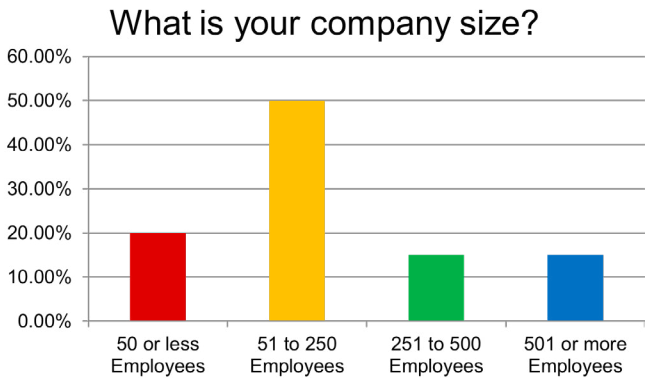

***Figure 29** – Size of companies surveyed.*

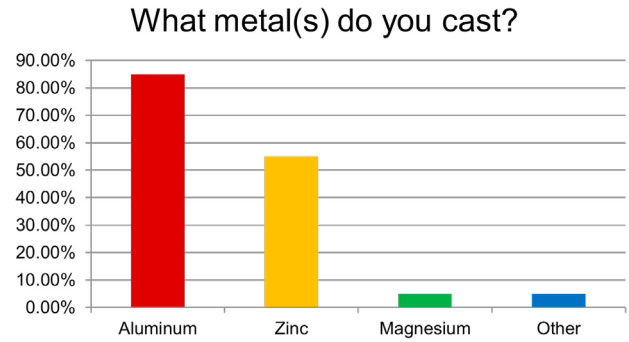

***Figure 30** – Metals cast.*

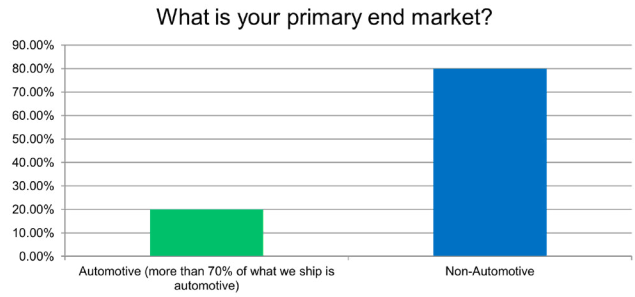

***Figure 31** – End markets.*

Overall shipments were down 13% in Q3'23 as compared to Q2'23. Aluminum shipments were down 19%, zinc shipments down 7%, and magnesium shipments were down 23% in Q3'23 compared to Q2'23. Automotive shipments were down 25% and non-automotive shipments were down 5% in Q3'23.

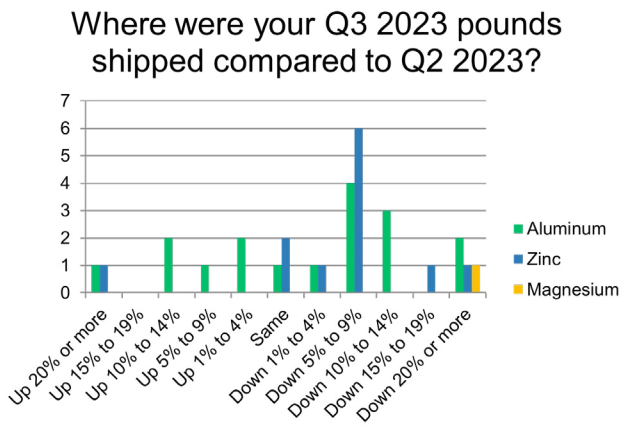

***Figure 32** – Shipments Q3 2023 vs Q2 2023.*

Overall shipments are currently forecast to be down 9% in 2023 compared to 2022. Automotive shipments are forecast to be down 13% and non-automotive down 4% in 2023 compared to 2022.

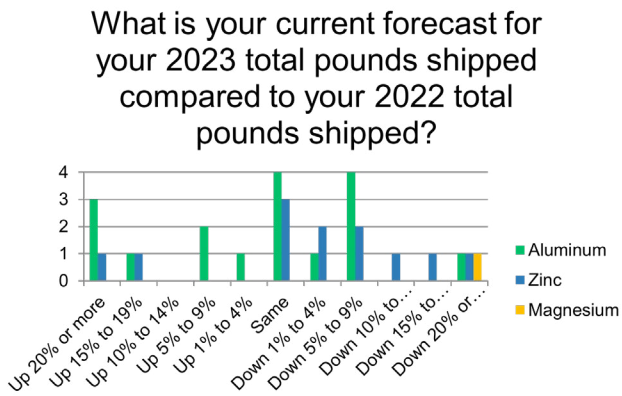

***Figure 33** – 2023 shipment forecast vs 2022.*

58% of the respondents report that quoting was up, 26% report about the same level of quoting, and 16% report that quoting was down in Q3 2023 as compared to the same time last year. Overall, quoting of new jobs was up a slight 2.2% in Q3 2023 as compared to Q3 2022. Automotive was up 2% and Non-automotive was up 3%.

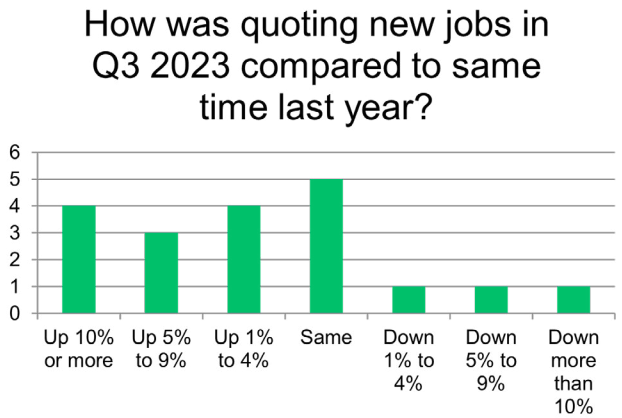

***Figure 34** – Quoting Q3 2022 vs Q3 2023.*

30% of the respondents report that new die builds were up, 50% report about the same, and 20% report that new die builds were down in Q3 2023 as compared to Q3 2022. Overall, new die builds were up 2% as compared to the same time last year. Automotive was up 2% and non-automotive up 2%.

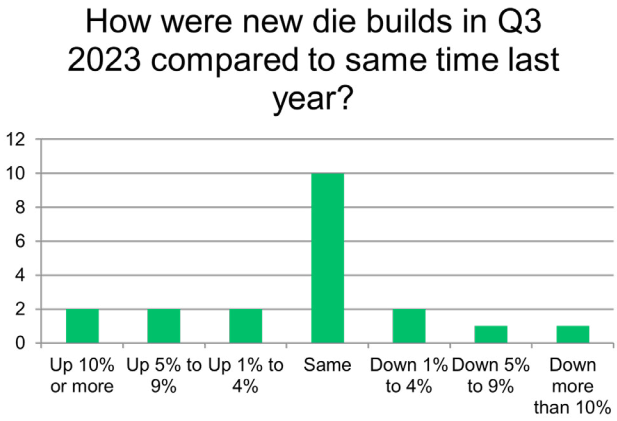

***Figure 35** – New die builds Q2 2023 vs Q3 2023.*

For capacity use, overall Q3 average was 55%. Calculated by taking the number of machines and multiplying by 1440 hours (12 weeks for the quarter times 120 hours/week), then divide by total up-time hours for the quarter.

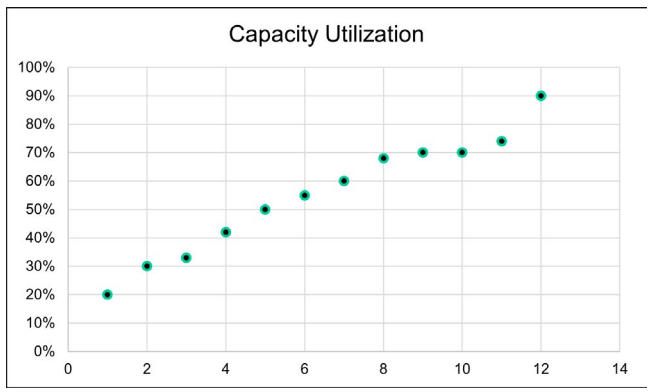

***Figure 36** – Capacity use in 3rd quarter 2023.*

Overall average energy cost for Q3'23 was $0.25/lb shipped. Automotive average energy cost for Q'3 was $0.16/lb. Non-automotive average energy cost for Q'3 was $0.29/lb.

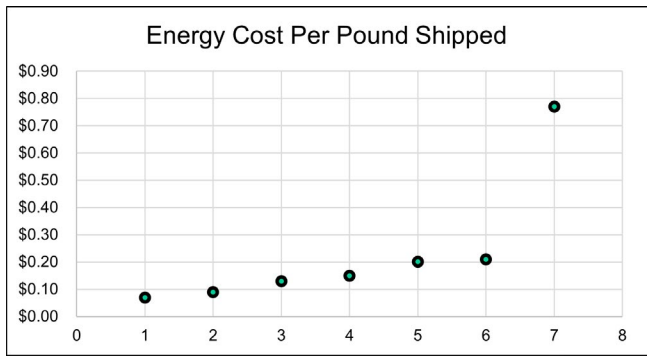

***Figure 37** – Energy cost in 3rd quarter 2023.*

Q3 2023 Barometer Summary

Overall shipments were down 13% in Q3'23 as compared to Q2'23:

- Aluminum: Down 19%
- Zinc: Down 11%
- Magnesium: Down 23%

Shipments are forecast to be down 9% in 2023 compared to 2022.

Quoting of new jobs in Q3'23 was overall up 2.2% as compared to Q3'22. New die builds were up 1.5% in Q3'23 as compared to Q3'22. The average number of dies built in Q3'23 was 6 per company. Capacity utilization for Q3'23 was an average of 55%. Average energy cost in Q3'23 was $0.25/lb shipped.

Conclusions

Despite many headwinds, the US economy has remained resilient. Wars in the middle east and Ukraine remain troubling, and overall our elected officials are not getting much done. Business is off by 15 to 20% compared to recent highs.

