High Integrity Processes & Alloys | Die & Plunger Lubricants / Plunger Tips | MAY 2022

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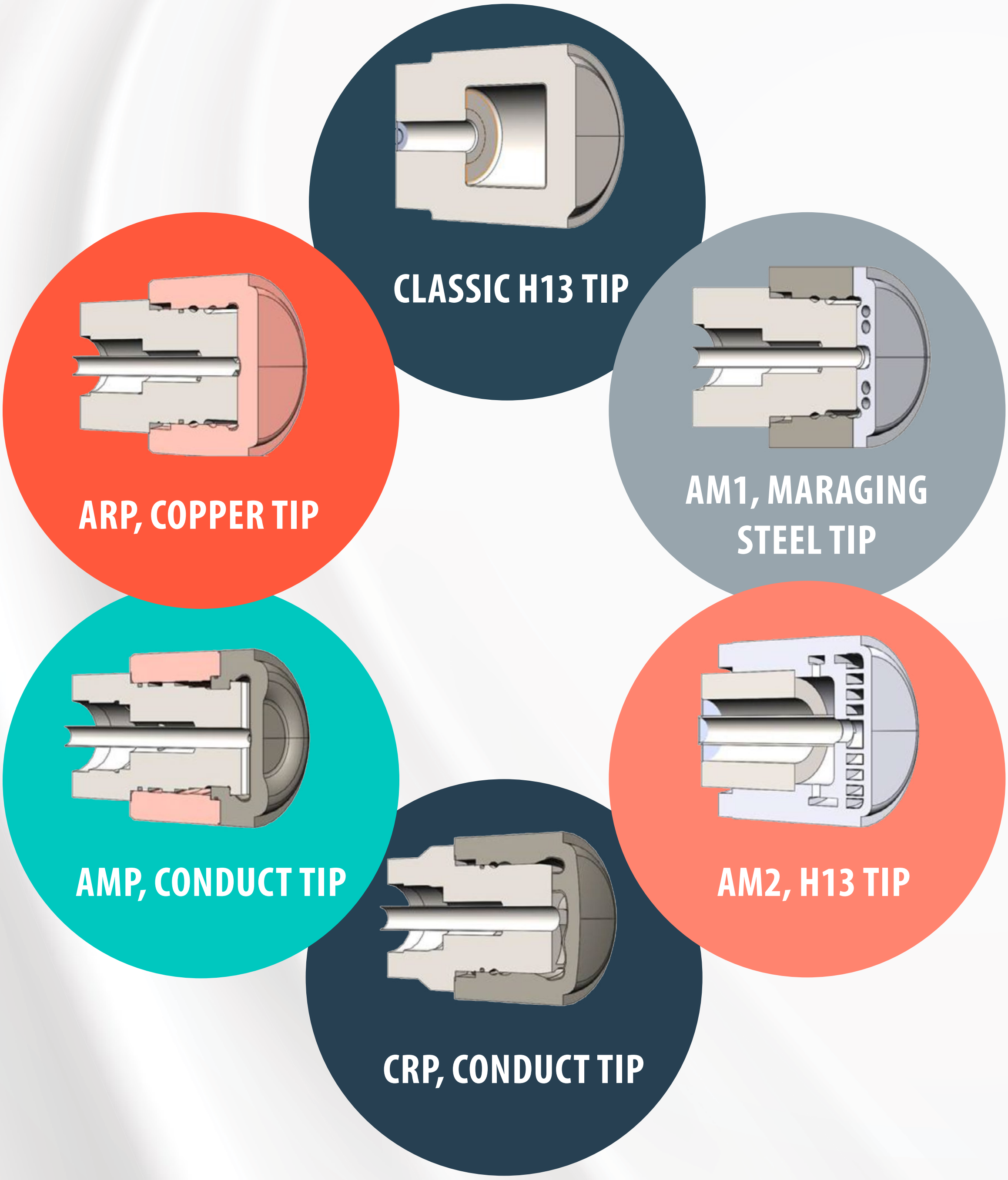

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Safety Awards

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Chairman's Note

Conditions in Our Industry Move Towards Improvement Even While New Challenges Emerge

The global and national political turbulence have added new instability to our local economies still recovering from the pandemic contraction. War in the EU and the impacts on the economy are too intertwined not to send shock waves through our local world. We are feeling them. Disruptions to the supply chain, while easing, continue. Inflationary pressures, increases to the cost of money, rising labor costs and reduced labor availability have added to our current challenges. China's latest Covid lockdowns are also affecting our planning. We do not see a quick return to the normal economic flows this year. The stock markets are attempting to recover even in the face of the volatility as much of the downturn from the last month of trading are moving closer to the mid-January 2022 levels. The recovery is expected to be choppy with surprises trailing the news of the day. Overreaction to both good and bad events, is to be expected.

The positive trends in the markets are visible. The demand for the products we produce is showing strength as money is available, inventories are depleted, and spending has not yet started to contract. Housing is in short supply predicting pressure on increased housing starts. Wages are climbing which also will tend to put cash into the system. Offsetting this is the inflation predicted to be in the 7% range by year end, with rates falling in 2023 and 2024. The Fed action to raise the cost of money to cool the economy will hopefully be measured and strategic enough to generate the desired effects.

At the NADCA Executive Conference earlier this March, reports from many companies also see these positive trends even while facing these challenges of recovering customers and the difficulties producing to meet the strong demand. The factors above, rising costs, material availability, and labor instability are shared concerns. This conference, with the excellent speakers discussing market, political, and business trends, and the broad conversations among colleagues, was very useful. For me, this was the best Executive Conference in my memory. It sets a high bar for the conference next year.

Our customers are still strongly pursuing the newer, high integrity technologies; lightweighting, alternate alloys, lower cost mechanical property improvement, complicated welding of HPDC assemblies, and castings shipped with the component joining already completed. The EV world advances more quickly with broad OEM investment and the momentum building as we approach the 2025 to 2028 model years. That means we are quoting, designing, building and launching now for these new vehicle applications.

One of the background issues that must be reckoned with is the higher level of process consistency demanded for the latest designs. Material properties are not well predicted if the manufacturing processes are full of variation and inconsistency. Capability must be held to CPK levels our industry typically struggles with. We must not change the designed process settings at the first signs of difficulty, but rather see what has changed that perhaps we do not monitor well that contributes to instability. It is often several factors that require attention. That is what our teams should discover and correct.

The topics in this issue of the NADCA magazine, High Integrity Processes & Alloys, are well-timed. New and altered alloys, reducing impurities in the metal matrices, lubricant and spray minimization, and quality consistency all play major roles in the pursuit of the best property castings possible. This is a moment when we should be looking at what to improve with deep consideration and care. Our plant floor employees are critical in this process. This is a time for educating, training, engagement and most importantly, listening to what they see and struggle with daily. Unless the floor activity becomes easier, improvement is always erratic and unsustainable. NADCA training programs can help here. Make sure you are taking advantage of the NADCA webinars and the subsidized Harbour Benchmarking offers to help you reach your goals.

Remember, we at NADCA are here to help. Our industry in 2022 needs to focus on broad, innovative activity and strategic investment in the future.

Engage with your teams to move forward together!

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"Our industry in 2022 needs to focus on broad, innovative activity and strategic investment in the future."

Andrew Ryzner
Editor
North American Die Casting Association

"We must stay diligent in our efforts to stay safe in the workplace."

Let's Congratulate Industry Members for Worker Safety

Greetings everyone. This is the May issue of Die Casting Engineer magazine, which means this is when NADCA recognizes our yearly Safety Award winners. Congratulations to those listed this year. The list can be found on page 28 of this publication.

The safety of our employees should be and is an extremely high priority for our industry as a whole. This is reflected yearly in our awards. According to osha.gov, the top 10 most frequently cited OSHA standards violations are as follows:

- Fall Protection, construction
- Hazard Communication Standard, general industry
- Respiratory Protection, general industry
- Scaffolding, general requirements, construction
- Ladders, construction
- Control of Hazardous Energy (lockout/tagout), general industry
- Powered Industrial Trucks, general industry
- Fall Protection–Training Requirements
- Eye and Face Protection
- Machinery and Machine Guarding, general requirements

I think it's safe to say (even though listed as "construction" for some) that many if not all of these apply to our industry. Safety equipment provided to the employees of your facility are there for more than the reason of "I'm just here so I don't get fined" (thank you to Marshawn Lynch for that quote), they are here so that everyone can live life safely at the workplace so as to avoid any completely avoidable, possibly life-altering injuries.

Nobody deserves to be hurt at work, potentially affecting their home lives as well, and I am proud that NADCA can award so many companies on a yearly basis for being safe. We must be diligent in our efforts to keep doing so. If someone is doing something deemed unsafe because of lack of awareness or equipment, we must speak up in the workplace in order to keep that person safe.

I hope your spring/summer is off to a good start. Congratulations to those in the awards list this year. Thank you for reading, and I'll see you in the next issue.

Competition Bill Moves to Conference

The U.S. House of Representatives and the Senate moved forward with legislation incentivizing manufacturing in America and countering China's technological rise by launching a formal conference process. The House passed the America COMPETES Act in February in response to the bipartisan Senate measure, the U.S. Innovation and Competition Act, which cleared the upper chamber in June 2021.

Both bills invest $52 billion to incentivize domestic semiconductor manufacturing, billions for STEM education and workforce, and funds to boost domestic production of critical goods to strengthen supply chains. They also place additional restrictions on exports to Chinese companies, incentivize manufacturers to leave China, and provide resources for domestic research and development.

The House bill also contains the National Apprenticeship Act providing funding to expand high-quality Registered Apprenticeship opportunities. Additionally, the House added language to include the JOBS Act and the College Transparency Act to the bill, provisions that expand federal Pell Grants to allow for their use to earn short-term credentials and provide transparency for students regarding tuition and postsecondary outcomes.

The House trade section, however, does not include several elements contained in the Senate's USICA trade title, such as language requiring the Office of the U.S. Trade Representative to immediately reopen a broad product-exclusion process for Section 301 tariffs on Chinese goods or the provision reinstating all expired Section 301 exclusions.

With the establishment of a conference committee, members of Congress are now hoping to reconcile the differences between the House and Senate measures and have a final package by Memorial Day, or possibly the July 4th break.

Supreme Court Hears Case to Limit EPA

The Supreme Court heard oral arguments on February 28 in the case regarding limiting the scope of EPA's greenhouse gas authority. At issue in West Virginia v. EPA is whether the agency can use section 111 of the Clean Air Act to establish GHG requirements for existing power plants on actions taken "outside the fenceline" of a regulated source, or whether it must base standards on "inside the fenceline" steps.

The dispute began in 2015 with the Obama administration's adoption of the Clean Power Plan (CPP). The plan never went into effect with several states and private plaintiffs challenging it in federal court, and then a divided Supreme Court put the rule on hold in February 2016. The Trump administration then repealed the CPP in 2019 and replaced it with the Affordable Clean Energy (ACE) rule, which established emissions guidelines only for existing coal-fired steam plants. The repeal of the CPP lead to further legal challenges, and in January 2021, the U.S. Court of Appeals for the District of Columbia Circuit vacated the repeal of the CPP, vacated the ACE rule, and sent the issue back to the EPA. The Supreme Court is now hearing a challenge to that ruling by Republican-led states and coal companies.

Under former President Trump, the EPA argued that it was compelled to repeal the Clean Power Plan as it exceeded the agency's authority. According to the Trump administration, under Section 7411 of the U.S. Code (Section 111 of the CAA), the EPA is limited to implementing measures that can be implemented on the physical premises of a power plant – a limitation known as "inside the fenceline." Inside-the-fenceline measures include things like installing equipment that can reduce a plant's pollution.

The CPP, by contrast, included some measures that operated industry-wide. For example, the plan called for "generation shifting," which is reducing emissions by shifting the source of power generation from higher-emitting power plants to lower-polluting sources of energy (such as wind or solar power), and "emissions trading," when the government sets a cap on emissions and requires permits for emissions allowed under that cap.

A major component of the case is a battle over the "major questions" doctrine. The coalition of states and coal companies, led by West Virginia, says the outside-the-fence approach in the Obama EPA's CPP is unlawfully broad and violates the major questions doctrine by giving the EPA more expansive authority beyond the expressed authority given by Congress. The challengers in the case are asking the Court to resolve who has the authority to act on industry-wide federal policies to address climate change, the EPA or Congress.

A ruling from the Supreme Court that adopts an expansive interpretation of the major-questions doctrine, requiring agencies to make "decisions of vast economic and political significance," only with the clear and explicit authority given by Congress, would limit the regulatory actions by the EPA and other federal agencies.

A decision in the case is expected by the justices this summer.

New Truck Emission Rules Released

On Monday, March 7, 2022, the Environmental Protection Agency (EPA) released long-awaited proposed heavy-duty truck nitrogen oxides (NOx) standards, which have been pending at the agency since Trump officials floated a preliminary rulemaking in January 2020. The EPA was under a tight deadline to issue a proposal in March, or it risked being unable to finalize the rule by the end of this year to allow the tougher limits to take effect in model year (MY) 2027.

The draft rule, which is the first step in the EPA's broader Cleaner Trucks Initiative, offers two options for curbing emissions of NOx from gas- and diesel-fueled trucks. While both would strengthen standards starting in MY 2027, the first would implement the tighter limits in two phases, with the second phase following in 2031 resulting in the MY 2031 being 90% lower than today's standards. The second option would immediately jump to full implementation in MY 2027 but result in lower NOx emissions reduction than the first option.

EPA scheduled a virtual public hearing on the proposed rule on April 12th and 13th, 2022 and will be accepting public comments through May 13, 2022, on both options outlined in the proposed rule as well as the full range of options between them. A final regulation is expected by the end of the year.

EPA Committee Recommends Lowering Soot Standard

The Clean Air Scientific Advisory Committee (CASAC) of the Environmental Protection Agency (EPA) formally sent on March 18, 2022, EPA Administrator Michael Regan their recommendation on tightening national soot standards. The standard, last set in 2012, was reviewed by the Trump administration in 2020 and left unchanged.

Despite the call to decrease the standard for fine particulate matter (PM2.5) to between 8 and 10 µg/m^3 by EPA career staff and outside experts, the Trump administration ultimately recommended retaining the existing National Ambient Air Quality Standard (NAAQS) levels of 12 micrograms per cubic meter (µg/m^3) and 150 µg/m^3 for fine particles (PM2.5) and coarse particles (PM10) respectively.

The seven-member CASAC recommended that the EPA now strengthen the NAAQS for PM2.5. EPA's current annual primary exposure standard was set in 2012 at 12 µg/m^3; the daily primary threshold, dating back to 2006, is 35 µg/m^3. The majority of the committee is recommending the annual limit be set somewhere in the range of 8-10 µg/m^3, with a minority calling for a range of 10-11 µg/m^3.

While EPA career staff has long supported the tightening of the annual limits, in a draft report released last fall EPA staff found the current daily limit to be adequate. The CASAC, however, disagrees and is recommending the 24-hour PM2.5 standard be lowered to somewhere in the range of 25-30 µg/m^3.

Although the EPA is scheduled to release a proposed rule in August 2022 and a final rule by March 2023, an ongoing legal battle could delay the timeline. Two former advisory committee members, who were among those removed by EPA Administrator Michael Regan Regan last year, are seeking to be re-appointed to the panels on which they once served. While a judge ruled on February 16 against imposing a preliminary injunction and allowing the advisory panels to continue to work, should the court eventually rule against the EPA, the panels would have to be disbanded and reconstituted forcing the CASAC to start its review process over.

NADCA will continue to monitor EPA's progress on developing the rule as the final regulation The EPA could impose limits on economic activity by manufacturers, producers, and other industries.

Tariff-Rate Quotas to Replace Steel and Aluminum Tariffs on UK; Steel Tariffs on Japan

The U.S. has come to agreements with Japan and the United Kingdom to replace the current Section 232 tariffs with a tariff-rate quota (TRQ) system similar to the one that took effect for the European Union on January 1, 2022.

