Dedicated to Diecasting Industry

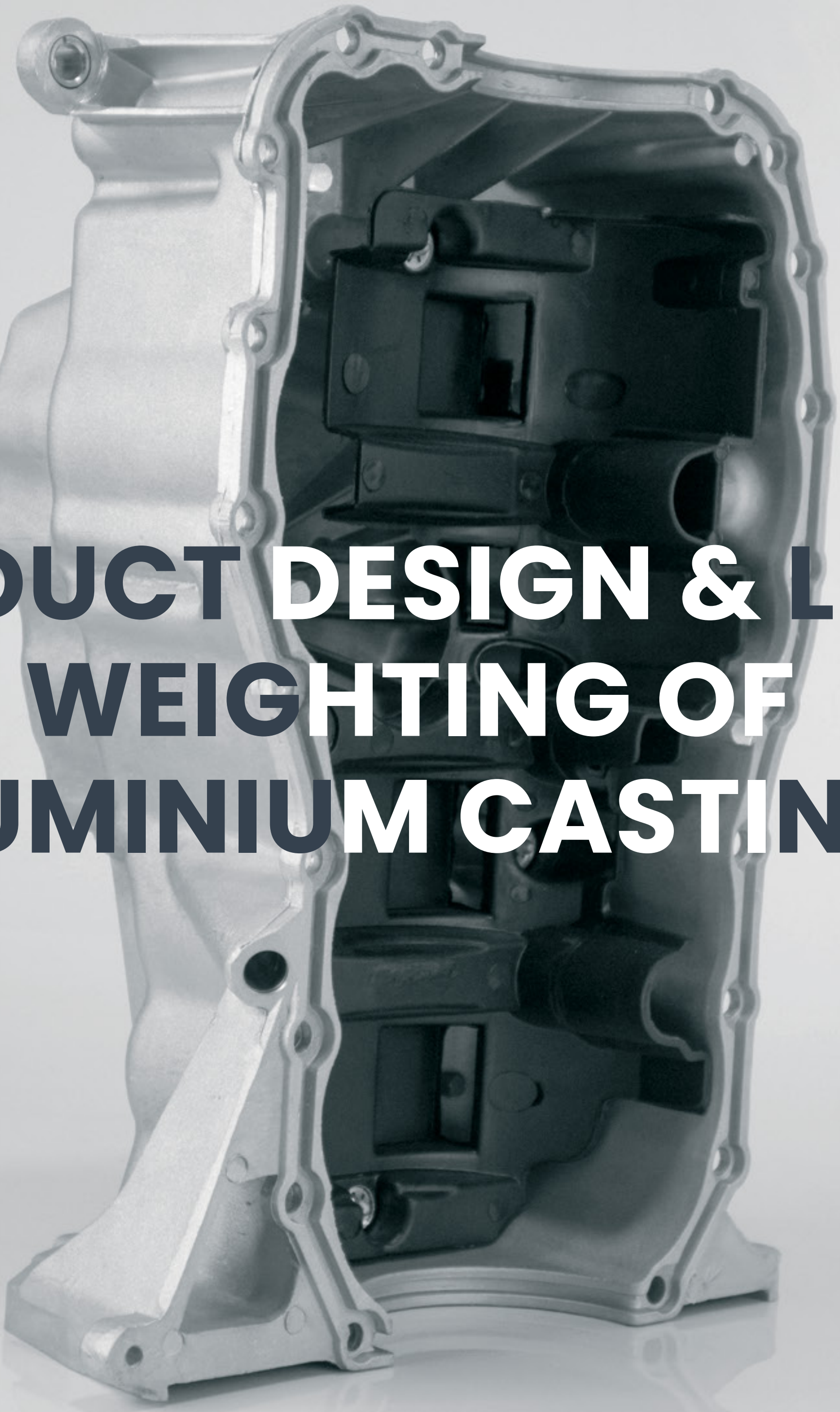
ALUCAST®

ALUCAST® PARTNER IN PROGRESS FOR ALUMINIUM AND DIE CASTING INDUSTRY

Official Journal of Aluminium Casters' Association

Issue 153 - April 2025

www.alucast.co.in



PRODUCT DESIGN & LIGHT WEIGHTING OF ALUMINIUM CASTINGS

Inside

IMPRINT

EDITOR

N. Ganeshan | natganesan72@gmail.com

EDITORIAL COMMITTEE

B. B. Lohiya | bblohiya@compaxindia.com

Rajesh Aggarwal | aggarwalrajesh 1972@gmail.com

TVL Narasimha Rao | tvl.narasimharao@sundaramclayton.com

Vidhi Daryanani | vidhi.daryanani@alucast.co.in

Veena Upadhye | alucastindia@alucast.co.in

PUBLISHER

Aluminium Casters' Association (ALUCAST)

ALUCAST Membership Status (as on 31.03.2025)

Zonal Centre	Corporate	SSI	Individual	Total Members
Bangalore	8	30	9	**47**
Chennai	8	22	9	**39**
Coimbatore	1	8	2	**11**
Delhi	20	47	12	**79**
Others	8	30	3	**41**
Overseas	6	-	-	**6**
Pune	20	73	25	**118**
TOTAL	**71**	**210**	**60**	**341**

INDEX

PARTNER IN PROGRESS FOR ALUMINIUM AND DIE CASTING INDUSTRY

www.alucast.co.in

N. Ganeshan
Editor

Dear Readers,

Lightweighting of Aluminium cast components plays a critical role in various industries, especially in automotive and aerospace. Designing of aluminium cast components involves several important features to ensure that the final product is efficient, functional, durable, and cost-effective.

In the automobile industry, lighter vehicles consume less fuel because they require less energy to move. Reducing the weight of aluminium cast components in vehicles contributes directly to improving fuel efficiency and reducing carbon emissions. Likewise in aerospace, every saved kilogram reduces fuel consumption, which can lead to significant cost savings over the lifetime of an aircraft. This is crucial for both commercial aviation and military applications. Lightweight components improve the vehicle's overall performance, including acceleration and braking. This is particularly relevant for sports cars, electric vehicles, and high-performance machines. Further, reduced weight leads to better handling and agility, as lighter components exert less strain on the suspension system and improve stability.

Using aluminium, a relatively lightweight yet strong material, can be more efficient as compared to other heavier metals like steel. Additionally, casting aluminium components can reduce machining time and material waste. Aluminium is highly recyclable, making it a more sustainable choice compared to other materials. Using aluminium cast components that are lightweight, and recyclable reduces the environmental impact. Lighter components reduce wear and tear on other mechanical parts, potentially extending the lifespan of the product. This leads to fewer repairs and replacements over time. Aluminium alloys can offer superior fatigue resistance, which can be further optimized through lightweighting in casting processes, improving the durability of the component under stress.

Aluminium casting process allows for the production of complex and intricate shapes that would be difficult or expensive to achieve with other materials or manufacturing methods. Lightweighting can be integrated into these complex designs without compromising structural integrity. Reducing weight makes new applications possible, such as more energy-efficient electric vehicles, drones, or space exploration technologies that require lightweight materials. Aluminium casting techniques allow precise manufacturing of lightweight components. The casting process, especially when using methods like High Pressure Die Casting or Low Pressure Die Casting, allows high-quality and repeated production that helps optimize weight reduction while maintaining strength.

The type of aluminium alloy used significantly affects the component's properties such as strength, ductility, corrosion resistance, and machinability. The choice depends on the intended application of the cast part. Many aluminium alloys can be heat-treated to improve their mechanical properties. Consideration should be given to whether heat treatment will be necessary to achieve the desired characteristics in the finished component. Different casting methods such as sand casting, die-casting, permanent mold casting, and investment casting are chosen based on the complexity, size, and tolerance requirements of the component. The chosen process will affect the design, particularly in terms of part geometry and material properties. For complex parts, the inclusion of sand cores in the mould allows internal cavities or passages.

The design of these cores must consider ease of removal and the prevention of defects like sand inclusions. Variations in wall thickness can cause problems such as uneven cooling rates, shrinkage, and internal stresses. A well-designed aluminium cast component should aim for consistent wall thickness, which helps reduce defects and improves casting quality. Some areas of a part may require thinner walls to reduce weight or improve cooling rates. This must be balanced carefully to avoid compromising strength or increasing the risk of casting defects. Ribs are often used to provide strength to the component without increasing weight. They help in preventing warping and improve the load-bearing capacity of the cast part. Sharp corners or transitions in the design can lead to stress concentrations, resulting in cracks or fractures. Designers should aim for radiused corners or fillets to reduce stress and improve strength.

The design must account for the tolerance limits of the casting process. Aluminium castings can achieve varying levels of dimensional accuracy, and it's essential to design with these limits in mind to minimize the need for secondary machining. To ensure that the casting can be easily removed from the mould, draft angles (tapered surfaces) are incorporated into the design. These angles prevent the component from sticking to the mould and reduce the risk of damaging the part during ejection. The surface finish of the casting is important, particularly for aesthetic applications or when components need to fit precisely. The casting design should account for the final surface finish required, whether it's a smooth, polished surface or a more textured finish. The design must ensure that the component has a uniform stress distribution to prevent failure under load. This includes considerations for areas that will experience high-stress concentrations and the integration of reinforcements or thicker sections where needed.

In summary, light weighting of aluminium cast components is essential for achieving greater efficiency, cost savings, and sustainability, while also enabling innovation in product design. These benefits are realized in industries ranging from automotive to aerospace, making aluminium an increasingly popular choice for lightweight, high-performance applications.

***

Product Design Optimization for Good Casting Quality

Rajesh R Aggarwal, Founder and Director
TechSense Engineering Services

INTRODUCTION

In die casting industry, product design of a die casting part plays a vital role in the final product quality. The various factors affecting the manufacturability of a die casting part are:

1. General Casting wall thickness and variation in thickness
2. Material Flow length in the part
3. Critical characteristics and quality requirements of the component

Most of the die casters produce the Aluminum die casting parts to the print i.e. as per customer drawing. The detailed analysis of the product design before developing the HPDC die of the part is not done, which is very crucial to determine the achievable casting quality and satisfy the end customer.

Today, with the available simulation tools and techniques, we can predict the probable casting defects in the parts before we make the die. This along with strong partnership with the end customer can help to optimize the product design and achieve desired quality of the part.

CASTING DEFECTS

Most of the casting defects in High Pressure Die Casting parts are due to:

- the product design related issues
- constraints at the end user to meet the product assembly and functional requirements
- awareness about the manufacturability and production method of the part
- design of feeding system
- thermal balancing of the die

Although some of the defects can be controlled during die design of the part, still majority of the defects remains unresolved due to constraints in die design and lead to high scrap rates on the shop floor. Some of such defects are:

- Leakage from the casting
- Cold shut
- Non filling
- Shrinkage porosity
- Casting Crack
- Surface finish due to soldering

PRODUCT DESIGN OPTIMIZATION

While analyzing the product design of a Die Casting Part, certain guidelines need to be followed in relation to manufacturability of the part thru HPDC process and achieve good casting quality:

1. Draft Analysis of the part as per die construction
2. No sharp edges in the casting, good filleting is required
3. Thickness analysis – no sudden change in cross section
4. Parting line construction as per casting quality and tool design requirements

Most of the OEMs do not involve the Tier 1 suppliers during their initial design stages. During development stage when the supplier suggests some changes to improve the casting quality, they are reluctant to accept the design changes as their product design is freeze. This leads to increased development time, poor quality of the product, dissatisfied customer and more scrap rate at the foundry

Virtual Simulation of HPDC process is used as an effective tool to predict the casting defects due to product design and optimize the product design accordingly. Some of the examples are described in next paragraphs.

