DMT®

Leading Technology

Innovative
additive
manufacturing

3D
Metal
Printer

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 HMI program 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.

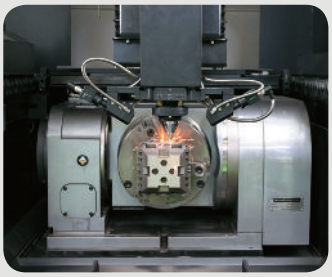
Our ambition is to make customer`s imaginations real. Passionate and challenging we move everyday towards our goal.

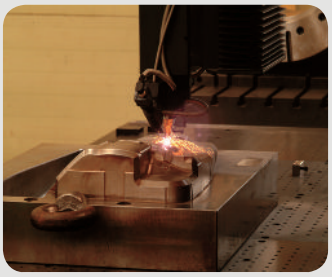
Mission of Insstek

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 Part

DMT 3D Metal Printers
- MX series (Standard DMT Machines)

Special Purpose DMT Machines
- MPC series

Engineered DMT Machines
- Taylor-made DMT & Laser Material Processing Machines
- Large-scale DMT 3D Metal Printers (ex. Grand Teton)

Software and Peripherals

Core Technologies

DMT 3D Metal Printing Technology

Laser Material Processing Technology

System-Developing Technology

Service Business Part

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

Special Industrial Services
- -Medical, Aerospace, Defense, etc.
- -Repair and restoration of aircraft engine parts

3D metal printing process development

Technical training

Business areas

System area

DMT 3D metal printers: Standard DMT 3D metal printer MX series are designed, manufactured and marketed. Currently 4 DMT 3D metal printer models are available.
Special purpose DMT 3D Metal printers: Tailored special machines based on the DMT 3D metal printing technology for individual industries are designed and produced.
Engineered DMT Machines: On customer`s request specifically to his need tailored machines are manufactured.
Software and peripheries: We offer software and Peripheries to simplify the use and to allow more diverse approach to the DMT 3D metal printing technology. Magics for InssTek, major spare parts and various options are being offered.
the DMT 3D printers with satisfaction.

Service area

Industrial Service: metal parts and molds are manufactured using the DMT 3D metal printing technology.

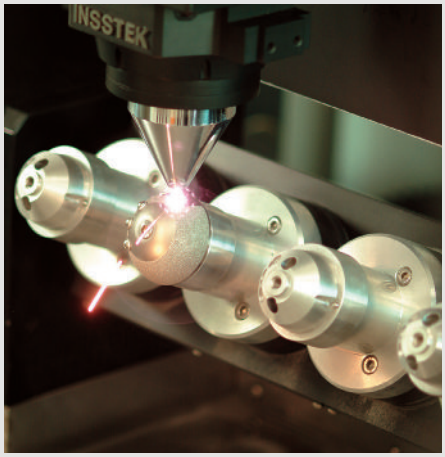
Special-purpose metal parts, molds with internal coolant supply, heat conductive parts, parts of several different kinds of metal, parts with a complex internal structure can be produced. Moreover, existing metal parts can be repaired, modified and reshaped.
Special industrial Service: Production of metal parts out of special alloys including Titanium, Nickel and Cobalt. This service aims at medical-, military-, aircraft-, power generating- and aerospace industry.

Process development: On customer´s request product or whole production processes can be developed. DMT 3D metal printing technology such as laser cladding technology is applied.

Technical training: In order to enable easier, versatile handling of DMT 3D metal printing technology, individual training and joint projects are offered.

DMT® Technology

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

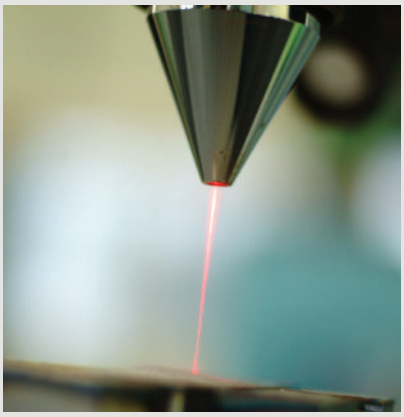


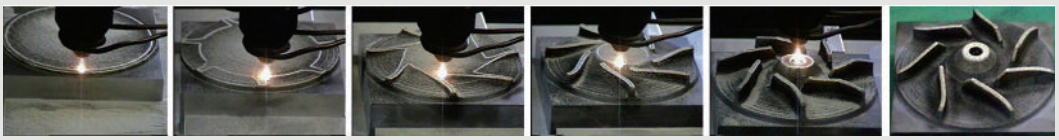
DMT® 3D metal printing

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.

