AHB TOOLING & MACHINERY

COMPLETE METALWORKING SOLUTIONS

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01.2020

ENAVISION 120 System Configuration and Options

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1. General Overview of the Selective Laser Melting

1.1. Process Description

A thin layer of metal powder is selectively melted by a laser. The parts are built up layer by layer in the powder bed.

Recoater distributes a layer of metal powder onto a build platform and a layer is melted by a laser. The build platform will then be lowered and next layer of metal powder will be coated on top. By repeating the process of coating powder and melting where need, the parts are built up layer by layer in the powder bed.

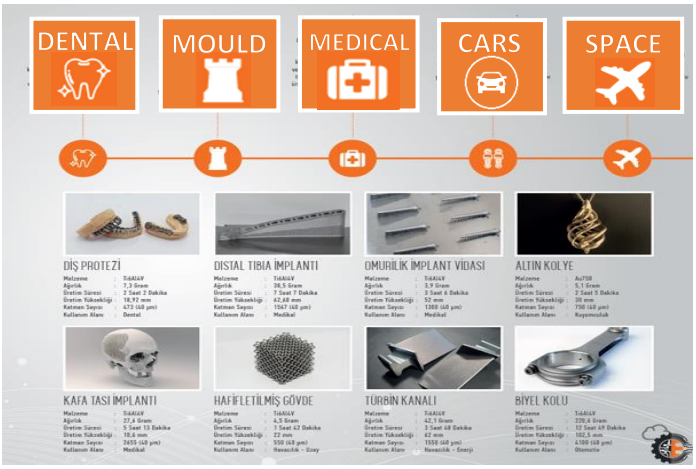
Laser melting requires support structures which anchor parts and overhanging structures to the build platform. This enables the heat transfer away where the laser is melting the powder. Therefore, it reduces thermal stresses and prevents wrapping. The build envelope can be filled by several parts being built in parallel as long as they are attached to the build platform.

Laser melting can manufacture parts in standard metals with high density (above %99) and good mechanical properties. Manufactured parts comparable to traditional production technologies. A constantly widening set of standard metals is available. Parts can be further processed as any welding part.

Manufactured parts can be required post-processing and heat treatment due to usage.

1.2. Application Areas

- ✓ Prototypes are produced in standard metals for form and functional testing by laser melting
- ✓ Molding Industry: This technology is using for complex molds.
- ✓ Automotive Industry: For prototypes and mass-produced parts.
- ✓ By using honeycomb structures to produce light weight parts
- ✓ Custom design production (powder material types depends according to production)
- ✓ Dental application (CoCr powder material)
- ✓ Biomedical application (Ti64 Powder material) for prosthetics and custom tools
- ✓ Aerospace and aeronautics application (Ti, In 718, 625 and other specific powder materials)
    - o Aircraft frames, structures, and parts
    - o Jet Engines
- ✓ Oil & Gas Equipment
- ✓ Turbine Blades for Energy Production
- ✓ Refractory Metal Components
- ✓ Industrial Pump Components
- ✓ Power Generation
- ✓ Tooling Repair and Reconditioning
- ✓ Marine Propulsion



2. ENAVISION 120 SYSTEM CONFIGURATION AND INTEGRATED FEATURES

2.1. Technical Specifications

- **Production Area (mm3)** : **Ø120 x 120 (ENAVISION)**
- **Production Area (mm3)** : **Ø120 x 120 (ENAVISION-TWIN-F-**Full Scanning **OPTIONAL)**

✓ Variable layer thickness	: 100 - 20 µm
✓ Laser Power	: 300 W (500 W optional)
✓ Scan Speed	: up to 7 m/s
✓ Scan System	: F-Theta High Speed Scan Head System
✓ Dimensions (LxWxH)	: 1200 x 900 x 1980
✓ E. connection /Power input	: 220V 1Ph/N/PE; 25 A, 60 Hz, 4,5 kW
✓ Inert Gas	: Argon or Nitrogen
✓ Inert Gas Consumption	: < 3,5 L / min
✓ Operating system	: Windows 7 embedded
✓ Network	: Ethernet / Ethercat

2.2. Laser Source

✓ Power	: YGL 300 W Ermaksan Resonator
✓ Power	: YGL 500 W Ermaksan Resonator (optional)
✓ Laser wavelength	: 1070 nm
✓ Mode of operation	: Single Mode
✓ Pulse frequency interval	: 0-10 kHz
✓ Power interval	: % 5-100
✓ Power stability	: ± % 1-3
✓ Output fiber delivery	: single mode
✓ Typical beam quality(M^2)	: < 1.2