Change in part geometry to minimize the sudden change in cross section In this example the shape of a mounting boss is changed from round shape to plus sign shape to optimize the section modulus and minimize the sudden change in the thickness. This is done without effecting the function and strength of the part. Solidification and Porosity results are compared and analyzed to conclude the change in product design. The net effect of this change in geometry is reduced porosity in the mounting boss.

the supplier suggests some changes to improve the casting quality, they are reluctant to accept the design changes as their product design is freeze. This leads to increased development time, poor quality of the product, dissatisfied customer and more scrap rate at the foundry

Virtual Simulation of HPDC process is used as an effective tool to predict the casting defects due to product design and optimize the product design accordingly. Some of the examples are described in next paragraphs.

Change in part geometry to minimize the sudden change in cross section

In this example the shape of a mounting boss is changed from round shape to plus sign shape to optimize the section modulus and minimize the sudden change in the thickness. This is done without effecting the function and strength of the part. Solidification and Porosity results are compared and analyzed to conclude the change in product design. The net effect of this change in geometry is reduced porosity in the mounting boss.

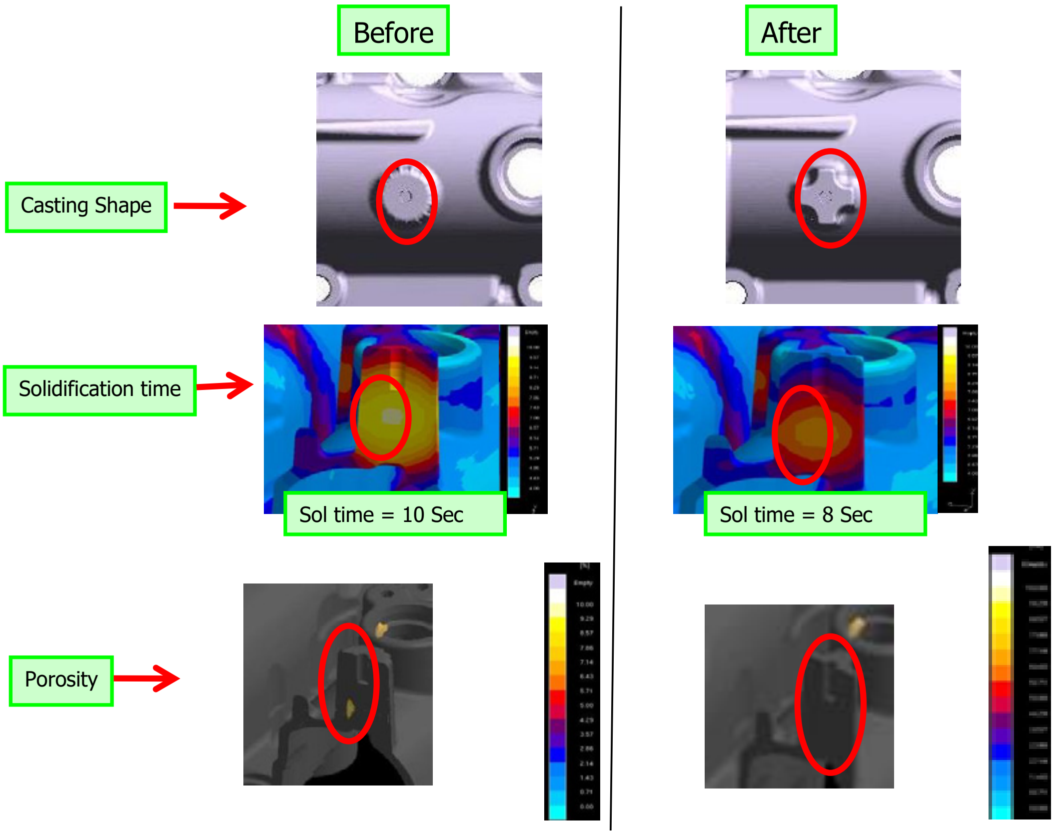


Fig. 1 - Solidification Time – Before (10 Sec) and after (8 Sec) change in shape of the boss

Change in parting lines to optimize the product design for HPDC process The following example indicates the effect of Air Pressure in the cavity before (~3.8 bar) and after changing the parting line (~1.8 bar) in the product design. The customer requirement was porosity level 1 as per ASTM E 505, which could not be achieved without changing the product design.

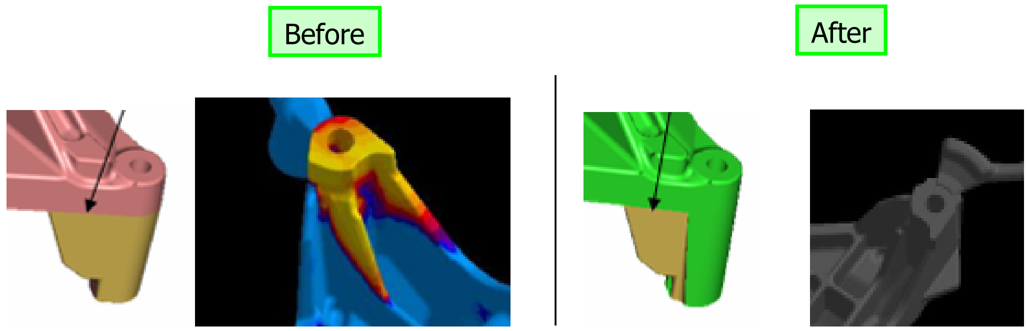


Fig. 2 - Air Pressure – Before (3.8 bar) and after 1.8 bar) change in parting line near the boss

Change in product design by providing additional ribs to improve the material flow

The following example indicates how the addition of ribs change the filling pattern and sudden change in cross section to improve the material filling and reduce the air pressure in the cavity. This has helped to reduce the cold fill and shrink porosity defect in the casting at this particular location.

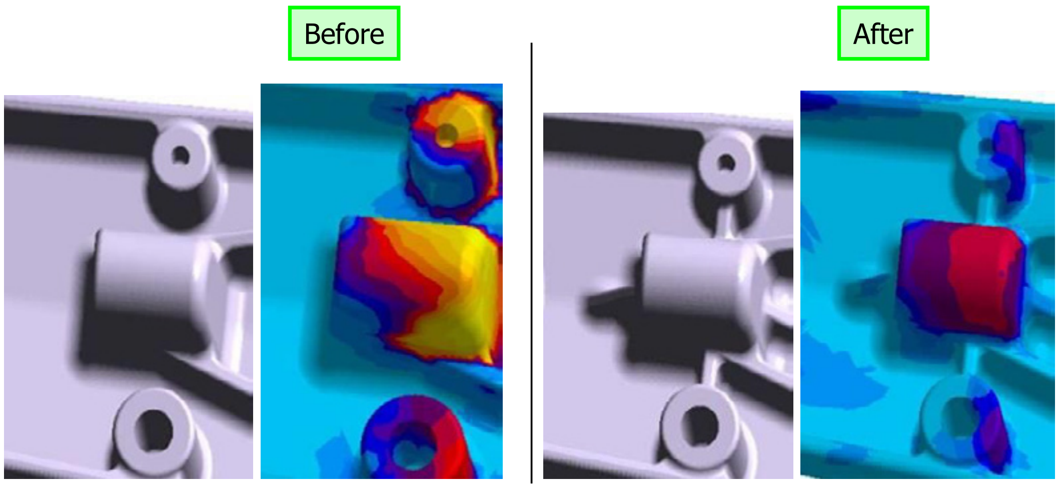


Fig. 3 - Air Pressure – Before (2.6 bar) and after 2 .0 bar) adding the ribs near the boss

Change in Fillet to improve the material flow and reduce air entrapment

The following example indicates how the change in the corner fillets in the product design helped to change the filling pattern and reduce the air entrapment in the part from 12% to 8% after the change in fillet. The end result is better casting quality and good surface finish.

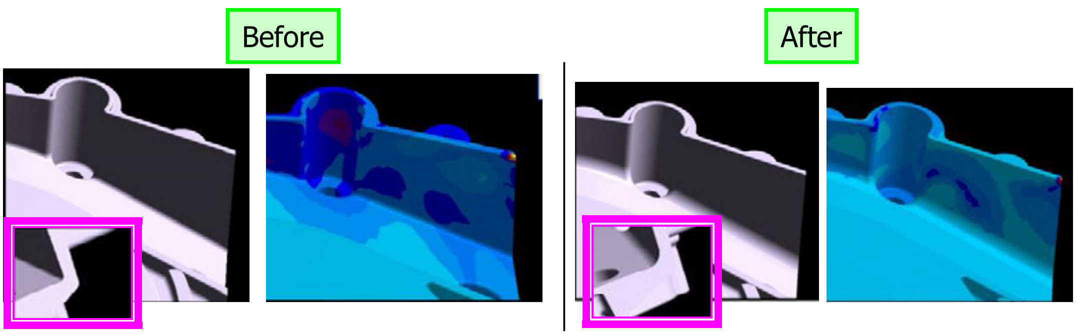


Fig. 4 - Air Entrapment – Before (12% air entrapment) and after (8% air entrapment) change in corner fillet

CONVERSION FROM GDC TO HPDC

Using these guidelines and learning, there are a lot of opportunities to convert the parts produced thru GDC process to HPDC process. One such example is Fly Wheel Housing for commercial vehicles.

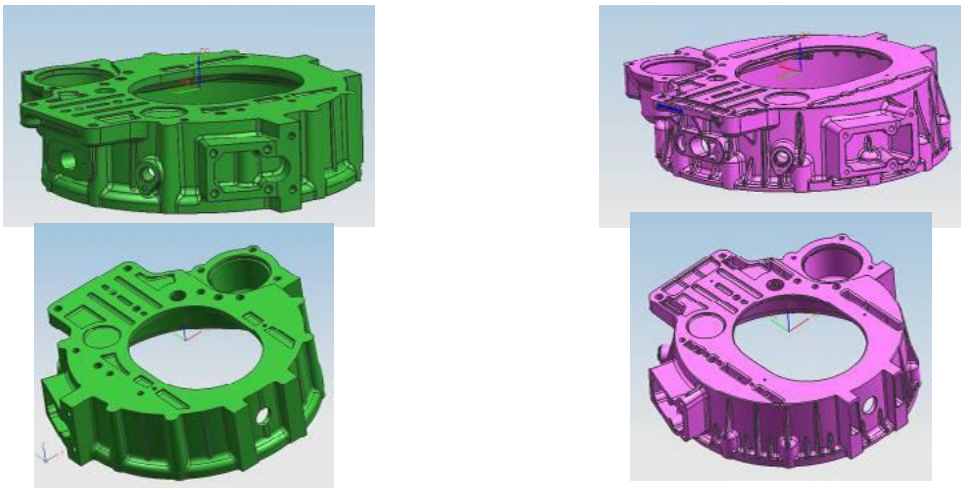
The Key challenges were:

1. Assembly features of Fly Wheel Housing in the Engine assembly should remain unchanged
2. All functional requirements should be met as per the part produced thru GDC process
3. Reduce the weight of the casting to make it viable to produce thru HPDC route
4. Mechanical properties and strength of the part should withstand the static and dynamic load on the part while in Engine assembly.
5. Quality requirements in terms of dimensional tolerance, porosity specs should be met.