On February 7, 2022, the U.S. and Japan announced an agreement to replace the current 25 percent tariffs on imported Japanese steel with the TRQ. Effective April 1, 2022, the new agreement with Japan will allow U.S. businesses to import 1.25 million metric tons annually under 54 product categories, after which, the 25 percent tariffs will resume on the category of product shipped to the U.S. until the quota restarts each quarter. The deal does not cover Japanese aluminum, which is still subject to a 10 percent tariff.

The U.S. reached a similar agreement with the UK on March 22, 2022. Under the agreement, 0.5 million metric tons under the 54 product categories will be allowed to be imported into the U.S. free of any Section 232 tariffs. In addition, the agreement does allow 21.6 thousand metric tons of aluminum to enter the U.S.

New Section 301 Investigation of China Delayed

The Biden Administration has delayed a decision on whether to initiate a new Section 301 investigation of China's industrial subsidies that could result in additional tariffs on products imported from China.

While the discussions within the administration are still ongoing, sources have said the action has been delayed due to Russia's invasion of Ukraine as well as disagreements on the scope of a new probe between the Office of the U.S. Trade Representative (USTR), the Commerce and Treasury departments and the White House.

Along with the potential launch of a new Section 301 investigation, USTR must soon review the tariffs which resulted from the Trump administration's Section 301 investigation. The "review of necessity" evaluation is required under the Section 301 statute and must occur within 60 days of the expiration of the tariffs. The first group of tariffs, imposed in 2018 on $34 billion in Chinese goods is set to expire on July 6, with tariffs on an additional $326 billion of goods from China set to expire in the following months.

The Biden administration has given no signal of plans to remove the tariffs, the full review will require USTR to undergo an assessment of the effects that tariffs have had on the U.S. economy and its consumers.

Dr. Die Cast

Die Cast Lubricants and Plunger Life

In HPDC, lubrication takes many forms. The machine bushings require continuous lubrication similar to an engine. The moving components of a die, such as slide cores, ejector pins and leader pins require lubrication as well. For some components such as ejector plate guide pins and bushings, lubrication during die assembly between production runs is sufficient. Other components need some type of ongoing lubrication. In HPDC aluminum, the cavity faces and core pins require lubrication each and every cycle. In addition, on cold chamber aluminum, the plunger tip requires lubrication every cycle.

Die lube and die release are terms used interchangeably. Die lube is applied to create a barrier between the molten material and the die steel. Applying and drying off/blowing-off excess die lube is a significant part of the die cast cycle time. In studying aluminum die casting cycle times, the spray and blow-off process consumes nearly 35 to 55% of the entire die casting cycle. Custom spray manifolds that can focus the spray more accurately have demonstrated significant cycle time savings.

Die lubricants are a major day-to-day expense in a die casting operation. Not only the purchase, distribution and application of the die lube but in most cases, dealing with the "overspray" and mist is a major expense. The waste stream must be collected and disposed of with respect for the environment in the shop, during transportation and at disposal sites. In the 60's, water-based die lubricants were not as common. Oil based lubes create a shiny carbon skin on the cavities that help with release. Slowly water-based lubes were adopted and have become the accepted standard. People had to adapt to a different behavior as the water-based lubes don't leave a carbon trace on the cavity the same way the old oil-based lubes did. Another characteristic of water based versus oil is that oil-based sprays would "wick" around behind slide cores where water-based lubes tend to "bead up" and behave more "line of sight" making it more difficult to reach the back side of slide cores. The short-term solution is spraying longer in order to force lubricant around to the back side of the slide core. Installing multiple focused spray nozzles greatly improves effectiveness of the spray. On larger slides, I have found it reduces the need to overspray and increases the effectiveness to install a spray nozzle in the holder block in order to spray directly at slide core surfaces that are otherwise hidden or blind. Ideally the sprayer would be on a separate timer to avoid over-spraying and wasting lube.

Plunger tips, cold chambers and lubrication. How good is good life?

Due to high metal temperatures, tips and cold chambers also require lubrication to reduce the chance for soldering. While most plunger tips have some form of internal cooling, cold chamber cooling is not as common. When operating with 390 alloy or some of the newer high ductility low iron alloys, cold chamber cooling is especially beneficial. Cold chamber and tip wear with the above alloys is many times greater than with typical 380/383 alloys.

For the best possible life, make sure you have the recommended water flow to your plunger tip. Five gallons per minute (GPM) for a 3 ½" tip is typical. Another way to look at it would be 0.5 gallons per minute per square inch.

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NADCA NEWS

Cast Your Company's Future by Hiring an Intern

Arlington Heights, IL - NADCA has a resume database of engineering students looking for summer internships on its Web site. Please consider hiring an intern and introduce that student to the world of die casting! Students from universities across North American are currently looking for opportunities and many are willing to re-locate for the summer.

The database is password protected, so you will need to login to your MyNADCA account for access. Once logged in, to review the available candidates, visit: www.diecasting.org/scholarship/resumes. Students may be contacted directly, and if you hire a student, let us know, (intern@diecasting.org) so we can limit their contact information.

Students that complete an internship in the die casting industry are eligible to apply for the David Laine Scholarship Program. That program opens for applications August 1. For additional information, visit: www.diecasting.org/scholarship.

TOOLS & RESOURCES

Wage and Benefit Survey Results Available

Arlington Heights, IL - NADCA has released the results of the 2021 Annual Wage and Fringe Benefit Survey. This survey is specifically designed for the die casting industry and represents 35 companies in the die casting industry nationwide with detailed summaries for direct labor employees. In addition, the survey includes: wage rates for 13 key direct labor employees, analysis of insurance coverage, determining compensation standards and selecting fringe benefit plans and insurance.

This year, participating die casting companies had a median annual sales of $23.69 million per year and employed 189 full-time employees. Approximately ten percent (10%) of die casting respondents were union shops. About eightpercent (8.4%) of the total production employees reported were temporary. Seventy-two percent (72%) of the participating die casters total employees were hourly production employees.

Wage and fringe benefit programs must be competitive in the current workforce in order to recruit and retain a top-notch staff in today's highly competitive job market. NADCA's 2021 Annual Wage and Fringe Benefit Survey is available as an instant download or hardcopy publication. To purchace visit the NADCA Marketplace and search for item #852.

UPCOMING EVENTS

Dust Off Those Books - National Courses are Back

The NADCA Spring National Course schedule has arrived. Please join us in Arlington Height, IL, where we will be hosting the following courses:

Process Control & Monitoring
5/10/2022 8:00 AM - 5/11/2022 4:00 PM

The primary purpose of this course is to show the processing engineer and operating technician what type of control method is applicable to each of the die casting machine/die/process systems, how to measure the performance of each critical variable, compare actual performance to the desired and to adjust the actual performance to meet the desired. The student will find this 2015 revision of the course more definitive and focused than the previous as the machine systems portion of the previous has been split off as a separate two-day offering.
Corporate Cost: $600
Individual Member Cost: $690
Non-Member Cost: $800

Engineering Die Casting Dies Course
5/24/2022 8:00 AM - 5/25/2022 4:00 PM

The die casting die has four basic functions: 1. To hold the molten metal in the shape of the desired casting; 2. To provide means for the molten metal to get into the space where it is to be held in the desired shape; 3. To remove heat from the molten metal to solidify the metal; and 4. To provide for the removal of the solidified casting. The overall goal is to design a die that will produce high quality castings efficiently and that is based on sound economic principles.

This course is targeted to the die casting tool designer, engineer, toolmaker and others involved in the design, construction and use of die casting dies. The course offers an understanding of what should be included in the die casting die design. The course begins with a tooling design philosophy and evolves into all the major systems that must be included in the die. Topics include parting line determination, die cavity placement and machine size requirements, dimensional requirements and capabilities, metal flow and gating considerations, heat flow in and out of the die cast cavity, including waterline placement for depth and length. Design of ejection systems and die materials.
Corporate Cost: $600
Individual Member Cost: $690
Non-Member Cost: $800

Die Casting Defects
6/16/2021 8:00 AM - 6/17/2021 4:00 PM

Defective die castings are quality deviations that must be corrected to meet the quality requirements of the customer. Defects are serious issues that are usually traceable to process settings and/or metallurgical problems. The good news is that most of them are correctable through operations control and process control. The purpose of this course is to provide useful information, skill and techniques to those individuals charged with the responsibility for process settings and production of quality castings.

The course is organized under four categories: 1. Process factors that control many defects, especially those concerning surface finish, cold flow and non-fills; 2. Metallurgy issues associated with defects. While all metals are covered, there is a special emphasis on aluminum; 3. Identifying defects and diagnosing root causes and corrective actions; and 4. Troubleshooting guide studied by type of defect in order to swiftly take the appropriate action.
Corporate Cost: $300
Individual Member Cost: $345
Non-Member Cost: $405

Die Casting Problem Solving
6/15/2022 8:00 AM - 4:00 PM

This course is specifically designed for die casting by focusing on the interactive nature of the die casting process. The course teaches logical and statistical methods that do not require a strong mathematics background. Prerequisites for this course are a basic understanding of algebra and statistical concepts such as standard deviation and variation. The course includes concepts from the following sources: Dorian Shainin-Statistical Engineering; Ford Motor Co.-Team Oriented Problem Solving; Box, Hunter and Hunter-Statistics for Experimenters; General Motors Co.-Problem Solving Basics; and Taguchi-Design of Experiments. The course will enable improved, data-driven process decision making; promote statistical thinking in regard to process variation; develop an objective defect ranking system for a subjective defect; correlate the process to the defect without preconception.
Corporate Cost: $300
Individual Member Cost: $345
Non-Member Cost: $405

To register visit: www.diecasting.org/store/events/registration.aspx?event=natspg22

Save the Date for NADCA's Annual Plant Management Conference

Arlington Heights, IL - The 2022 conference will be held May 4-6, 2022 in Birmingham, AL. The Annual Plant Management Conference provides a venue for operations and plant management personnel to meet and network with peers from other die casting facilities.

Together, attendees can share experiences and gain knowledge and information through round table discussions and topical presentations.

Mark your calendars and plan on attending this conference!

NADCA is Trotting Onward to Lexington for the 2022 Die Casting Congress & Tabletop

Arlington Heights, IL - The Die Casting Congress & Tabletop will be held September 13-15, 2022, at the Central Bank Center, Lexington,KY. 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 100 exhibitors, the International Die Casting Design Competition and the Die Casting Industry Awards Luncheon. Attendee registration will open in the summer of 2022.

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

Plunger Tip Evolution in the Die Casting Industry
Material, Design, and Lubrication

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Abstract

This paper reviews the evolution of water-cooled plunger tips and discusses available design improvements, optimizations, material selection, and manufacturing methods. Overall performance is evaluated by utilizing computer simulation based on water flow, cooling rate and biscuit formation. Computational Fluid Dynamics (CFD) is used to calculate the cooling performance of plunger tips. Considerations are also made for the often-ignored Leidenfrost effect, as the phenomenon affects plunger tip cooling performance: specifically, when the water flow is low or thermal conductivity of the tip material is high.

Thermomechanical simulation is used to estimate stresses and deformations in the plunger tip, which can evaluate the plunger tip's thermal stability and life span.

Lubrication of plunger tip and proper lubricant selection are also discussed in this paper with presenting measurement of key physical properties of some popular lubricants in the industry.

Introduction

The basics of high-pressure die casting have not changed since the first high-pressure diecast machine, and neither has the tooling. The plunger tip's external appearance is mostly the same,[1] but there has been a gradual evolution in the range of materials, internal design, and manufacturing methods.

The main function of the plunger tip is to push the molten aluminum from the shot sleeve into the die cavity. Secondly, it should have enough cooling capacity to solidify the thick biscuit before the press releases and the die opens. Finally, one of the main design factors is leaving a proper gap between the plunger tip and sleeve to prevent the blow-by or leakage and allow the plunger tip to move freely inside the sleeve without scratching it.

Although the cooling performance of the tip is very important, it is hardly the only factor: cost, thermal stability, scrap, wear, material strength, life span, and safety are necessary considerations when manufacturing a proper plunger tip for any application. Copper alloy tips are popular in North America and Europe; steel tips are popular in Asia.[1]

Regarding plunger tip material, some key factors are thermal conductivity and strength. Although copper alloys deliver excellent thermal conductivity, they are not as strong as steel. Castool Tooling Systems has recently used ConDuct,[2] a high conductivity alloy steel, in successfully manufacturing plunger tips.

Several factors are usually missed regarding material evaluation and design of plunger tips: the critical softening temperature, the tip face's heat capacity, and the Leidenfrost effect.

Knowing the temperatures and stresses in the plunger tip helps with proper material selection, but measuring these parameters is either too difficult or impossible. Computational simulation is an effective tool to estimate stresses and temperatures in the plunger tip.

In this work, a combination of Finite Element and Computational Fluid Dynamics is used to simulate multi-physic phenomena affecting the plunger tip. The simulation captures the combined effect of water cooling, Leidenfrost effect, heat transfer and biscuit solidification to calculate resultant temperatures of the plunger tip, biscuit and coolant water. The performance and life of different plunger tips are evaluated based on simulation results, and the rationale behind the evolution of design, materials and manufacturing are also discussed.

***Table 1** – Key material properties for some popular materials used in manufacturing plunger tips.*

Material		Strength [MPa]	Temper Resistance [°C] at Specific Hardness	Toughness (Impact Energy) [J]	Thermal Conductivity [W/m°C]	Cost Factor per Unit Mass
Steel	**ConDuct**	1000	580°C @32HRC	100	42	75
	H13	1300	580°C @46HRC	25	24	100
	DieVar	1400	555°C @46HRC	30	30	125
Copper Alloy	**A25**	900	460°C @29HRC	40	120	2400
	A45	650	320°C @190HB (<20HRC)	65	220	1300
	A52	750	460°C @26HRC	60	240	1800

Table 2 - Heat capacity, density and coefficient of thermal expansion for Iron and Copper.

Material	Specific Heat Capacity [J/kg°C]	Density [kg/Lit]	Volumetric Heat Capacity [J/L]	Coefficient of Thermal Expansion [1/°C]
Iron	460	7.85	3611	0.000012
Copper	377	8.94	3370	0.000018

Material

A general decision theory for tooling material selection was discussed in a previous publication.[3]

In Table 1, important material properties are listed for alloys used in manufacturing plunger tips. Temper resistance is the temperature above which the material loses hardness over time. In terms of strength and temper resistance, hot work tool steels (i.e., H13 and DieVar) are at the top of the spectrum, and copper alloys are at the bottom. Copper benefits from excellent conductivity, but it is much more expensive. The soft copper alloy, i.e. A45, does not have enough strength to be used in the highly-stressed tip face, so it is mostly used in the body of modular plunger tips.

ConDuct[2] has a combination of good strength, temper resistance and thermal conductivity. In addition, it is the toughest with the lowest price among the provided list of materials. For the first time, Castool Tooling Systems used ConDuct for mass production of plunger tips, and the use is continuously increasing in manufacturing plunger tips.

The heat capacity of the plunger tip material helps with instant heat removal from the aluminum biscuit. The specific and volumetric heat capacity of steel material is higher than copper, so with the same tip face volume, the heat capacity of the steel is higher, and it provides more strength. On the other hand, the density of copper is about 15% higher than that of iron (Table 2), which adds to the total material cost when using copper.

Material selection is affected by process control methods. For example, copper has lower temper resistance than steel, and it can not survive when in contact with molten aluminum without water cooling. While using copper tips, the cooling must be running continuously and consistently. Any interruption in the cooling can cause thermal shock and unwanted expansions. On top of these are the boiling of the water inside the tip and the Leidenfrost effect, which reduces the cooling efficiency and may produce backward pressure in water supply pipes. On the other hand, the thermal expansion rate for copper is about 45% more than iron/steel (Table 2), which magnifies the mechanical effect of thermal shock.

Due to the higher strength of steel, more complex geometries can be achieved to get better cooling while keeping the stiffness within the accepted range. Figure 1 shows a recent plunger tip design with a stainless steel holder, a ConDuct tip and an H13 ring.