It appears the economy in 2024 will start a little softer than recent records economic highs. Forecasts of production of 15+ million vehicles are encouraging, but we all would welcome 16 or 17 million. While there has been a strong push towards EVs, the pace of that growth is much less than forecasted just a year ago. Housing starts would be stronger if interest rates would come down, but significant declines are not forecasted for 2024. It will be important to be nimble and react appropriately to market trends in 2024.

Microstructure and Mechanical Properties of High-Pressure Die Cast Steel

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Abstract

Different steels were high-pressure die cast (HPDC). The resulting microstructures near the surface and at the center of the castings are shown. The microstructure is characterized by a thin chilled layer at the surface and an equiaxed dendrite in the center. Some castings present an intermediate columnar dendrite microstructure, others a gradual increment of the grain size from the chilled layer toward the center. Extracted samples from the castings were subjected to tensile testing and hardness measurement. The results were compared with the mechanical properties reported for steel bars of the same composition and similar hardness. Porosity and other defects were found in the castings. Despite those defects, HPDC 316 SS, S7 tool steel, and 1045 steel samples demonstrate yield strength (YS) and ultimate tensile strength (UTS) higher than the minimum reported for heat-treated steel bars.

Introduction

The interest in studying the steel HPDC process has been renewed in the last years, driven in part by the potential of extent the benefits of HPDC as a manufacturing method to steel castings, but also by the successful steel die casting plant trials performed at the Mercury Marine die casting plant in Fond du Lac, WI.[1,2] Although the entire process represents a challenge that requires identifying the different areas that need improvement to make steel HPDC feasible, one part that can't be set aside is the casting itself. In the end, the steel casting is the final product; therefore, a complete understanding of its properties is necessary to assess the real benefits of the HPDC as a process for the steel industry.

Most of the steel casting production is done in sand and investment casting molds, not permanent molds. The conditions of filling and solidifying the casting in an HPDC machine are expected to produce microstructures and properties different from the ones obtained from most common steel casting methods. The availability of literature on steel HPDC is limited, which generates the necessity of identifying the characteristics of steel casting made by HPDC.

This paper presents some of those characteristics regarding the microstructure of the castings in the as-cast condition and some mechanical properties of different steels cast produced in trials at Mercury Marine.[1,2] The results include microstructural images, tensile testing, and hardness testing. The steels used were 15-5 PH SS, 17-4 PH SS, 316 SS, S7 tool steel, and 1045 steel.

Literature Review

There has been previous commercial production of HPDC steel and other high-temperature alloys.[3] The commercially die-casting materials were mild and low-alloy steels, a range of stainless steels, and some nickel and cobalt-based alloys.[4] Some of those castings were produced in TZM dies and showed a different microstructure compared with sand and investment casting due to the high thermal diffusivity of the TZM. In the permanent molds, the metal solidifies rapidly. This high solidification rate appears beneficial because it produces castings characterized by extremely fine microstructures.[4]

The typical microstructure reported of HPDC steel is shown in Figure 1 and consists of three main zones[4]:

- A thin, chilled, mostly equiaxed surface structure, often difficult to resolve (top of Figure 1).
- A subsurface structure of extremely fine columnar dendrites.
- A central core of uniform fine, cellular-type dendrites.

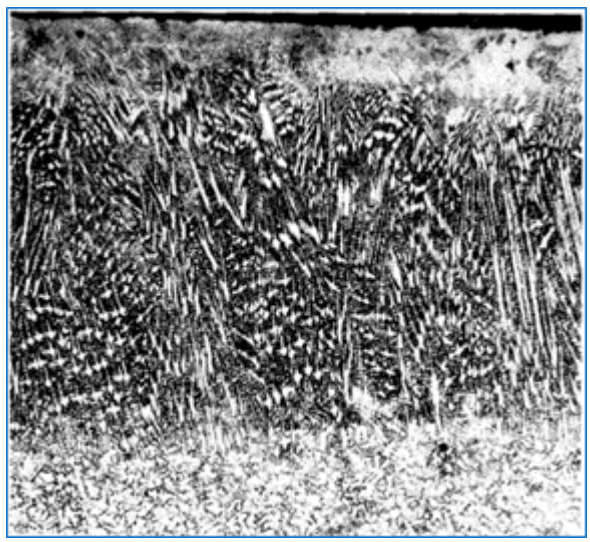


***Figure 1** – Diecast type 316 SS. Three zones, namely the outer skin, the subsurface structure, and the central core (X100). Presumably, cast in TZM dies.[4]*

The microstructure in Figure 1 is typical of die-cast steel, although certain mild steel microstructures differ due to a phase transformation during cooling. In simple terms, the high-pressure diecasting microstructure can be considered similar to a finer version of the conventional ingot structure.[4]

Hurd and Barto were contributors to studying the HPDC of ferrous materials in the US. Both also noted that ferrous diecasting made in refractory metal dies shows evidence of rapid cooling and is distinctly different from typical casting structures.[5]

In the case of low alloy steels like 1020, the microstructure looks more pearlitic, almost like 1080 instead of 1020. In stainless steel, the change is less dramatic, but the grain structure is much finer than that of sand casting.[5]

The 304 SS was one of the steels commercially diecast in the past. Its microstructure has an extremely fine dendritic pattern with minimal segregation. Figure 2 shows the microstructure of this steel.[5]

***Figure 2** – As cast HPDC 304 stainless steel.[5]*

As an example of the excellent mechanical properties, specifically ductility, Figure 3 shows a die-cast straight part (right side) to allow a flat parting line. A similar part was bent and twisted to demonstrate its ductility (left side).[4]

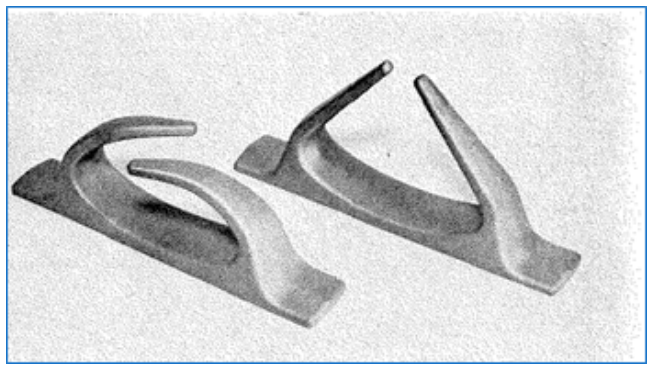


***Figure 3** – Ductility demonstration of HPDC 316. This component is diecast with straight arms, and cold bending is carried out as a subsequent operation.[4]*

Hurd and Barto claim that after making the necessary adjustments, various metals can be cast with very smooth surfaces, a minimum of porosity, and the absence of cold shuts and hot tears. The attention to mold design, mold and metal temperature, and other die casting parameters has accomplished this. They even claim that mechanical properties are superior to sand-cast metals of the same composition.[6]

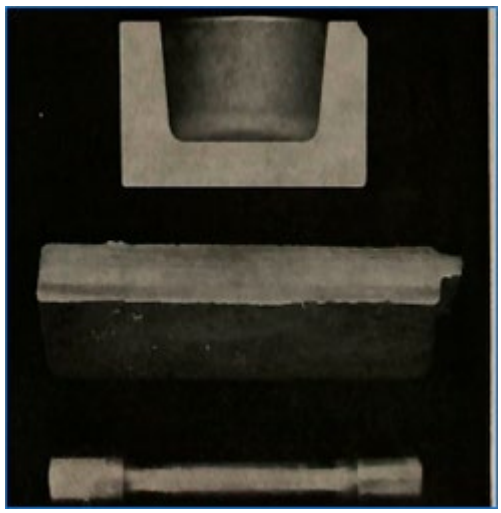


***Figure 4** – Sections through castings show soundness and smooth as-cast surfaces.[6]*

Figure 4 is an example of a diecast, malleable iron, thick wall cup that demonstrates the very smooth cast interior surface of the cup and the soundness of the cast metal, equivalent to ASTM 32-64.[6]

***Table 1** – Summary of steel HPDC properties in as-cast condition vs. sand/investment casting found in the literature.[5,7,8,9]*

	Typical steel HPDC properties (As cast)			Investment/sand cast properties		
	0.2% Yield Strength [MPa]	UTS [MPa]	Elongation %	0.2% Yield Strength [MPa]	UTS [MPa]	Elongation %
AISI 304 SS	290 - 303	517 - 565	20 - 38	255	530	55
AISI 403 SS	-	584	0	-	-	-
AISI 1020	310 - 413	620 - 723	13	255 - 275	455 - 482	22 - 33
AISI 4618	586 - 861	992 - 1323	2 - 3	-	-	-
AISI 4340	806 - 1378	1275 - 1516	1 - 7	-	-	-

After finding the appropriate parameters, Hurd and Barto reported that, in most cases, over a dozen iron and steels have strength and ductility higher than sand castings of the same type.[7]

The same authors reported that the easiest steels to HPDC are stainless steels, especially 304 SS.[8]

Table 1 summarizes the mechanical properties reported in the literature for some steel HPDC.

Description of the Activities

Castings from different trials at Mercury Marine[1,2] were cut with wire electrical discharge machining (EDM) to extract tensile specimens. The tensile sample dimensions correspond to the sub-size specimen dimensions from the standard test methods for steel products,[10] with the difference that the gripping section length was reduced from 1¼" to 1".

Tensile specimens were extracted from castings made of 15-5 PH SS, 17-4 PH SS, 316 SS, S7 tool steel, and 1045 carbon steel. Figure 5 shows a coaster after being cut with wire EDM. Two tensile specimens were extracted from the flat section of the coaster (away from the waffle pattern).

Additionally, the remaining center of the coaster was sectioned into three parts (see Figure 5). The upper and lower parts of these sections were reserved for microstructure analysis and the center for hardness measurements.