To meet the above challenges, the complete part was re-modeled considering:

1. The HPDC process requirements,
2. Tool design requirements and
3. Simulation feedback

To finalize the product design, total 4 iterations were done on the product design in co-ordination with OEM team, two iterations of the FEA analysis done by the OEM team and 12 iterations done on the Magma Simulation.



GDC Part **HPDC Part**

Fig. 5 - Part produced thru GDC and HPDC process

The tool was designed and manufactured with 8 complex slides, Centre Feeding, high yield of 65.3% and proved "First Time Right".

The First trial samples were validated and approved by the customer and the part was productionized.

The results achieved are:

1. Part production process changed from GDC to HPDC without any changes in the engine assembly line and child parts
2. Weight of the casting reduced from 9.49 kg to 6.31 kg (~33% saving)

3. Machining areas reduced as better finish and tolerances achieved by HPDC process

4. All customer quality requirements in terms of strength, porosity, and dimensional tolerances are met

5. Productivity increased from average 50 parts per day thru GDC process to 600 parts per day thru HPDC process

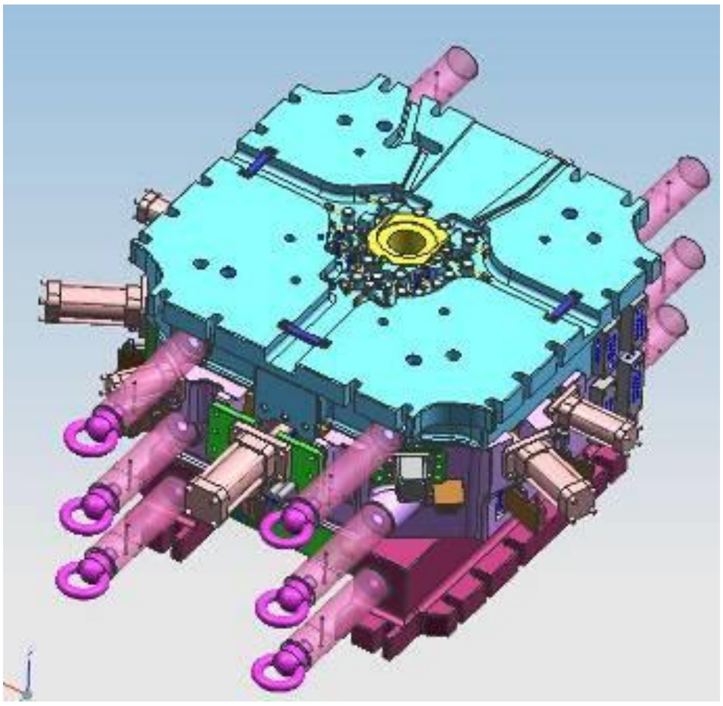


Fig. 6 - HPDC die with 8 complex slides

CONCLUSION

Above examples indicates how the joint working between the Customer and Die Casting supplier helps to optimize the product design to meet the customer requirements, optimize the production process, reduce the weight of the part and scrap rate at the foundry. Simulation analysis as a supporting tool gives us the indication of the probable casting defects in the part and helps us to optimize the product design and justify the changes in product design.

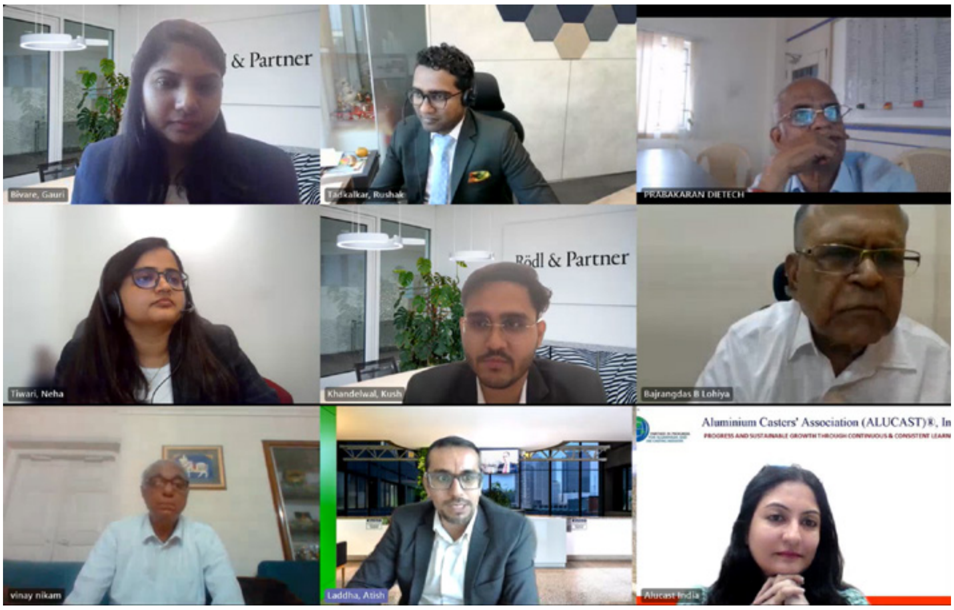
Rajesh R Aggarwal
Founder & Director, **TechSense Engineering Services**
E-mail: Rajesh.aggarwal@techsense.co.in

ALUCAST WEBINARS HELD IN FEBRUARY - MARCH 2025

Webinar 1	**Navigating Opportunities and Challenges: Insights into Union Budget 2025 (Attendees-46)**
Date	**Tuesday, 04th February 2025 from 3.00 pm to 4.30 pm**
Speaker	**Team - Roedl and Partner Consulting Pvt. Ltd.**

Topic insights:

- Latest changes in the Tax and Legal Framework
- GST and Custom Related aspects
- Direct Tax, International Taxation
- Transfer Pricing related aspects
- Regulatory Aspects



Webinar 2	**Critical Parameters for Die Life Improvement of HPDC Dies (Attendees-34)**
Date	**Friday, 14th February 2025 from 3.00 pm to 5.00 pm**
Speaker	**Mr Rajesh Aggarwal, Founder & Director – TechSense Engineering Services**

Topic insights:

- What is Die Life?
- Causes of die failure
    - Heat Check, Crack in dies, Soldering and Erosion
- Understanding the root cause of these defects
- Critical parameters to improve die life

Webinar 3	Finance Management Workshop (Attendees- 18)
Date	Friday, 28th February 2025, from 10.00 am to 12.00 pm
Speaker	Mr. Pranav Mankad, Senior Manager F&A, TechNova Imaging Systems Pvt. Ltd.

Topic insights:

A. Financial Statements:

a. Components of:

- Balance Sheet
- Profit & Loss Account
- Cash Flow Statement
- Annual Report

b. Profit & Loss Account + Balance Sheet with examples

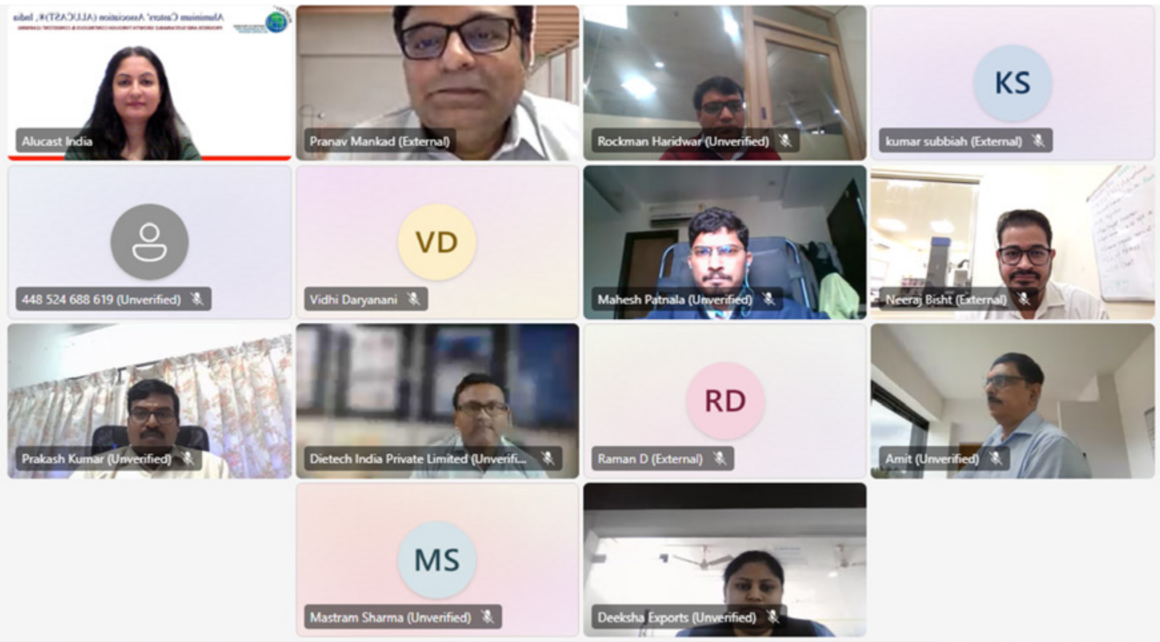
c. Cash Flow Statement with examples

B. Financial Ratios

a. Types of Ratios:

- Balance Sheet Ratios
- Profit & Loss Ratios
- Other Ratios

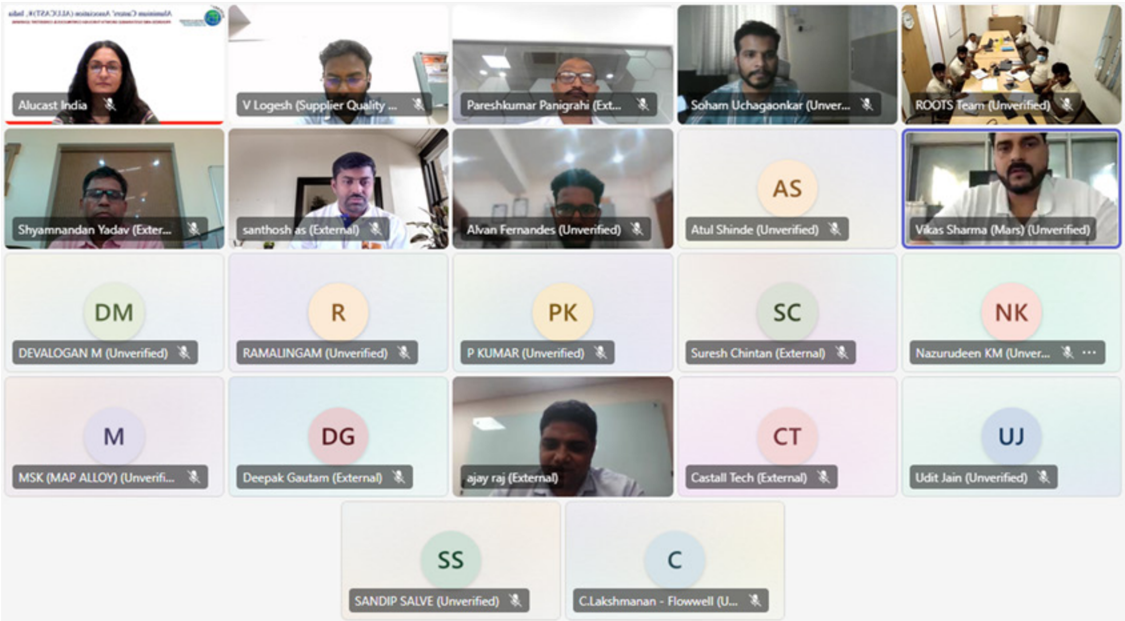
b. Ratio Analysis - Financial Statements with examples



Webinar 4	Casting Defects – Root Causes and Prediction Using Casting Simulation Software (Attendees – 28)
Date	Wednesday, 19th March, 2025 – 3.00 pm to 5.00 pm
Speaker	Mr. Santhosh Kumar A.S. General Manager Casting Operations, Aganita Ventures Pvt. Ltd. Mr. Pavan Ajay Raj Sr. Application Engineer, Aganita Ventures Pvt. Ltd.