Innovative Additive Manufacturing





Outline of the DMT® Process

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.

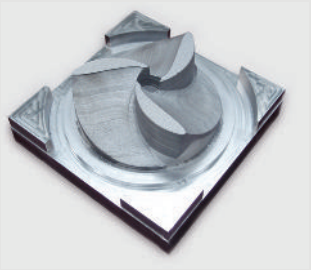
Crucial for high-precision 3D metal printing is the precise fine tuning of the 2D layer thickness. Our DMT technology uses the in house developed DMT closed-loop feedback control system which measures and monitors all layer thickness affecting parameters during the printing process.
In our machines series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

DMT® 2 Build-up method of DMT® Technology

Two build-up methods of the DMT® 3D metal printing technology

To have more flexibility in fabricating 3D metal products, InssTek has developed two different build-up methods, a 'simple build-up method' and a 'hybrid build-up method'



DMT® simple build-up method

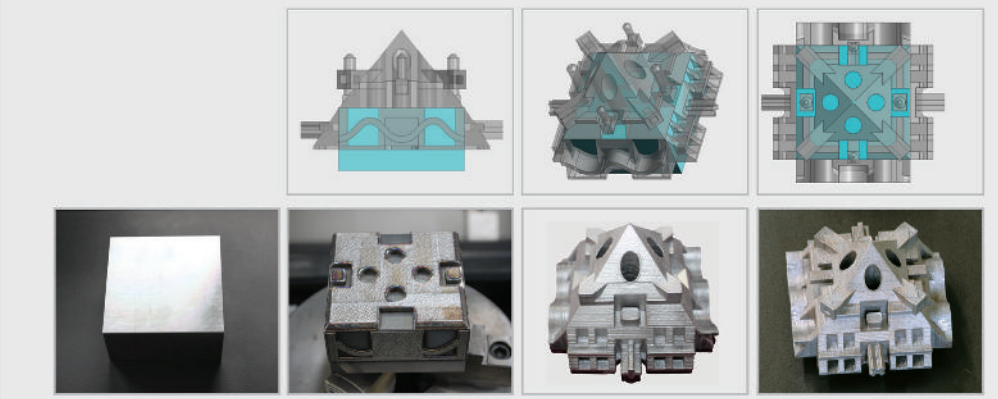
A method fabricating a whole 3D metal structure using DMT technology out of nothing.

DMT® hybrid build-up

In order to reduce the printing time and cost for fabricating a 3D metal structure, no matter how big or complicated it is, the best way is to build-up only a complex working part using DMT technology on the surface of a simple structure already-made by conventional manufacturing methods such as machining, cutting, casting, etc..
It doesn't matter whether the simple structure has 2D planar surface or 3D curved surfaces.

This hybrid build-up technic in the DMT 3D Printing process is attributed to perfect metallurgical bonding together with the simple metal structure, which can accomplish a perfect color matching between already-made structure and the built-up part using DMT technology, so that each part cannot be distinguished with bare eyes.

Hexahedron structure build-up by Hybrid-DMT using a metal block (Material : SUS 420J2)



DMT® 5 Outstanding merits of DMT® Technology

The 5 main advantages of DMT® 3D printing technology compared to Powder Bed Fusion.