***Figure 5** – One of the HPDC coasters after wire EDM cutting showed where the tensile coupons were extracted. The area in the center was saved for hardness measurements and microstructure analysis.*

The upper and lower parts highlighted in Figure 5 were mounted, ground, polished, and etched as per the ASM Handbook.[11] 15-5 PH SS and 17-4 PH SS were etched with Fry's reagent. 316 SS was etched with Marble's reagent. S7 tool steel and 1045 steel were etched with Vilella's reagent. The surface to be analyzed is the plane perpendicular to the one shown in Figure 5, which corresponds to the cross-section area of the coaster. All the samples were extracted from the same position (lower part) in the different castings, except the S7 tool steel, which was the upper part, and the 15-5 PH SS, which is actually a sample used for a previous publication.[12]

Results

Microstructure

Figure 6, (a) through (j) are light microscope images captured from the different samples. The pictures on the left side are low-magnification images of the area near the external surface of the castings. The pictures on the right side are high-magnification images in regions in the center of the castings.

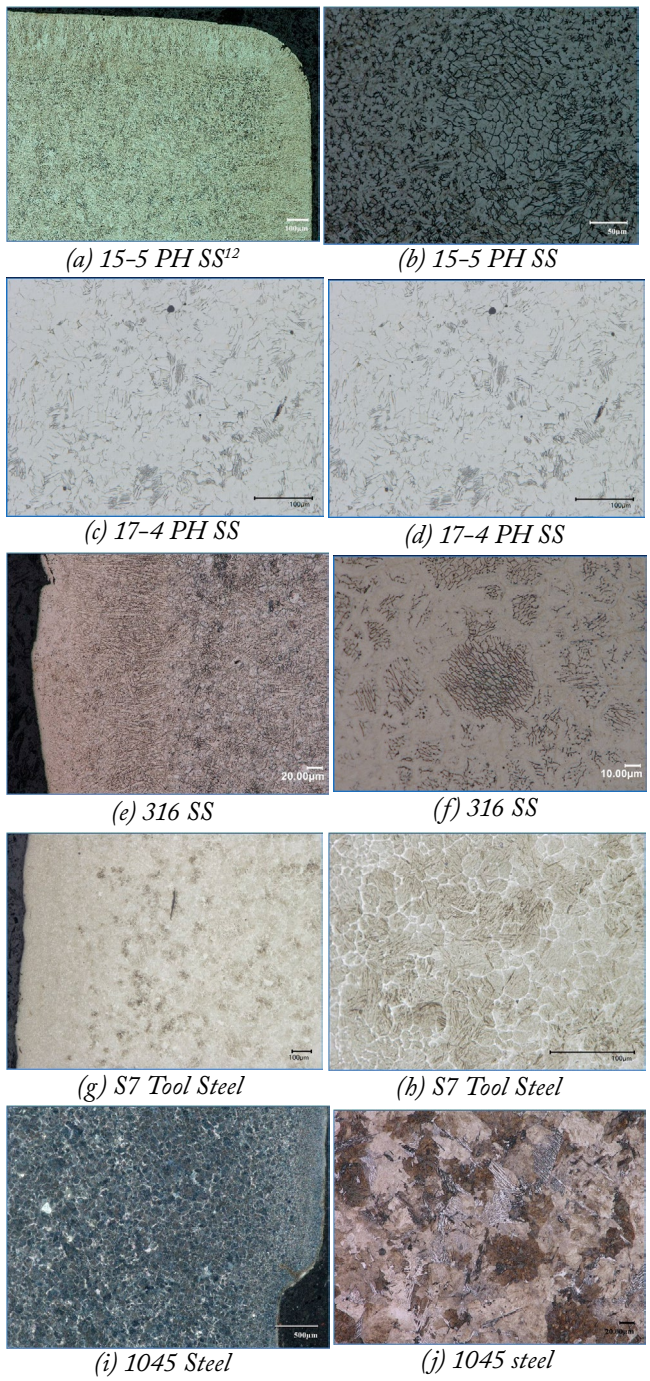


***Figure 6** – Different HPDC steel microstructures.*

Tensile Test

The tensile specimens were pulled in a Servo Hydraulic Test System MTS Landmark with a force capacity of 27 kip. The test conditions were according to the standard test methods for steel products.[10] An extensometer MTS, model 634.31E-25, with a 1" initial aperture, was used to measure the strain of the samples. Only one tensile specimen per steel was pulled.

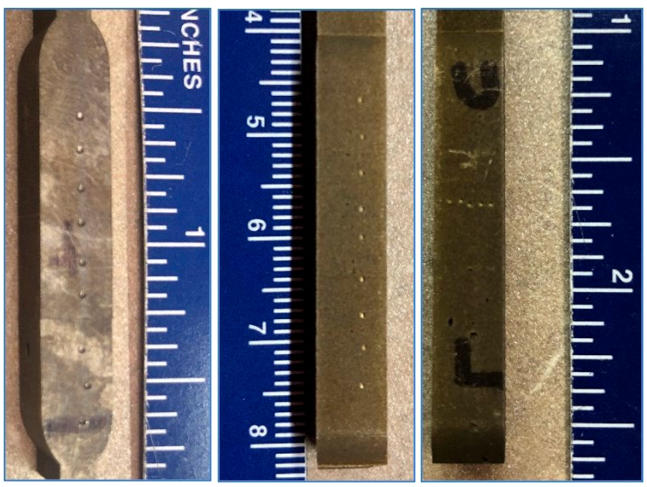
Table 2 summarizes the results of the tensile tests. In the analysis of the results section, these mechanical properties will be compared with the mechanical properties of steel bars of the same composition.

***Table 2** – Tensile test results for different steels HPDC.*

	0.2% Yield Strength [MPa]	Ultimate Tensile Strength [MPa]	Elongation
15-5 PH SS	572	600	0.5%
17-4 PH SS	638	749	1.1%
316 SS	324	480	8.0%
S7 Tool Steel	-	344	0.2%
1045 steel	616	754	1.8%

Hardness Test

The center of one coaster of each steel type was reserved for hardness measurements (Figure 5). A Wilson Rockwell Hardness Tester was used with a C penetrator, 10 kg of minor load, and 150 kg of major load. As shown in Figure 7, the measurements were taken from three locations: (1) on the front face of the sample, the one that was in contact with the die; (2) on the cut face, approximately along the center line of the coaster, and (3) across the thickness of the sample.



(a) (b) (c)

***Figure 7** – The center of the coasters shows the location of the hardness measurements. The front face (a). The cut face (b). The cut face across the thickness of the coaster (c).*

Hardness values measured for 316 SS were below the range of the Rockwell C scale and so are not reported below. Typically, the hardness of 316 SS is reported in Rockwell B or Brinell scale.

Figure 8 shows the results of the hardness values for the rest of the steels from the front face (Figure 7(a)) and the cut face (Figure 7(b)). Table 3 provides the mean of the hardness values.

Seven to ten hardness measurements were taken from each face of the samples and used to calculate the mean. The hardness measurements across the thickness of the coaster (Figure 7(c)) are represented in Figure 9.

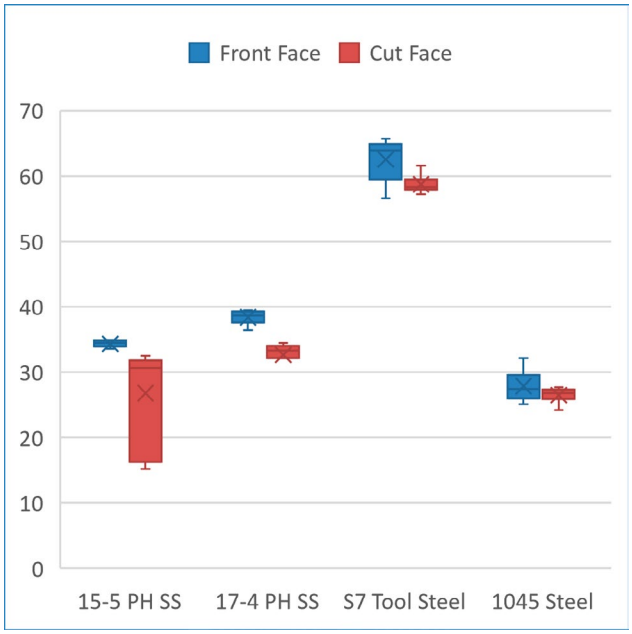


***Figure 8** – Hardness in Rockwell C for different HPDC steels.*

***Table 3** – Mean Hardness Rockwell C for different HPDC steels.*

Sample	Front Face	Cut Face
15-5 PH SS	34.3	28.6
17-4 PH SS	38.4	32.6
S7 Tool Steel	62.5	58.7
1045 steel	27.9	26.5

The measurements across the thickness of the coaster were done as close to the edge/surface as possible with the Hardness testing equipment, as seen in Figure 7 (c). Figure 9 shows a distribution of 5 points across the thickness of the samples.

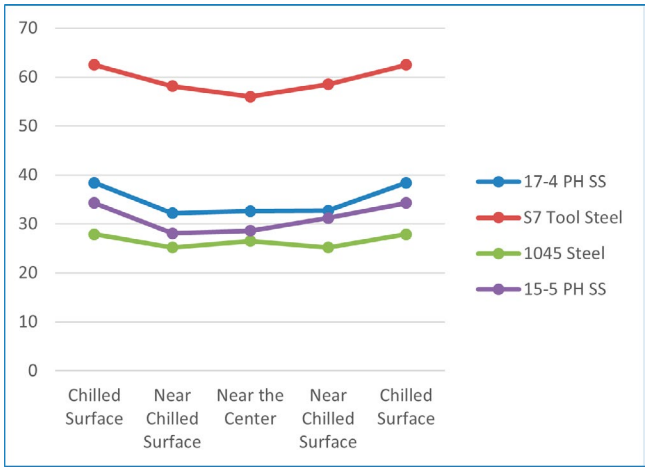


***Figure 9** – Hardness Rockwell C across the thickness of different HPDC steels.*

Analysis of the Results

All the castings present a similar pattern in their microstructures, featuring a chilled layer at the surface, a transition zone, and a core or center area characterized by equiaxed grains. In some castings (15-5 PH SS and 316 SS), the transition zone consists of columnar dendritic, while in others, it is a gradual increasing of equiaxed grain size.

The similar nature of the microstructures is expected because, in addition to the similar filling conditions, the solidification is driven primarily by the degree of supercooling of the molten metal in the cavity, producing a high nucleation concentration. However, after the first layers of the casting solidify, even with the mold's heat extraction capacity, the casting's flow of heat is limited by the casting material itself.