2.3. Optical System (Galvano Scanner)

2.3.1.System Specification

✓ Scan Speed	: 7 m/s
✓ Scanning System	: F-Theta Lens High Speed Scan Head System
✓ Cooling	: Air
✓ Typical scan angle	: ± 0.35 rad
✓ Wavelength range	: 1064 / 532 / 355 / 266 nm
✓ Repeatability (RMS)	:<2µrad

2.4. Control System

- ✓ Industrial Process Control : Beckhoff
- ✓ Processor : Intel i5/i7, 2,4 GHz
- ✓ Ram : 4 GB DDR3L
- ✓ Operating system : Windows 7 Embedded 64bit
- ✓ PLC : TwinCat 3
- ✓ Motion Control : TwinCat 3 NC PTP
- ✓ Screen : 15.6 inch, multi touch,
- ✓ Interface : DVI/USB
- ✓ Communication port : USB

2.5. Software

2.5.1. Machine Control Software

User friendly and intuitive operation software enable safe working condition and minimize user faults. Ease of use combined with state-of-the-art technology.

- ✓ Control of all sensors
- ✓ Automatic build chamber conditioning due to predefined humidity and O_2 level
- ✓ Real time integrated process control
- ✓ Intelligence software algorithm to prevent misuse in manual operation
- ✓ Automatic and manual usage of powder feeding system
- ✓ Automatic and manual usage of re-coater system
- ✓ Automatic and manual usage of production platform
- ✓ Automatic filter shaking system to clean the filter element (filter element manually should replace predefined period)
- ✓ Automatic gas circulating of build chamber
- ✓ Warning and error log files
- ✓ ER 4.0 software:
    - Cloud based machine control software
    - Remote machine access through secure VPN connection
    - Monitor and track machine performance over the flexible easy to use Web interface from any where
    - Record and track machine real-time and historic performance data
    - Integrate machine data with MES and ERP software
    - Store and categorize the machine data

2.5.2.Part Preparation Software

2.5.2.1. Materialise Magics Print for ENAVISION

- ✓ Modern, intuitive interface branded to match your machine
- ✓ Set of tools for quick editing and fixing
- ✓ Fast and reliable support generation and build platform preparation
- ✓ One-on-one relationship between hardware and software

Features

	Magics Print Metal
Fix	1-click automatic fixing solution, manual and semiautomatic fixing tools
Edit	Simple section cut and polyline cut, label, hollow and perforator
Position	Automatic placement and manual positioning tools
Support	Automatic support generation (point, line, block, cones, trees) and manual support (cones and trees)
Analyze	Out of bounds, collision detection, wall thickness analysis, measurement tools
	The standard solution allows basic workflow automation and satisfies common needs for fixing and editing

➢ Import

- ✓ The STL (*.stl) import format is included in Magics Print for ENAVISION:

2.6. Re-Coating System

Features of Powder Deposition System

- ✓ Four ways speed control system
  - o Powder deposition – manual
  - o Returning speed – manual
  - o Powder deposition – automatic
  - o Returning speed – automatic
- ✓ Patented re-coater blade adjustment system
- ✓ SS Re-coater blade with rubber (standard)
- ✓ Carbon fiber brush re-coater blade (optional)
- ✓ Max speed is 400 mm/s

2.7. Building Platform

The parts build on this platform. Due to powder types building platform configured accordingly. Recommendations:

- ✓ Ti building platform for Ti alloy powders
- ✓ Aluminium platform for AlSi10Mg powder
- ✓ Steel platform for S316L powder

2.8. Filtering Unit

Its designed for ENAVISION 120. Laminar air flow and conditioned gas reach over the filter system to guaranteed the desired chamber condition. System specifications:

- ✓ Wet separator decomposes the wet from used gases (used gases can be argon, N2 etc.)
- ✓ Blower system adjust the air flow in the chamber due to settled parameter
- ✓ Stainless steel pipe systems
- ✓ With vacuum pump easily reaching the working condition
- ✓ Adjustable frequency of shaking period for powder cleaning onto the filter element
- ✓ Automatic filter fullness recognition and warning system

3. Optional Accessories / Peripherals

3.1 Ermaksan Semi-Automatic Sieve Station (optional)

Ermaksan Semi-automatic sieve station guarantees the quality of your additive manufacturing (AM) powder, and has been designed to provide optimum sieving efficiency, ensuring your powder is ready for use or reuse as and when you require it. With a simple one-button operation and mobile design, this automated check screener ensures your powder at every stage of the process is qualified for use quickly and safely. System Specifications:

- ✓ Sieving virgin powders - Guarantee the quality of virgin powder before it enters your production process
- ✓ Closed-loop powder recovery - Connect directly to your 3D printer, allowing you to transport your powders quickly and safely to the sieve station, and return immediately to the printer ready for re-use
- ✓ Build chamber evacuation - Quickly evacuate and screen loose powder from your build chamber, minimizing production downtime
- ✓ Powder vessel transfer - Easily connect to your loading container to guarantee the quality of your AM powder before use
- ✓ Fast and efficient sieving
- ✓ Hygienic, easy clean design prevents cross-contamination of the powders.