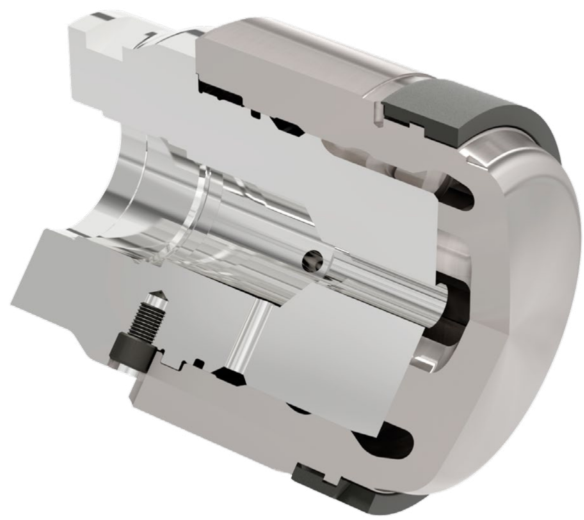

Figure 1 *- A Castool Ring Plunger (CRP) with a ConDuct tip.*

Design Evolution

The outer shape of the plunger tip has not changed over time. All plungers have water cooling to efficiently cool down the tip face, especially during dwell or solidification. Figure 2 exhibits 6 different plunger designs. Classic solid tips are one piece with a cooling cavity inside them. As there is no holder to support the inside walls, the material should be strong enough to provide stiffness during the process. An ARP plunger is made of copper tip and steel holder. Copper with high conductivity can efficiently remove heat from molten aluminum and solidify the biscuit. Recently released CRP tips have a similar concept as ARP with a stronger ConDuct tip. In CRP, complex cooling channels are made on the inside of the tip face to make more surface contact between coolant water and the tip, while AMP has a flat tip face on both sides with simple cooling grooves on the holder's front face. A modular AMP design makes it possible to use different materials for the body and face of the tip. In the AMP design shown in Figure 2, the body is made of soft copper alloy, and the tip face is made of ConDuct. AM1 and AM2 are concept designs with complex internal cooling channels to provide maximum surface contact with the coolant water. The internal cooling channels in AM1 and AM2 can not be made by conventional machining methods, which dictates the use of Additive Manufacturing methods. The material selection for AM1 and AM2 is based on required material strength for the specific design and available material for the specific manufacturing method. For example, Laser Powder Bed Fusion (LPBF) is suggested for manufacturing AM1 tip out of Maraging steel and Ultrasonic Additive Manufacturing (UAM) for manufacturing AM2 tip made of H13 steel.

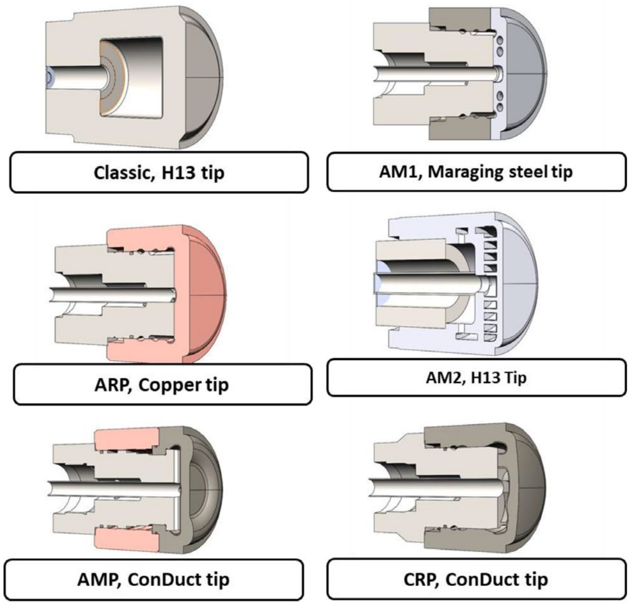

***Figure 2** – Different plunger tip designs.*

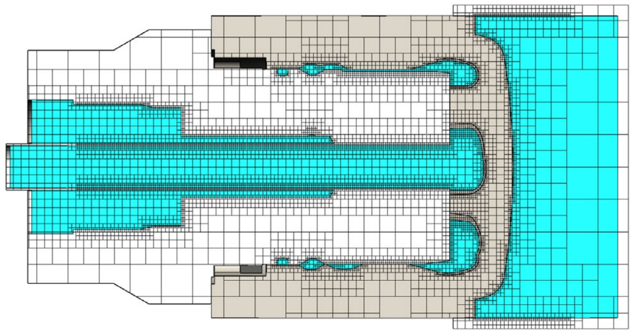

***Figure 3** – Mesh distribution: fluid mesh in blue.*

The effect of the sleeve and die is ignored in these simulations so that the results show the pure effect of plunger tip design and material. Simulations were performed for 3 cycles of 65 sec. Each cycle has 5 sec of pouring time, 20 seconds of contact with molten aluminum (delay+plunge+dwell) and 40 seconds not in contact with aluminum before the start of the next cycle. A356 casting aluminum alloy was selected for this study with a pour temperature of 680°C. The OD of the tips is 140 mm, and the biscuit volume is set to 0.85 Liter.

Computational Model

Multi-physical mathematical models were used to predict temperatures in the tooling and solidification of the biscuit. SolidWorks simulation tools were used to solve the problem. The fluid flow and heat transfer were simulated using the SolidWorks CFD package. The solidification was captured by changing the molten aluminum's viscosity and specific heat capacity at the solidification range, and the Leidenfrost effect was captured by defining the heat transfer as a function of the surface temperature of the tip. Figure 3 shows the mesh distribution in the tip, holder, water and aluminum biscuit.

Simulation Results and Discussion

Thermal CFD simulations were performed on different plunger tip designs to evaluate the efficiency and durability of different plunger tip designs presented in this paper. Different tip materials were used for some of the designs to capture the materials' effect on tip performance. Figure 4 and Figure 5 compare the effect of design and material on biscuit solidification and tip temperature for 9 different plunger tip designs. The reported solidified thickness is the minimum thickness of a solidified layer at the end of dwell time, which is the weakest part of the solidified layer.

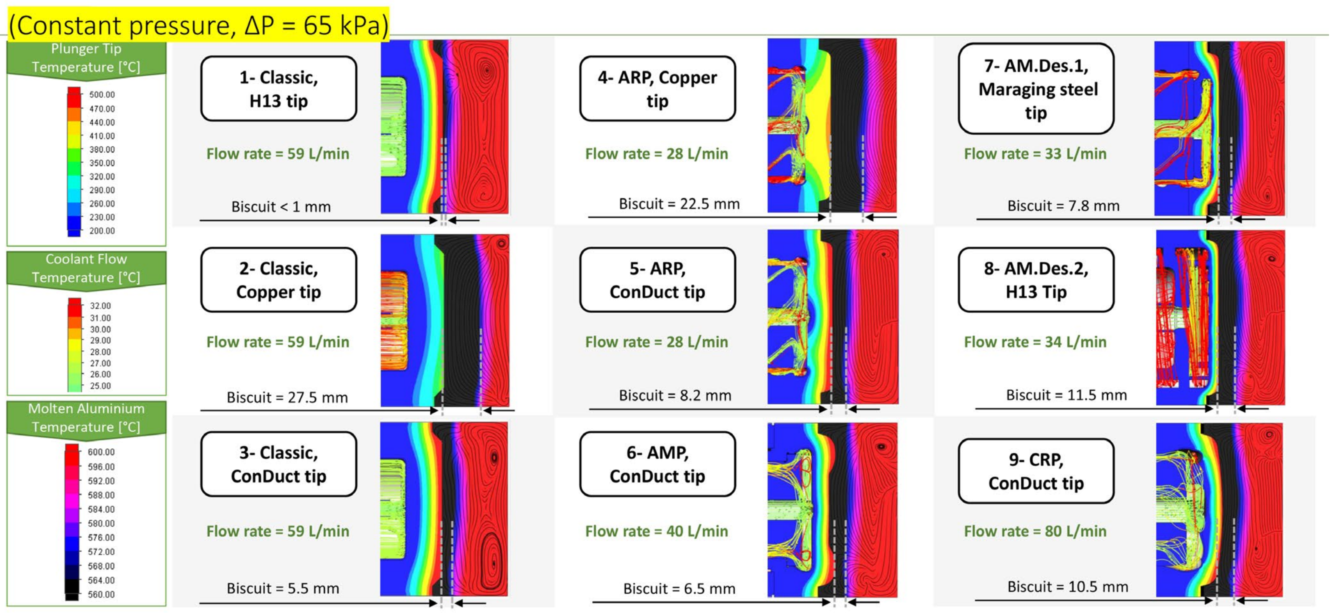

***Figure 4** – Biscuit solidification (black layer), tip and coolant water temperature at the end of dwell time, with constant water pressure of ΔP = 65 kPa at the tip. The water flow rate is reported for each case.*

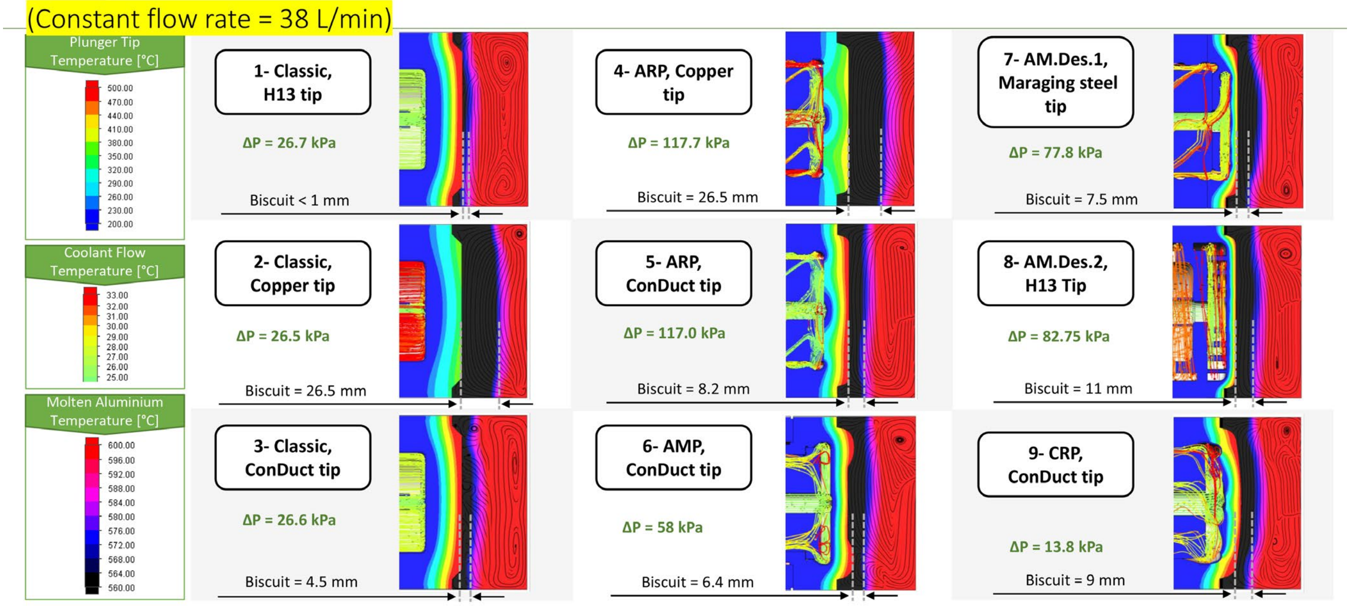

***Figure 5** – Biscuit solidification (black layer), tip and coolant water temperature at the end of dwell time, constant water flow of 38 L/min at the tip. The water pressure is reported for each case.*

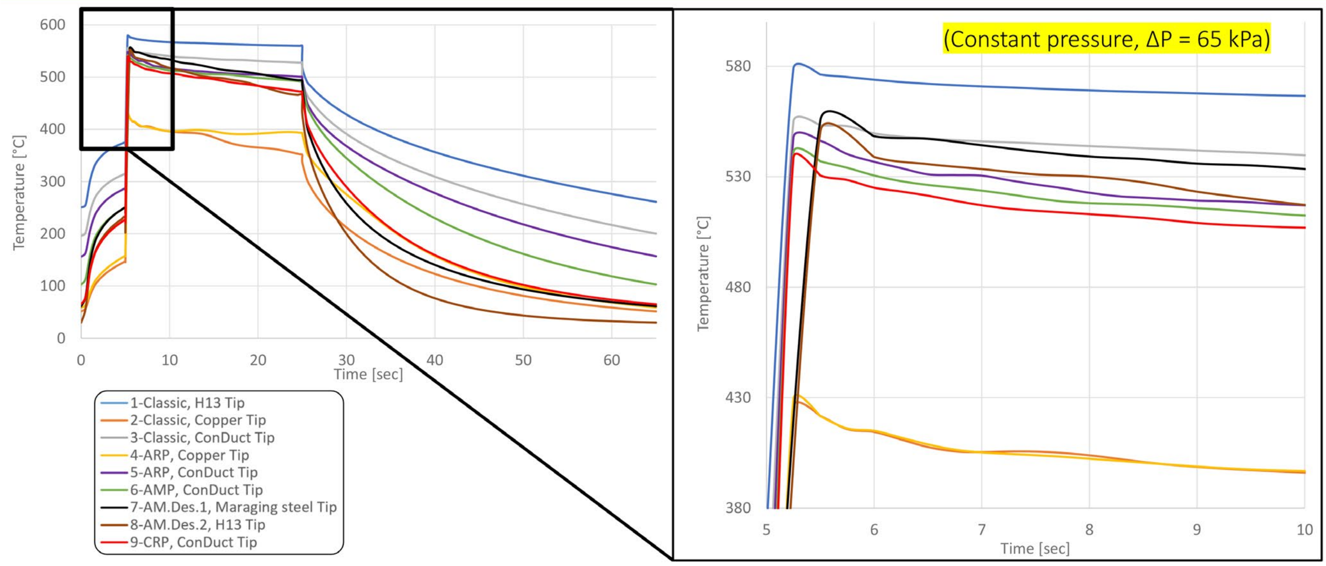

***Figure 6** – Temperature history during one casting cycle at tip face, with constant water pressure of ΔP = 65 kPa at the tip.*

In Figure 4, the water pressure was kept constant for all simulations so that based on the amount of friction and cooling channel design; the flow rate was different for each design. For example, CRP design provides the best water flow (80 L/min) with the same water pressure, and the ARP tip has the lowest water flow. The most influential factor on the biscuit's solidification rate seems to be the tip material conductivity, as all copper tips have a very high solidification rate and H13 and Maraging tips have meager solidification rates. Instead, steel has a higher strength, allowing for more complex designs such as AM1 and AM2. Cases 1, 2 and 3 are only presented to show the thermal effect of the tip material with the same dimensions; otherwise, the material change would mandate some dimensional changes to compensate for the mechanical and thermophysical property changes. For example, switching from steel to copper (with lower hardness), the thickness of the tip face should increase to provide enough strength.

Expensive additively manufactured tips (7 and 8) did not make considerable improvements in the cooling performance of the tip. AM1 made of Maraging steel has less of a cooling effect than ARP and CRP ConDuct tips. AM2 made of H13 can improve the cooling to some extent, but it provides lower structural strength due to design features.