This can be observed with the S7. This alloy behaves differently from the 15-5 PH SS. Despite the finer grain size, there is some evidence of dendritic grain growth in the center regions of the coaster. This can be observed in Figure 10. A dendritic structure can be seen at the image's top right side (located near the casting's center), while the left side (near the casting's surface) can be seen to be equiaxed. This result is similar to microstructures observed by Hurd and Barto.[8] The same picture shows the almost perfect circle-shaped porosity on the left side.

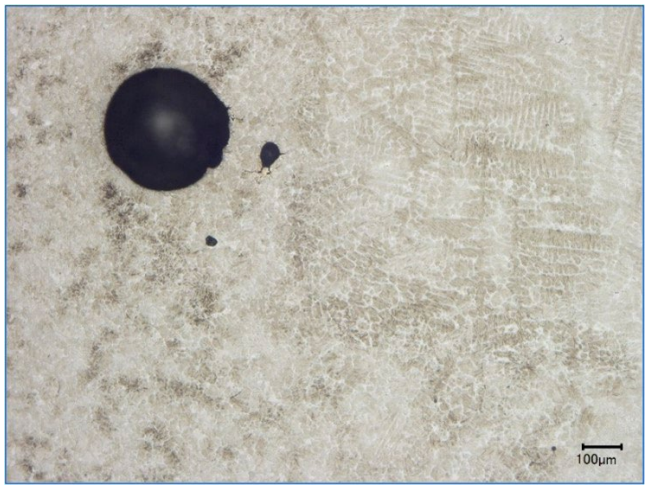


***Figure 10** – S7 Tool steel microstructure showing equiaxed (left side), dendritic microstructure (right), and gas porosity.*

Another observation is related to the 1045 carbon steel. The microstructure appears as the microstructure of a carbon steel of higher carbon content. At higher magnification (Figure 6 (j)), the microstructures of the darker areas are extremely fine pearlite (difficult to observe even at high magnification) mixed with acicular ferrite. Again, this result is aligned with Barto and Hurd's observations.[8]

Table 4 compare the mechanical properties of the steel HPDC with those of steel bar of the same composition. There are different mechanical properties for steel bars depending on the heat treatment. The mechanical properties are from bars with similar hardness.[13,14,15]

For all the HPDC steels, the elongation values are particularly low. The YS and UTS of HPDC 15-5 PH SS and 17-4 PH SS are low compared to the typical values of wrought steel with similar hardness. There are no hardness values for 316 SS to compare; therefore, this steel is compared with the range of minimum YS and UTS reported for this steel.[14] The HPDC 316 SS YS is higher than the top minimum reported, and the UTS reached the lowest minimum.

HPDC S7 tool steel only shows an elastic behavior. The strength reached before rupture was higher than the minimum UTS reported for steel with similar hardness. There are no 1045 steel properties reported in the literature with a similar hardness; therefore, HPDC 1045 carbon steel is compared with two 1045 steels with a lower and higher

***Table 4** – Comparison of mechanical properties of steel HPDC and bars.*

	Steel HPDC mech. properties				Steel bars mech. properties			
	0.2% Yield Strength [MPa]	**Ultimate Tensile Strength [MPa]**	**Elongation**	**HRC (center)**	**0.2% Yield Strength [MPa]**	**Ultimate Tensile Strength [MPa]**	**Elongation**	**HRC**
15-5 PH SS	572	600	0.5%	29	725	930	11-16%	28
17-4 PH SS	638	749	1.1%	33	860	1000	13%	32
316 SS	324	480	8.0%	-	170 - 310	480 - 620	30 - 51%	-
S7 Tool Steel	-	344	0.2%	59	210	315	7%	58
1045 steel	616	754	1.8%	27	842	1343	-	42
					405	675	24%	≈ 16

hardness. The HPDC 1045 steel has YS and UTS within the values reported for wrought steel.

The results of hardness values (Figures 8 & 9 and Table 3) in the castings are aligned with the one observed by Suzuki, where the hardness on the surface was higher than the hardness in the center of the casting, even though he used Vickers hardness and measured the hardness values within 15 mm from the surface, he was able to note the difference in the hardness.[16] This is due to the surface layer solidifying faster than the rest of the casting.

The steels HPDC analyzed were characterized by excellent surface finish and sound detail reproduction but also by the presence of porosity. Some porosity was observed to be spherical, most likely entrapped gas porosity (Figure 11). Some of the porosity was irregular in shape and was concentrated in the center line of the casting. This porosity was concluded to be related to solidification shrinkage.

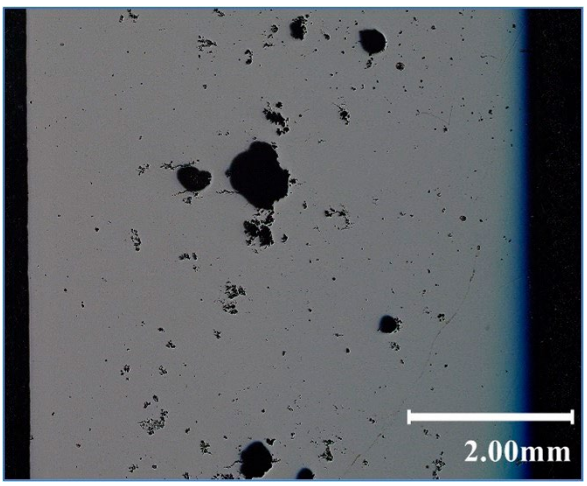


***Figure 11** – Cross section of one 15-5 PH SS casting. Note the porosity.*

Another defect observed in the coasters was cracks, probably hot tears. An example is depicted in Figure 12. Hot tears may occur due to casting conditions, mold rigidity,

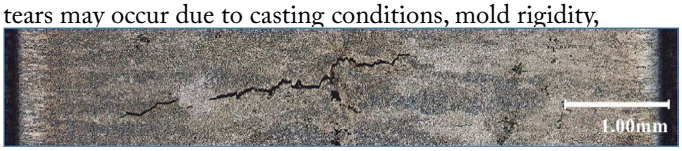


***Figure 12** – Cracks were observed in a 15-5 PH SS sample cross-section.*

The porosity content and other defects drive the mechanical properties of steel HPDC and not the fine microstructure. McMillin already recognized the porosity as one of the problems that need to be solved for the HPDC of steels. This is a die design and operational parameter problem rather than a part-related; once this problem is solved, better mechanical properties are expected.[9] As a reference, results of another study performed in Japan with Iron HPDC show that even thicker castings (more than 1" thickness) with no porosity visible by the unaided eye can be achieved.[16] The steel HPDC produced at Mercury Marine are ¼" thick.

Conclusions

The microstructure analysis of all casting reveals a typical pattern featuring a chilled layer at the surface, a transition zone, and an equiaxed grain core at the center. Primarily, it is porosity rather than fine microstructure that impacts the mechanical properties of the castings produced at the trials. Other defects, like hot tears, were observed.

Despite the porosity found in all the castings and the low elongation values, the 316 SS, 1045, and S7 tool steel show YS and UTS similar to or higher than the minimum required for a steel bar of the same composition.

Reducing porosity and other defects is important to fully harness the potential of steel HPDC. Studies have mentioned that if appropriate operational conditions are used, porosity content can be reduced, and mechanical properties can surpass those of conventional sand and investment casting.

Future Work

Research is planned to identify the best operational parameters to produce high-quality sound castings. A new HPDC High Temperature Alloys project phase is planned to start in Q1 2024.

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Since 1966, Hanson International has specialized in the design, build, sample, and inspection of precision molds and high pressure die cast dies-primarily for the automotive industry. Hanson's campus, located in Saint Joseph, Michigan, consists of an office and engineering group, a 42,000 square foot tooling facility, and a 10,000 square foot die testing facility. Hanson utilizes modern equipment and engineering software to provide the die cast industry with the finest, most efficiently designed, high-quality, long-lasting tooling available. The company's highly experienced workforce is committed to manufacturing excellence. In-house die cast machines (600-ton and 1,600-ton) offer convenience and cost savings. All parts are inspected and validated using laser scanning technology and coordinate measuring machines in compliance with ISO 9001:2015 standards. Hanson's single-source assurance and single-point of contact approach guarantees outstanding service and support from design to delivery.

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

Able Die Casting Corporation
Schiller Park, IL

ACE Precision International, LLC
Marshalltown, IA

Acme Alliance LLC
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ADC Aerospace
Buena Park, CA

Advance Die Cast LLC
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Ahresty Wilmington Corp.
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Alupress LLC
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Anderson Die Casting Co.
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Anderton Castings De Monterrey
Apodaca NL

Anderton Castings LLC
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Apex Aluminum Die Casting Co.
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Arbomex S.A De C.V.
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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.
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Caldwell Casting Company*
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California Die Casting Inc.
Ontario, CA

Canimex Incorporated
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Carteret Die Casting Corp.
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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-Rite Corporation
Gardena, CA

Cast Specialties Inc.
Warrensville Heights, OH

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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

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

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

Greenfield Industries Inc.
Freeport, NY

H

Heritage Die Casting Co.
Denver, CO

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 Tennessee-Morristown Inc.
Morristown, 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

Le Sueur Incorporated
Le Sueur, MN

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

Ljunghall Canada Ltd.
Grand Bend, Canada

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.
Strathroy, ON, Canada

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

Miniature Casting Corp.
Cranston, RI

Mumford Companies - Metal Casting Division
Chicago, IL

N

Nebraska Aluminum Castings Inc.
Hastings, NE

Nemak Alabama
Sylacauga, AL

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
Commerce, CA

Pacific Die Casting Corporation
Vancouver, WA

PHB - Die Casting Div.
Fairview, PA

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

Russellville Engineered Castings, Inc.
Russellville, KY

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

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

V

VAZLO SA DE CV
Fresnillo, Zacatecas, Mexico

W

Walker Die Casting
Lewisburg, TN

Whitehead Die Casting Co. Inc.
Gainesville, GA

Wilkast, Inc.
Grand Rapids, MI

Y

Yamada North America
South Charleston, OH

CORPORATE OEM

ZF Transmission
Gray Court, SC

CORPORATE SUPPLIERS

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AarKel Tool & Die Inc.
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Absolute Machinery Corporation *
Worcester, MA