In most cases the main 3D metal printing technologies are classified into two groups, namely the 'Powder Bed Fusion' and the 'Direct Energy Deposition'. Although both technologies use metal powders and a laser beam, there is a big difference in powder feeding method.
In the 'Powder Bed Fusion' technology a thin layer of metal powder is spread on a powder bed on which a laser beam with relatively low power is scanned to sinter or melt selectively the metal powder and thus to form a 2D metal layer. A 3D metal structure is manufactured by repeating this process in a layer-by-layer manner. SLS (selective laser sintering) and SLM(selective laser melting) belong to this technology.
On the other hand, for the 'Directed Energy Deposition' technology, a high-power laser beam and metal powders are injected simultaneously on a substrate surface. Process variables are controlled in real time during the deposition process to fabricate the precise 2D metal layer. A 3D metal structure is manufactured by repeating this process layer by layer. DMT technology comes under this category.
These differences in the metal powder feeding methods causes a huge technical difference in the properties of the manufactured structures.
Five Main Characteristics of DMT technology Different from those of the PBF

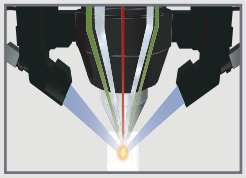
1. Use of commercially available metal powders
   - DMT technology uses a variety of metalpowders commercially available inmarket while the PBF very often uses expensive metal powders made and specified by the 3D printer manufacturer.

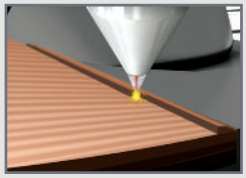
2. Diverse Usage of DMT technology:
   - Hybrid 3D metal printing
   - Processes formerly not able with the PBF technology:
     - Restoring & repairing damaged metal structures
     - Manufacturing 3D metal structures composed of multi-metals
     - Reconfiguration of metal parts
     - Special coatings, surface modifications, etc.

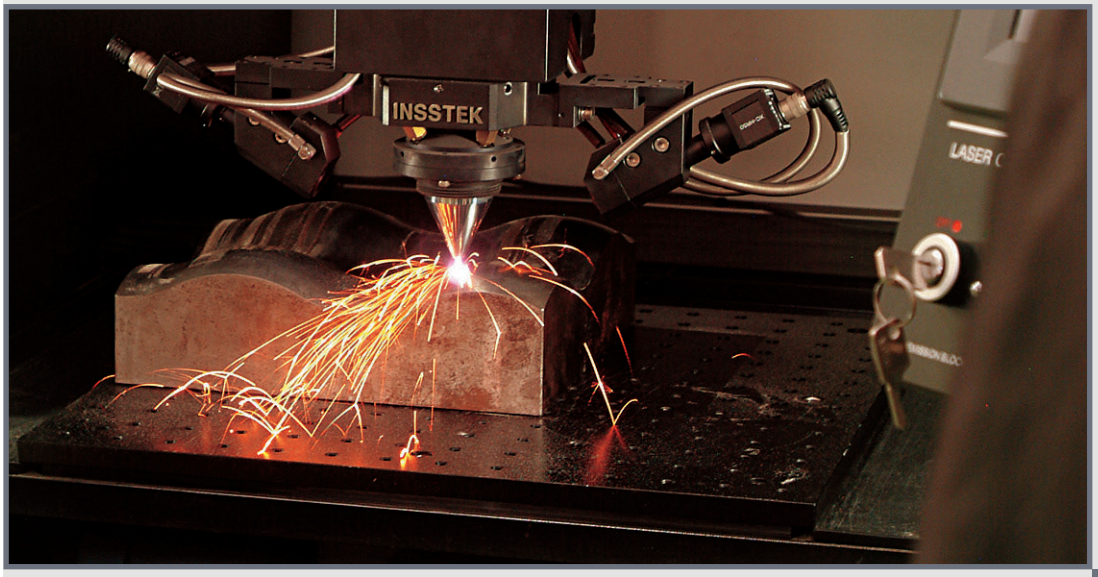
3. Complete melting & excellent mechanical properties
   - DMT technology fully melts the metal powders and allows rapid cooling of the melt pool, resulting in nearly 100% dense and very fine microstructures. The manufactured 3D metal components show mechanical properties equal to or better than those of the forged ones, even without post heat treatment.

4. Auto-tracking technology with Semi-Teach-to-Learn function.
   - Repairing the damaged components having 3D curved surfaces by tracing automatically the damaged surfaces without any help of 3D CAD/CAM. It`s InssTek`s unique technology.

