



DMT[®]

3D Metal Printer

www.insstek.com

**InssTek**

InssTek, Inc

After successful development of 3D metal printing technology for complex geometries in 1999 InssTek Inc. was established in 2001 with the aim of developing and commercializing the DMT 3D metal printing technology.

DMT 3D metal printing technology produces complex and functional 3D metal parts and structures using high power laser and commercially available metal powders. According to the standard of ASTM (American Society for Testing and Materials), DMT technology is to be categorized as 'Directed Energy Deposition'. It provides a multitude of new technical solutions for our customers.

InssTek offers, from DMT metal printing process and MX-OS to Magics for InssTek software, all components for the 3D metal printing process. Furthermore we strive to meet increasing consumer demands by offering comprehensive services in addition to many tailored technical solutions.

Our ambition is to make customer's imaginations real. Passionate and challenging we move everyday towards our goal.

Mission of InssTek

To offer technology and service of unique value.
To cover from nano to macro all metal printing areas.



Business Areas

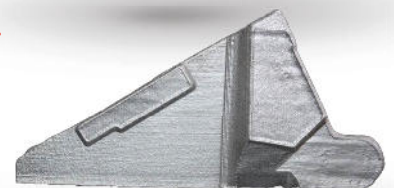
InssTek's core competencies lie on DMT 3D metal printing technology, laser material processing and system development. Main activity can be divided into two groups, namely system area and service area.

System Business

- DMT 3D Metal Printers
 - MX serie (Standard DMT Machines)
- Special Purpose DMT Machines
 - MPC
- Customized DMT Machines
 - MX-Grand



Tyre mold test piece



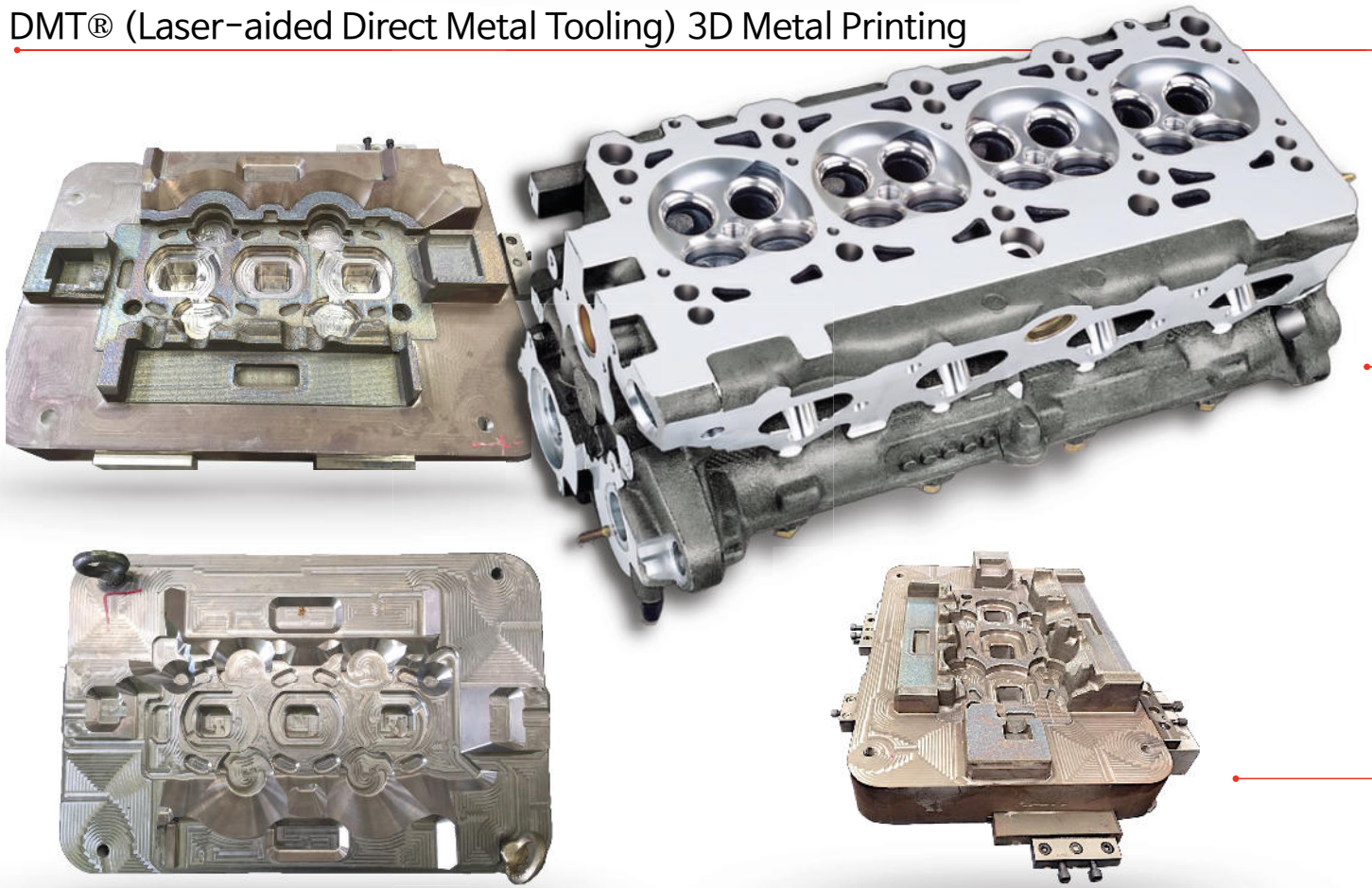
Military Aircraft door hindege
*Material : SUS420J2