Topic insights:

- Common Casting Defects in castings
- Root Causes of casting defects
- Prevention Methods for casting defects
- Interpretation of common casting defects using casting simulation software



Die concepts for Lightweight Aluminium castings

- Bharataj Ashok Patil, Godrej & Boyce Mfg. Co. Ltd.

BRIEF BACKGROUND OF LIGHTWEIGHT CASTING TREND

Drive for Lightweight Aluminum body parts in Automobile industry was started in overseas countries 10~15 years back for Environmental Responsiveness. They have successfully developed these thin wall parts by using various technologies. Recent development trend in these countries is on Mega casting by combining many parts. Currently two main changes in the EV market are impacting the DC industry- `e-mobility & trends towards larger parts.'

Indian Automotive OEMs are also working on EV projects for Greener India initiatives as per Indian Government's directive. Indian die casting foundries & Tooling industry are also aligned to support them for making lightweight aluminum parts required for EVs by adopting technology upgradations. To learn such latest technologies, Godrej Tooling is associated with overseas Technical Expert of the Die casting Industry from FY 2008 and acquired deeper knowledge in this subject to develop Die casting dies for Light weight -Thin wall, Structural castings, and other latest die casting technologies.

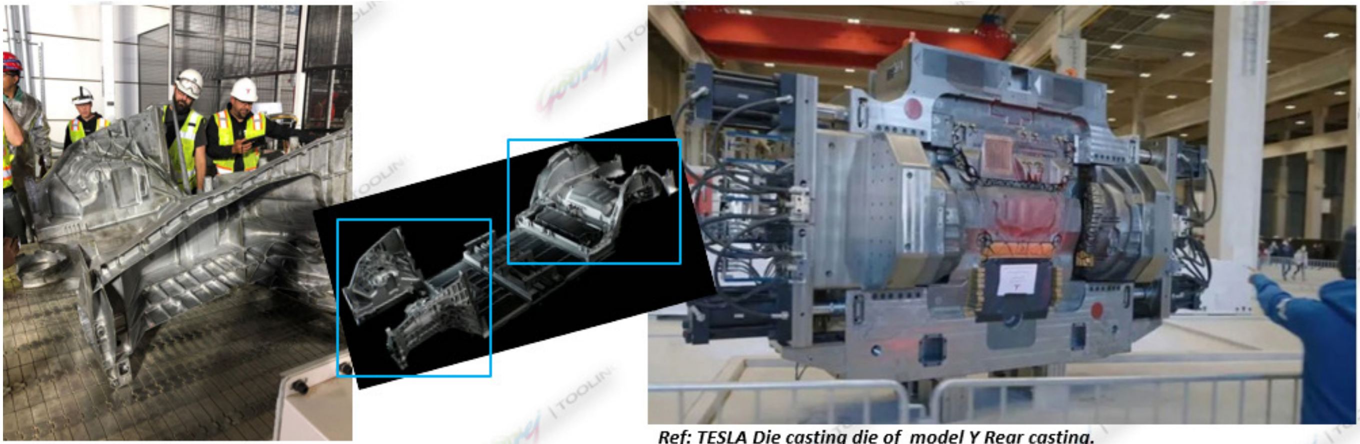
LIGHT WEIGHT - THIN WALL DIE CASTING APPLICATIONS:

Aluminium-based thin wall casting is used by a broad range of industries throughout the world to manufacture parts and components that possess beneficial qualities that customers enjoy. Some of the industries that utilize thin wall casting include

- Automobile/Automotive
- Aircraft/Aerospace
- Engine manufacturing
- Military
- Medical
- Commercial

EXAMPLES OF MEGA CASTING & DIE CASTING DIE FOR LIGHT WEIGHTING:

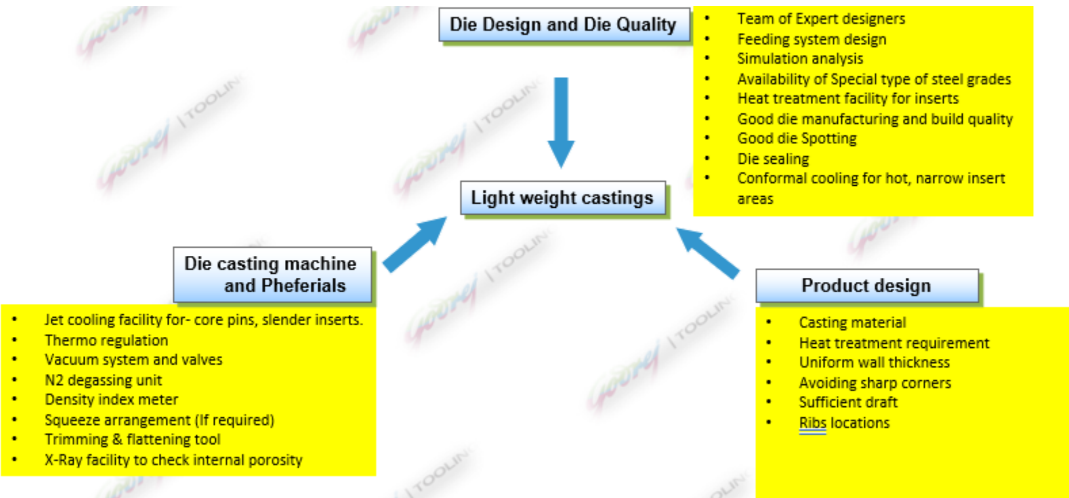
Mega casting replaces many stamped parts. 370 parts are combined to make 2 Mega casting by TESLA in model Y car. It has reduced mass by 10%, part weighs 130kg.



Ref: TESLA model Y Front casting

Ref: TESLA Die casting die of model Y Rear casting.

Important Factors for Light weight casting



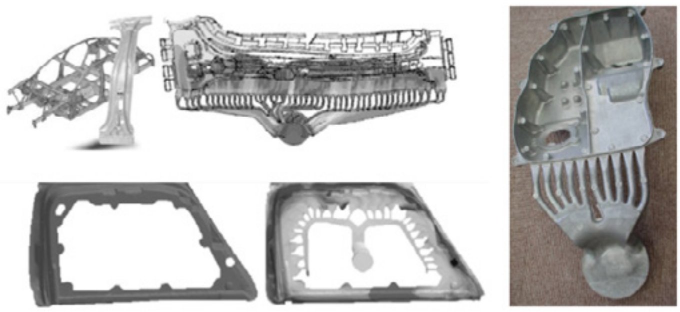
FACTORS TO BE CONSIDERS WHILE DIE DESIGN

In HPDC, because of compactness, thinner parts are OK. It increases toughness and strength. Aluminum has a very high melting and freezing point, so when molten metal is injected into a die, the aluminum starts cooling quickly and becomes solid. The window between the liquid state to the solid state is very narrow, which means the Fill Time needs to be less than 30 milliseconds for a thin wall feature to be created. Simulation and process engineers do this with extremely precise process control. Thinner parts have less shrinkage value, around 0.4%.

FEEDING SYSTEM DESIGN:

- Feeding system should be designed for shorter filling time. e.g. for 2mm casting thickness, use 20 milli-seconds fill time.
- Fill ratio of <30% is to be considered.
- For thin wall castings, smaller size gates are to be provided and design islands in main insert near gate area.

> This will avoid sticking of runner and reduce the distortion. It also distributes the metal flow equal.



Examples of gate design in thin wall castings

- Gate trimming and part flattening tools are to be considered to avoid the distortion.

VENTING SYSTEM:

- Thin parts need very good venting system. Normal venting through overflows is not sufficient for such castings. We need to consider chill-vents, Vacuum system, High level vacuum arrangements based on the casting quality requirements and simulation results.
- In vacuum die casting die, insert spotting condition must be maintained in less than 20micron gap for sealing purpose and effective venting through vacuum.
- For high level vacuum, O'ring is required at parting surfaces, ejector and other holes for sealing purpose.

THERMAL MANAGEMENT:

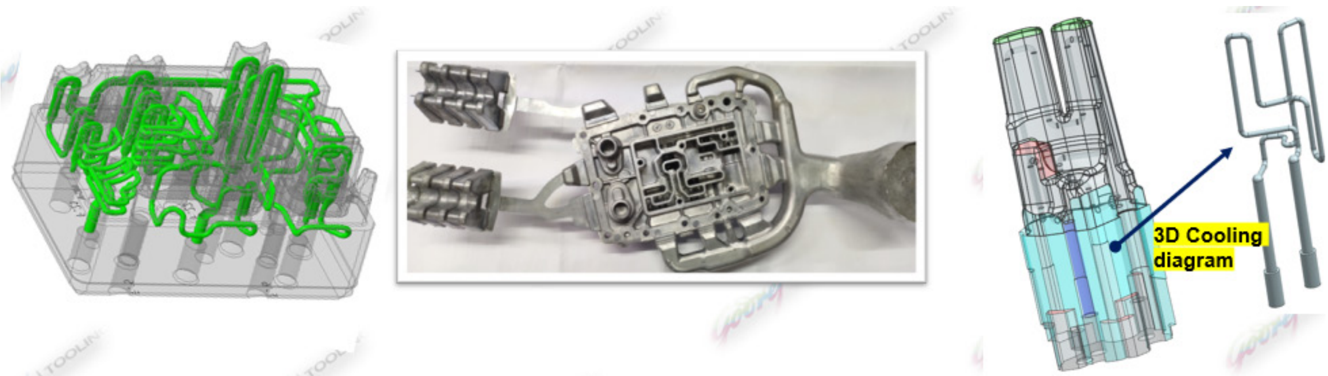
To maintain the shorter feeding time, following points are to be considered –
- Insert temperature should be maintained 200 +/- 30 Degree C by oil heating. For soldering problem, use cyclic cooling.
- Maintain molten metal temperature within +/- 5 degree C
- No cooling spray, only die coat spray is to be considered
- Thermoregulation is to be considered in the insert and Housing to maintain above die temperature and maintain the die condition dry to avoid generation of additional gases inside the cavity.