In contrast to Figure 4, in Figure 5, the water flow rate is kept constant for all 9 cases. Beside each case, the required pressure to provide 38 L/min water flow is reported. Compared with Figure 4, the biscuit solidification rate does not increase proportionally with the water flow rate; for example, increasing the water flow rate in a CRP tip from 38 to 80 L/min (more than 100% increase), the solidification rate increases by only 12%. It is worth mentioning that for a highly conductive copper tip, using a thicker tip face can make the tip run colder and increase solidification rate, but for less conductive materials such as steel, using a

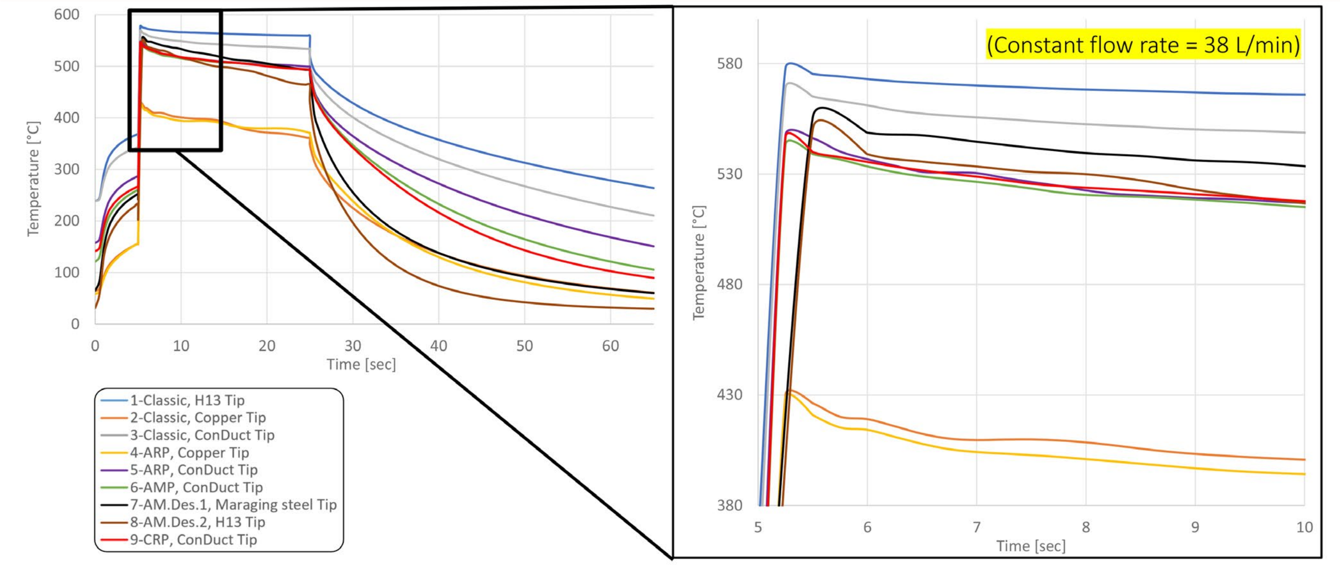

***Figure 7** – Temperature history during one casting cycle at tip face, with a constant water flow of 38 L/min at the tip.*

thicker tip would make the front face hotter lessening the solidification rate. For example, compare a classic ConDuct tip (#3) with an ARP ConDuct tip (#5). The CRP design results in the best biscuit solidification among ConDuct tips (3, 5, 6 and 9).

Figure 6 and Figure 7 show the history of the average temperature at the front face of the 9 different plunger tip designs. As observed, copper tips have the lowest tip face temperatures during the dwell time, and CRP ConDuct has the lowest tip face temperature among steel tips. After dwell time, the AM2 tip shows the fastest cooling, and it reaches the lowest temperature at the end of the cycle just before starting the next casting cycle. Although the cooling capability of AM2 is much higher than other designs, this can cause severe thermal shock and extraordinary thermal stresses in the tooling due to high thermal gradients.

Effect of the Leidenfrost Phenomenon on Tip Cooling

To show the effect of Leidenfrost on tip cooling efficiency, tip simulations were performed without considering the Leidenfrost effect and repeated for two different Leidenfrost points of 200°C and 230°C. Results for tip face temperature and biscuit solidification are summarized in Table 3 and Table 4. Although 230°C is a more realistic number, 200°C was also used to show a worst-case scenario and determine the designs that may show low efficiency under poor water flow. It must be noted that this study is done for a constant flow rate of 38 L/min.

The ARP conduct tip is the most affected by Leidenfrost, and the next are AM1, AM2 and CRP. All are tips with good cooling and solidification.

It can be concluded that keeping a proper water flow rate is more important for more efficient plunger tips to avoid boiling coolant water inside the tip. It is worth mentioning that the backpressure from boiling water is not considered in the simulation.

***Table 3** – Average tip face temperature during dwell time for 9 different designs (constant flow rate 38 L/min).*

Design	Average tip face temperature during dwell time [°C]		
	Leidenfrost @ 200 °C	Leidenfrost @ 230 °C	Without Leidenfrost
1-Classic, H13 Tip	562	562	562
2-Classic, Copper Tip	389	385	385
3-Classic, ConDuct Tip	542	541	541
4-ARP, Copper Tip	399	386	380
5-ARP, ConDuct Tip	509	509	509
6-AMP, ConDuct Tip	508	506	506
7-AM1, Maraging Steel Tip	523	512	512
8-AM2, H13 Tip	500	492	492
9-CRP, ConDuct Tip	510	504	501

Table 4 - Minimum thickness of solidified biscuit at the end of dwell time for 9 different designs (constant flow rate 38 L/min).

Design	Solidified biscuit thickness at the end of dwell [mm]		
	Leidenfrost @ 200 °C	Leidenfrost @ 230 °C	Without Leidenfrost
1-Classic, H13 Tip	<1	<1	<1
2-Classic, Copper Tip	26	26.5	26.5
3-Classic, ConDuct Tip	4.5	4.5	4.5
4-ARP, Copper Tip	20	26.5	27.5
5-ARP, ConDuct Tip	8.1	8.2	8.3
6-AMP, ConDuct Tip	5.5	6.4	6.5
7-AM.Des.1, Maraging Steel Tip	5.5	7.5	7.5
8-AM.Des.2, H13 Tip	9.8	11	11.5
9-CRP, ConDuct Tip	6.5	9	9.5

Plunger Lubrication

Plunger lubricants help with the smooth running of the die casting system. A good lubricant can improve the castability of the metal, limit porosity and improve injection.[4] On top of these, plunger lubrication prolongs the life of the shot sleeve and plunger by:

1. Reducing the friction between the plunger and the shot sleeve,
2. Producing a thin insulating film between tooling (plunger and sleeve) and molten aluminum.[5]

The lubricant layer must be strong enough to avoid its washout from the surface with the flow of the molten aluminum inside the sleeve;[5] otherwise, the molten aluminum is going to contact the surface of the die and make Aluminum-Iron alloys or intermetallic, which cause early failure of the tooling.[6]

However, high viscosity is not always a good parameter, especially where the lubricant is sprayed onto the surface.

Plunger lubricants can be dry or wet, but wet lubricants are more popular due to their ease of application. Most used plunger lubricants are oil-based, made from mineral, vegetable, or synthetic oils.[4] They can carry graphite or Boron Nitride and can be very effective for greasing pistons. An ideal lubricant might have the following specifications[6]:

1. It is satisfactory to both surfaces and does not chemically react with them.
2. It forms a tight and adherent film on the surface.
3. It has good surface coverage with the capability to spread fast and uniformly.
4. It does not fume toxic or problematic gases that affect the health of the operator.
5. It has a reasonable price because large amounts of lubricants are being used.
6. It has a relatively high flash point to avoid excessive vaporization.
7. It is environmentally friendly.

The most important rule for lubrication is to use just as little lubricant as needed and only where needed. Excessive lubricant will end up deteriorating the quality of casting since the molten aluminum would decompose the oil and produce moisture and gasses that affect the casting soundness.[6] On top of this, excessive lubricant is an unnecessary cost and a workplace pollutant.

Every effort must be made to eliminate the possibility of any non-metallic substance getting into the mould. Graphite-based lubricants, for example, can cause porosity in the casting.

Additives

There can be several additives to provide an optimum mixture of properties to the lubricant[5]:

- Cohesion and wetting (animal and vegetable fats).
- High-temperature viscosity control and insulation (pigments like Boron Nitride, graphite, aluminum, mica, and other powdered solids).
- Anti-welding and rust protection (chemical additives).

Wetting Capability

One of a lubricant's most important physical properties is wetting capability, especially when droplets of lubricant are sprayed onto the hot surface. When the surface temperature is much higher than the boiling point of the droplet, a vapour layer will form between the droplet and hot surface that prevents the conductive heat transfer (Figure 8). This phenomenon is called the Leidenfrost effect, a combination of surface tension and vapour pressure.[5]

The temperature of the shot sleeve must be controlled to avoid the Leidenfrost phenomenon during applying or spraying the lubricant onto the hot surface. Figure 9 shows two scenarios: on the left side, the Leidenfrost effect prevents the droplet from wetting the surface, whereas on the right, the droplets wet the surface and form a film.

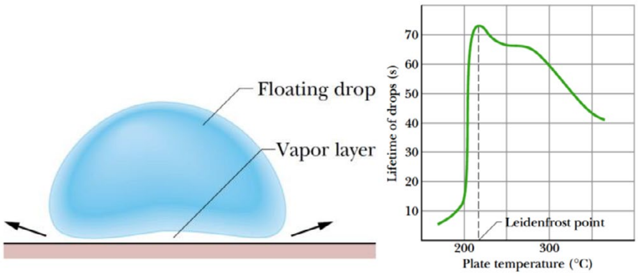

Figure 8 – A Leidenfrost drop in cross-section (left) and water drop lifetime on a hot plate (right).[7]

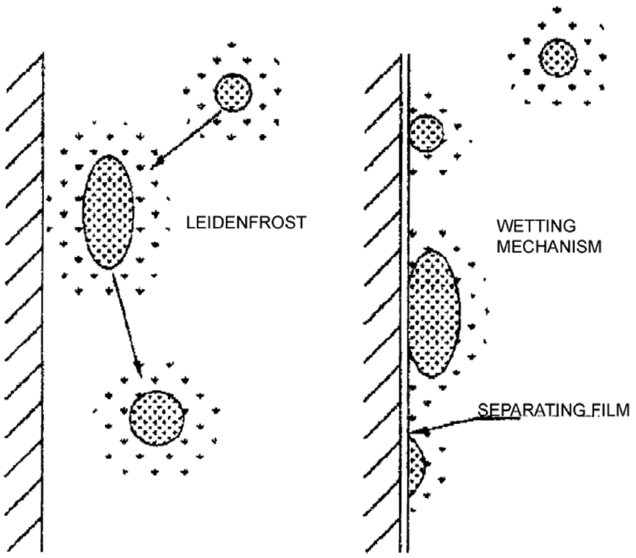

Figure 9 – Leidenfrost effect causes the droplet to bounce back from the hot surface (left) versus the wetting phenomenon that forms a separating layer on the surface (right).

Plunger Lubricants

There are several types of lubricants. Among them, two types are more popular: ALS192 (synthetic oil-based with Boron Nitride particles) and CLS200 (vegetable oil-based).[8] The table below summarizes the physical properties of these lubricants. ALS192 has relatively high viscosity at room temperature, which gives a good strength to lubricant film but makes it difficult to spray at room temperature, so preheating is needed for proper atomization. CLS200 does not have this issue.

Both lubricants are resistant to high temperatures as they have a high flash point and boiling temperature that helps avoid the Leidenfrost effect and excessive fume production. Therefore, it is surprising that the CLS200 with lower viscosity has a higher flash point that puts it in a better position regarding fume production.

Lubrication Methods

Different methods for applying lubricants are shown in Figure 10. Lube drop is the oldest and easiest method for lubricating plunger tip, but with this method, the lubricant is not carried properly along the shot sleeve, so low viscosity lubricants may not work effectively. Combi Lube and Rod lube methods can apply lubricants to wide areas inside the sleeve so that they are recommended for large tooling (Table 6). These methods can benefit from low viscous, high flash point lubricants. The lubricated location and amount of lubricant are well controlled with these methods. This makes it possible to have more effective lubrication using less lubricant.

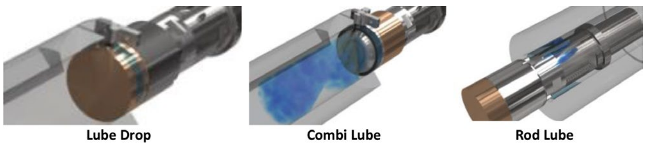

Figure 10 – Different lubrication methods.[9]

Summary and Conclusions

- Computational Fluid Dynamics (CFD) and Heat Transfer models were used to evaluate the plunger tip cooling and biscuit solidification in different plunger tip designs.
- Material selection is an important part of product design—the mechanical and thermo-physical properties of the material affect productivity and tooling durability.
- Although the outer shape of the plunger tip is not changed over time, the inside design and material have evolved significantly.
- The thermal conductivity of the tip's material is the main factor in the biscuit solidification rate.
- A thinner face shows a better solidification rate in steel tips, but for copper, with high thermal conductivity, the thicker tip may show a better solidification rate due to more thermal mass.
- A CRP ConDuct tip with cooling grooves on the tip shows a considerable advantage over the previous generation of tips (ARP and AMP) in solidification rate and tip temperature.

Table 5 – Key properties for ALS192 and CLS200 lubricants.

Property	ALS 192	CLS 200
Kinematic Viscosity (at 40°C/104°F)	930 mm^2/s	35 mm^2/s
Flashpoint	270°C (518°F)	290°C (554°F)
Boiling point	305°C (281°F)	325°C (617°F)

Table 6 – Lubrication methods recommended based on shot sleeve size.

Shot sleeve size	Recommended method
Small diameter	Lube Drop
Medium diameter	Combi Lube
Large diameter	Lube Drop + Rod Lube
Large diameter and long	Combi Lube + Rod Lube

- Additive Manufacturing does not add considerable value to plunger tip performance considering much higher manufacturing costs. On the other hand, the complex design of these tips can cause excessive thermo-mechanical stresses.
- Although the Leidenfrost effect is not considered in the plunger tip designs studied in this paper, simulations show that it may cause issues specifically in high-performance plunger tips in poor water cooling conditions.
- Good lubrication is a combination of proper lubricant and proper lubrication methods.
- For large tooling, low viscosity lubricants with spray application methods are recommended.

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Abstract

The Rheocasting process has been around for many decades – and so has vacuum die casting – but only the combination, together with special alloys and heat treatments is now enabling the production of large castings with ultra-thin-walled fins (0.4mm / 0.016" at the top) of significant height (up to 120mm / 4.72"). Besides the ability to join these casting by welding (generally a challenge for die castings due to porosity issues) the main purpose of these castings is to serve as heat sinks, which made it impossible to work with any of the typical die casting alloys (383 and 518 have a thermal conductivity of 96 W/mK, A380's thermal conductivity is 109 W/mK, A360 is at 113 W/mK, A413 is at 121 W/mK, C443 delivers 146 W/mK), as the objective is to guarantee a minimum of 190 W/mK. In order to achieve this the C443 (with lower silicon than the others and low Cu) is offering the closest starting point for development work, but several improvements to the alloy were needed, and a special heat treatment had to be developed in order to consistently achieve this objective. Weldability makes high integrity (very low porosity) of the casting vital, so Rheocasting and high vacuum were obvious candidates to achieve this goal, but they had not really been used in combination before. The ability of filling thin sections is one of the advantages of the special microstructure and high viscosity of a semi-solid melt, but only with high vacuum was it possible to achieve the necessary flow-lengths. This paper describes the development work leading up to today's series production process and alloy for these highly sophisticated telecom castings used among others for 5G housings.

Introduction

The telecom industry is currently facing significant challenges, 5G products (castings) have substantially increasing requirements in terms of cooling requirements compared to previous technologies. This can be obtained either through materials with improved heat transfer capabilities or better / increased cooling surfaces. Castings have traditionally been used for this type of applications (see figure 1). It is advantageous if these applications use "unforced air-cooling systems" (meaning that fans or liquid cooling is not required). The use of castings has previously fulfilled all requirements, but the existing casting methods and alloys with their achievable properties and geometries are being pushed to their limit (and beyond). Rheocasting is a solution to increase the use of the already installed HPDC capacity with only small additions in terms of equipment. The use of Rheocasting allows for new alloys to be cast, that provide improved properties and simultaneously can offer thinner walls, which reduces the overall weight of the components. The global telecom industry has so far had a majority of its production in China. However, governments in Europe and North America are increasingly putting pressure on the industry players to produce more locally due to political reasons. This means that the supply base has to be expanded in both Europe and North America in order to provide the required components. Sustainability is now also a topic of growing importance; and again, HPDC and Rheocasting enable the use of secondary alloys with high thermal conductivity, especially when staying away from the Al-Si eutectic (Si reduces the thermal conductivity in Al-Si alloys, and the Si addition is also adding high carbon footprint to the metal as its production is similarly carbon intensive as primary aluminum production).