Alcoa USA Corp.
Alcoa, TN

Allied Metal Co.
Chicago, IL

American Metal Chemical Corp.
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

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

Buffoli North America, Inc.
Holland, 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

Comet YXLON
Hudson, OH

Conticast Hormesa LLC
Weston, FL

Custom Alloy Sales, Inc.
City of Industry, CA

D

Daido Steel Co. Ltd.
Hebron, KY

Daiichi Jitsugyo (America) Inc.
Wood Dale, IL

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

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 SAS
Richmond Hill, ON, Canada

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

Midland Technologies, Inc.
Rogers, MN

Mokon
Buffalo, NY

MORESCO USA Inc.
Fountain Inn, SC

N

New Brunswick Plating Inc.
New Brunswick, NJ

New Century Heaters Ltd.
Eau Claire, WI

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

PiQ2
Livonia, MI

Progressive Components
Wauconda, IL

Prolong Surface Technologies
West Chicago, IL

Pyrotek Inc.
Columbia City, IN

Q

Quaker Houghton
Dayton, OH

R

RAYTEQ LLC
Healdsburg, CA

Regloplas Corporation
Saint Joseph, MI

Ryoei USA Inc.
Indianapolis, IN

S

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

Spectro Alloys Corp.
Rosemount, MN

Stotek Inc.*
Pewaukee, WI

StrikoWestofen America
Kalamazoo, MI

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

TOYO Machine America, LLC
The Villages, FL

U

UBE Machinery Inc.
Ann Arbor, MI

Uddeholm USA
Elgin, IL

Ultraseal America Inc.
Ann Arbor, MI

V

Valor Renewables
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

Wes-Tech Automation Solutions
Buffalo Grove, IL

Wheelabrator Group
LaGrange, GA

Wollin USA
Plymouth, MI

Y

YIZUMI-HPM Corp.
Iberia, OH

Yushiro Manufacturing America, Inc.
Shelbyville, IN

Z

Zitai USA - Die Casting Equipment Group
Highland Park, IL

*New Corporate Member Companies

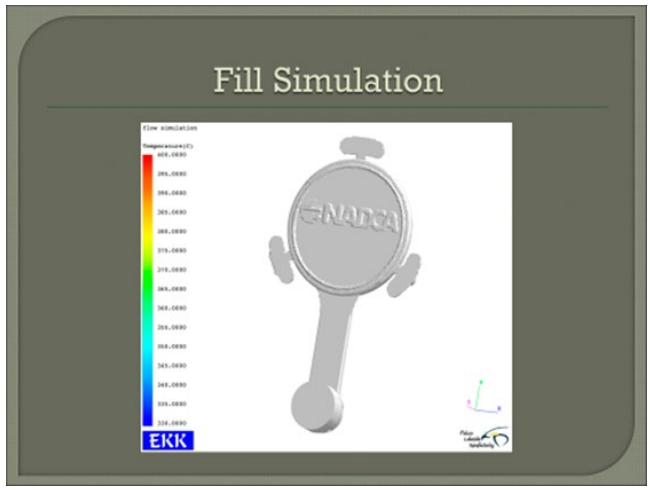
Chapter News & New Members

Chapter 3 - Michigan

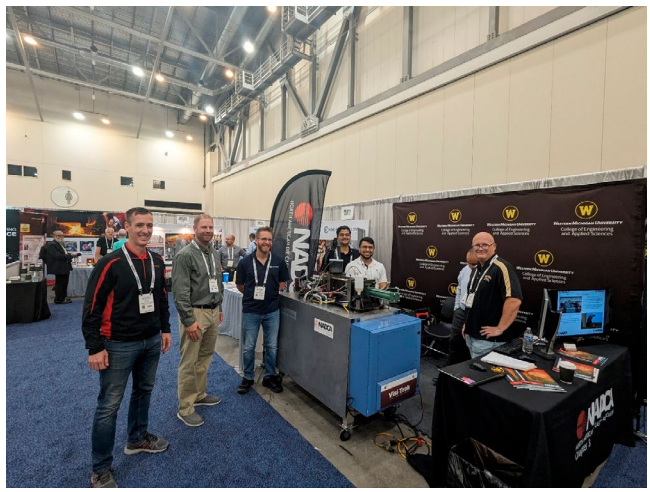
WMU Teams up with Chapter 3

Chapter 3 teamed up with Western Michigan University to display the die casting machine in a box (DCIB) project at the recent NADCA Tabletop and Congress, held in Grand Rapids, Michigan. As part of the Dept. of Engineering Design, Manufacturing, and Management Systems at WMU, Dr. Ramrattan challenged his students to build a functioning scaled down version of an 800 ton die cast machine. The machine was designed by his students and is completely solid modeled before being manufactured. Since its inception, chapter 3 has supported the DCIB project. Each year Dr. Ramrattan challenges his students to improve the design and operation of the machine. Support of industry partners has allowed his students to add many features over the las few years. The functional machine now includes a safety PLC, Visi-Trak shot monitoring system, casting removal and metal dosing. It produces the WMU coin, Aka – NADCA chapter 3 golf outing ball markers. Students who have had the opportunity to work on this project enter the manufacturing industry with a fantastic understanding of the high pressure die casting process. It is also used as a recruiting tool to promote interest in the die casting industry and as a tool to safely train students and new employees at die cast companies. Chapter 3 would like to thank NADCA national for holding the Tabletop in Grand Rapids, supporting chapter 3 efforts and we are looking forward to holding more shows in West Michigan.

***Chapter 3** – Students with the machine at the booth. Including Shawn Tye Waltz, Shantanu Shambhoo Phalke, and Jeet Gajaria. Also pictured Tom Vann of Visi-Trak and of course Dr. Ramrattan.*



***Chapter 3** – WMU coin – Aka Chapter 3 Golf Outing Ball marker.*



***Chapter 3** – Attendees at the Chapter 3 booth review the DCIB project.*

Chapter 3's theme for 2023 was **Education** and we were able to continue the tradition of "Free" Education classes for members. On October 24-26, Paul Cnossen of BuhlerPrince, Inc. taught the "Process Control" class to 16 Chapter 3 members at BuhlerPrince's state of the art training facility in Holland Michigan.

This Class is the study of the functions that the die casting machine provides to the die casting process. It included a detailed look into the clamp and shot ends of the machine. What, why, and how to monitor these functions, as well as their purpose and effect on the casting process. An explanation and interpretation of shot profiles and the data that can be taken from these profiles was covered. Shot traces, castings, capability studies, and machine power

curves were referred to during this course all of which are from actual machines and casting-making processes. It provided useful information, skills and techniques to those individuals charged with the responsibility of setting up the die cast machine.

The students reported that the instruction was very detailed and that they can immediately start using the training that was presented. Paul reported that this group of students posed a lot of questions and inquired about other classes. Keeping with the Chapter 3 tradition of educating its members we will be scheduling more classes in 2024.

***Chapter 3** - Paul discusses the details of the Shot System.*

Chapter 3 would like to thank BuhlerPrince, Inc. offering their world class training facility, it is with the help of companies like BuhlerPrince, Inc. and Cascade Die Cast (where classes have also been held) that make it possible for the chapter to offer these classes. Funding for these classes is generated by our annual golf outing and the annual chapter directory.

***Chapter 3** - Paul and his happy students!*

In conclusion, Chapter 3 will continue to offer free education classes for members and is looking for suggestions on other classes. Mark your calendars for our classes for next year, they will be in March and October and the Chapter 3 golf outing is scheduled for August 16th at the beautiful Saskatoon Golf Club in Alto, Michigan. Refer to the chapter's web site www.nadcachapter3.org for other chapter information.

New Members: *Brandyn R. Bont, Jesse Brugger, Michael L. Keller, Nicholas M. Kok, all with Auto Cast Inc.; Glen Mann, Hardy Process Solutions; Jason Murphy, Next Chapter Manufacturing; Brian Surch, Smart Coast*

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: *Damian Czernek, Tim Foley, both with Dart Casting Inc.; Chuck Michelle Newell; Jacob West, Deco Products Company*

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: *Emre Cinkilic, The Ohio State University*
Collin DeWood, REFCOTEC

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: *William Shambley, New England Foundry Technologies; Richard Temblador, Arlington Industries Inc.*

Chapter 10 - Ontario

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

Chapter 12 - Wisconsin

On November 1st, Chapter 12 hosted the Fall Education Seminar at Moraine Park Technical College in West Bend, WI. The focus of the seminar was on gating design, presented by Mr. Beau Glim, Project Manager at NADCA. The seminar was a condensed version of the NADCA gating class, touching on some of the critical topics from the longer class.

The meeting was well attended with more than 55 people, including approximately 20 college students from various schools in Wisconsin. Throughout the afternoon seminar there was good discussion and dialog among the active participants. It was another successful event for the chapter!

***Chapter 12** – The auditorium at Moraine Park Technical College – West Bend was fill with those interested in learning about gating design for high pressure die castings.*

***Chapter 12** – Beau Glim being introduced to start the seminar.*

Upcoming events for Chapter 12 include the state of the industry presentation on Feb 1st at Delafield Brewhaus by NADCA's Mr. Mike Meyer. Registration for this event and details of all Chapter 12 events can be found at: www.nadca12.org.