Service Business

- Industrial Services
 - Mold/die cores having 3D conformal cooling channels
 - High-performance multi-metal parts and molds
 - Repair and restoration of damaged molds and machine parts
 - Remodeling of machine parts and molds
 - Special coatings and surface modifications

DMT® Technology

DMT® (Laser-aided Direct Metal Tooling) 3D Metal Printing



automotive cylinder heads

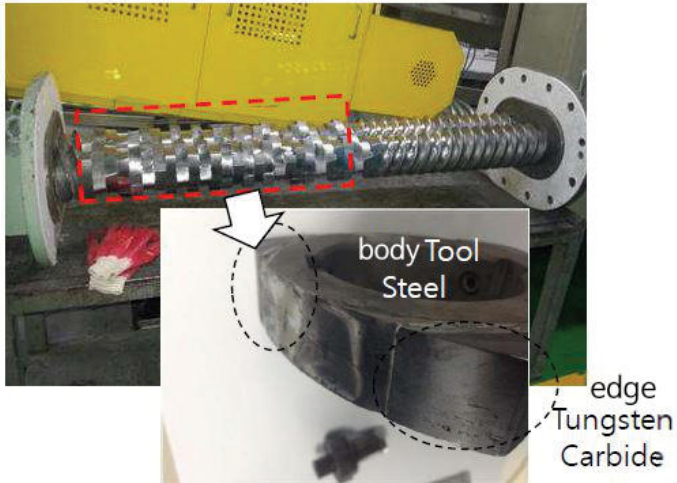
- Body part of the mold: SCM 440 alloy (Steel alloy)
- Surface part of the mold: Hastelloy C22 alloy (Ni alloy)
- The size of the mold: 570 X 380 X 126 (mm)

DMT 3D metal printing Technology belongs to most advanced generative manufacturing processes. This technology melts commercially available metal powders using high power laser and shapes complex metal structures with the aid of 3D CAD file. It is one of the latest 3D metal printing technologies and is classified according to ASTM standard in the category of 'Directed Energy Deposition'. Compared to more famous 'Powder Bed fusion' Technology, DMT 3D metal printing technology uses commercially available industrial-metal powder.