5. No size limitations in structures to be printed
   - The 'Powder bed fusion' is very hard to fabricate 3D metal structures larger than 250x250 mm in size, whereas DMT technology has no size or structure limitation.







DMT®
outstanding merits compare with powder bed fusion

Use of comercially available metal powders

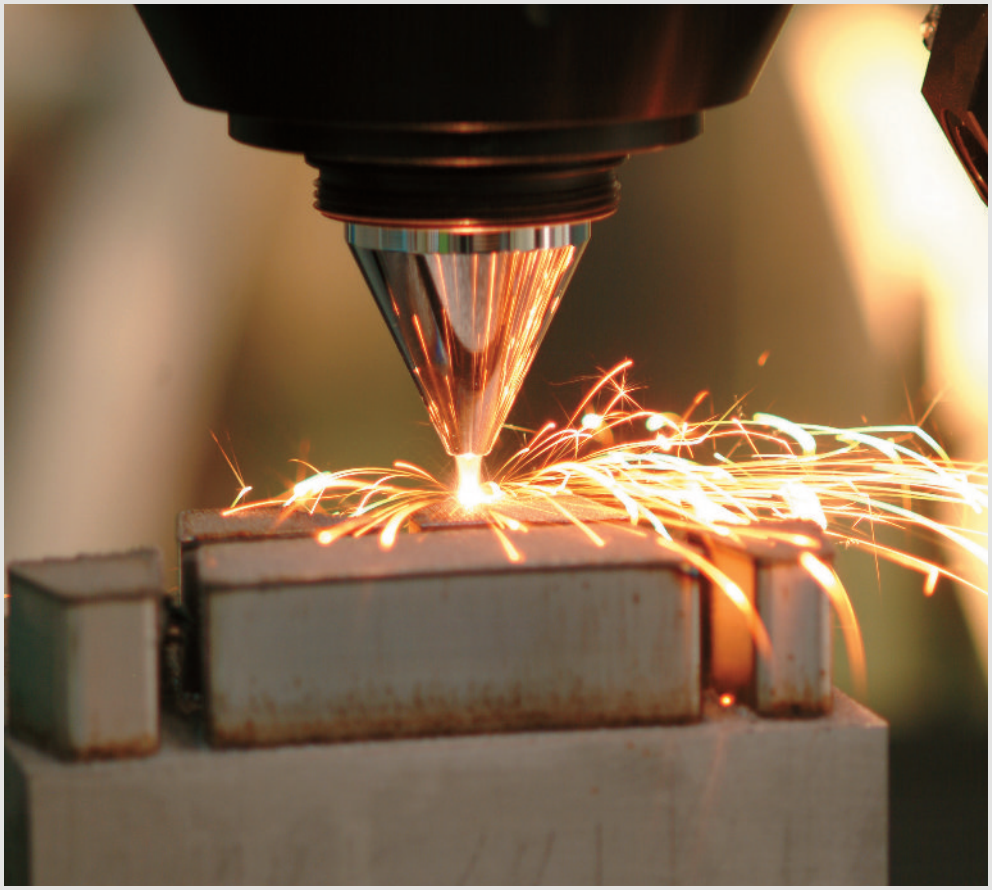
Diverse solutions

Full powder-melting and superior properties

Auto-tracking Technology. with Semi Teach-to-learn Function.

No limitation in the sizes of the manfactured structures and DMT 3D printers

DMT® 3D Metal printing features & applications



1.Use of commercial metal powders.

While most 3D metal printers use only the specially prepared, very expensive special metal powder, DMT 3D metal printer requires usual industrial metal powders.

This solution is very economical and has the advantage of greater variety of metal and metal alloys.

Alloy Class	Alloy	Alloy Class	Alloy
Steels	P20, P21	Titanium	CP Ti
	H13		Ti-6-4
	D2, (M2, M4)		Ti-6-2-4-2, Ti-6-2-4-6
	304, 316, 420	Nickel Base	600, 625, 690
	S7, A2		713, 718, 738
	17-4PH, PH 13-8Mo, CPM 1V,Invar		Hastelloy X, Waspalloy,C-276, Nistelle C
Copper	Cu-Ni, Cu-Sn, Al Bronze	Cobalt Base	CoCr, Stellite 6, Stellite 21, Stellite 706, MERL 72
Aluminum	4017, 4140, 4340	Tin	White Metal
Others	Cu-Sn alloy-Diamond composite, Pure W, W-Re, Mo, Re, Nb, Nb-Si, Norem, etc.		

