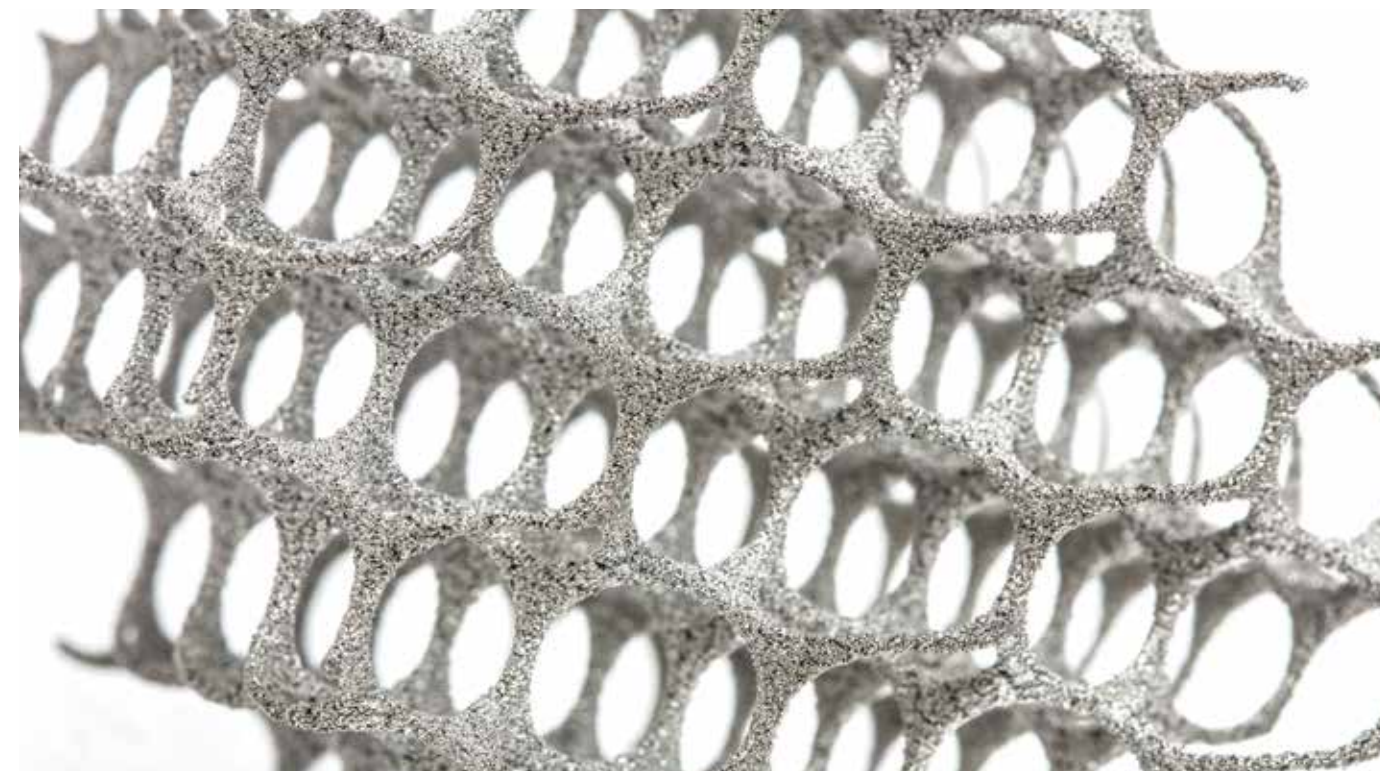


Additive Manufacturing Solution



Next Generation Metal 3D Additive Manufacturing

Fusion of existing technology and AM(Additive Manufacturing)
to bring a flexible idea to your molds



DYNAMO,INC.

Kyouei-douri 7-107 Seto-City Aichi-Ken Japan 489-0809

Tel: +81-561-88-1076 Fax: +81-561-88-1077

<http://www.dynamo.co.jp/>



CHANGE FUTURE

Additive Manufacturing changes the future of the Die casting Industry

Dynamo's Manufacturing

Mold manufacturing technology
that has been pursued to the
utmost limit



Additive Manufacturing

Fusion of existing technology and
AM (Additive Manufacturing) to
bring a flexible idea to your molds