DIE CONDITION:

- Optimum die thickness to avoid the die distortion is to be considered based on calculations
- Corner wedges are to be provided to maintain uniform wall thickness
- Consider Bigger diameter ejector pins and define the proper ejector pin locations to avoid depression in the thin casting and casting crack/breaking.
- Maintain Good insert polishing of Ra value ~ 2microns
- Consider PVD coating for smooth ejection
- Die life of thin wall casting dies is 20~50% less because of tight process control.

CONFORMAL COOLING:

Use the Conformal cooling by 3D printing for high temperature and narrow areas. It helps for-
- Cycle time reduction in casting production,
- Reducing casting rejection percentage
- Extension of the die life of inserts



Examples of insert made with Conformal cooling by 3D printing process for hot areas in narrow insert sections

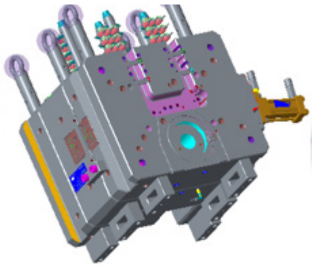
PRE-ENGINEERING FOR CO-CREATION:

It is always a good idea to include a die casting engineer during the part design phase. It can translate into major cost savings in both design and production over the die life.

1. Collaborate with team of experienced Die Designers to make the unique changes to your specific part early on it at the design phase to avoid costly re-designs.
2. Allow for Lenient tolerance zones & Lower porosity requirement on non-critical design elements

3. Increasing draft angles of non-critical design elements allows for easier part extraction, which extends the service life of the tool

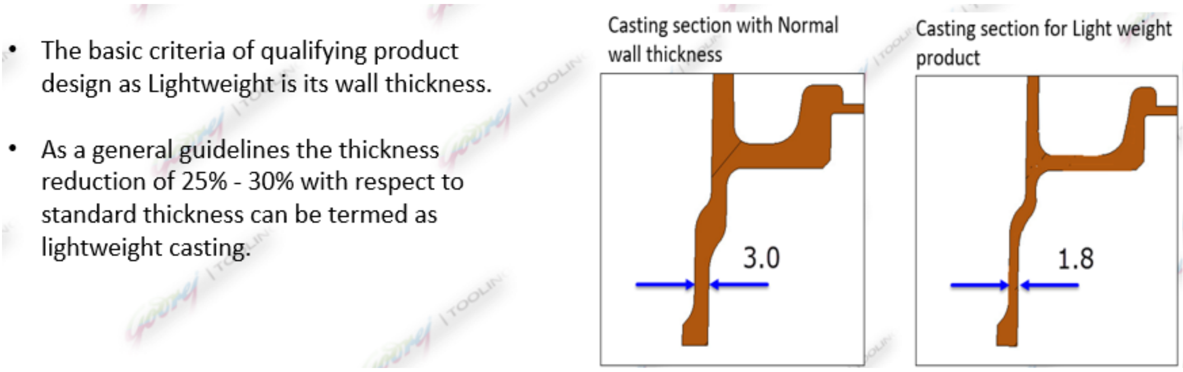
Value engineering helps for cost optimization throughout the manufacturing process of the components. With the die casting expertise, designer can predict exactly where to remove unnecessary material without compromising the strength of the component.



PRODUCT DESIGN OBJECTIVE & RECOMMENDATIONS FROM TOOLING PERSPECTIVE:

- To improve casting quality.
- To reduce product development timeline & cost.
- To simplify product geometry and die cost.
- To optimize product design and features.
- To enhance die life.
- Smooth die functioning & Improve productivity
- To reduce die maintenance cost.

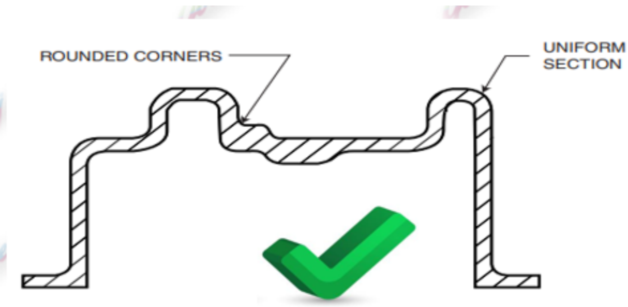
WHAT IS THIN WALL CASTING:

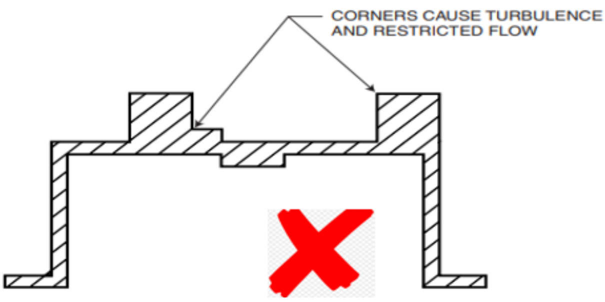


For a thin wall casting, the section thickness can be as low as 0.6 mm.

RECOMMENDATIONS FOR BETTER CASTING QUALITY:

- Wall thickness uniformity:





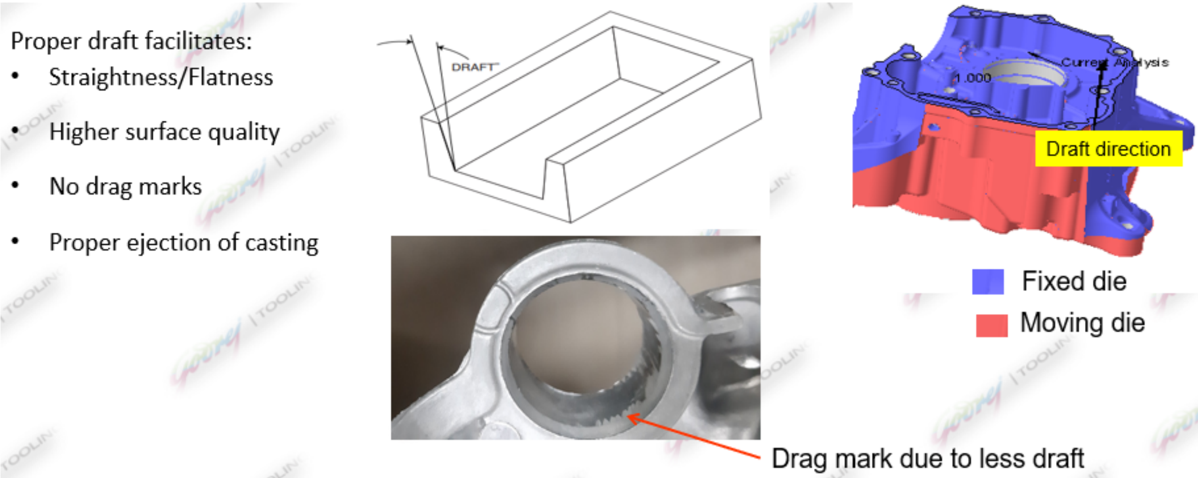
- Non-uniform wall thicknesses results in various casting issues, including dimensional variations of the part.
- Sharp changes in sectional area and heavy sections should be avoided if possible.
- Uniform wall thickness helps better flow of aluminium and casting filling which results in quality product.

MAINTAINING UNIFORM WALL THICKNESS -

- Reduces shrinkage porosity.
- Reduces casting weight.

DRAFT :

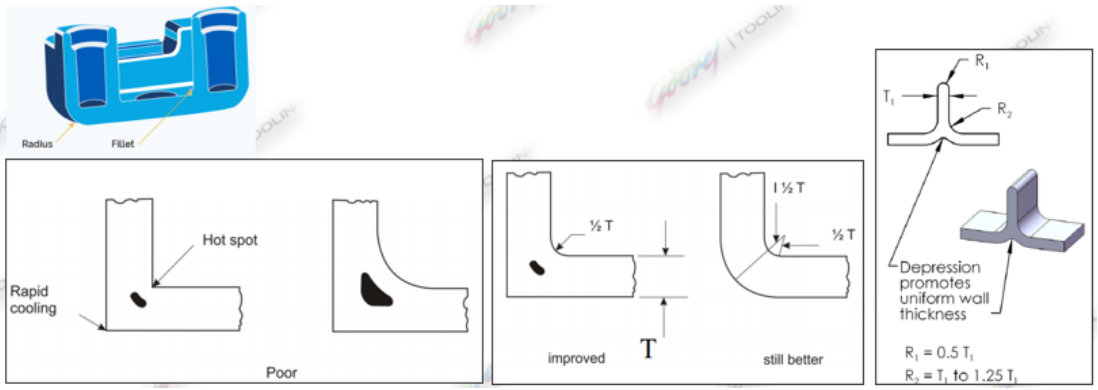
Draft is a slight taper on casting walls which is provided in the direction of the die open-close movement.



RADII:

- Radii are provided for Rounding of an interior or exterior corner of a part design.
- Sharp external corners are undesirable because they become a localized point of heat and stress build-up in the die steel that can cause die cracking and early failure.
- Sharp corners cause uneven cooling, while rounded corners permit uniform cooling with much less stress.
- Rounded corners that maintain uniform wall thickness results in better metal flow in die

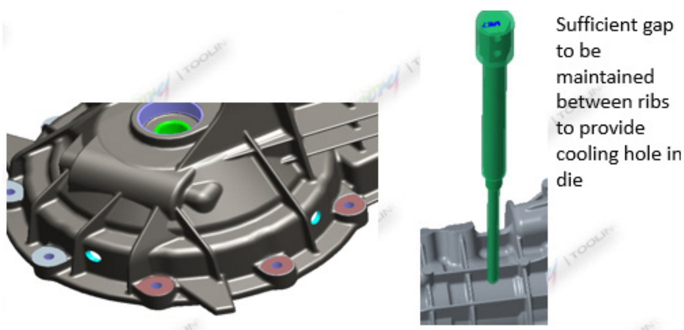
Recommended radii is min.1.5 times the wall thickness for both inside and outside



RIBS:

Ribs are added to thin-walled castings to increase part strength.

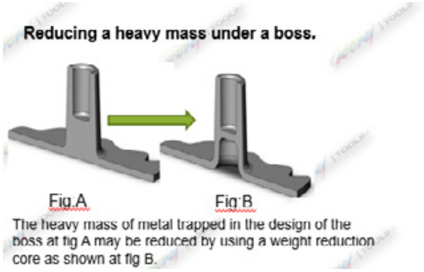
- Ribs axis must be perpendicular to the parting line to allow the removal of casting from the die.
- The width of the rib should not exceed the wall thickness of the casting to avoid sink.
- Sufficient gap to be maintained between ribs to provide cooling hole in die.
- Sufficient draft per side, should be provided to help in ejection.

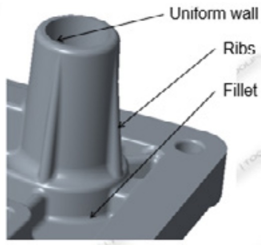


BOSSES:

Bosses are the integral features added to a casting for several potential functions.