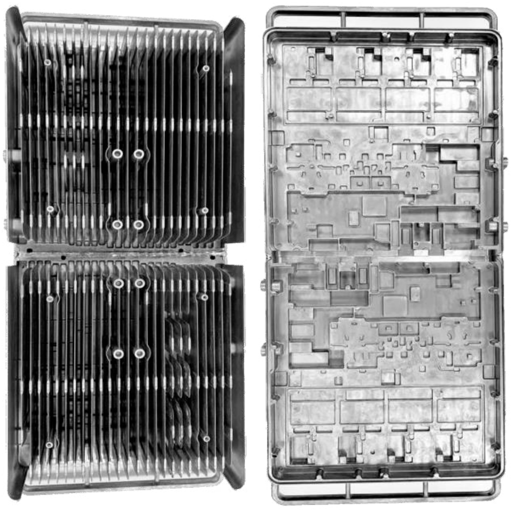

***Figure 1** - Example 5G housing made with the RheoMetal™ Rheocasting process using vacuum.*

The RheoMetal™ Rheocasting Process

The RheoMetal™ process (developed in Sweden) is a high solid fraction Rheocasting process that allows slurry preparation in a very short time (never slowing the die casting machine cycle time down). A pre-solidified piece of aluminum (of the same alloy that is Rheocast in the die casting machine), the so-called enthalpy exchange material (EEM) is produced in a small permanent mold carousel (Figure 2a). In the first stage the EEM is cast onto a rod, it then cools down and the riser is removed in step 2. In step 3 it is used to create the semi-solid slurry in the ladle. After this, the rod is cleaned and ready for step 1 again.

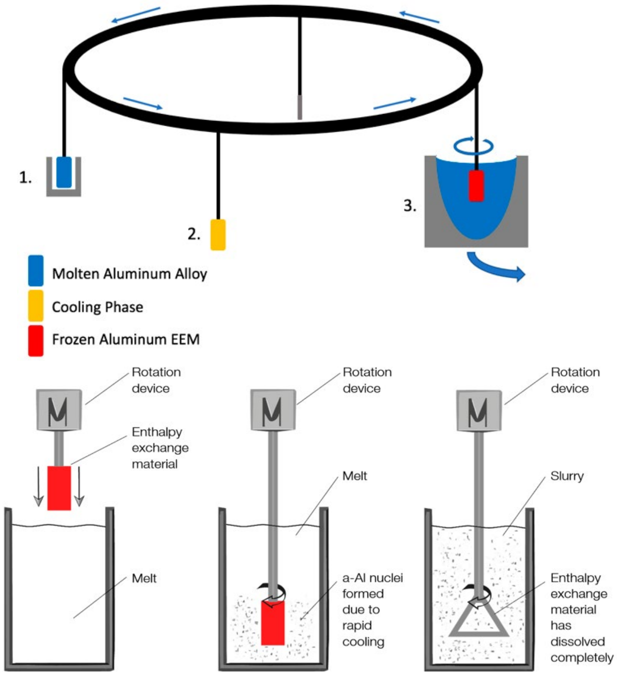

Figure 2a (top) and 2b (bottom) *– The RheoMetal™ Rheocasting process.*

Figure 2b shows the slurry making process in the ladle: The EEM is immersed under rotation into the ladle and melts during the slurry forming step (the rod is spinning at a controlled speed to minimize any splashing or surface turbulences). This allows controlling the final temperature and solid fraction of the slurry in a simple but very precise manner, and also ensures that the formed grains are globular (non-dendritic). This step usually does not take more than 20 seconds even for large slurries. At maximum 45% solid fraction the slurry can still easily be poured into the shot sleeve so that no modification to the die casting machine is necessary. Depending on the alloy the slurry remains semi-solid for up to 90 seconds, which makes this process very robust.

Rheocasting Applications in Electronics

The first component commercially produced with the RheoMetal™ process was a heatsink that was developed in 2013 and has been in mass production since 2014. The original design was made for regular HPDC with a fin thickness of 1.6mm and requiring machining in the inner cavity and sealing grove. However, the use of semi-solid casting allowed for the casting of fins with a thickness of only 0.9mm and the resulting part did not require any machining. The use of Rheocasting significantly improved the thermal conductivity from 100W/mK to 150W/mK as well as reducing the weight of the piece considerably.[1] Rheocasting has since been used heavily for the production of radio frequency filters (which have a highly complex geometry), where it improved the resource efficiency by reducing the fin thickness. The fin thickness for these components has since been taken to the extreme, and in figure 3 (left) we can see a radio filter with fins of only 0.4mm (0.016”) thickness at the top and a height of 45mm (1.8”). This was only possible with the combination of Rheocasting and high vacuum.

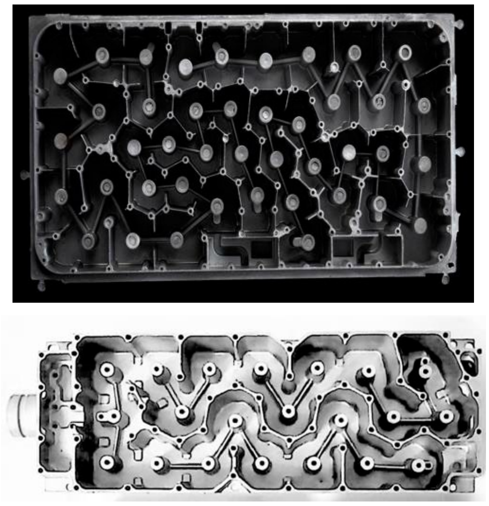

Figure 3 *– Examples of telecom radio filters made with the RheoMetal™ Rheocasting process using high vacuum.*

Figure 3 (left) above shows a newly developed telecom filter cast in AlSi7Mg-alloy (ENAB 42000 / A356) where the air flows are separated by the aluminum walls. The thinner the walls, the more air can fit into the same volume. On a case-by-case basis the component designer can chose between a high performance or a smaller volume and lower weight product.

Today, the developments in 5G mobile networks increase the demand for exactly such highly advanced components with complex geometries such has heatsinks with increasing cooling requirements. The parts in the figure 1 above are cast with AlSi7Mg (ENAB 42000 / A356). 5G products are getting bigger and bigger and require larger HPDC machines, which are a very costly investment. There is also limited choice in suppliers for many larger HPDC machines. It has been proven that the weldability of Rheocasting parts has greatly improved due to a more laminar filling pattern which allows 50% of the metal to solidify before it takes its final shape. This in turn decreases the amount of micro porosity which allows the welding of two castings into one. Therefore, larger structures are possible to make with smaller die casting machines if the Rheocasting process is used. For buyers, this means they have a larger choice in suppliers and for foundries it means that they can use their existing machines and avoid investing in larger machines in a market with rapidly changing volumes.

Another example of Rheocast components in electronics are also LED housings that often combine thick and thin sections in one component. The filling of thick, larger areas with close to zero porosity is not possible with conventional HPDC but is however possible with Rheocasting. Optimizing the filling process to allow the larger base plates of such parts to fill first is only possible using the semisolid process.

Development of a High Vacuum Rheocasting Process for Telecom Components

With the requirements of telecom castings: (1) high thermal conductivity – requiring very low Si alloys, (2) light weight / very thin walls, (3) sometimes thick walls in the same part, and (4) high production volumes, the Rheocasting process seemed to be just the right process to choose. The laminar filling minimizes air entrapment and converging metal fronts that would generate porosity and inclusions in the casting. The globular microstructure allows feeding during solidification far longer than a dendritic microstructure (achieved with liquid casting) would allow (due to much lower shear strength). Alloys with low Si and hence large freezing ranges, injected at slow speeds and low temperatures (much lower than in liquid die casting), with high viscosity melt, allow filling of even very thin cross sections and long feeding, with minimum die wear. Traditionally Rheocasting was rather intended to produce thick-walled parts (and e.g. replace forgings), and for ultra-thin-walled castings most people thought that liquid casting would always be better. It has now become clear that in fact in liquid die casting the atomized droplets of liquid metal contain very little heat and if they enter individually a thin section (even of a strongly heated die) they will quickly freeze and block the passage for subsequent droplets. The laminar and continuous, homogeneous metal front of Rheocasting however arrives with all its heat at the thin section and does not freeze until the section is filled (with the globular structure helping with filling and feeding). It was found however that a certain solid fraction in the semi-solid slurry is ideal, and a low solid fraction (especially if below 25%) can help reduce porosity in a casting, but will not be sufficient to allow casting of those very thin sections, and neither allows casting very high integrity components. If the solid fraction is too high, the slurry becomes difficult to transfer into the shot sleeve (at 50% solid fraction and above it is basically a self-sustaining billet and does not "flow" any more at all). It seems therefore that with a solid fraction of 30 – 45% the optimum properties of the semi-solid slurry can be achieved for high quality/integrity applications. For this reason, Comptech chose the RheoMetal™ process as it allows great flexibility of producing slurries with precisely those sold-fraction ranges and based all its development on this process.

In earlier Thixo- and Rheocasting applications (of usually thick-walled components) it had not been found useful to apply vacuum as the laminar flow already avoided air entrapment in the casting. For ultra-thin-walled castings however any counter pressure in the very thin walls must be minimized to guarantee filling without problems, and therefore the application of vacuum was found to be very important. For latest developments of (especially ultra large) structural Rheocastings it has also been found very helpful to apply vacuum in order to achieve highest integrity of large thin-walled components.

Why Cast Heat Sinks[2]

Die cast heat sinks usually offer lower cost and higher geometric complexity than extruded and machined alternatives. The problem is usually the castability of high conductivity alloys, as traditional die casting alloys tend to have rather low thermal conductivity. A380's thermal conductivity is 109 W/mK, A360 is at 113 W/mK, A413 is at 121 W/mK, C443 delivers 146 W/mK) due to its lower Si content (4.5-6%), but it is also more difficult to cast and not typically identified as a die casting alloy. Thermal conductivity of rheocast (and HPDC) aluminum alloys range from relatively low (155-165 W/(m·K) at 100°C for alloy Stenal Rheo1 (Al-6Si-2Cu-Zn alloy)) to relatively high values (200 W/(m·K) at 100°C for a newer alloy), depending on the alloying elements and process parameters.

Heat treatment can then significantly improve the thermal conductivity. Figure 4 shows that thermal conductivity increases with the temperature of the component. It also shows that in T5 temper the thermal conductivity is always higher than in F (as cast / AC) temper (and remains higher over the entire temperature range).

Temperature, °C	AC, W/(m*K)	T5, W/(m*K)
23	170.0	193.9
50	171.9	193.9
100	175.2	195.8
150	178.1	195.9
200	181.3	198.5

Figure 4 *– Thermal conductivity at different temperatures in F and T5.*

As shown in figure 5 the thermal conductivity of a casting with a given Si content (2.5, 3.5 and 4.5%) increases with increasing temperature during the heat treatment process of up to 300-400°C (basically a soft annealing heat treatment), but then continues to rise after the casting is cooled back down to room temperature. The lower the Si content, the higher the thermal conductivity from the beginning until the end, and the graph shows that with a 2.5% Si alloy after this soft annealing heat treatment a maximum thermal conductivity of 215 W/mK was achieved.

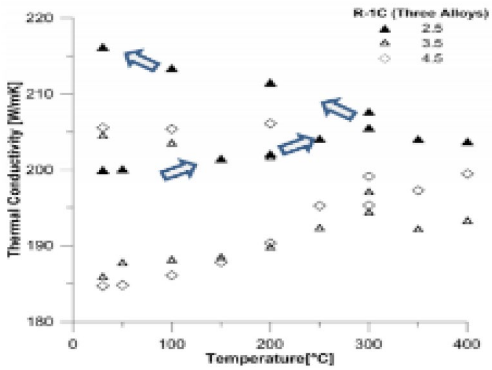

Figure 5 *– Thermal conductivity with different Si contents with different temperatures.*

Figure 6 shows a heatsink cast with the Rheocool (AlSi3Fe) alloy. Due to the increasing cooling requirements of heatsinks, new heatsinks with higher flanges are being designed in order to have a larger surface area. With Rheocasting it is possible to make these fins much taller and thinner and with lower draft angles. This increases significantly the cooling performance of the heat sink. In conventional HPDC the fins are thicker and need to be machined in order to be thin enough to meet the weight requirements, and in addition to this they could not be cast in an alloy with sufficiently high thermal conductivity.

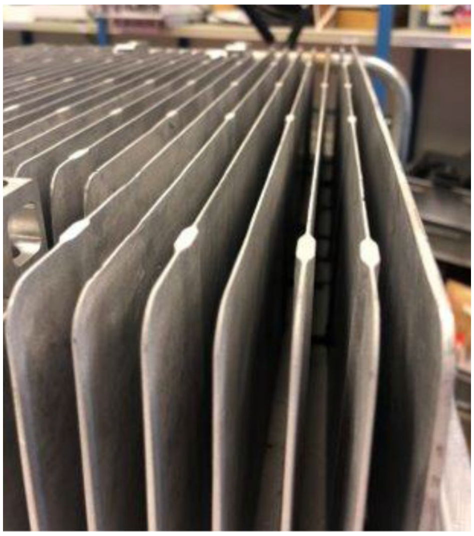

***Figure 6** - Large heat sinks with 120 mm fins, showing the effect of shear thinning, see above. A +20 kg part approx. 900 mm long part.*

Microstructure[3]

As shown in figure 7, the microstructure of Rheocast (Stenal Rheo 1) components consists of two main particle sizes: the α1-Al particles and the α2-Al particles.3 The primary, lower hardness α1-Al particles are large, globular and are formed during the slurry fabrication process, whereas the secondary fine α2-Al particles are dendritic and formed in the cavity during solidification. The α2-Al particles increase the inhomogeneity in the final microstructure. Analyzing the local thermal diffusivity, it was found that regions with high α1-Al particle density yielded higher thermal conductivity whereas region with a high α2-Al particle density had lower thermal conductivity. This can be attributed to the fact that the α1-Al particles contain lower concentrations of Si and Cu than α2-Al particles. Silicon, when dissolved in the α-Al phase, has a strongly negative influence on the thermal conductivity and can be precipitated by T5 heat treatment (silicon precipitation takes place between 200 and 250°C). Alloying elements negatively affect the thermal conductivity since the thermal conductivity depends on the electron mean free path, which decreases with the presence of impurities, alloying elements, vacancies or dislocations, since these all disrupt the lattice structure. Therefore, the regions with more α1-Al particles, i.e. with less alloying elements, have a higher thermal conductivity.

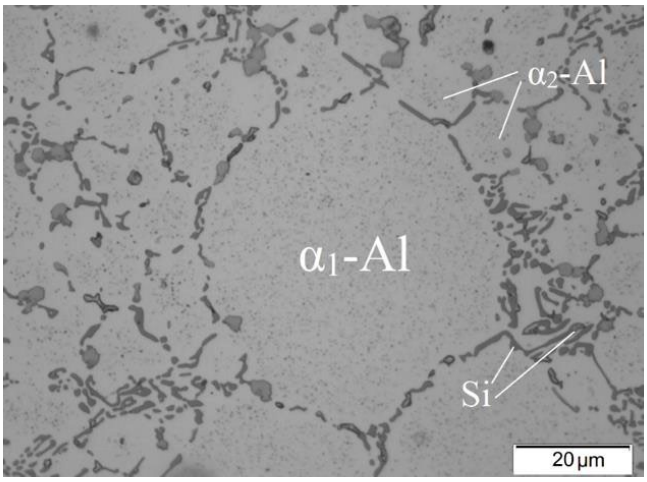

***Figure 7** - Typical microstructure of the as-rheocast alloy showing large α1-Al particles, fine α2-Al particles and Si eutectic.*

Conclusions

The telecom industry has traditionally used die cast parts in conventional alloys and components, which have mainly been produced in Asia (especially China). With the current developments towards 5G networks, combined with political pressure to produce these components more locally in Europe and North America, an excellent opportunity is opening up for die casters to participate in a challenging new opportunity with new technologies. Radio filters, 5G housings, LED housings, etc. can ideally be produced on basically any conventional die casting machine equipped with (ideally high) vacuum and a Rheocasting technology that allows for solid fractions of 30-45%. This combination allows both the casting of thick wall sections with very low porosity and extremely thin sections like ribs or fins – even with significant height and very small (1 degree) draft angle. The Rheocasting process allows production of much larger components on a die casting machine (compared to liquid die casting, due to lower pressure and reduced projected area). At the same time, it improves part quality and helps extend die life significantly, so that the investment is usually amortized in a very short period of time. Those who already seize this opportunity – like Dynatool Inc. in Montreal, QC, Canada – have realized quickly that using this technology of high vacuum Rheocasting can also open many other opportunities in high integrity castings, and besides their traditional telecom business they now also started producing structural castings for EVs.