It is therefore very economical. The powder flows constantly and is completely melted through laser beam and rapid solidified again. The microscopic metal structure is thus 100% tight and not different from conventionally produced metal parts or has in some cases even better mechanical properties.

DMT technology allows technical solutions that were unthinkable with traditional method. Molds with complex internal structure fully equipped with sensors and cooling channels, metal parts with multiple layers of different metals, repair of complex surfaces, modification, transformation and special coating work are just some of many examples. DMT 3D metal printing technology is already widely applied in electrical, automotive, medical, aerospace and defense industries. Molds with internal coolant supply, metal parts consisting of several layers of metal types, parts with complex geometries are already being used in hundreds in mass productions. Furthermore, artificial joints for surgery, components of aircraft engines are produced using DMT 3D metal printing technology.

DMT® vs. Cladding



***Autotracking : Repair automatically without CAD/CAM**

The basic principle of 3D metal printing technology is relatively simple. A 3D CAD file is transformed into a collection of 2D layers by slicing and built up mechanically layer by layer. DMT 3D metal printing technology builds the 2D layer with the aid of high-power laser and metal powder.

Laser beam forms a melt pool on the metal surface and in this pool a finely-aligned beam of metal powder is shot. The powder is completely melted and solidified again. The laser beam and the melt pool move in all four directions calculated from the 3D CAD file and thus form layer by layer the desired metal structure.

Crucial for high-precision 3D metal printing is the precise fine tuning of the 2D layer thickness. Our DMT technology uses the in house developed DMT closed-loop feedback control system which measures and monitors all layer thickness affecting parameters during the printing process.

In our machines series of MX type we can select between 3 standard modules with 150, 250 and 450 microns layer thickness. According to customer's need the layer thickness can be varied between 100 and 1000 microns.