- Bosses must have uniform wall thickness.
- Bosses must utilize ample fillets and ribs
- Bosses' outer and inner surfaces must be designed with the correct draft angle





Alloys for High vacuum Die casting (HVDC) Thin wall Components:

- **Basic Alloy Requirement for HVDC Structural Components-**

1. High ductility (Elongation>5%)
2. Good corrosion resistance
3. Good heat treatability
4. High fluidity
5. Low die soldering trend

- **Major Metallurgical Characteristics of Alloys for HVDC-**

1. Low iron (Fe<0.2 %)
2. Low copper (Cu<0.2%)
3. High silicon (Si = 8~12%)
4. Controlled magnesium (Mg = 0.2~0.6%)
5. Controlled manganese (Mn = 0.3~0.8)

OEM REQUIREMENTS OF MECHANICAL PROPERTIES FOR STRUCTURAL PARTS:

High mechanical properties required since Structural components are safety components (e.g. energy absorption in vehicle collision). Structural components must be ductile, weldable, adhesive and rivetable.

Version	UTS [MPa]	Yield Strength [MPa]	Elongation A [%]
Standard die casting	≥ 240	≥ 140	0.5 - 1.5
Crash-relevant	≥ 180	≥ 120 - 150	≥ 10
Strength-relevant	≥ 215	≥ 150 - 180	≥ 7

Structural castings Alloy Composition:

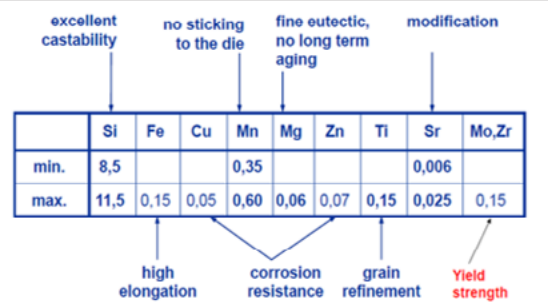
Name of Manufacturer	Si	Fe	Cu	Mn	Mg	Zn	Ti	Other
Silafont 36	9.5-11.5	0,15	0,03	0.8	0,1-0.5	0,08	0.04-0,15	Sr
Castasil37	8.5-10.5	0.15	0.05	0.35-0.6	0.06	0.07	0.15	Sr 0.006-0.025 Zr 0.3
Trimal-05	9.5-11	0.25	0.05	0.7	0.4	0.07	0.12	
Aural 2	9.5-11.5	0.13-0.2	0.03	0.3-0.6	0.1-0.4	0.03	0.02-0.06	Sr 0,01-0.018
Aural 3	9.5-11.5	0.13-0.2	0.03	0.3-0.6	0.4-0.6	0.03	0.02-0.06	Sr 0,01-0.018
Aural 5	6.5-9..5	0.13-0.2	0.03	0.3-0.6	0.1-0.6	0.03	0.02-0.06	Sr 0,01-0.018
Calypso 61D	10-11	0,35-0,45	0,02	0,35-0,45	0,08-0,2	0,02	0,10-0,15	Sr, Ni, Pb, Sn
Magsimal 59	1.8-2.6	0,2	0,03	0,5-0.8	5.0-6.0	0,07	0,20	Be

Properties of Castasil-37 (AlSi9Mn) :

- High ductility, i.a. A > 10% in temper F
- Yield strength $R_{p0,2}$ > 120 MPa
- Resistance to corrosion
- No hot tearing
- Easy castability

(No hot tearing and Easy castability: important for complex designs)

- No long term ageing behaviour



	Si	Fe	Cu	Mn	Mg	Zn	Ti	Sr	Mo,Zr
min.	8,5			0,35				0,006	
max.	11,5	0,15	0,05	0,60	0,06	0,07	0,15	0,025	0,15

Castasil-37 is used by many OEMs in overseas countries to produce structural parts.

MECHANICAL PROPERTIES OF ALLOYS:

- Heat treatments and their influence on Yield strength vs. Elongation-Silafont36 (AlSi9MgMn

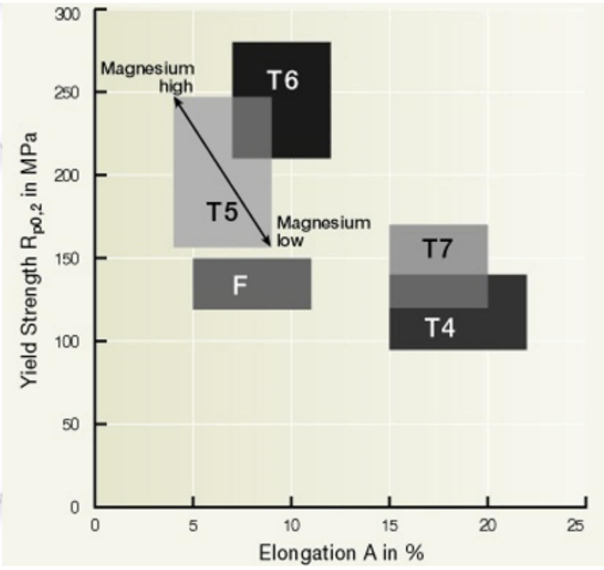
F: As-cast condition

T4: Solution annealing, quenching, more then 6 days of natural (cold) aging

T5: Fast quenching after casting, and aging at 300˚C

T6: Solution annealing, quenching and warm-aging

T7: Solution annealing, quenching and over-aging



DIE CASTING MACHINE AND PHEFERIALS FOR THIN WALL CASTINGS:

- Jet cooling facility for- core pins, slender inserts.
- Thermo regulation
- Vacuum system and valves
- N_2 degassing unit
- Density index meter
- Squeeze arrangement (If required)
- Trimming & flattening tool
- X-Ray facility to check internal porosity

JET COOLING

The primary focus of Jet cooling is to take away the heat from smaller diameter core pins or slender inserts during solidification of aluminum. It helps to reduce the shrinkage porosity. Jet coolers are used when regular spot cooling cannot be provided. We can provide minimum Ø2 hole in core pin for Jet cooling.

WORKING PRINCIPLE OF JET COOLING

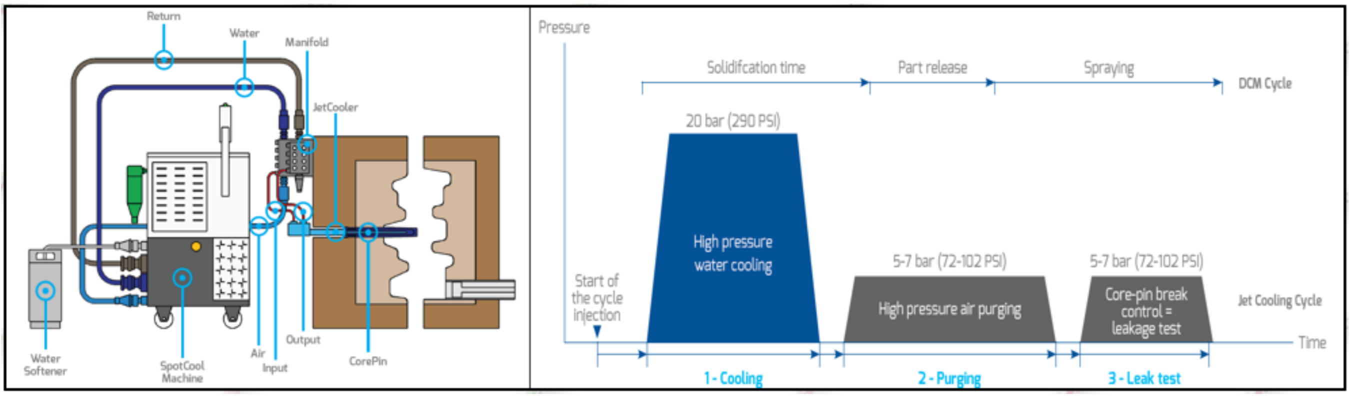
A hydraulic unit ensures the circulation of pressurized cooling water (from 3 Bar to 20 Bar) for a given period in the circuits of small diameter injectors (Ø from min2mm) inserted in the specific core pins.

At the end of the cooling period, a pneumatic distributor injects air into the injector's circuits to purge it. In this way, the cycle can be carried out safely without the presence of water inside the circuits.

The cooling cycle is synchronized by adjustable temporizations with the die casting machine.

VACUUM DIE CASTING

Vacuum system helps to minimize gas content levels in the material, thereby reducing the gas porosity and improving weldability. Reduced wall thickness is another benefit achieved further optimizing weight and increasing design flexibility.

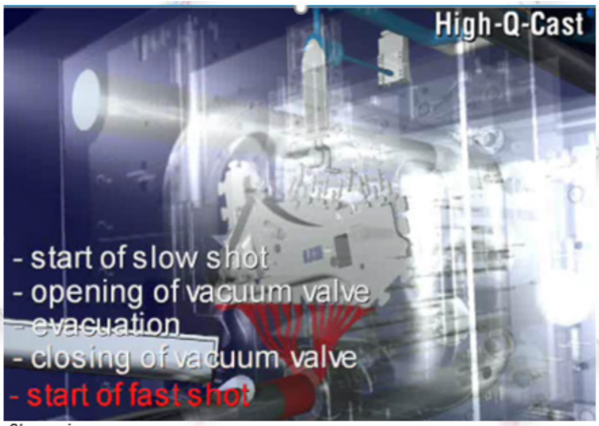


Reference: Lethiguel, USA

In die-casting melt injected at a high velocity, gases and air remaining in the die & shot sleeve may cause internal defects; therefore, the product's mechanical properties are degraded. An enhanced die-casting method, vacuum die-casting, has been developed by adding a vacuum device. Because vacuum die casting creates a vacuum inside the die cavity during casting, gases or air in the melt is removed, decreasing the volume of gas pockets, and improving the mechanical properties and smoothness of the resulting surface. From die, air can be evacuated through standard vacuum valves or through chill vents.