Acknowledgments

We would like to thank Dr. Magnus Wessén from RheoMetal and Prof. Anders Jarfors from Jönköping University for their contributions to the research on this topic.

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Toward Zero-Defects Manufacturing: An Introduction to Predictive Quality

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IoTco
Cincinnati, Ohio

Using predictive analytics within a smart factory is usually geared towards uptime improvements., improving spare parts, improving maintenance and labor, scheduling activities, and so on. However, predictive analytics can also detect, predict and reduce waste and scrap in the manufacturing sector. "Predictive quality" is the key concept.

Predictive quality solutions (see Figure 1) aim to detect, diagnose, and/or predict potential deviations in critical process parameters that impact the quality of the final product. So, how do we detect, diagnose and predict quality issues to drive improvements in some of the pain points that are related to quality? The key pain points related to quality in the manufacturing industry that need to be looked at are cost of scrap; decreased productivity and efficiency; lost profits and time due to inspection tasks; warranty claims and recalls; and lack of quality-driven process optimization.

Just imagine making a part every ten seconds and each part needs to be inspected. That's extremely expensive in terms of time and effort for the business. But worse, the cost of that part—as it goes down the value chain from, say, casting to machining to painting and eventually out to the end user—is increasing exponentially.

And if a bad part goes to the end user, the cost can be beyond measure. You cannot put a price sticker on it because warranty claims and recalls are going to kick in and then it becomes a significant loss for the business and potentially ruinous to its reputation.

Prediction vs. Automated Inspection

At IoTco, we consider data analytics to be the defining technology of Industry 4.0—but there are other "smart-factory" technologies, of course. Another relevant one is automation, and there are many manufacturers that address their quality issues by turning to robotic inspection rather than predictive analytics. There are cases where this may make great sense, but we would argue that predicting and preventing flaws is a better solution than detecting them after they occur. Automated inspection systems offer speed and repeatability—but after all still depend on a check of a part's quality at the end of a production process rather than foreseeing and preventing a cause of imperfection before it happens.

Also, many automated inspection systems are based on one form of imaging or another. But camera-based inspection isn't perfect: It can be complicated to set up a system to provide a 360° view of the part being checked. Also, in casting processes porosity defects may not be caught by optical imaging.

Another advantage of predictive quality analytics is that the data collected for it greatly overlaps with the data collected for other reasons, such as for predictive maintenance purposes. That means that any enterprise that plans to implement—or is already implementing—predictive main-

Figure 1 *– Predictive Product Quality explanation.*

tenance measures may find the barriers to also implementing predictive quality to be relatively low.

An Automotive Supplier Case Study in Die Casting

Predictive quality has had a significant impact on the high-pressure die casting (HPDC) process used by one of our manufacturing clients. This $1-billion automotive Tier 1 supplier was experiencing losses due to quality issues in its casting process—not a rare occurrence in an industry in which casting scrap rates can often reach 10% or higher.

The typical scrap rate for one of the company's aluminum casting parts is 3.5%. For a lot size of 160,000 parts, on average 5,600 parts are scrap. Here are the costs along the value stream "per part" and "per scrap part":

- Foundry: $3.8 per part ($21,280 cost of scrap)
- Machining: $11 per part ($61,600 cost of scrap)
- Assembly: $28 per part ($156,800 cost of scrap)
- Customer: Priceless!

Predictive quality and early scrap detection can provide significant production risk reduction and savings ranging $70k – $135K per product.

It's important to understand your costs per part and per scrap part across the value stream and to be able to put such solutions in place right at the source of quality issues, which is usually the foundry—and if they're caught in the foundry, you're able to completely minimize quality issues across the rest of your value stream.

System Inputs and Outputs

In order to stem its losses, this company engaged IoTco to deploy predictive quality analytics on multiple HPDC cells. Over a period of six months, we were able to implement a predictive quality system that identified defective parts and separated them from good parts as they exited the casting cell (see Figure 2).

Predictive quality techniques enable you to catch quality issues right at the source, right at the casting machine—or the CNC machine, the molding machine, or whichever critical asset for your business.

Predictive quality solutions enable manufacturers to identify issues before they occur, improve quality, optimize process, minimize scrap, reduce rework, and avoid lost production time.

The goal is to establish a multivariate model. There are a lot of inputs going in that could affect the quality of the part: Process parameters, material properties, product specifications, inspection information, and expert domain knowledge need to be leveraged to establish the actions needed throughout the process and ensure products are of the highest quality.

We also need historical data about inspections to be able to build and train machine learning (ML) models, not to mention expert domain knowledge needs to be leveraged into those models to ensure the accuracy of the predictions. Specifically, we need information about what disruption to the production process causes the part to fail inspection. Broadly speaking, the types of disruptions include unexpected changes or critical drift in process parameters; poor environment conditions; incorrect configuration of machines (operator error); and equipment failure of one kind or another.

Our model's inputs are data we gather about quality disruptions and how they were evident, if undetected, in real-time data and observations. These data are culled from expert domain knowledge, historic product quality data, and the application-dependent availability of key signals in the production process.

Our predictive quality analytics correlated machine parameters like pressure and temperature with quality parameters in the end part, proactively flagging anomalies in machine function that indicate that the part is likely to have a defect. We collected 40 to 50 process parameters and trained its algorithms on several weeks of baseline data, which allowed it to identify and predict over 95% of quality issues in 10 seconds or less—faster than the cycle time of the part.

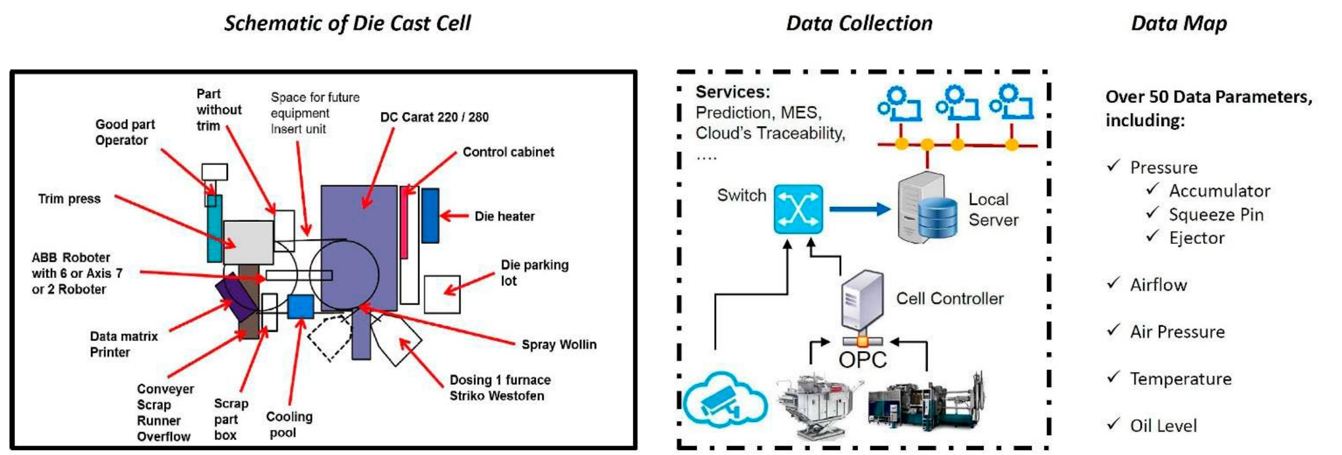

***Figure 2** - Data Collection in High Pressure Die Casting.*

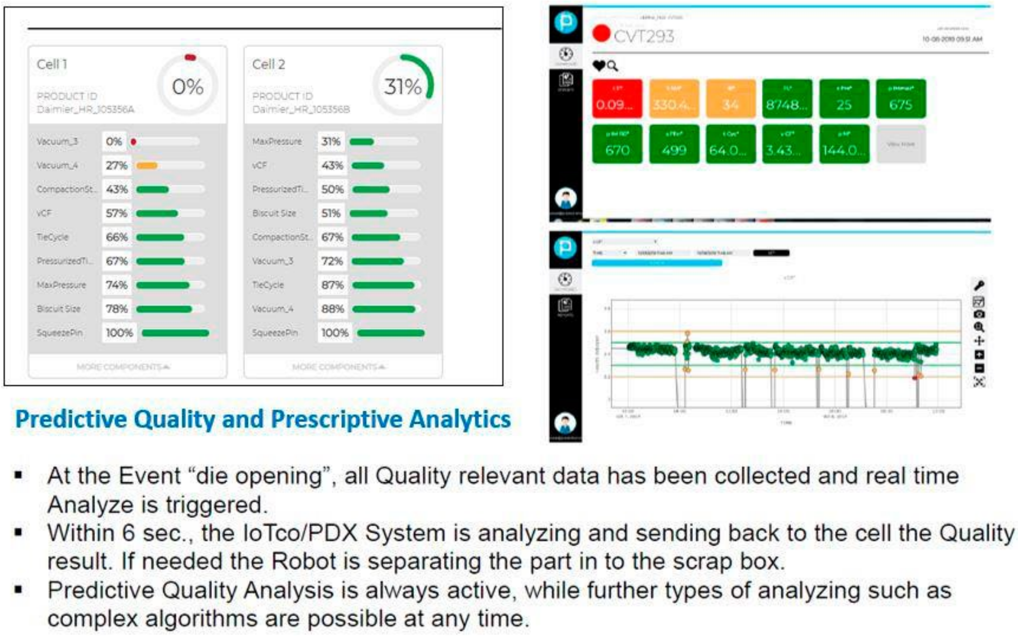

***Figure 3** – Predictive Quality Realization and User Experience.*

The output of a predictive system can be shared in a number of ways, including real time dashboards for shop floor personnel, real time alerts and reporting, mission critical dashboards to monitor all shop floor machines, configurable warning and alarm thresholds for potential drift in process parameters, and reports summarizing production activity at periodic intervals, whether by hour, shift or day. See Figure 3.

Ultimately, this manufacturer's facility saw a reduction in scrap rate of one percent—which may not sound like much but this "power of 1%" translated to $250,000 in annual savings and payback on the entire investment in under 12 months. The customer is now scaling the solution across multiple plants.

Predictive quality is just one way data analytics can improve production in the Smart Factory—or your factory.

Key Takeaways:

1. Predictive quality solutions aim to detect, diagnose, and predict potential deviations in critical process parameters that impact the quality of the final product.
2. Predictive quality solutions enable manufacturers to identify issues before they occur, improve quality, optimize process, minimize scrap, reduce rework, and avoid lost production time.
3. Predicting and preventing flaws is a better solution than merely detecting them after they occur through manual or automated inspection.
4. Algorithm input data includes expert domain knowledge, historic product quality data, and the application-dependent availability of key signals in the production process. Output can take various forms including dashboards, warning/alarms and periodic reports to make the data actionable.
5. Reducing scrap by 1% at a mid-size castings manufacturer, ultimately led to a $250K per year savings and payback on their entire investment in under 12 months. Predictive quality is a scalable solution.

About the Author

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P: (920) 550-2333
F: (920) 550-2334
www.dieprocesscontrol.com

Dynamo Inc 116

7-107 Kyoei Street
Seto, Aichi 489-0984,
Japan
P: +81 561 88 1071
F: +81 561 88 1072

Dynamo is the world's leading manufacturer of jet-cooled pins and die components for the High Pressure Die Cast Industry

- Core pins, bushings, spreaders, inserts, bore cores, water jackets, spline cores
- 3D Printing services of inserts in H-13 steel
- We offer a large selection of steels and surface treatments
- We manufacture high quality products to meet our customers' most stringent requirements at a competitive price

ELLWOOD Specialty Steel 104

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

EKK, Inc. 134

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

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

Fisa North America Inc. 129

260 Stanley St.
Elk Grove Village, IL 60007
United States
P: (847) 299-8400
F: (847) 299-8440
www.fisa.com

For 40 plus years now, Fisa has been supplying ultrasonic die cleaning machines to high- and low-pressure casting operations. Ultrasonic cleaning provides the benefits of a labor free cleaning process and more importantly, it is never abrasive to the tooling/die surface. Our cleaning process can remove oil/grease, oxides and even Aluminum or Zinc soldering/flash in as little as 30 minutes.

We're always looking forward to tackling the next die cleaning project.

Flow Science 338

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

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

FONDAREX SA 229

Route Industrielle 13
St-Legier Vaud, 1806,
Switzerland
P: +41 21 943 00 00
F: +41 21 943 00 01
www.fondarex.com

Vacuum Technology plays a key role in the production of high quality, safety and complex parts. From the origin of a traditional foundry, Fondarex SA is offering an innovative range of vacuum systems and has evolved successfully into the Industry 4.0 standards. Fondarex Vacuum Technology enables in High Pressure Diecasting a continuous process control, complete data analysis and statistical evaluations. Fondarex SA can guarantee high quality, stable, efficient, cost effective and sustainable production for everybody!

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Michigan City, IN 46360-7757
United States
P: (219) 874-2812
www.frechusa.com

Godfrey & Wing	**102**

220 Campus Drive
Aurora, OH 44202
United States
P: (330) 562-1440
www.godfreywing.com

Hill and Griffith Co	**322**

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

HTS International Corporation	**329**

123 Center Park Dr
Ste 233
Knoxville, TN 37922
United States
P: (865) 410-8880
www.htsintl.com

IECI SRL	**223**

30 Chapin Road, Unit 1
Pine Brook, NJ 07058-9392
United States
P: 00390306850370
F: 00390306850511
www.iecionline.com

IECI, leading company in the field of temperature control of dies. The organization was born in 1972 in Brescia (Italy); its main products are temperature control units. However, IECI can also offer core-cooling systems, quenching tanks and connection plants. In a nutshell: a thermal solution for every part of the process.

Inductotherm Corp.	**309**

10 Indel Ave
Po Box 157
Rancocas, NJ 08073
United States
P: (609) 267-9000
F: (609) 267-3537
www.inductotherm.com

International Mold Steel	**327**

1155 Victory Place
Hebron, KY 41048
United States
P: (859) 342-6000
F: (859) 342-6006
www.imsteel.com

J&S Chemical Corp	**228**

170 N Industrial Way
Canton, GA 30115-8217
United States
P: (770) 720-8100
F: (770) 720-8109
www.jschemical.com

USA-based J&S Chemical is a leading manufacturer of specialty chemicals for the die casting foundry and metalworking industries with sister companies in China, Mexico, and S. Korea. In addition, they have sales, service, and warehousing in over 28 other countries. J&S Chemical's business philosophy is to create value for their customers by developing high quality, high performing, value added products. Substantial investment in R&D as well as working closely with their customers is driving new product developments. Many of their brands are product leaders in their industry such as, TurboCast® (die release agents), ShotBeads® (solid plunger lubricants) and TurboCut® (metalworking fluids).

Midland Technologies, Inc	**113**

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

Midland Technologies designs and manufactures chill blocks, jet coolers and custom machined products for the high pressure die casting industry at our facility in Minnesota. We also offer our new patented Vac-Alert system, which measures the vacuum level inside the die cavity during the casting process. In addition, we sell, service and support jet cooling machines, immersion heaters and furnaces in North America, which are designed and manufactured by Lethiguel, our parent company based in Lyon, France.