Case Study

Application example of
AM Technology

Case Study

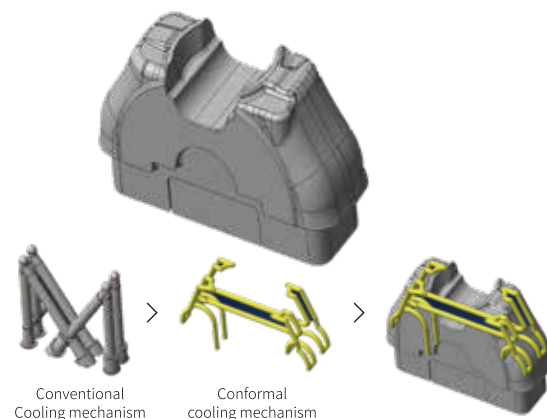
Application example of AM technology to molds

Conformal cooling insert

We identify the areas that can benefit from conformal cooling and design molds with an optimum combination of conventional and conformal cooling channels, and achieving improvement of insert's productivity by using 3D printer.

This process can be used effectively not only for cooling but also as a temperature control mechanism.

By manufacturing molds and inserts with Additive Manufacturing, casting cycle times can be shorter and defects can be decreased.



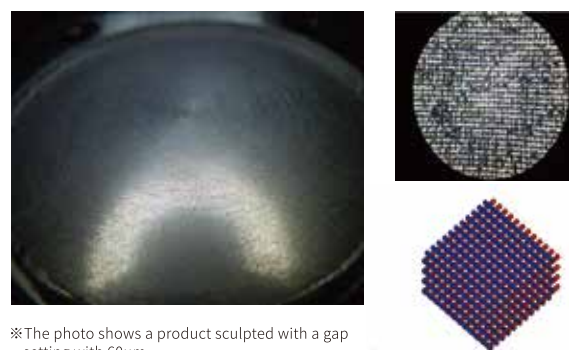
Lattice structure

By using the design method of the 3D data, Lattice can design a variety of shapes, such as Body-centered cubic or Face-centered cubic which mimic the crystalline structure of metals and anisotropic structures, which refer to the truss structure of a bridge to increase strength in the vertical direction.

In addition, lattice structure can be utilized in a variety of situations, not just for weight reduction.

In molds, combining with conformal cooling channels can add not only cooling effect but also rigidity and durability.

These channels can also be used to effectively supply water or oil, or to discharge or draw in air.



※The photo shows a product sculpted with a gap setting with 60μm.

Our Policy

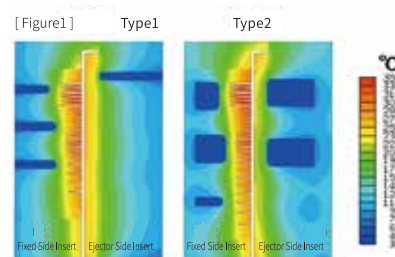
AM technology
utilization to molds

Policy Our policy for AM

Dynamo's Group will provide you further improvement and innovation by combining mold-making technology we have developed over many years and Additive Manufacturing. Flow analysis and thermal analysis software can be used to analyze conventional and conformal cooling respectively and simulate the expected results. (Figure 1) We compare the temperatures, check

the differences in cooling effect and cooling uniformity and make an optimal design and proposal for each component. This method can also be applied to the entire mold at the conceptual design stage of the mold. This will turn the improvement activities for the events that have occurred so far into innovation. Activities to realize the idea from the initial stage. Additive Manufacturing allows us to create ideas with a degree of freedom that transcends preconceived notions in mold making.

We do not compromise in manufacturing either. We will continue to develop our recipes by adopting SKD61 series die steel, which exceeds the composition and special characteristics of maraging steel. With a commitment to providing 3D additive manufacturing in the most suitable grades of steel for die-casting molds, we have acquired the facilities and technology to carry out all processes from heat treatment and final finishing to quality assurance. (Figure 2) We continuously work on further improvement. Having a wealth of experience in the field of surface preparation and coating and can offer you the best possible coordination. With this system, we aim to solve our customers' QCD issues together.



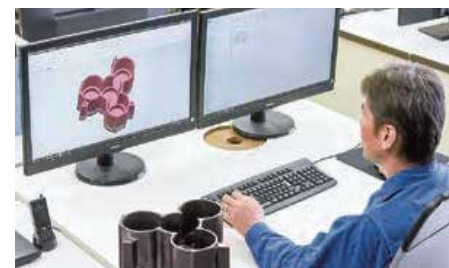
[Figure2]

	Hardness as molded (HRC)	Use Hardness (HRC)	※1 Thermal conductivity	Main Purpose
HTC™45	45~47 (○) ※2	40~50	※3 1.5times (○)	Die Casting Mold
HTC™40	40~42 (○)	35~45		Die Casting Mold, Plastic injection mold
SKD61	53~55 (×)	40~53	1times (○)	Die Casting Mold, Hot forging mold
maraging steel	34~36 (○)	45~54	0.7times (×)	Metal powder for additive manufacturing (for die casting)