DMT® Features & Applications

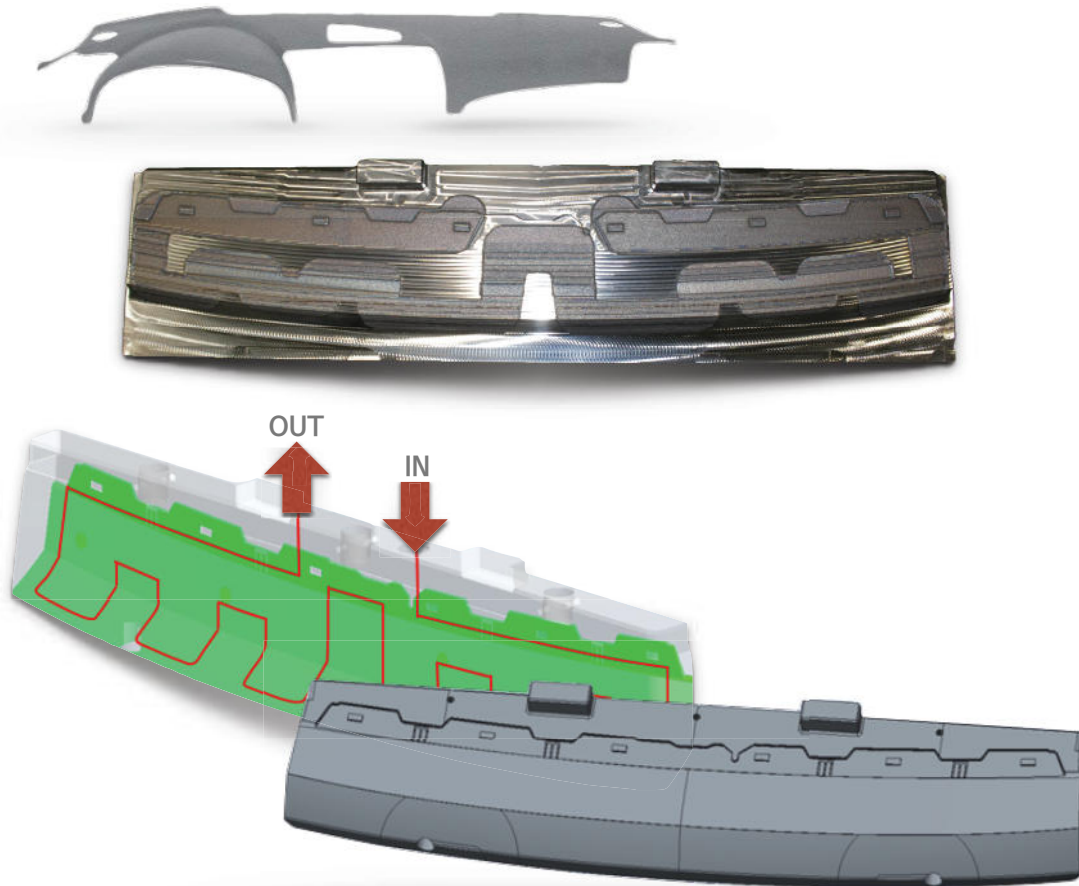
1. Commercial metal powders



DMT uses commercially available powders

| Alloy Class | Alloy | Alloy Class | Alloy |
|-------------|--|-------------|---|
| Steels | P20, P21 (DIN 1.2311) | Titanium | CP Ti (DIN 3.7024) |
| | H13 (DIN 1.2344) | | Ti-6-4 (DIN 3.7164/ 3.7165) |
| | D2 (DIN 1.2379) | | |
| | 304 (DIN 1.4301, 1.4303) 316 (DIN 1.4401, 1.4436) 420 (DIN 1.4021, 1.4007) | Nickel Base | 713 718 (DIN 2.4668) 738 Hastelloy X (DIN 2.4665) |
| Copper | Al Bronze (DIN 2.09XX) | Cobalt Base | CoCr Stellite 6 Stellite 21 (DIN 2.4979) Stellite 25 |

2. Molds with 3D Conformal cooling channels



TL Dashboard mold
- Base material : NAK
- Powder : P20

DMT 3D metal printing technology is able to produce products with complex internal structure like molds with 3D cooling channels. Already many molds produced with DMT methods are used in industries such as automobile production and are characterized by excellent cooling properties with injection molding, die casting process as well as in hot stamping.

In particular, the shortening of production cycle time contributes to increased productivity. Homogenous temperature distribution on the casting surface prevents unwanted deformation of plastic products, avoiding that aluminum scrap bonds to injection molding cases provides better overall quality.

Corrosion problems that occur on 'powder bed fusion' production in the manufacture of cooling channels and can lead to constipation can be excluded entirely.

What distinguishes the DMT technology in terms of making molds with 3D internal coolant supply especially from 'powder bed fusion', is the opportunity to not only create new molds but to equip existing molds with new cooling channels. There are many methods to provide molds with 3D cooling channels. The most popular 2 methods are described below.

3. Graded materials

Multi-metal parts composed of two or more different metals can be fabricated by quickly switching a powder feeder to another one during a printing process with DMT technology.

Fabricating multi-metal parts has 2 significant industrial advantages; one is to significantly reduce the production cost in fabricating structures made of special (expensive and strategically important) metals by depositing them to the right places where their functional properties are needed.

Second is to be able to apply a new concept to develop a new product. For example, a thermally conductive mold can be fabricated by using two different kinds of metal powders, Cu or Cu alloy powder for the part needing high thermal conductivity, and tool steel powders for the working part needing high wear resistance.

4. Innovative Repair



Airplane Turbin blade Repair
- material : Ti6Al4V (Gd5)

Repair and restoration of damaged metal products are one of the strongest functions in DMT 3D technology. It means the restoration of their shapes and properties same as the original one using the exactly same metal compositions as the damaged ones.