The table shows just the metals already printed with our technology so far. Almost every week a new metal is added to our experience.

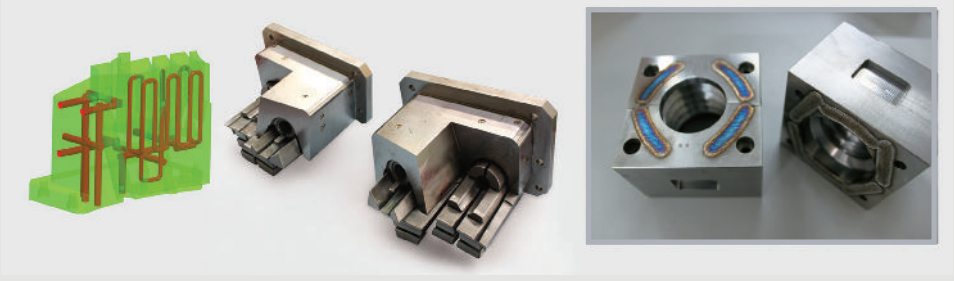
2. Manufacturing metal products having complex internal structures (molds with 3D conformal cooling channels)

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.

1. Copper tube insertion: In the manufacturing process of molds copper tube is inserted in the space provided and sealed with DMT technology. Through use of copper pipe corrosion risk is minimized.

2. New technology for 3D cooling channel production: In the by InssTek developed and patented coupon method parts of desired shape are produced in advance and put together to a whole structure during 3D metal printing process. This already in mass production proven method is particularly suitable for complicated structures and has excellent corrosion resistance.



3. Fabrication of High-performance multi-metal parts

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. DMT 3D metal printers have 2 or 3, even more metal powder feeders each of which filled with different kind of metal powder. The part fabricated with multi metals can maximize its performance and life time because a functionally suited metal can be deposited to the right place. This is one of distinctive values of DMT 3D 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.

The thermally conductive molds fabricated using DMT 3D technology are already being used in mass production in automobile industry and confirmed their excellent performance.

4. Restoration and repair of damaged metal products such as molds

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.

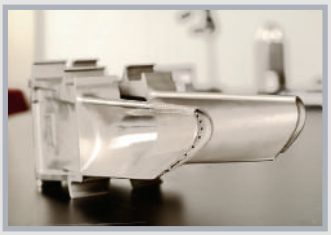
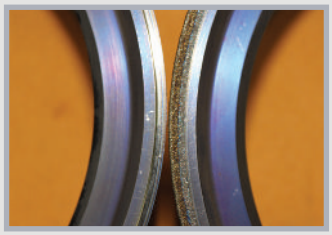
DMT 3D technology can also be used for reverse engineering. This process can be done by repairing the damaged part after creating their 3D CAD data using a 3D scanner and comparing them with their original 3D CAD data.

Another strong and unique merit of DMT 3D metal printing technology is an 'autotracking' technology working in a 'semi-teach to-learn' mode.

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.

This unique technology is offered optional to InssTek`s Magics software.

Restoration and repair technologies of DMT are getting more and more popular among the traditional industries.

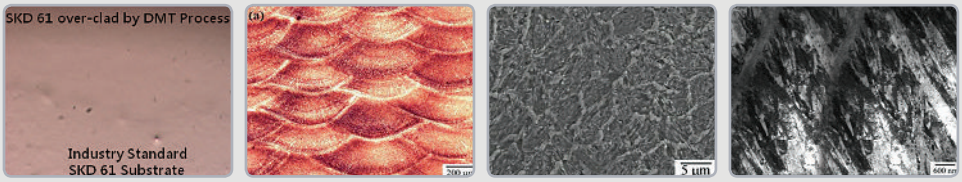
Reconfiguration of Metal Parts

5. Reconfiguration of metal products

DMT 3D technology can reconfigure outdated or faulted 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 tryouts.