※1 Comparison of the thermal conductivity of SKD61 at room temperature with 1
※2 Resistance to cracking during molding
○:High Resistance ○:Normal Resistance ×:Low Resistance
※3 Mold performance ○:Very Good ○:Good ×:Not Good

Service

Features of Dynamo — AM solution services with integrated production within the group —



01. Analysis and design optimization

Thermal Analysis, AM Optimization design & Mold design

It is possible to optimize designs to improve cooling efficiency based on the results of thermal analysis using dedicated software. We are developing a new mold design method that uses AM from the structural design stage of the mold. The strength and physical properties of AM products can also be analyzed to evaluate and improve their suitability.

3D Additive Manufacturing

GE Additive CONCEPT LASER - M2 cusing SL 400 W Series 4, 2 machines
Modeling size : 245x245x350mm (W/D/H)
Maximum molding volume : 22L, Layer thickness : 20~80 μm, Production speed : 20cm 1/h

※Material: Daido Steel - HTC45
High Conductivity Material for molds
(Specializing in SKD61 type of steels)



02.

DMLS (Direct Metal Laser Sintering)



03.

Heat treatment/ Tempering

Heat Treatment

Nabertherm - Chamber furnace N41/H
※Maximum temperature:1280℃
※Size of the furnace:350x500x250mm, Volume:41L, Weight:260kg
※Mainly used in tempering process

Finishing

We have more than 200 machines in our group, including 5-axis MC, vertical MC and EDM lathes. Our specialists in mold and part manufacturing select the most suitable processing method for each shape, and perform highly efficient and accurate finishing of the product. We can also coordinate polishing, shot blasting, mirror finish, and surface treatment. As an option we offer abrasive water jet polishing of internal cooling lines to improve surface roughness and flow.

04.

Finishing



05.

Assurance and Follow-up After Delivery

Quality assurance / Follow-up after delivery

We have a variety of inspection equipment, including CMMs and Non-contact measuring machines, to meet the most strict quality requirements. We have established a system that allows you to access the material and heat-treat certificates, and dimensional inspection result by simply scanning QR codes. We can also check for water flow, flow rate and pressure leak test.
※See page 7 for details on quality assurance in the molding process. After delivery, we will appreciate your evaluation of our products to improve in the future.

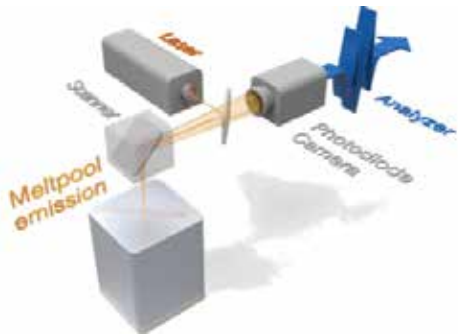


Quality Assurance

— Modeling quality control methods —

Image Analysis System for Quality management

- Real-time monitoring of melt pool radiation
- Management automatic coating
- Monitoring of build envelope
- Controlling of power and laser condition
- Measuring powder bed's laser power before and after molding.
- Analysing and controlling oxygen concentration in inert gas, management and filtering of gas flow rate.



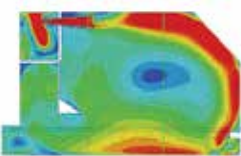
Improvement of gas flow

As AM process uses gas laser irradiation in the insert, uniformity of gas flow is important under molding. Conventionally the gas flow rate varies depending on the shape of part, this affects the quality. However, currently gas flows uniformly, and the consistency has been improved.

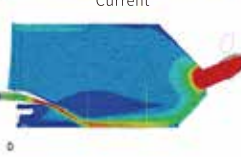
Example of difference in inert gas flow



Previous



Current



Quality identification

The quality of the internal structure is audited with non-destructive testing. In this image analysis, by imaging luminance of melt pool, will enable us to check every layer like CT cross section. With high image quality, surface errors, voids, and inclusions in melting are easily identified.



Imaging luminance of melt pool

Melt Pool 3D Visualization



3D Visualization of melt loop data (VG Studio)

Partner

— Our Partners —

Our development of additive technologies for SKD61 die steel are supported by our partners. With our partners co-operation, our technologies will continue to evolve. We will continue to develop our technology with new techniques and alloys as they become available.