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

New Members: *Barry R. Bruce, Tracy B. Geschke, Mike Mielke, Al Roller, all with Strohwig Industries; Antonio Cerda, Brandon Goke, both with STRATTEC Component Solutions; Sara Ninneman, New Century Heaters; Anthony Rodriguez, Boyd Allenton, LLC; Tomas Torp, Stotek Inc. 14 Steve Saunders, Yamada North America*

Chapter 14 - S. Ohio

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

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: *Hayden I. Murdock, Goodyear Tire and Rubber Company*

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: *Gid Herman, Kurt Manufacturing Company Amit Lodha*

Chapter 17 - St. Louis

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

New Members: *Kayla Barrett, Ozark Die Casting Corporation; Ryan McClain, PE, Pinnacle Energy Services*

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: *Erica Cline, Madison Precision Products; Suresh Kannan Ponnusamy, Faist Light Metals Tennessee LLC*

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: *Rogelio Ibarra, Schlage De Mexico*

International Members: *Linlin Bao, Foundry Institution of Chinese Mechanical Engineering Society; Felipe Choza, Angelisaias Esparza, both with Schlage De Mexico; THIYAGARAJAN S, DOITER CASTINGS*

Exhibitor Spotlight

Allied Metal Company 708

4528 West Division Street
Chicago, IL 60651-1605
United States
P: (312) 225-2800
www.alliedmetalcompany.com

Allied Metal Company, a U.S.A. producer of aluminum and zinc alloys, supplies die casting and foundry operations that serve the appliance, automotive, electronics, furniture, hardware, housewares, sporting goods and toy industries, to name a few. Celebrating over 70 years in business, Allied Metal's innovation and expansion have shown our ongoing commitment to provide quality metals and superior service. A 4th generation family owned and operated business, Allied Metal Company has grown into one of most respected smelting companies in the United States.

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United States
P: (419) 467-5727
www.asddayton.com

B&L Information Systems Inc 806

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Bridgman, MI 49106-9723
United States
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B&L Information Systems is the global leader in cloud-based Enterprise Resource Planning (ERP) software for foundries, die casters and investment casters. Since 1976, B&L has implemented their unique ERP solutions at over 500 metalcasting operations, making their cloud-based Odyssey ERP match how metalcasters operate. With Odyssey, metalcasters maximize their resources, minimize costs, and make better decisions faster.

Bedford Machine & Tool Inc. 1118

2103 John Williams Blvd.
Bedford, IN 47421-2447
United States
P: (812) 275-1948
www.bedfordmachine.com

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World leader in HPDC injection tools since 1968, enthusiastically opened Brondolin NA division in 2021 to better support NA customers and share the best solutions for injection systems necessary to produce complex aluminum castings

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Die Casting Machines and systems made by BuhlerPrince are ideal for the most varied processes. Whether you are interested in aluminum, magnesium, zinc, vacuum, structural or engine block processes – BuhlerPrince has the right solution. BuhlerPrince supports customers throughout the life-cycle of their equipment with global services including process optimization, flow simulations, remanufacturing, retrofits and upgrades.

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P: (317) 872-3882
www.castec-inc.com

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Uxbridge, ON L9P 1R1
Canada
P: (905) 852-0121
www.castool.com

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United States
P: (517) 302-2962
www.chemtrend.com

Chem-Trend provides specialized solutions and expertise in release agents and lubricants for the die cast industry. We offer a comprehensive portfolio of die cast solutions and services. Products include die lubricants, plunger lubricants, hydraulic fluids, ladle coatings, die maintenance products, technical support and expertise. Chem-Trend aims to help customers improve operational efficiency, productivity, and part quality while ensuring the longevity and performance of dies and equipment.

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Diehl Tool Steel is a fully integrated distributor of specialty tool steels, powder metals, aluminum, carbon and stainless alloys. Diehl Tool Steel is the largest distributor of Yasugi® Specialy Steel proprietary grades in North America and a wholly owned division of Proterial Business Group. Diehl Tool Steel processes orders to exact customer specifications.

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

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www.fisa.com

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www.flow3d.com/products/flow-3d-cast

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United States
P: (248) 656-5900

Hill and Griffith Company **618**

1085 Summer St
Cincinnati, OH 45204-2037
United States
P: (800) 543-0425
www.hillandgriffith.com

HTS International Corporation **606**

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Knoxville, TN 37922
United States
P: (865) 382-5601
htsintl.com

IECI SRL **428**

IECI C/o SR Mechanical Llc 3631
Washington Ave
Bedford, IN 47421
United States
P: 00390306850370
www.iecionline.com

Inductotherm Corp. **913**

10 Indel Ave Po Box 157
Rancocas, NJ 08073
United States
P: (609) 267-9000
www.inductotherm.com

Industrial Innovations Inc **536**

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

International Mold Steel **603**

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Hebron, KY 41048
United States
P: (859) 342-6000
www.imsteel.com

J&S Chemical Corp **802**

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United States
P: (770) 720-8100
www.jschemical.com

Lethiguel USA **517**

14800 James Rd
Rogers, MN 55374-9361
United States
P: (763) 428-4229
www.lethiguelusa.com

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Edinburgh, IN 46124
United States
P: (616) 796-0777
www.lkadvantage.com

MAGMA Foundry Technologies Inc. **702**

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Schaumburg, IL 60173
United States
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NovaCast USA Inc. **817**

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Naperville, IL 60563
United States
P: (630) 450-1647
www.novacastusa.com

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United States
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www.visi-trak.com

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

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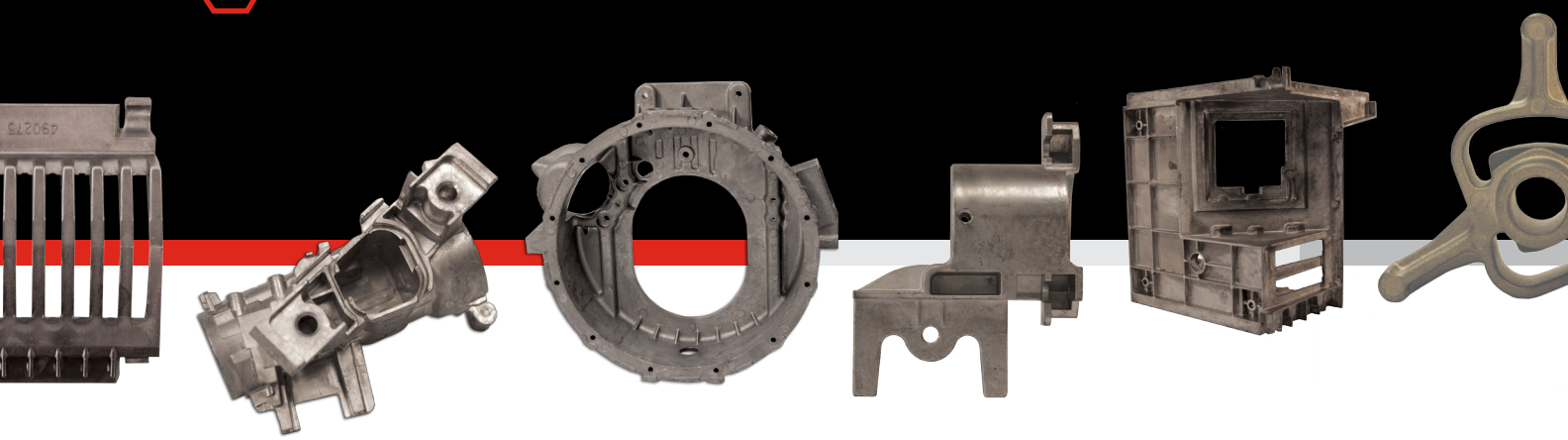

NORTH AMERICAN DIE CASTING ASSOCIATION

Corporate Membership

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

Why do so many companies invest in NADCA Corporate Membership?

- To Stay Current on News/Technology
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NADCA
North American Die Casting Association
P: 847.279.0001 F: 847.279.0002
www.diecasting.org

NADCA

NORTH AMERICAN DIE CASTING ASSOCIATION

CORPORATE DIE CASTER MEMBERSHIP APPLICATION

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TITLE DEPARTMENT/DIVISION

COMPANY'S NAME

COMPANY'S MAILING ADDRESS (INCLUDES P.O. BOXES AND/OR MAIL DROPS)

CITY STATE OR PROVINCE ZIP OR POSTAL CODE & COUNTRY

COMPANY'S BUSINESS PHONE (WITH AREA OR COUNTRY CODE) COMPANY'S BUSINESS FAX (WITH AREA OR COUNTRY CODE)

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CORPORATE DIE CASTER DUES CALCULATION

Base Membership:			$1000
Machines 65 tons or less:	_____ x $50	=	+
Machines 66 tons -399 tons:	_____ x $100	=	+
Machines 400 tons or more:	_____ x $200	=	+
Total Yearly Dues:			

- *Complimentary members are allocated to your record based on your dues level. All corporate members receive 3 complimentary individual members plus one for each $1000 of corporate dues over $3000.*
- *The maximum yearly dues are $16,000.*
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Total Payment Amount* CSV Code

Credit Card # Expiration Date

Cardholder's Name *(as it appears on the card)*

Please complete and return this application, along with your remittance to:

North American Die Casting Association
3250 N. Arlington Heights Rd., Ste. 101
Arlington Heights, IL 60004

P: 847.279.0001
F: 847.279.0002
E: corporate@diecasting.org
W: www.diecasting.org

NOTE: *NADCA dues are not deductible as charitable contributions for federal income tax purposes, but may be deductible as a business expense.*

**Credit Card Convenience Fee = 3% of invoice amount*

Industry News

MARTINREA INTERNATIONAL INC. ANNOUNCES STRATEGIC RELATIONSHIP WITH YAMADA MANUFACTURING CO., LTD

Toronto, Canada - Martinrea International Inc. (TSX : MRE), a diversified and global automotive supplier engaged in the design, development and manufacturing of highly engineered, value-added Lightweight Structures and Propulsion Systems, today announced a strategic relationship with Yamada Manufacturing Co., Ltd. based in Gunma, Japan. Yamada specializes in the development and manufacturing of chassis, drive units, and powertrain components. The strategic relationship signifies a broader global manufacturing footprint for Martinrea in Japan, encompassing Yamada's production expertise and network.

"Yamada brings a deep understanding of the Japanese market and provides an outlet for additional collaboration and growth with our customers," said Pat D'Eramo, President and CEO, Martinrea International Inc. Yamada and Martinrea share several Japanese OEM customers already and this relationship allows us to further expand our capabilities as a global supplier of aluminum castings."

Martinrea and Yamada have signed a memorandum of understanding allowing the two entities to work together in the Japanese market. Initially, Martinrea and Yamada plan to seek opportunities to jointly promote lightweight solutions within automotive, including electric vehicles, through large aluminum diecast for body and chassis parts. Martinrea will utilize its expertise in manufacturing parts with stringent mechanical performance criteria, both with and without heat treatment.