OEE Companies 231

3855 Village Center Drive #336
Saint Paul, MN 55127
United States
P: (612) 440-5714
www.oeecompanies.com

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

Progressive Components 335

235 Industrial Drive
Wauconda, IL 60084
United States
P: (800) 269-6653
F: (847)487-1027
www.procomps.com

Prolong Surface Technologies 315

3840 Ohio Ave
Saint Charles, IL 60174
United States
P: (630) 762-6500
www.solvenite.com

Prolong Surface Technologies is the exclusive provider of SOLVENITE & MAXXSHOT for Die Cast Tooling. Prolong's treatments and coatings are proven to increase Die-Life. Tools run longer, require less die lube and Maintenance, saving you time and money! Owned and Operated by Die Cast Experts who understand how to handle and process precision tooling. Any block size, Fastest turnaround. SOLVENITE & MAXXSHOT fight Heat Check, Solder & Washout. Increase Shot Count and Die-Life with Prolong!

Pyrotek Inc 122

705 West 1st Ave
Spokane, WA 99201
United States
P: (866) 797-6835
www.pyrotek.com

Pyrotek's foundry team offers process and product solutions designed to increase metal and casting quality, improve process efficiency, reduce energy and replacement costs and optimize performance. Pyrotek's fully engineered systems include: Melt circulation and recovery systems, Molten metal pumps, Transport ladles and launders, Rotary degassing and flux-injection equipment, Degassing consumables, Holding furnace refractory relining, and Underheated immersion furnaces

Backed by global research and development, Pyrotek is equipped to provide die casters with comprehensive and customized solutions.

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One Quaker Park
Conshohocken, PA 19428-2380
United States
P: (610) 832-4000
www.quakerchem.com

With a comprehensive product range and unrivalled process expertise and experience, Quaker Houghton provides the complete solution to improving your die casting performance.

We offer the ultimate choice of best-in-class die casting lubricants and process fluids, application systems and support services which can be customized precisely to your process needs, solving your challenges and delivering improved quality and productivity, lower total cost of ownership and exceptional environmental performance. Find out more at quakerhoughton.com/product-lines/die-casting.

Regloplas Corp 208

1088 Miners Rd
Saint Joseph, MI 49085-9625
United States
P: (269) 428-1100
F: (269) 428-1155
regloplasusa.com

Regloplas Corporation is a manufacturer of cutting-edge Temperature Control Devices and Systems for the Die Cast Industry. With over 50 years of experience, we have a solution for your process requirements.Our Sales, Service, Parts and Tech Center is centrally located in St. Joseph, MI. With a complete line of accessories, we can supply a quick and affordable installation.

Ryoei USA Inc 313

8545 Challenger Dr
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P: (317) 912-4498
F: (317) 912-4168
www.ryoei-usa.com

With RYOEI's EcoShot® spray system, die casters can achieve up to 20+% reduction in cycle time, 95% reduction in die lube, and 90% reduction in air blow time while minimizing airborne lubricant, improving environmental conditions, and eliminating the need for ventilation hoods. Optimize your cycle time, scrap rates, die life, and part quality with our proprietary hardware and simulation. We also provide ancillary equipment including ladling, extracting, laser marking, conveyor systems, inspection, and more.

SAPP Inc 239

600 S Kyle St
Edinburgh, IN 46124
United States
P: 00393348108947
www.sappgroup.com

Shibaura Machine Company, America 238

755 Greenleaf Ave
Elk Grove Village, IL 60007
United States
P: (847) 709-7409
www.shibaura-machine.com

Shibaura Machine established in 1875 (FKA Toshiba Machine) is a leading global manufacturer of injection molding, machine tools, and die casting machines.

In 2020, we returning to our roots with the reintroduction of our original "Shibaura" name.

At our state-of-the-art manufacturing facilities, we produce all components to the superb precision and impressive infrastructure of our machines.

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Sinto America 203

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P: (517) 371-2460
F: (517) 371-4930
www.sintoamerica.com

Sinto Surface Treatment, a Sinto America company, is a full line shot blasting, shot peening and mass finishing machine supplier for the cleaning, deburring and burnishing of aluminum die cast parts. Sinto offers traditional wire mesh belt, spinner hangers, blast tables and drum machines. Our DZB line of machines are specifically designed to clean aluminum castings. Uniquely Sinto, the D-SCC, D-Check and D-Flow processes improve die surface quality for extending die life. Visit Sinto at booth #203.

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Rosemount, MN 55068-2510
United States
P: (612) 480-6124
www.spectroalloys.com

Swiss Steel USA, Inc. 312

365 Village Dr
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United States
P: (800) 323-1233
swisssteelgroup.com

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

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P: (514) 694-4110
F: (514) 694-2634
www.techmire.com

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F: (937) 253-2306
www.theschaefergroup.com

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3431 Wise Way
The Villages, FL 32163
United States
P: (614) 551-1225

Uddeholm USA 222

2505 Millennium Drive
Elgin, IL 60124
United States
P: 800-638-2520
www.uddeholm.com/us

Uddeholm is the world's leading manufacturer of tool steel. Our goal is to provide a die cast tooling solution that ensures quality for our customer. We offer the best of two worlds - Uddeholm tool steel and PVD coatings from voestalpine eifeler Coatings Technology. Tool Steel: Uddeholm Dievar® (≥18.4 ft-lbs. toughness value), Uddeholm Orvar Supreme® (>=12 ft-lbs. toughness value). PVD Coatings: Duplex-TIGRAL®, Additive Manufacturing: Powders and 3D Printing

Visi-Trak Worldwide LLC 212

2595 Meadowvale Blvd
Mississauga, ON L5N 7Y3
Canada
P: (905) 812-9440
F: (905) 812-8658

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

Voestalpine Additive Manufacturing Centre Ltd. 117

2595 Meadowvale Blvd
Mississauga, ON L5N 7Y3
Canada
P: (905) 812-9440
F: (905) 812-8658
www.voestalpine.com/highperformancemetals/canada/en/services/additive-manufacturing

vAMC offer One-Stop-Shop for Additive Manufacturing Services in Die Cast Tooling. Working with our customers to provide tailored solutions, we follow our approach of Optimized Design, Powder and Printing, in combination with value-added services such as Heat Treatment & Coating. We combine state-of-the-art AM know-how and extensive Die Casting experience Providing best solution for tooling needs.
Service: Conformal Cooling design, process simulation & consultation, turn-key tooling manufacturer & spare management.

Voestalpine Eifeler Coatings Technology 123

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United States
P: (630) 587-1220
F: (630) 587-1230
www.eifeler.com/northamerica

voestalpine eifeler Coatings offer PVD coating Services to the North American Die Casting Industry. Our Duplex-TIGRAL® coating, with its high hot hardness characteristics, is a great solution for wear protection, as well as, both chemical resistance and oxidation. Additionally, when subjected to shear loads, the nanostructure properties help to prevent crack propagation, resulting in more production and less downtime.
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United States
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F: (740) 382-2008
www.yizumi-hpm.com

NADCA Welcomes Its Newest Corporate Members

Briggs and Stratton Corp.

Poplar Bluff Engine Plant
731 Highway 142
Poplar Bluff, MO 63901-8602

Statesboro Engine Plant
7251 Zell Miller Pkwy
Statesboro, GA 30458-3487

Briggs & Stratton, headquartered in Milwaukee, Wisconsin, is focused on providing power to get work done and make people's lives better. Briggs & Stratton is the world's largest producer of gasoline engines for outdoor power equipment, and is a leading designer, manufacturer and marketer of power generation, pressure washers, lawn and garden, turf care and job site products through its brands. Briggs & Stratton products are designed, manufactured, marketed and serviced in over 100 countries on six continents. The company's die casting operations are based in Poplar Bluff, MO and Statesboro, GA. For additional information, please visit www.basco.com and www.briggsandstratton.com.

Die Pro LLC

315 Forest Ave
Sheboygan Falls, WI 53085
920.550.2333

Die casting is highly dependent on controlling thermal properties in the die. Improper or inadequate cooling leads to defects such as shrink porosity, cracks, leaks and soldering. Costly defects lead to increased production time and customer dissatisfaction. Die Pro, headquartered in Sheboygan Falls, WI, has developed state-of-the-art high-pressure water-cooling systems trade named "CoreCool" to reduce and eliminate these defects. By providing cooling to troublesome areas, process cycle time is significantly reduced and die life extended, thus improving the bottom line.

Die Pro also offers a complete line of Water Thermal Control Units, WTCU's, to control conventional water-cooling lines.

The company offers a complete solution starting with flow simulation review to die component design. Die Pro will work with your engineers to identify, then develop proper cooling channels to address hot spots and thermally balance a customer's dies. Once the tooling is completed, a repeatable process that reduces defects is developed. To learn more, visit www.die-pro.com.

West Michigan Tool & Die

1007 Nickerson Ave
Benton Harbor, MI 49022-6117
269.925.0900

Founded in 1978, West Michigan Tool & Die has established a reputation for innovative design, quality and integrity of molds produced. Our capabilities include:

- ► Prototype / production tooling and parts, tooling repair and upgrades for machines up to 1000 tons
- ► Custom, low volume and high volume machining
- ► Die cast parts
- ► Misc. services

- Operate flexible shifts out of a 30,000 sq. ft ISO 9001:2015 certified QMS (recertified January 2022) facility with 12 tool & die/machining production cells.
- WMTD serves the automotive, consumer, industrial, medical, power tool and (indirectly) defense/aerospace industries via OEM and indirect relationships achieving 99.9% acceptance of products.

Learn more at www.wmtd.com.

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Celaya, Mexico

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L

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Meridian Lightweight Technologies Inc. - GTC
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Quality Metal Finishing Co.
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Sparta, IL

Spartan Light Metal Products LLC
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Spartan Light Metal Products -Corporate Office
Hannibal, MO

Spartan Light Metal Products LLC
Mexico, MO

STRATTEC Component Solutions
Milwaukee, WI

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Stellantis - Kokomo Casting Plant
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Holland, MI

C

Cal-Miser Aluminum Systems Inc.
Rock Island, IL

Canmet MATERIALS - Natural Resources Canada
Hamilton, ON, Canada

Castec Corporation
Indianapolis, IN

Castool Tooling Systems
Uxbridge, ON, Canada

Chem-Trend Ltd. Partnership
Howell, MI

Colosio Die-Casting Machines & Accessories
Dayton, 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

Delaware Dynamics LLC
Muncie, IN

Die Cast Press Manufacturing Co.
Paw Paw, MI

Die-Pro LLC *
Sheboygan Falls, WI

DieTech & Engineering Inc.
Grand Rapids, MI

DISA Group
LaGrange, GA

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

Exco Engineering USA
Toledo, OH

F

Fisa North America Inc.
Elk Grove Village, IL

Flow Science
Santa Fe, NM

FONDAREX SA
Kokomo, IN

Foseco
Brook Park, OH

Frech USA Inc.
Michigan City, IN

Fremar Industries
Brunswick, OH

FRISA Metals LLC
Spring, TX

G

Godfrey & Wing Inc.
Aurora, OH

H

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

Hitachi Metals America Ltd.
Arlington Heights, IL

HTS International Corporation
Knoxville, TN

I

IDRA North America
Kokomo, IN

IECI Srl *
Pine Brook, NJ

Imperial Zinc Corp.
Chicago, IL

Inductotherm Corp.
Rancocas, NJ

Industrial Innovations
Grandville, MI

Intuit Inc
Mountain View, CA

IoTco, LLC*
Cincinnati, OH

Italpresse Gauss
Lagrange, GA

J

J&S Chemical Corp.
Canton, GA

K

Kind Specialty Alloys LLC
Youngstown, OH

L

LaFrance Manufacturing Co.
Maryland Heights, MO

LK Machinery Inc.
Edinburgh, IN

Lethiguel SAS
Richmond Hill, ON, Canada

Lincoln Electric Automation, Columbus RIMROCK® Die Casting Products
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

MagReTech, LLC
Bellevue, OH

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

Norican Group
LaGrange, GA

O

OEE Companies
North Oaks, MN

Oerlikon Balzers Coating USA
Rock Hill, SC

P

Pascal Engineering
Arlington Heights, IL

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
Lafayette, IN

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 - Division Kopo International
Hazlet, NJ

Sinto America
Grand Ledge, MI

Spectro Alloys Corp.
Rosemount, MN

StrikoWestofen America
Kalamazoo, MI

Superior Aluminum Alloys
New Haven, IN

Swiss Steel Canada, Inc.
Mississauga, ON, Canada

Swiss Steel USA, Inc.
Carol Stream, IL

T

Techmire
Pointe-Claire, QC, Canada

Therm-Tech of Waukesha
Waukesha, WI

Titus Technologies
Bellevue, WA

Tool-Temp US, Inc.
Concord, NC

U

UBE Machinery Inc.
Ann Arbor, MI

Uddeholm USA *
Elgin, IL

Ultraseal America Inc.
Ann Arbor, MI

V

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

West Michigan Tool & Die *
Benton Harbor, MI

Wheelabrator Group
LaGrange, GA

Wheelabrator Group
LaGrange, GA

Wollin USA
Plymouth, MI

Y

YIZUMI-HPM Corp.
Iberia, OH

Yushiro Manufacturing America, Inc.
Shelbyville, IN

YXLON
Hudson, OH

Z

Zitai USA - Die Casting Equipment Group
Highland Park, IL

Chapter News & New Members

Chapter 3 - Michigan

Chapter 3 is pleased to announce the following scholarship award winners for 2022/2023 school year. Thanks to the leadership of our board and our generous supporters and benefactors we have been able to continue to provide increasingly significant scholarships.

***Chapter 3** - Emma Wilkerson receiving her Scholarship Certificate from Bob McClintic, NADCA Chapter 3 Scholarship Chair.*

Emma Wilkerson
Emma is the daughter of Tom and Cindy Wilkerson of ADA, MI. The Wilkerson's' are partners of Wikast, Inc., a Grand Rapids based Aluminum and zinc die casting company.

Emma is a senior at Grand Valley State University where she is finishing her studies in advertising and public relations. Emma is a third time applicant and received a $2,200 scholarship.

On graduating she hopes to join the family business and help it continue to grow and prosper.

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

New Members: *Bryan Belile, Cascade Die Casting Group - Mid-State; Eric Ernvall; Brad Guthrie, BOHLER; Jerry Jones, Michigan Automotive Compressor, Inc.; John A. Koetje, Cascade Die Casting Group – Group Services/Corporate Headquarters; Alan J. Shevela, Aludyne; Rene Silva, Ital-PresseGauss of America; Robert Young, Cascade Die Casting Group - Great Lakes*

Chapter 5 - Chicago

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

New Members: *Charles Goldfuss, Kyle Hanen, Girish Yashwant Ramdasi, Tech Mahindra Americas; Frank Carl Rodgers, ORYAN Corp; Nicole Salata; Rachel Sylverne, Acme Alliance, LLC; Alexander Yeverino; Chapter 6 John Hilbert, Jr., PHB Inc., Die Casting Division; Spencer Sorenson*

Chapter 6 - Cleveland

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

Chapter 7 - New York

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

New Members: *Kathryn Bauer, Eastern Alloys Inc.*

Chapter 10 - Ontario

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

Chapter 12 - Wisconsin

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

New Members: *Kurt Achter, Boyd Corporation; William B. Dodge, John Shi, both with Dynacast International, LLC - Germantown Plant; Larry Kubisiak, Kubi Global Solutions LLC*

Chapter 14 - S. Ohio

Our regularly scheduled NADCA Monthly meeting for February was held on Tuesday March 8th at 6PM at one of our favorite Venue's "Smith's Boat House" in Troy OH. Beau Glim – Project Manager for NADCA presented on the "State of the Industry".

Chapter 14 *– Beau Glim presents to those in attendance.*

The crowd was smallish due in part to other members attending the NADCA National Meeting in Key West. Beau did a great job explaining the year gone by and what to expect in the year ahead. Two die casting companies were represented, Apex Die Casting and Fort Recovery Industries. Good conversation was held and all in attendance contributed.

Chapter 14 *– The group listening intently to Beau's presentation.*

Beau was plugged into the audience and participated in all of our conversations regarding our own pieces of the "Die Casting Manufacturing pie".