Vacuum through chillvent

Vacuum block



Stages in vacuum process

Reference: BDW technologies

VACURAL TECHNOLOGY:

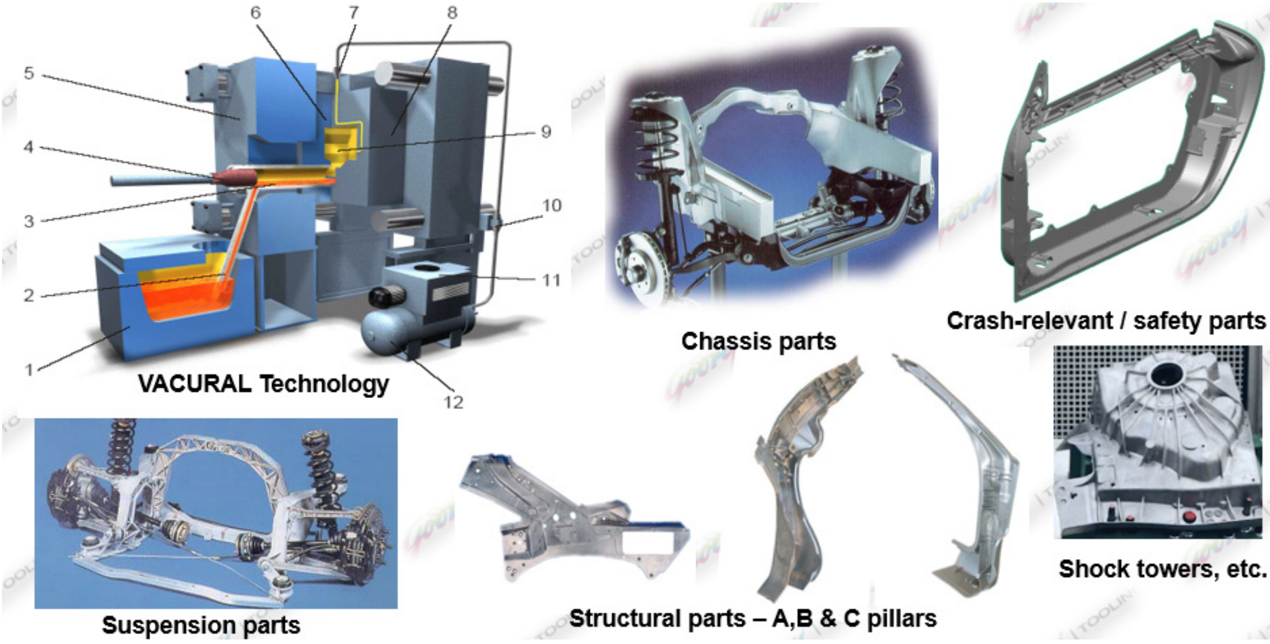
The patented VACURAL process developed by FRECH has proven its advantages for long years in the production of castings with minimal gas and oxide inclusions. It facilitates the reliable production of:

- Highly Elastic Structural Components & Chassis Parts
- Optimized Quality of Castings at Maximum Shot Speeds
- Surface-Critical Parts, Suitable for Coating
- Parts can be heat treated T5, T6

VACURAL® TECHNOLOGY VS CONVETIONAL HIGH-VACUUM SYSTEMS:

- Casting process is fully under deep vacuum ≤ 30 mbar
- Extremely low gas and porosity content (density index ≤ 0,1%)
- Vacuum starts with Dosing. Very long evacuation time and degassing of melt
- Melt is free of oxides during dosing until end of cavity filling
- All gases and vapors are absorbed during dosing from die cavity before shot is released
- No thermal loss during dosing / casting near Liquidus-temperature – increased energy efficiency
- Laminar filling of sleeve from below
- Self-controlled / regulated process

VACURAL TECHNOLOGY & COMPONENTS PRODUCED BY USING THIS TECHNOLOGY-



Vacural System - Reference: FRECH

DIE LUBRICATION

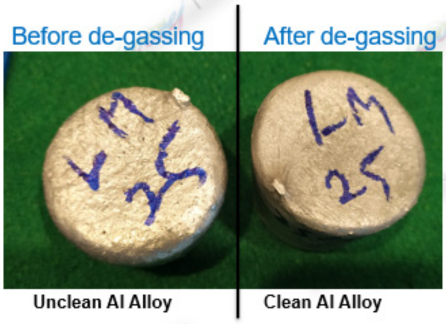
Important influence on the welding quality and blisters.

POINTS TO BE CONSIDERED:

- Cavity must be dry after spraying.
- Spraying with a low amount of release agent (micro spraying) desirable. Requires a thermal balanced die with internal cooling in the inserts.
- Increased mean mold temperature from 180 to 240 °C.
- Use approved mold release agent with low outgassing.
- Mist spray is used to maintain uniform lubrication

PERIPHERALS TO CHECK INPUT ALUMINUM MATERIAL QUALITY

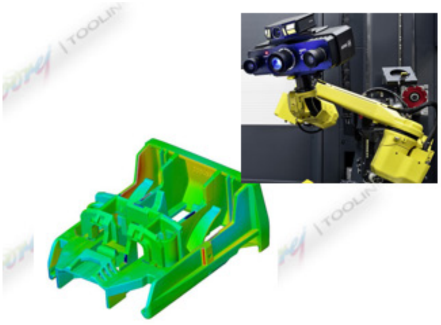
- To clean the molten Al material, use N2 Rotary de-gasser.
- Density index meter to be used to ensure the Alloy purity before casting production
- These are basic requirements to reduce the porosity in HPDC parts



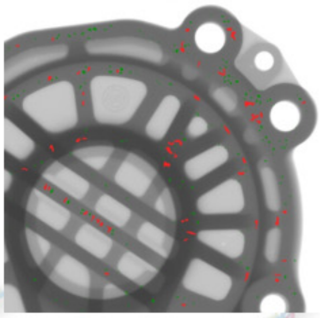
PERIPHERALS TO CHECK CASTING QUALITY:

Measuring & Inspection Systems: CMMs, Blue light scanning, CT & X-RAY scanning, etc.

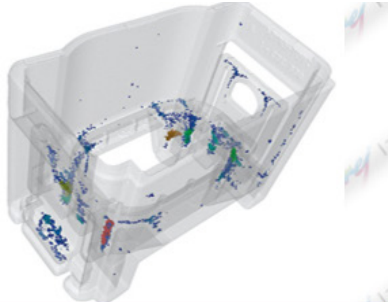
- Inspect the invisible in one scan.
- The easy-to-use CT technology
- Anyone can efficiently perform complex measurement and inspection tasks with just one scan.
- Measure and inspect hidden defects and internal structures



Perform complex measurement of internal & external features by Blue light scanning



2D X RAY to check internal porosity / defects



CT scanning for better clarity of internal porosity / defects & Indicates porosity level

CONCLUSION:

For making good quality of Light weight castings, - Product design, Material selection, Die Design, Feeding system design, Thermoregulation, Gas venting, Jet cooling, Die build Quality, necessary peripherals in the foundry & their operating knowledge are very important factors. Same time knowledge of simulation analysis & production processing are equally important. For the development of Light weight castings, - Latest technologies in the foundry area, Die manufacturing capability and the peripherals are now available in India. Use of such advance technology is must to produce Good Quality of Light weight Thin wall castings based on the Die design considerations.Due to localisation of most of these peripherals, it is now affordable for MSMEs also to make an investment in them and produce the good quality thin wall castings of smaller sizes.

This Paper was presented in November 2023 at ALUCAST 2023, Vadodara

Bharataj Patil
Dy. General Manager
Godrej & Boyce Mfg. Co. Ltd.

ALUCAST SNIPPETS

ROCKMAN INDUSTRIES: PIONEERING GREEN HYDROGEN ADOPTION FOR INDUSTRIAL DECARBONIZATION

As industries worldwide move toward net-zero emissions, Rockman Industries, in partnership with Hero Future Energies (HFE), has taken a significant step forward in sustainable manufacturing by setting up India's first green hydrogen-LPG blending plant at its Tirupati manufacturing facility. This pioneering initiative was inaugurated by the Honorable Chief Minister of Andhra Pradesh, Shri Nara Chandrababu Naidu Garu, marking a transformational shift in industrial energy usage and reinforcing the role of green hydrogen in reducing carbon emissions in high-impact manufacturing processes.

Pioneering a New Era of Sustainable Manufacturing

The aluminum foundry industry, including casting is a high carbon-emitting sector due to the energy-intensive nature of melting, holding, and casting processes. These operations require high-temperature heating, traditionally powered by fossil fuels such as LPG, diesel and natural gas, resulting in significant carbon dioxide (CO_2) emissions.

By integrating green hydrogen into these processes, Rockman Industries is setting a new benchmark for low-carbon industrial operations. Hydrogen-blended LPG offers a cleaner alternative, reducing the overall carbon footprint while ensuring energy efficiency. This shift not only lowers direct emissions from casting operations but also positions green hydrogen as a scalable solution for energy-intensive industries.

A Step Towards a Greener Future

The hydrogen used in this initiative is produced through electrolysis, powered by renewable solar energy. In this process, captive solar power is harnessed to generate clean electricity, which is then used to split water (H_2O) into hydrogen (H_2) and oxygen (O_2) through electrolysis. The resulting green hydrogen is then stored, blended with LPG, and used as a fuel source in industrial operations. The entire cycle ensures zero carbon emissions in the hydrogen production phase, making the overall energy cycle significantly greener and more sustainable.

Driving Industrial Innovation in Clean Energy

This groundbreaking project, spearheaded by Rockman Industries and Hero Future Energies, is a major milestone in proving the feasibility of green hydrogen in industrial applications. It serves as a replicable model for industries looking to transition toward cleaner fuel alternatives while maintaining operational eficiency.

Beyond green hydrogen, Rockman Industries has been at the forefront of sustainable initiatives, integrating multiple renewable energy solutions across its operations. The company has installed solar power plants across multiple facilities to ensure a steady supply of clean energy, implemented biogas solution by harnessing organic waste to generate sustainable fuel alternatives, and adopted energy-eficient manufacturing processes to reduce overall power consumption and emissions.

By investing in hydrogen-based solutions, Rockman Industries is reafirming its commitment to sustainable and responsible manufacturing. This initiative is just the beginning of our journey toward a carbon-neutral future, and we believe that it will inspire other manufacturing sectors to accelerate their adoption of clean energy solutions.

Through this initiative, Rockman Industries is demonstrating that green hydrogen is not just a future aspiration but a present-day reality for industrial decarbonization.

INDIA AUTO COMPONENT INDUSTRY MAY NOT FACE BRUNT OF US RECIPROCAL TARIFFS: REPORT

India's auto component industry is expected to face only a limited impact from the potential reciprocal tariffs proposed by US President Donald Trump on auto industry, according to a report. India's auto component industry is expected to face only a limited impact from the potential reciprocal tariffs proposed by US President Donald Trump on auto industry, according to a report by Nomura. The report highlights that India accounts for just 3 per cent of the USD 97 billion worth of auto components imported by the US from outside North America in 2024. In contrast, other major auto component suppliers to the US, such as the European Union (EU), China, Japan, and South Korea, are expected to be hit the hardest by these tariffs.

The report showed that in 2024, the EU exported USD 22 billion worth of auto parts to the US, China USD 18 billion, Japan USD 16 billion, and South Korea USD 13 billion. While China and Japan saw slight growth in their exports, the EU and South Korea witnessed declines. India's share in US auto parts imports remains small compared to other major suppliers. However, the country has been steadily expanding its role in the global automotive supply chain. The introduction of new tariffs could make Indian exports less competitive and force automakers to look for alternative sources of components.

Apart from auto components, the report also sheds light on car imports to the US. Outside North America, the largest sources of new cars sold in the US in 2024 were from South Korea around 1.39 million units (+25 per cent year-on-year). Japan at second position with 1.31 million units (-2 per cent Y-o-Y) and EU at 0.77 million units (-2 per cent). Interestingly, Thailand and Vietnam saw the biggest growth in auto parts exports to the US in 2024, with increases of 9 per cent and 14 per cent year-on-year, respectively. This suggests that the US auto industry is already diversifying its supply chains.