3.2 Semi-Automatic Electrical Lifting Device (optional)

- ✓ It provides manually back -forth movement of the machine but removal of lifting with battery.
- ✓ It has 700 mm turning radius allows easy use in tight spaces.
- ✓ Its hoist motor has 0.8 kw power. It provides performance operation with 12-volt 20-amp battery.
- ✓ Loading capacity is 150 kg and 1440 mm lifting capacity.

3.3 Safety Kit

- ✓ 3M Versaflo™ Faceshield M-107 with 3M™ Adflo (Motorized Safety Mask)
- ✓ Antistatic gloves
- ✓ Antistatic apron
- ✓ Antistatic carpet

3.4 Industrial Vacuum Cleaner System (Wet Separator)

Wet Separator vacuums the dust loaded air and guides it into a collecting tank which is filled with liquid. In this collecting tank air, dust and liquid are swirled. It is perfectly suitable for dust extraction of explosive material or fine dust. While using reactive powder materials like titanium and aluminum it has to be used.

- ✓ Housing : Stainless Steel
- ✓ Motor power (kW) : 1.1 / 1.3 / 1.5
- ✓ Voltage (Volt) : 230
- ✓ Sound Pressure level (db(A)) : 60
- ✓ Air flow rate (m^3/h) : 135 / 145 / 145
- ✓ Filter cartridge Dust class (m^2) : 3x0,1
- ✓ Residual dust filter class (m^2) : 3x0,1
- ✓ Height (mm) : 755
- ✓ Width (mm) : 480
- ✓ Length (mm) : 705
- ✓ Container Capacity(lt) : 7
- ✓ Protection class : 65

3.5 Industry 4.0 – ER 4.0 Software

ER 4.0 is Ermaksan Industry 4.0 concept software for increasing of your productivity. Its records your machine historic performance data. By the way you can track your machine and operator performance from anywhere. Monitor and track machine performance over the flexible easy to use Web interface. Keep under control of the machine whole the product lifecycle of the machine.

4. Powder Types

With ENAVISION 120 you can use below powders and more. Chemical composition will be released together with the powder.

- ✓ Ti 64
- ✓ 316 L
- ✓ In 625
- ✓ In 718
- ✓ AlSi10Mg
- ✓ CoCr

For any other powder types, you can contact directly with us.

5. Installation and Commissioning

At the customer facility machine and peripherals runs. Comprises:

Machine will be installed with peripherals in client's facility. Following operations will be done listed below:

- ✓ Levelling the machine
- ✓ Electric and gas connection
- ✓ Laser power measurement and calibration
- ✓ Adjustment of the re-coater
- ✓ Adjustment of the building platform
- ✓ Recoater, building platform and powder platform position control and calibration

6. Training

6.1. Basic System Training At Customer Facility (2 days)

- ✓ ENAVISION 120 specifications
- ✓ Peripherals specifications and operations
- ✓ Safety instructions and usage of the protective equipment
- ✓ Powder handling
- ✓ HMI explanation
- ✓ Machine operation
- ✓ MaintENAVISIONnce
- ✓ Troubleshooting & calibration procedures
- ✓ Machine parameters explanation

6.2. Job File Preparation Training At Customer Facility (2 days)

Basic level design rules training

Magics module training:

- ✓ Import file
- ✓ Repair
- ✓ Mesh enhances
- ✓ Support

Ermaksan Build Processor:

- ✓ Up-skin, down-skin, border types explanation
- ✓ Build processor parameter explanation
- ✓ Explanation parameter of scanning strategies
- ✓ Sample part's job file preparation (for one material type)

6.3. Additional Training Based on Metal Production (At Ermaksan's Facility)

According to customer requirement due to chosen powder material:

- ✓ Part design
- ✓ Parameters setup
- ✓ Defining production parameters by using special software
- ✓ Questions and replies

7. Maintenance

Maintenance details will be given together with machine manual. Maintenance recommended to done every year by Ermaksan technician. Maintenance includes Ermaksan machine control software. Magics maintenance has to ordered separately.

8. Warranty Extension

2 years machine and laser resonator warranty included while purchasing machine. Additional warranty extension can be ordered to protect your machine.

9. Documentation

- ✓ Pre-installation manual
- ✓ Machine and machine control software manual
- ✓ Cad interface software manual (Magics; Ermaksan Build Processor)
- ✓ MaintENAVISIONnce manual

Note: This document does not mean commitment, Ermaksan Machinery save rights to change any of feature or specification without prior notice.