Chapter 14 *– The group asks Beau questions over food & drinks.*

Future Meetings:

- April 12th- Godfrey & Wing – John Holliday
- May 10th- LK Giga Press Applications – Scott Burkett
- June 2nd- Golf Outing at Pipestone GC

Watch for upcoming mailings for details on these events.

Your Chapter 14 executive staff looks forward to working with our members in 2022 and beyond. Please feel free to contact me or any of our executive team with your ideas on how we can become an even more effective chapter for you, your workmates and your respective companies.

Please visit www.diecasting.org and click on Chapters under the Membership tab for contact information.

New Members: *Jay Knapke*

Chapter 15 - Southeastern

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

New Members: *Brian Adkins, Sean Regan, both with Dynacast International, LLC; Jon Clifford, Marvin Hensley, both with Norican Group; Robert C. DeNeff, TOYO Machine America, LLC; Sidney Foreman, DISA Group; Tim McLaughlin, Wheelabrator Group; Erik Messick, StrikoWestofen America; Ken New, Kason Industries, Inc.*

Chapter 16 - Minnesota

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

New Members: *Kristi Heisinger, Northern Iowa Die Casting Inc.*

Chapter 17 - St. Louis

Chapter 17 is storming back after the two-plus year hiatus created by Covid-19. We certainly hope that everyone has stayed safe and sane. We will kickoff 2022 events by hosting National President Steve Udvardy for a State of the Industry presentation on Tuesday, May 10 at the Holiday Inn Six Flags. Our annual Golf Outing will be on Friday, August 5, again at The Links of Dardenne. Suppliers Night will be on Tuesday, October 11, also at the Holiday Inn Six Flags.

Additionally, Educational Seminars will be offered in conjunction with the May 10 and October 11 events. The education classes will be Engineering Dies and Thermal Control.

The Chapter 17 Board of Directors is thrilled to offer this exciting lineup of chapter activities in the coming months and encourages you to join in the fun and fellowship with other Die Casting industry professionals. Please watch your email for details/sign-up information as events draw near.

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

New Members: *Kory Behnken; Caleb Schwenk*

Chapter 25 - Indiana

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

New Members: *Alexandra Cerrone-Allsup, Thyssenkrupp Presta North America, LLC; Sagar Kota, Rane Light Metal Castings Inc.; Megan Worley, Nissan Powertrain Decherd*

Chapter 30 - Los Angeles

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

New Members: *Brad Hicks, Dynacast International, LLC - Lake Forest Plant; Leigh Walczak, Intuit Inc.*

Chapter 39 - SW Michigan

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

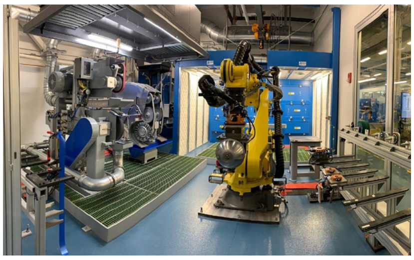
New Members: *Rodney Hardesty, Titus Group / Titus Technologies; Patrick McCrevan, B&L Information Systems Inc.*

International Members: *Jorge Alberto Aguilar Navarro, David Gloria, Mehdi Rahimian, all with Martinrea Honsel Mexico S.A. De C.V; Simon De La Rosa De La Cruz; Sang Woo Lee, KOREAD DIECASTING SOCIETY; Karen Siller*

New Products, Services & Solutions

New Norton Abrasive Process Solutions Program

Equipped To Solve Wide Range of Unique Grinding and Finishing Challenges



Worcester, MA – Saint-Gobain Abrasives, one of the world's largest abrasives manufacturers, has introduced its new Norton Abrasive Process Solutions (APS) Program which was established to help customers determine the optimal grinding or finishing solution for the application at hand, ranging from simple to complex, off-hand or automated, and for metal fabrication, production grinding and virtually any abrasives operation. The APS Program draws upon the vast knowledge of the Norton team along with access to 30 different machines, and a new state-of-the-art APS Robotic Automation Cell, which is at the core of the new APS Program located at the Higgins Grinding Technology Center in Northborough, Massachusetts (U.S.A.). The APS team provides abrasive process development, optimization, automation and in-house testing. APS services encompass the testing and optimization of new abrasives, improving quality and/ or throughput, and trying entirely new and customized processes.

The new APS Program is positioned to be an extension of the customer, where tests can be conducted so that customers do not have to re-assign limited in-house resources and pause their own production. "At a time when North American manufacturers need to deliver high-quality products faster, while stressed with labor shortages, we are thrilled to announce the new APS Program which can relieve some of their burden," said Tony Landes, APS Lead, Norton | Saint-Gobain Abrasives. "The APS Program is uniquely setup to deliver a comprehensive array of services, including a quick response and short turnaround. The APS team can provide the broadest array of grinding and finishing process development solutions for any type of abrasive."

For more information, please visit https://nortonsga.us/aps.

Industry News

LINAMAR ACQUIRES PARTNER'S INTEREST IN GF LINAMAR JOINT VENTURE CASTING FACILITY

Gueloh, Canada - Linamar Corporation announced an agreement with GF Casting Solutions to acquire their 50% interest in their Joint Venture, GF Linamar LLC, located in Mills River, North Carolina. GF Casting Solutions is a division of Georg Fischer AG. The two parties originally formed the joint venture in 2015. Following this announcement, Linamar will assume 100% ownership and operational control of the business. The agreement has been executed and given there are no pre-closing steps or required regulatory approvals, the transaction is expected to close April 1st, 2022.

GF Linamar LLC (GFL) is a North American joint venture between Linamar Corporation and GF Casting Solutions. The JV combined leading expertise in high pressure die casting and machining to provide lightweight solutions for automotive and commercial vehicle customers. GFL manufactures structural and powertrain components in aluminum and magnesium.

"We are very pleased to complete this transaction with GF," said Linda Hasenfratz, Linamar's Executive Chair & CEO. "GF has been an excellent strategic partner; however, we view this ownership change as key to securing our long-term growth plan in Lightweight Structural Castings. Increasing our Structural content per vehicle is a key strategic priority for Linamar in reducing our business concentration in vehicle powertrains and increasing our content in electrified vehicles where lightweighting is so critical. Acquiring full control over this facility will enable us to be more agile and pursue further market opportunities."

"Cast light metal structural components are a strategic priority in our automotive business and the future of electrified mobility," added Jim Jarrell, Linamar's President and COO. "The book of business that GF Linamar secured demonstrates the strong customer demand for these products. Going forward, our new management structure will enable us to use one operational system to better focus on launching new business in the near-term and fully achieving our Lightweight Structural Strategy in the long-term." In the interim, GF will continue to support Linamar and the customer's requirements throughout this transitionary phase.

Please visit www.linamar.com for more information.

GM HONORS TOP GLOBAL SUPPLIERS WITH 30TH ANNUAL SUPPLIER OF THE YEAR AWARDS

Detroit, MI - General Motors celebrated its top global suppliers in March at its 30th annual Supplier of the Year awards ceremony held in Phoenix, Arizona. Recipients of the Supplier of the Year recognition included 134 suppliers representing 16 countries. Additionally, 31 suppliers from 12 countries earned GM's Overdrive Award.

The Supplier of the Year award recognizes distinguished global suppliers that exceed GM's requirements, in turn providing GM customers with innovative technologies and among the highest quality in the automotive industry.

First presented in 2012, the Overdrive Award is a distinction reserved for suppliers who display outstanding achievement across the Global Purchasing and Supply Chain organization's key priorities. They include sustainability, innovation, relationships, total enterprise cost, launch excellence and safety.

"This year's Supplier of the Year event was special not only because it's the 30th anniversary of the program, but because it provided us with the opportunity to recognize our suppliers for persevering through one of the most challenging years the industry has ever faced," said Shilpan Amin, GM vice president, Global Purchasing and Supply Chain. "These top suppliers showed resilience and reinforced their commitment to pursuing sustainability and innovation. Through our strong relationships and collaboration, GM and our suppliers are poised to build a brighter future for generations to come."

To view the list of winners visit, https://tinyurl.com/2ks9f7wr.

JIANGZHONG TRUSTS TF TECHNOLOGY FROM ITALPRESSEGAUSS TO INCREASE CASTING CAPACITY

Manchester, England - Nantong Jiangzhong Photoelectricity Co., Ltd. ("Jiangzhong") has ordered two new die casting machines from ItalPresseGauss to increase casting capacity and extend its position as the leading producer of die-cast aluminium alloy parts for lifts and escalators in China.

The TF 2800 High Pressure Die Casting (HPDC) machines, to be installed at Jiangzhong's facility in Jiangsu Province later this year, reflect the focus of Nantong Jiangzhong on toggle free two platen technology as the future of modern die casting on which IPG has very long experience. Last year, the company become the first manufacturer in China to commission delivery of ItalPresseGauss' TF5700 High Pressure Die Casting (HPDC) machine – a toggle free giant ideally equipped to support Jiangzhong in producing larger parts for its traditional escalator market, and for servicing new market opportunities for structural castings.

INTERNATIONAL ZINC DIE CASTING AWARD 2022

Brussels, Belgium - To be awarded in today's economy, you must meet — and even exceed — expectations. In a competitive global market, customers take notice of the best. International Zinc Association (IZA) knows that rewarding improves the competitor.

In the context of the Fifth International Zinc Diecasting Conference 2022, which will be held in Koblenz, Germany, 5-7 October 2022, IZA organizes an International Zinc Diecasting Competition. It recognizes, rewards and publicizes the outstanding casting designs of the year. Each entry will be judged on its design, quality, cost savings, ingenuity and innovation. Awarded die casters will be asked to present their work at the Conference in Koblenz, as speaker within the conference program. It will be their opportunity to highlight the main characteristics of the winning casting and explain the reasons and benefits for selecting zinc alloys for the specific part presented.

Participating and being awarded is one of the best ways to gain visibility with leading decision-makers.

This award will be organized by the IZA Zinc Diecasting Steering Committee. The award is supported by International Zinc Association, Initiative Zink (D), Experience Zamak (F), Assofond (It) and Tedfun (E).

For more information visit: www.diecasting.org/docs/zinc.pdf.

NORTHERN IOWA DIE CASTING ANNOUNCES NEW OWNER

Lake Park, IA - Per the Dickerson County News, Northern Iowa Die Casting, Inc., a Lake Park and Spirit Lake based company which produces die cast alloy components, recently announced a transition in ownership.

The business' new owner will be Tony Powe, managing director of Epoch Capital Management.

CLASSIFIEDS

Classified advertisements are accepted for publication in *DIE CASTING ENGINEER* for sale of equipment and notice of services and employment available or wanted. The net rate is $60 per inch or fraction thereof (for NADCA members, individual and corporate) and $70 per inch for all others, in the $2^{1}/_{8}$ in. wide column, payable with order. Please make remittance payable to *DIE CASTING ENGINEER*, and send with copy to: NADCA, 3250 N. Arlington Heights Rd., Ste. 101, Arlington Heights, IL 60004. Contact Athena Catlett at 847.808.3153 or email catlett@diecasting.org.

HELP WANTED

MANUFACTURING REPRESENTATIVES

Northeastern Ohio Die caster looking for manufacturing representatives, most territories are open in the United States.

We are looking for mostly non-automotive. If interested, please call 440-309-2080 and leave a message.

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E-mail: **RMcClintic@DrDieCast.com**
Web: **www.DrDieCast.com**

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FOR SALE

FOUNDRY MELTER:
2004 LINDBERG/MPH 62-ARP-6000-SP Melter (Capacity = 8,000 lbs/hr)

High Pressure Die Cast Machines:
1998-2005 BUHLER 800T Die Cast Machine (4); 2002-2006 BUHLER 1,800T Die Cast Machine (5); 2001/2005 BUHLER 2,200T Die Cast Machine (2);

Die Cast Ancillary Equipment:
Dosing/Holding Furnace: STRIKO WESTOFEN Dosing Furnace (11)
Trim Press: PARMERIT 50T Trim Press (5); MID-WEST 50T Trim Press (3); TECHNOPRESS 50T Trim Press (2); REIS 50T Trim Press (1)
Spray Robot: ABB IRB 6400S/2.9-120 (4); WOLLIN GMBH 2-Axis Die Spraying System (7)
Extractor Robot: ABB IRB4400/45 (2); ABB IRB IRB 6400/2.8-150&175 (4); ABB IRB 6650/3.2-125 (2)
Quench Tank (11)

Horizontal CNC Machine Centers:
2002 MAKINO A51 (1); 2007 TOYODA FH450S (7); 2001 MORI SEIKI SH403 (1); 2007 MORI SEIKI NH4000 (4); 2010 MORI SEIKI NH5000 (4); 2011 MORI SEIKI NHX4000 (4); 2012 MORI SEIKI NHX5000 (3); 2008 TOYODA FH550S (3); 2014 ENSHU GE460H (14); 2014 ENSHU GE580H (2); 2016 ENSHU GE580H (3)

Vertical CNC Machine Centers:
2010 MAZAK VCN 510C-II (2); 2004 MORI SEIKI NV 5000 (2); 1991 ENSHU 800V (1); 2012 OKUMA M560-V

CNC Boring Machine:
2001 TOS Varnsdorf WH105CNC (1)

Manual Milling Machines:
FIRST LC 1 1/2VS Manual Milling Machine (3); 1989/1991 KAFO KF-VBM-AL (4V) Semi-Auto Milling Machine (2)

Radial Drill Machine:
200 MAS V050/1250S Radial Drilling Machine (2)

EDM Machines:
1998 SURE FIRST Sinker EDM (2); SODICK AQ535L Wire EDM (1)

Surface Grinder:
CHEVALIER FSG-618M Surface Grinder (3); 2007 CHEVALIER FSG-1224AD Automatic Surface Grinder (2)

CNC Gear Shaping Machines:
2005 WAHLI LAMBERT W6140 CNC Gear Shaping Machine (2); 2006-2008 MITSUBISHI SE25A CNC Gear Shaping Machine (5); 2013 MITSUBISHI SE25A CNC Gear Shaping Machine (2)
CNC Internal Grinders:
2006 STUDER S151 CNC Internal Grinder (High Freq Drive Spindle) (2)

CMMs:
MITUTOYO Crysta (2); MITUTOYO Mach 403 (2); BROWN & SHARPE GLOBAL STATUS (1); BROWN & SHARPE XCEL (1); 2003-2004 ZEISS CONTURA (2); 2013 ZEISS CONTURA; 2016 ZEISS CONTURA (2); 2014 ZEISS ACURA (2)

Washers:
2005 PROCECO ICW 18-4HPW-BO In-process Cleaning and Deburring System (1) Hammelman HP Pump 5,000 psi, NLB 1300E SPINJET Asm; 2005 PROCECO MBCW 24×16-E-4W-2R-BO/CD-SS (1) Modular Belt Conveyor Washer (500 PSI); 2007 RANSOHOFF General Purpose Pass-Through Washer (1); 2005 RANSOHOFF LEANVEYOR General Purpose Pass-Through Washer (1); 2005 RANSOHOFF Deburring Washer 5,000 psi, NLB SPINJET Asm (1); 2014 BRICAN 1,000 psi Pass-Through Washer with Walking Beam (1); 2016 RANSOHOFF LV-24 General Purpose Pass-Through Washer (1)

Conveyors:
2007 Flexus Motorized Parts Conveyor (1); 2010 Cirrus Overhead Parts Conveyor (1); 2014 Magnum Overhead Parts Conveyor (1); 2015 Pacline Overhead Parts Conveyor (1)

Facility Equipment:
KAESER DSD200 200HP Air Compressor (5); KAESER TG301E/TH301E Air Dryer (5); RINGWOOD Waste Water Treatment System w/ Holding Tank (1); CNG Canada MCH14-CNG Natural Gass Compressor (4); AVERY WEIGHTRONIX Outside Truck Scale (1);

Overhead Cranes:
KONECRANES 40/20T Crane w/ Hoists; 30/10T CRANE w/ Hoists (2); 40T Crane w/ Hoist; 40/10T Crane w/ Hoists; 10/10T Crane w/ Hoist (2); 2T Crane w/ Hoist; CANADIAN CRANE 5T Crane w/ Hoist

CONTACT
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