If Trump implements his proposed tariffs, it could significantly impact the global auto supply chain. While India may not bear the brunt of these tariffs due to its relatively small market share, the country's growing automotive sector may still face challenges. The focus will now be on how global automakers adjust their sourcing strategies in response to potential trade policy changes.

***

Summary Report: Cumulative Production, Domestic Sales & Exports data for the period of April - January 2025									
Report I - Number of Vehicles									
Category	Production			Domestic Sales			Exports		
Segment/Subsegment	April - January			April - January			April - January		
	2023-24	2024-25	% Change	2023-24	2024-25	% Change	2023-24	2024-25	% Change
Passenger Vehicles (PVs)*									
Passenger Cars	16,37,121	14,20,959	-13.2%	12,80,899	11,03,580	-13.8%	3,60,191	3,38,840	-5.9%
Utility Vehicles(UVs)	22,20,894	25,33,660	14.1%	20,20,396	22,61,715	11.9%	1,88,819	2,89,324	53.2%
Vans	1,19,681	1,28,252	7.2%	1,21,391	1,25,303	3.2%	6,452	7,509	16.4%
Total Passenger Vehicles (PVs)	**39,77,696**	**40,82,871**	**2.6%**	**34,22,686**	**34,90,598**	**2.0%**	**5,55,462**	**6,35,673**	**14.4%**
Three Wheelers									
Passenger Carrier	7,11,549	7,60,121	6.8%	4,61,875	5,05,769	9.5%	2,47,054	2,48,819	0.7%
Goods Carrier	93,351	98,662	5.7%	89,851	94,963	5.7%	2,801	3,129	11.7%
E-Rickshaw	27,983	17,361	-38.0%	28,086	16,658	-40.7%	-	34	-
E-Cart	2,840	3,405	19.9%	2,962	3,429	15.8%	-	-	-
Total Three Wheelers	**8,35,723**	**8,79,549**	**5.2%**	**5,82,774**	**6,20,819**	**6.5%**	**2,49,855**	**2,51,982**	**0.9%**
Two Wheelers									
Scooter/ Scooterettee	52,74,722	62,09,660	17.7%	48,57,373	57,53,946	18.5%	4,21,096	4,90,532	16.5%
Motorcycle/Step-Throughs	1,20,99,719	1,34,07,901	10.8%	97,08,775	1,03,78,782	6.9%	23,80,465	29,46,077	23.8%
Mopeds	4,01,856	4,41,260	9.8%	3,99,877	4,33,060	8.3%	1,656	5,574	236.6%
Total Two Wheelers	**1,77,76,297**	**2,00,58,821**	**12.8%**	**1,49,66,025**	**1,65,65,788**	**10.7%**	**28,03,217**	**34,42,183**	**22.8%**
Quadricycle									
Quadricycle	3,865	6,020	55.8%	658	117	-82.2%	3,080	5,984	94.3%
Grand Total of All Categories	**2,25,93,581**	**2,50,27,261**	**10.8%**	**1,89,72,143**	**2,06,77,322**	**9.0%**	**36,11,614**	**43,35,822**	**20.1%**
* BMW, Mercedes, JLR, Volvo Auto data is not available and Tata Motors data is available for Apr-Dec only. Society of Indian Automobile Manufacturers (13/02/2025)									

Summary Report: Cumulative Production, Domestic Sales & Exports data for the period of April - February 2025									
Report I - Number of Vehicles									
Category	Production			Domestic Sales			Exports		
Segment/Subsegment	April - February			April - February			April - February		
	2023-24	2024-25	% Change	2023-24	2024-25	% Change	2023-24	2024-25	% Change
Passenger Vehicles (PVs)*									
Passenger Cars	17,88,659	15,67,224	-12.4%	13,96,836	12,14,546	-13.1%	3,91,631	3,63,088	-7.3%
Utility Vehicles(UVs)	24,42,849	27,79,168	13.8%	22,11,831	24,70,510	11.7%	2,10,638	3,20,712	52.3%
Vans	1,32,929	1,40,672	5.8%	1,33,538	1,36,796	2.4%	7,236	8,511	17.6%
Total Passenger Vehicles (PVs)	**43,64,437**	**44,87,064**	**2.8%**	**37,42,205**	**38,21,852**	**2.1%**	**6,09,505**	**6,92,311**	**13.6%**
Three Wheelers									
Passenger Carrier	7,77,577	8,31,814	7.0%	5,05,048	5,51,880	9.3%	2,72,257	2,74,644	0.9%
Goods Carrier	1,04,148	1,09,127	4.8%	99,864	1,05,566	5.7%	3,439	3,328	-3.2%
E-Rickshaw	28,737	18,011	-37.3%	29,595	17,399	-41.2%	-	34	-
E-Cart	3,407	3,849	13.0%	3,442	3,762	9.3%	-	-	-
Total Three Wheelers	**9,13,869**	**9,62,801**	**5.4%**	**6,37,949**	**6,78,607**	**6.4%**	**2,75,696**	**2,78,006**	**0.8%**
Two Wheelers									
Scooter/ Scooterettee	58,42,185	68,15,161	16.7%	53,72,713	62,66,729	16.6%	4,68,460	5,35,276	14.3%
Motorcycle/Step-Throughs	1,33,19,166	1,46,16,439	9.7%	1,06,73,137	1,12,17,032	5.1%	26,60,607	32,91,799	23.7%
Mopeds	4,44,480	4,85,683	9.3%	4,40,936	4,66,632	5.8%	2,232	6,516	191.9%
Total Two Wheelers	**1,96,05,831**	**2,19,17,283**	**11.8%**	**1,64,86,786**	**1,79,50,393**	**8.9%**	**31,31,299**	**38,33,591**	**22.4%**
Quadricycle									
Quadricycle	4,196	6,371	51.8%	694	120	-82.7%	3,536	6,242	76.5%
Grand Total of All Categories	**2,48,88,333**	**2,73,73,519**	**10.0%**	**2,08,67,634**	**2,24,50,972**	**7.6%**	**40,20,036**	**48,10,150**	**19.7%**
* BMW, Mercedes, JLR, Volvo Auto data is not available and Tata Motors data is available for Apr-Dec only. Society of Indian Automobile Manufacturers (13/03/2025)									

ADVERTISEMENT TARIFF FOR NON-MEMBERS

Revised w.e.f 01 April 2024

Advertisement Placement	Six Issues				Single Issue			
	Basic (₹)	Total with GST (₹)	Basic (US$)	Total with GST (US$)	Basic (₹)	Total with GST(₹)	Basic (US$)	Total with GST(US$)
Back Cover Page	121000	142780	2662	3141	-	-	-	-
Front Inner Page	96800	114224	2178	2570	-	-	-	-
Back Inner Page	84700	99946	1875.5	2213	-	-	-	-
Inside pages	42350	49973	931.7	1099	8770	10348.6	211.75	250

ADVERTISEMENT TARIFF FOR MEMBERS

Revised w.e.f 01 April 2024

Advertisement Placement	Six Issues				Single Issue			
	Basic (₹)	Total with GST (₹)	Basic (US$)	Total with GST (US$)	Basic (₹)	Total with GST(₹)	Basic (US$)	Total with GST(US$)
Back Cover Page	114950	135641	2528.90	2984	-	-	-	-
Front Inner Page	91960	108513	2069.10	2442	-	-	-	-
Back Inner Page	80465	94949	1784.75	2106	-	-	-	-
Inside pages	40232.5	47474	883.30	1042	8391.35	9902	201.1625	237

GST @ 18%

ADVERTISEMENT SIZES & FILE FORMAT

Full Page	**Final Trim Size:** Width 210mm X Height 297mm **Bleed:** 3mm all sides
Half Page	Width 180mm X Height 135mm (non-bleed)
Quarter Page	Width 90mm X Height 135mm (non-bleed)
File Format	Print ready PDF in CMYK color space. No spot colors. All fonts embedded & images @ 300dpi resolution

Please send cheque in the name of ALUMINIUM CASTERS' ASSOCIATION (ALUCAST) payable at Pune to:

ALUCAST®
PARTNER IN PROGRESS
FOR ALUMINIUM AND
DIE CASTING INDUSTRY

Aluminium Casters' Association (ALUCAST)
702, AMar Neptune, Baner Road, S. No. 6/1/1
Plot No. 45, 46A, 46B, Pune 411045
T: +91 20 27290014 E: alucastindia@alucast.co.in

Sustainable megacasting production for the car body of tomorrow

BÜHLER Page

INTRODUCTION

Sustainability is of paramount importance for car manufacturers. Until now, the focus has been on reducing emissions during the use phase of their vehicles, i.e. Scope 3 downstream emissions. Increasingly, however, the focus is also on reducing emissions in the production of vehicles, including emissions from the raw materials required for this, i.e. Scope 3 upstream emissions.

Many car manufacturers are aiming to reduce emissions by 30 to 50% by 2035, while the long- term goal is net-zero emissions in vehicle production. Volvo, for example, has set itself the goal of being climate-neutral by 2040. (VolvoCars, 2024)

ADVANTAGES OF MEGACASTING TECHNOLOGY

Body-in-white production is a central aspect of vehicle production and is therefore a significant factor for costs and emissions during vehicle manufacture. Megacasting offers many advantages and enables economic and sustainable production of the vehicle bodies of the future.

Economic advantages:

- Reduction in assembly complexity: Megacasting technology enables a massive reduction in assembly complexity through functional integration. Up to 100 individual sheet metal parts can be replaced by a single cast part.
- Simplification of warehousing: By consolidating many smaller parts from various different steel grades into one aluminum casting, procurement and warehousing in the assembly plant is simplified.
- Reduction in investment in production facilities: The investment costs for body-in-white production can be reduced. Up to 300 fewer robots are required and the production area is reduced accordingly by approx. 30%.

Advantages in terms of sustainability

- Flexibility in the choice of alloys: In die casting, the raw material is first melted in a specially designed melting furnace. This enables the use of customer-specific alloys and facilitates the recycling of return material from the process. Pre-consumer waste can therefore be avoided.
- Aluminum with a low CO2e footprint: The electrolysis process in the production of primary aluminum is powered by electricity. The use of electricity from renewable energies is possible without having to invest in plant technology. This enables the production of aluminum alloys with a low CO_2e footprint. Corresponding aluminum is already available in large quantities today.
- Secondary alloys: With megacasting, secondary alloys can also be processed without any problems. The limiting factor is not the casting process, but the requirements for corrosion protection and, under certain circumstances, mechanical properties such as elongation at break. Secondary alloys with the lowest possible iron and copper content are preferable.

In conclusion, sustainable megacasting production represents a significant advancement in the automotive industry. It not only reduces assembly complexity but also lowers investment costs in production facilities.

Moreover, the flexibility in alloy choices and the use of aluminum with a low CO_2e footprint contribute to a more sustainable manufacturing process.

As car manufacturers strive to achieve ambitious emission reduction targets, megacasting offers a promising solution for producing the vehicle bodies of tomorrow in an economically and environmentally friendly manner.

SOURCE

VolvoCars. (2024, 11 18). VolvoCars. Retrieved from https://www.volvocars.com/de- ch/sustainability/climate-action/

For more information: die-casting@buhlergroup.com