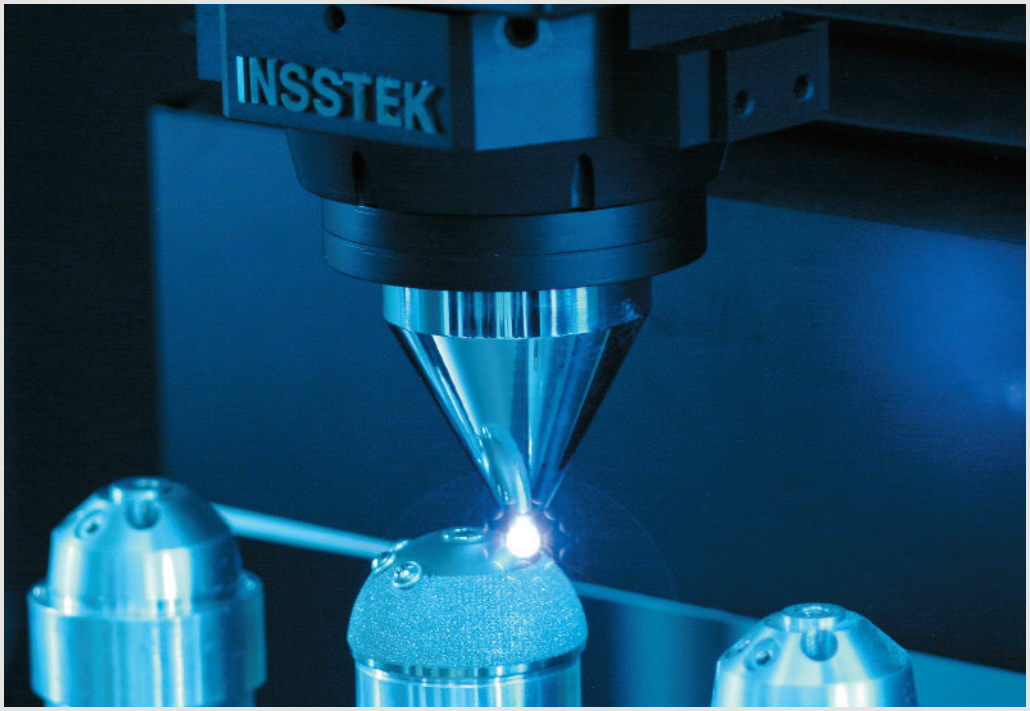
6. Superior mechanical properties

The structures manufactured by the DMT 3D printers have been confirmed to have equal or superior metallurgical and mechanical properties compared to wrought ones, even without post heat treatment. They show fully dense and very fine microstructures resulting from rapid solidification of complete melt-pool.



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		

Special Metal Components

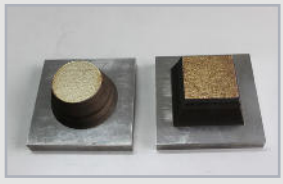


7. Manufacturing structures with special metals

In the DMT metal 3D printing technology, the metal powder which was not used for printing, will be collected and reused. Material loss is therefore very low, which is especially helpful on high-quality metal alloys such as Ti, Co, Ni alloys and refractory metal alloys. Thus artificial joints with porous Ti surfaces coating is produced on InssTek system.
DMT technology is also able to create forms quickly and easily from a 3D CAD file. It is therefore ideally suited for custom contract manufacturing and e-manufacturing. This possibility is in the medical, defense and electricity industry widely accepted.

8. Application to alloy design

A constant challenge in metallurgy is the production of samples with exactly the desired chemical, mechanical properties. In the DMT 3D metal printing technology, we offer the opportunity to fill various metals in several hopper. The amount of powder from the individual hoppers is precisely dosed and flows in the desired ratio exactly into the melt pool. In the melt pool is always very active convection, so that a homogenous mixing of the different metal powder is guaranteed. In this way, we can manufacture metal alloy samples of the desired composition and desired shape.