LONG-TERM EXECUTIVES COMPLETE PURCHASE OF THE HILL AND GRIFFITH COMPANY AND HG LOGISTICS

Cincinnati, OH - Mike Lawry and Ryan Canfield, two long-term executives of The Hill and Griffith Company, have completed the purchase of all assets of the company and that of HG Logistics.

After the transition, the new executives will focus on actively growing the two companies. Mike Lawry has spent 32 years with The Hill and Griffith Company and has served as Chief Operations Officer since 2012; he will now serve as its Chief Executive Officer and as President of HG Logistics. Ryan Canfield has been with The Hill and Griffith Company for 17 years, most recently as Executive Vice President of Sales and Marketing. Ryan will now serve as Chief Executive Officer for HG Logistics and President of The Hill and Griffith Company.

Under new ownership, all products, services, formulations, patents, and trademarks will remain. In addition, both companies' teams will remain in place, barring title changes for Lawry and Canfield.

"The company has a tremendous reputation for integrity, quality, and support; the same can be said for the people that work for it," said Lawry. "We strive to continue to build upon that sterling reputation and our 127-year history—all with little to no disruptions to our customers."

HG Logistics is a third-party transportation logistics company with a focus on building relationships its partners can count on. The new owners will continue its growth through new and existing partnerships, such as its access to Van, Refrigerated, Flatbed, Over Dimensional, LTL, and over 16,000 qualified carriers.

Canfield commented, "We know firsthand from our tenure at The Hill and Griffith Company that we have an excellent foundation, which will provide support and stability as we reinvest to enhance and expand our products and services." After the transition, the new executives will focus on actively growing the two companies, investing in more significant R&D and technology enhancements.

VOLVO JOINS THE GIGACASTING REVOLUTION

Romania - Per Dan Mihalascu from InsideEVs.com - A growing chorus of automakers and car industry experts will tell you that giga presses – the high-pressure die-casting machines for car body assembly pioneered by Tesla – will be the key to cranking out future electric vehicles cheaply and in huge volumes. Now, it looks like Volvo is the latest automaker to join the gigacasting revolution.

Last month, we learned that Ford and Hyundai had bought giga presses from Italy's IDRA Group, the same company that supplies Tesla with massive die-casting machines that churn out large pieces of vehicle underbodies for the Model Y and Cybertruck. The report from Reuters noted that there was a third automaker that bought two giga presses. While nothing was confirmed at the time, unnamed sources told the news agency that the company could be Volvo Cars. It turns out the report was accurate because IDRA Group confirmed the transaction on its LinkedIn page yesterday. The company said it was awarded a contract by Volvo Cars for two 9,000-ton giga press machines – the largest model IDRA makes – that will be installed at the automaker's future electric vehicle factory in Košice, Slovakia.

"These state-of-the-art machines are set to revolutionize the automotive manufacturing industry and position the brand's new plant in Košice as a strategic hub for Giga Casting," IDRA said in a statement.

The company noted that the 9,000-ton aluminum casting machines, which are said to be among the largest die-casting machines in Europe, should represent "a remarkable leap forward in automotive manufacturing technology."

LINAMAR TO SUPPLY EV INDUSTRY FROM NEW ONTARIO GIGACASTING PLANT

Canada - Linamar's facility, when it opens, will be the first gigacasting plant owned and operated by a North American parts maker.

"There are 15 or 20 Chinese suppliers that are looking to put in this type of capacity in China. But from a European and North American standpoint, we're the first one," says Mark Stoddart, Linamar's chief technology officer and executive vice-president of marketing and sales, in an interview with Electric Autonomy.

Stoddart says Linamar's initial plans call for the installation of three 6,100-tonne gigacast molding machines. (Tonnage is the clamping pressure the machines exert to hold molds together; bigger molds need higher pressure.) The plant's production is earmarked for one specific customer, which at this point Linamar is unable to name.

GM BUYS GIGACASTING MOLD/TOOLING DEVELOPER

Livonia, MI General Motors Corp. has acquired Tooling & Equipment International, a Livonia, MI, developer and manufacturer of casting molds and tooling, as well as prototypes and low-volume production castings. Details of the transaction have not been announced, though a Reuters report estimated the acquisition price to be in the range of $80 million to $100 million.

TEI became a part of GM's Global Manufacturing division as of July 1. It's expected to remain a wholly owned subsidiary operating independently from the parent company.

Tooling & Equipment International designs and produces tooling for gravity and low-pressure sand casting molds, cold-box and hot-box coremaking, and lost-foam casting production. It emphasizes its experience in designing molds and core boxes for high-volume manufacturing of automotive castings, including tooling for cylinder head, cylinder block, driveline, chassis and suspension castings.

For GM, the significance of the takeover may be TEI's role as a producer of large-dimension mold tooling, and specifically as a supplier to Tesla Inc. for its "gigacasting" high-pressure diecasting operations: the EV manufacturer has pioneered the use of HPDC to produce large automotive chassis structures to reduce vehicle assembly time and costs.

While high-pressure diecasting has grown in the past decade to be a preferred process for high-volume production of structural and drivetrain castings, Tesla's implementation gigacasting has emerged as a decisive factor in minimizing production time and lowering costs.

TEI's expertise in tooling for gigacasting may support GM's future vehicle assembly capabilities, and possibly

benefit the corporation as other automakers adopt the same emerging process technology.

"General Motors acquired Tooling & Equipment International (TEI) to bolster its portfolio of innovations and secure access to unique casting technology," according to a GM statement provided to Reuters. "Bringing TEI into the GM enterprise builds on decades of the company's own casting experience and provides a competitive advantage with strategic castings for future low volume products like the Cadillac Celestiq."

NSI EXPANDS ELECTRICAL DIVISION WITH ADDITION OF CAST PRODUCTS, INC.

Huntersville, NC – NSI Industries, LLC, a leading provider of electrical product solutions for more than 45 years, has announced that it has acquired Cast Products, Inc., a Norridge, Ill.-based manufacturer and supplier of high volume engineered zinc die cast components. As part of its commitment to connecting distributors to the products, services, and technologies they require to move forward and satisfy their customers' needs, the acquisition also allows NSI to further key inroads into the electrical technologies market.

"The addition of Cast Products to NSI's stable of leading brands is a testament to NSI's commitment to growing our Cable and Conduit Fittings category," said Joe Saganowich, NSI Electrical Division President. "Cast Products' strategic manufacturing focus of American-made products, its storied history spanning more than five decades, and its strong technical and engineering capabilities makes them an ideal addition to the NSI family."

Founded in 1966, Cast Products, Inc. has become a recognized leader in the zinc die casting industry. They push the technological edge in casting technology and are constantly seeking newways to improve the processes and services they provide their customers. Cast Products, Inc. is focused on delivering high volume engineered zinc die cast parts at a competitive price without sacrificing quality, service, or integrity.

"Cast Products has been manufacturing zinc die cast components nearing 60 years, and we have been a leader so long because we take quality seriously," said Zoli Salata, Cast Products Inc. President & CEO. "We provide the resources necessary to monitor the performance of our processes in order to demonstrate continuous improvement as quality is inherent to our processes throughout the life cycle of each part produced. We strongly believe our commitment to our customers through providing top tier products and services aligns with those same values as NSI, and we will all be even stronger as a result."

CASCADE DIE CASTING GROUP EXPANDS SPARTA, MICHIGAN, OPERATIONS

Sparta, MI - Cascade Die Casting Group, Inc., a Tier 1 and Tier 2 aluminum and zinc die cast manufacturer supplying custom engineered products, plans to expand its operations in Sparta, Michigan. The $6 million project is expected to create 30 jobs. The investment will include energy efficient furnaces, advanced robotics and automation equipment, and facility enhancements.

"We are excited about this investment, which represents a significant milestone for Cascade Die Casting Group," said Patrick Greene, CEO of Cascade Die Casting Group. "Our growth projections, primarily in the automotive sector, necessitate this strategic decision, allowing us to better serve our customers and contribute to our employees' well-being by creating job opportunities and improving our employee environment."

The project is being supported by $180,000 Michigan Business Development. In addition, the Right Place will assist the company in finding candidates for the newly created positions.

"We're thrilled to partner with the MEDC to ensure Cascade Die Casting continues its growth right here in West Michigan," noted Eric Icard, Senior Business Development Manager at The Right Place and project lead. "Since 1978, Cascade Die Casting has remained a pillar in Greater Grand Rapids, and this expansion serves as a testament to our region's dedication to the manufacturing sector. We're happy to see their continued success and we look forward to the exciting new opportunities they bring to the people in our communities as a result."

People in Die Casting

NADCA Remembers

Robert E. "Bob" Eppich
1938-2023

Robert E. "Bob" Eppich, age 85, passed away unexpectedly and surrounded by loved ones on October 19, 2023, at Goshen Hospital in Goshen, IN. He was born on May 1, 1938, in Cleveland, OH, to John Emil Eppich and Dorothy (Terepka) Eppich. A naturally curious and hardworking youth, Bob learned the accordion, ran paper routes, boxed, and participated in Boy Scouts. In his teens, he focused on academics and competitive swimming, graduating Shaw High School in 1956.

Bob attended Cornell University, then The Ohio State University, earning a BA and then an MA in metallurgical engineering. He later earned an MBA from Wayne State University. He dedicated his professional life to metallurgy, making significant contributions throughout his career, including patented inventions. A proud and active member of The American Foundrymen's Society, Bob earned peer accolades as a lecturer and published author.

Bob started his career serving ten years as a senior research metallurgist at General Motors Research Laboratories in Detroit, MI. He then spent fifteen years as a vice president of Dalton Foundries in Warsaw, IN. He went on to serve as COO of the Isaac Corporation in Maumee, OH, and later, as vice president at The American Foundrymen's Society in Des Plaines, IL. Later, and through retirement, Bob's expertise remained highly respected and he consulted for both industry and the U.S. Department of Energy until the time of his passing.