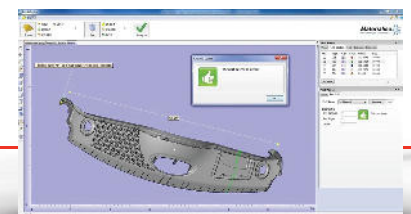
DMT 3D technology can also be used for reverse engineering. This process can be done by repairing the damaged part after creating their 3D CAD data using a 3D scanner and comparing them with their original 3D CAD data.

This technology can make it easy to repair the structures damaged on their curved surfaces having no original CAD/CAM data by self-creating 3D geometrical information on the damaged curved-surface following randomly designating three or more point coordinates (X, Y, and Z) on its imaginary surface in real-time.

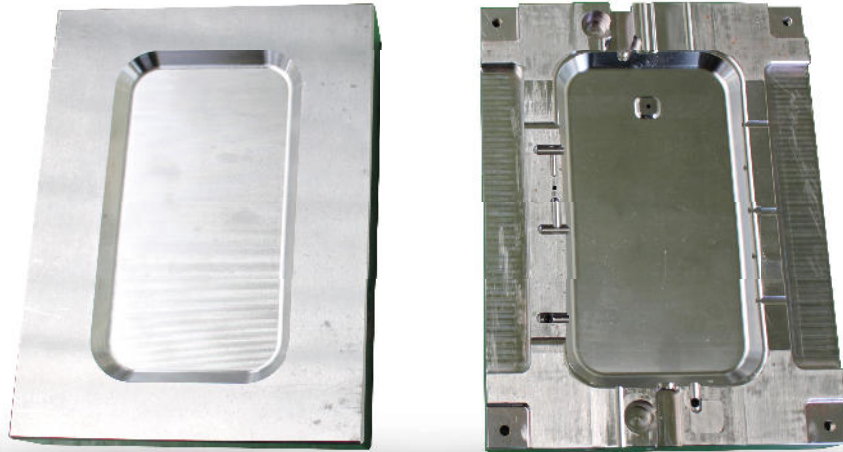
5. Magics for InssTek

Magics for InssTek is a builder processor, developed through Collaboration between InssTek and Materialise.

The 2G MX-CAM software is fully transformed to 'Magics for InssTek', under a new name with "Easy & Simple to Use" concept.



6. Remodeling



Mobile phone parts injection mold
- material : SUS420J2

DMT 3D technology can reconfigure outdated or damaged molds much effectively by comparing CAD data of new and outdated ones using a reverse engineering technique followed by

removing unnecessary parts and subsequently building-up required ones using the DMT 3D printers. This technique can also be applied for large-size structure for try-outs.

7. Mechanical properties



cross section
- base substrate : SM45C
- deposition material : SUS420J2(STAVAX)

It's eventually a new alloy through atomic bonding

| Materials | UTS(MPa) | YS(MPa) | Elongation(%) | Materials | Hardness(HRC) |
|---------------------------|----------|---------|---------------|------------------|---------------|
| DMT SKD 61 (H13) (Length) | 1,927 | 1,066 | 5 | DMT SKD 61 (H13) | 54 |
| DMT SKD 61 (H13) (Width) | 1,998 | 1,477 | 5 | Wrought SKD 61 | 51 |
| Wrought SKD 61 | 1,821 | 1,385 | 9 | DMT P21 | 33 |
| DMT P21 (Length) | 920 | 793 | 20 | KP4M | 32 |
| DMT P21 (Width) | 1,090 | 1,016 | 18 | | |
| Wrought KP4M | 958 | 857 | 16 | | |

DMT® Machine

DMT® 3D Metal Printers (MX series)

MX series is a brand name of the InssTek's DMT 3D metal printers with various functions for 3D metal printing processes, which have been developed for over-all purposes. 3 types of DMT 3D metal printers, "MX-250", "MX-450" and "MX-1000", are available now, which have 3 axis and 5 axis motions.