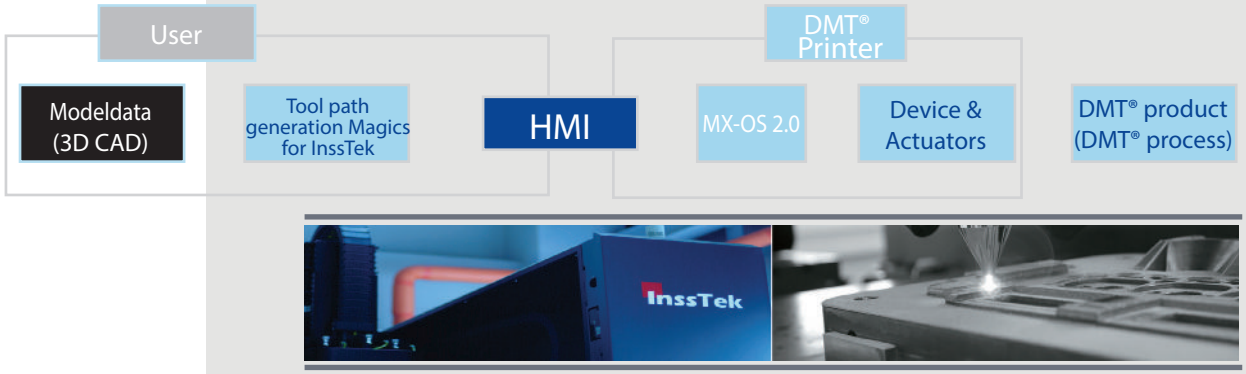


Genius DMT® 3D Metal Printing Machines

DMT® systems

InssTek offers from DMT 3D metal printing process, core technology and HMI program to Magics for InssTek all the features and technologies that allow the customer to use DMT technology. Following the motto `easy & simple to use` we strive every day to make the operation easier, more versatile and interesting.
Our product range can be divided into 3 groups, namely DMT 3D metal printers, Special purpose DMT Machines and DMT Engineered Machines

Technical pipeline



Classification of DMT® Machines

Classification	Description	DMT® Machines
DMT® 3D Metal printers	Standard DMT® printers for general purposes	- MX series machines - MX-4 & MX-3 machines (3-axis & 5-axis models)
Special Purpose DMT® machines	Standard DMT® Machines for special purposes	-MPC series
Engineered DMT® Machines	Custom-made DMT® & Laser material processing machines	- Custom-made machines - Large-scale DMT® 3D Metal Printers (ex. Grand Teton)
Software & Peripherals	Software, materials, consumable parts, technical services for use & maintenance of DMT® machines	- Preprocessor, Magics for InssTek software - HMI & Control program update - Metal powder, consumable parts - Maintenance

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. 2 types of DMT 3D metal printers, "MX-3" and "MX-4", are available now, which have 3 axis and 5 axis motions.

MX-4

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: Φ250 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

MX-3

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: Φ450 (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

Special purpose DMT® 3D metal printers

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.

MPC

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

[Specifications]

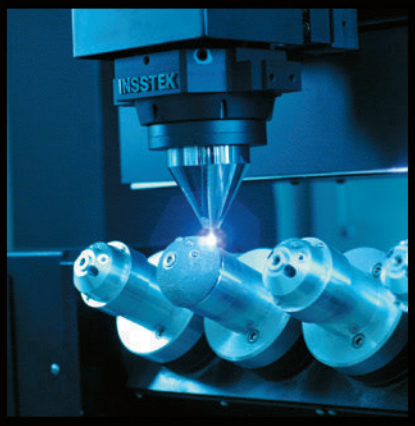
- 500W Ytterbium Fiber Laser
- 5 Axis Motion
  - XYZ Linear Gantry & A/C Tilt/Rotation
  - (Tilt/Rotation Motion)
    A/C: -100° up to +5° / 360°, No. of T/R Stage: 4 Set
- Standard DMT module 800
- Max. 3 Powder-feeding Systems (Optional)
- PC-based Control System with 17" Touch Screen
- Self-calibration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

Engineered DMT® machines Grand Teton

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 motion: -15° up to +95° / 360° / Φ450 mm
  - U motion: max 25 RPM / Φ650 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® 3D metal printer

DMT 3D Metal Printer

Build up Your Imagine!
Easy and Simple to Use

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