Bob married Marilyn (Frey) Eppich in 1960, residing initially in Southfield, MI, serving actively in the Jaycees, and welcoming three beautiful daughters, Laurel, Kathy, and Julie. His career took them to Winona Lake, IN where he and Marilyn raised their family amid the joys of lake life and a growing community. In 2007, Bob married Judith (Schmahl) Eppich, who together spent the past 15 years lovingly enjoying their Golden Years, residing in both Lake Wawasee, IN, and Punta Gorda, FL and traveling extensively. Bob found solace in his quiet faith in Christ and Bible study and attended Calvary United Methodist Church in Syracuse, IN, and Burnt Store Presbyterian Church in Punta Gorda, FL. He was prayerful and praised God every day for his many blessings.

Bob's achievements and legacies were many, but it was his warm personality and easy smile that endeared him to all he met. Intelligent but humble, he possessed that rare ability to listen attentively and make everyone feel comfortable. He was kind hearted and interested in other peoples' stories. He read voraciously on wide ranging topics. His love of fishing never wavered, nor did his enthusiasm for swimming; his Florida neighbors witnessing his pool laps nearly every day. These activities brought him great joy and granted him both physical fitness and mental acuity until he passed.

Bob's proudest accomplishments lie within the realm of his family. He is survived by his wife, Judy Eppich; his three daughters: Laurel (Jim) Canan, Kathy (Mark) Slezak, and Julie Eppich; his grandchildren: Robert (Molly) Canan, Tyler (Kelsey) Canan, Matthew Slezak, David (Rachel) Slezak, and Zion Lee;' and great-grandson, Theo Canan. Bob also loved and was loved in return by his bonus family whose survivors include five stepchildren: Jeffrey (Donna) Schmahl, Stephen (Amy) Schmahl, Julie Sanders, David Schmahl and Carrie (Brad) Vonderheide and sixteen step grandchildren. He was preceded in passing by two brothers, John and Kenneth Eppich, and step son-in-law, Bob Sanders.

Memorials can be made to the Wagon Wheel Center for the Arts in Warsaw, Indiana or to Calvary United Methodist Church in Syracuse, Indiana. To leave a condolence visit www.TitusFuneralHome.com.

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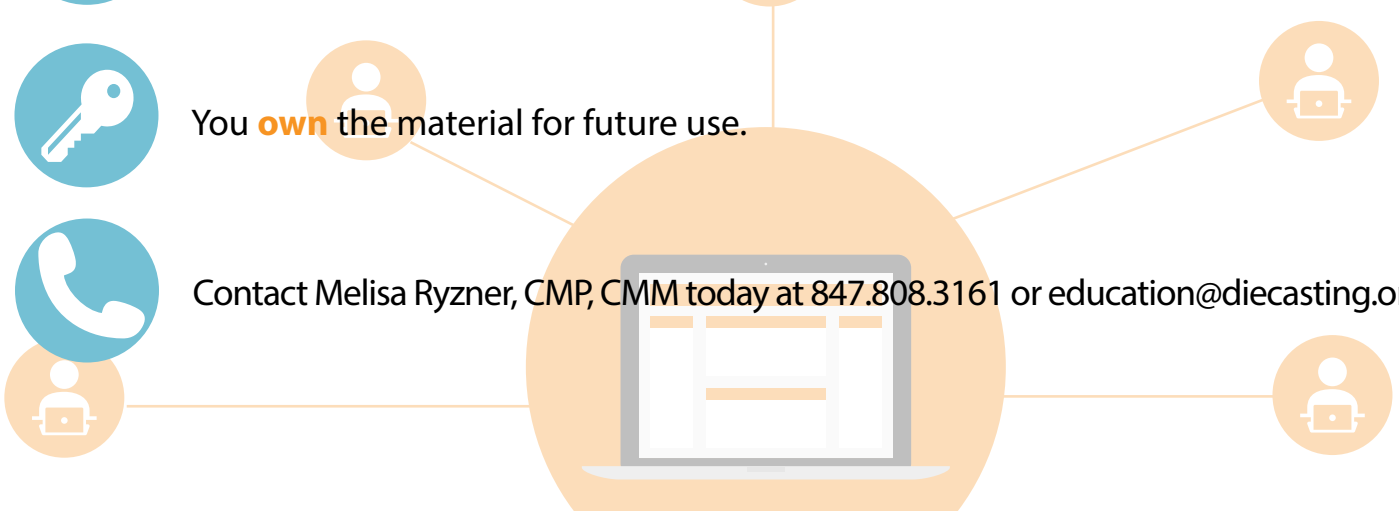

Contact Melisa Ryzner, CMP, CMM today at 847.808.3161 or education@diecasting.org

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Exciting Opportunities for Experienced Die Cast Professionals at Deco Products in Decorah, Iowa!

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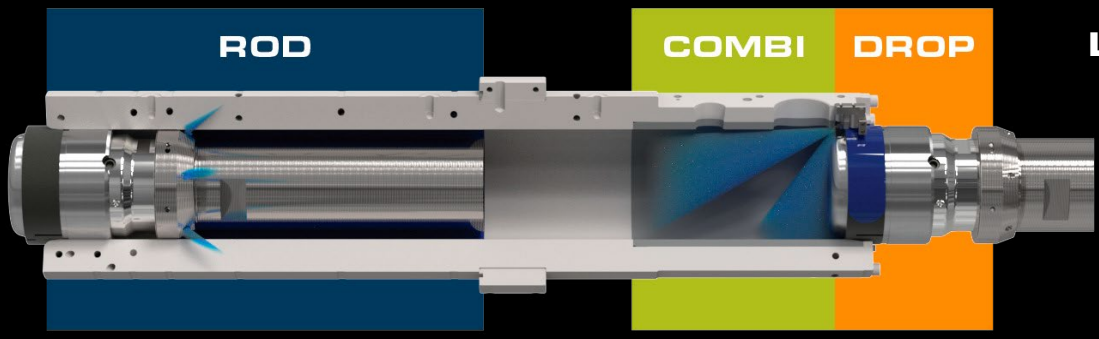

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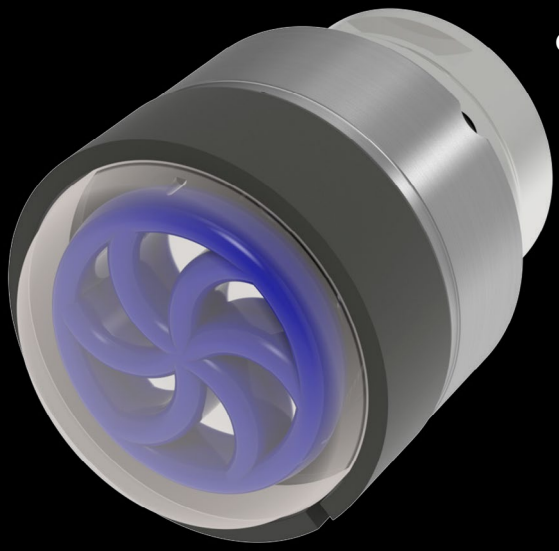

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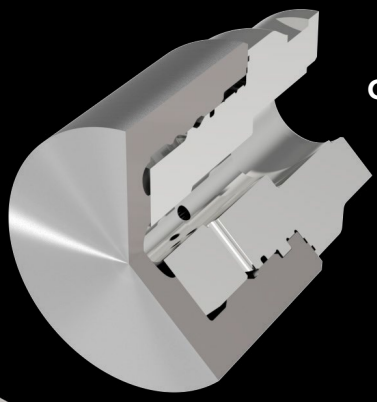

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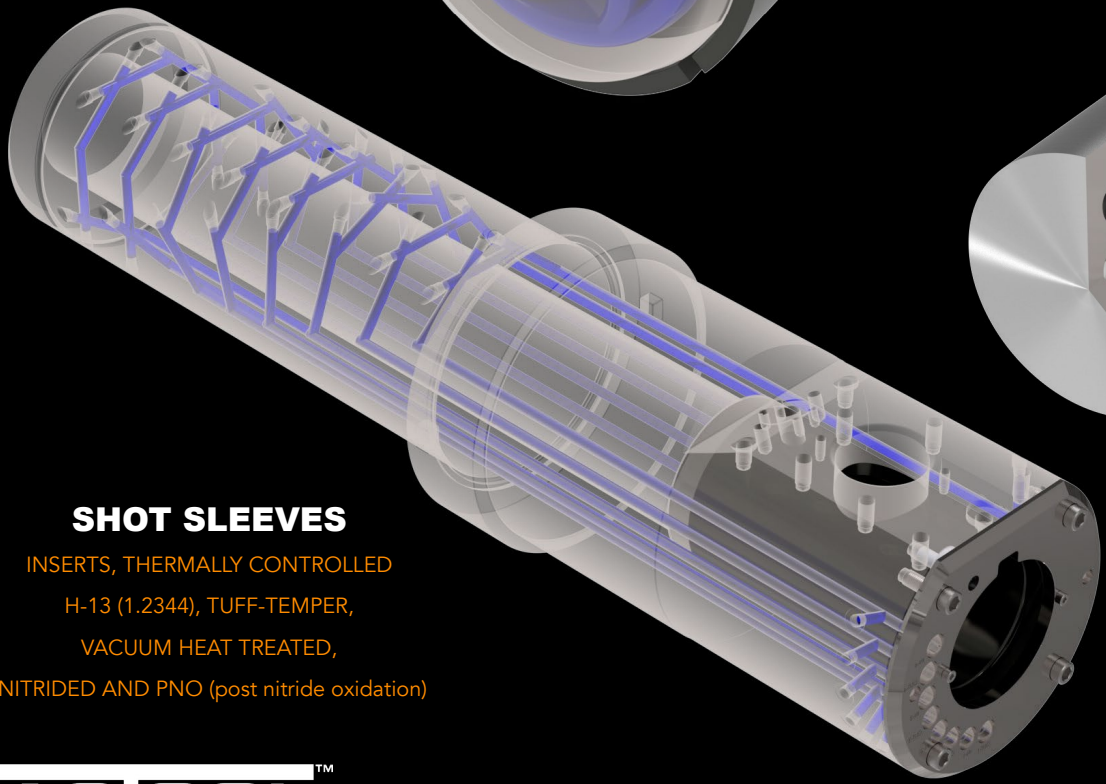

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