MX-250

Entry model

Specifications

- 300W Ytterbium Fiber Laser (or Optional Laser Power)
- Work Envelop 250X250X250
- 3Axis Motion Model (Optional 5 Axis)
- Standard DMT Module 500 (or SDM 800)
- Max. 3 Powder-feeding Systems (Optional)
- DMT Close-Loop Feedback Control System (Optional)
- Auto-tracking System with Semi Teach-to-learn Function (Optional)



MX-450

DMT® 3D printer for small & medium sized metal products

Specifications

- 1 kW Ytterbium Fiber Laser (or Optional Laser Power)
- 3 Axis or 5 Axis Motion Model (Optional)
- XYZ Linear Gantry & A/C Tilt/Rotation (Optional)
- Work Envelop: 450 X 450 X 350 (mm)
- (Tilt/Rotation Motion optional)
 - A/C: -100° up to + 5° / 360°, Size of T/R: ϕ 250 mm
- Standard DMT module 800 (or SDM 500 or SDM 1200)
- Max. 3 Powder-feeding Systems (Optional)
- PC-based Control System with 17" Touch Screen
- DMT Closed-loop Feedback Control System
- Auto-tracking System with Semi Teach-to-learn Function (Optional)
- Magics for InssTek Software for DMT Process Only

DMT® Machine



MX-1000

DMT® 3D printer for medium & large sized metal products

Specifications

- 2 kW Ytterbium Fiber Laser (or Optional Laser Power)
- 3 Axis or 5 Axis Motion Model (Optional)
- XYZ Linear Gantry & A/C Tilt/Rotation (Optional)
- Work Envelop: 1,000 X 800 X 650 (mm)
- (Tilt/Rotation Motion)
 - A/C: -100° up to +5° / 360°, Size of T/R: ϕ 450 (mm)
- Standard DMT module 800 (or SDM 500 or SDM 1200)
- Max. 3 Powder-feeding Systems (Optional)
- PC-based Control System with 17" Touch Screen
- DMT Closed-loop Feedback Control System
- Auto-tracking System with Semi Teach-to-learn Function (Optional)
- Magics for InssTek Software for DMT Process Only

Customized DMT® 3D Machines



MX-Grand

Engineered DMT machines are the 3D metal printers on demand of the customers for their special purposes and conditions.

Specifications

- 5kW Ytterbium Fiber Laser
- 6 Axis Motion
 - XYZ Linear Gantry & A/C Tilt/Rotation & U Rotation
- Working Envelop:
 - 3 axis mode: 2,000 X 1,000 X 1,000 mm
 - 3 axis machine: 4,000 X 1,000 X 1,000 mm
- A/C: -100° up to +5° / 360°, Size of T/R: ϕ 450 (mm)
- U motion: max 25 RPM / ϕ 650 mm
- Standard DMT module 1200
- 3 Powder-feeding Systems
- PC-based Control System with 17" Touch Screen - DMT Closed-loop Feedback Control System
- Auto-tracking System with Semi Teach-to-learn Function
- Magics for InssTek Software for DMT Process Only

DMT® Machine

Special Purpose DMT Machines

Special purpose DMT machines reinforced with specific functions are developed for specified industrial purposes. At present, a DMT 3D printer named MPC is commercially available, which is applicable only to coat orthopedic implant surfaces with porous Ti alloys. In near future, DMT 3D Repair machine and DMT 3D Dental machine will be released.



Porous Cup & Stem for Orthopedic implant
Material : Pure Ti with DMT Porous coating



MPC

DMT® 3D metal printer for special coating of orthopedic implants

Specifications

- 500W Ytterbium Fiber Laser
- 5 Axis Motion
- XYZ Linear Gantry & A/C Tilt/Rotation
- (Tilt/Rotation Motion)
 - A/C: -100° up to +5° / 360°, No. of T/R Stage: 4 Set
- Standard DMT module 800
- Max. 3 Powder-feeding Systems (Optional)
- PC-based Control System with 17" Touch Screen
- Self-calibration System for Powder-feeding Rate
- Nozzle Self-cleaning System
- MX-OS for MPC



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