ALL IN 1: Laser Deposition Welding and Milling.

The unique combination of laser deposition welding with a powder nozzle and milling on the LaserT, is an innovative generative machining method. It allows a faster production ofcomplex geometries and individual 3D-parts. Especially large components up to Ø 500 mm can be produced cost-effectively with this hybrid solution. The flexible changeover between laser and milling operations enables the direct machining of areas that can no longer be reached later on the finished part. The laser process uses a metal powder feed, which allows the additive manufacture of parts without a processing chamber nor the need for a supporting structures. The additive process is up to 10 times faster than the generation in a powder bed. We is offering the complete process chain, starting with the NC-programming in the hybrid CAD / CAM system, via the usage of proven technology parameters coming from a material data base, through to machining operations, process monitoring and documentation.

Highlights

+ The flexibility of the generative process combined with the precision of milling technology

+ Laser generation of the workpiece with intermediate milling

+ High buildup rates due to coaxial powder nozzle

+ Large machining area for workpieces up to Ø 500 mm × 400 mm height

+ Reduced material usage

Applications.

PRODUCTION

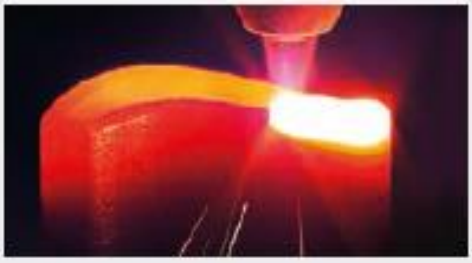
AEROSPACE
Turbine Casing

ENGINEERING
Nozzle

VACUUM TECHNOLOGY
Cooling Tube

MOULD MAKING
Cooling Element

REPAIR



AEROSPACE
Blisk

ENERGY
Pelton Wheel

MOULD MAKING
Injection Mould

ENERGY
Impeller

COATINGS

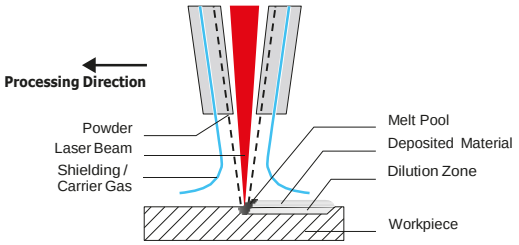
OIL & GAS
Drill Bit

ENGINEERING
Bearing Block

PLANT EQUIPMENT
Drive Shaft

VACUUM TECHNOLOGY
Flange

Basics
Laser Deposition Welding.



Working Principle

Using a coaxial nozzle the metal powder is welded to the base material in layers (non-porous and crack-free melting). Thereby the metal powder is joined with the surface in a high strength bonding. The coaxial nozzle shielding gas protects against oxidation during the build-up process. After cooling the metal layers can be machined mechanically.

Materials

Tried and tested materials:

+ Stainless Steel
+ Nickel-Based Alloys (Inconel 625, 718)
+ Tungsten Carbide Matrix Materials
+ Bronze and Brass Alloys
+ Chrome-Cobalt-Molybdenum Alloys
+ Stellite
+ Tool Steel (weldable)

Metallurgy

Continuous process development in consideration of the following material characteristics:

+ Inspection of the powder material
+ Density measurement, structural analysis
+ Mechanical tests (tension, stress, bending)
+ Measurement: Surface quality, hardness, corrosion
+ **99.8% achievement of the density of the casting (e. g. Stainless Steel 316L / 1.4404)**

Characteristics		Material Requirements	Results
316L / 1.4404		**Conventional**	**Laser Welding**
Elastic Limit [$R_{p0,2}$]	Mpa	≥ 200	229.5
Tensile Strength [R_m]	Mpa	500–700	506
Elongation [A]	%	≥ 40	53.05
Impact Test [KV_2]	J	≥ 100	126–132
Hardness [H]	HV5	≤ 230	160

Hybrid CAD /CAM
for Additive and Subtractive Programming.

1: CAD / CAM data of the customer; seperation in additive and subtractive areas; slicing of the single workpiece sections

2: Generation of the NC-pathes for the laser process and milling in the post processor; definition of the program order

3: 3D-simulation for collision protection with consideration of the integrated laser head

4: Laser Deposition Welding and Milling combined on the LaserT (flexible changeover possible)

5: Finished workpiece ready for quality inspection

Highlights

+ One software package for the complete process (design, programming, simulation)
+ Unique SAUER LaserT build-up strategies - fully integrated in the CAD / CAM software
+ The workpiece can be built up in several steps, while flexibly switching between laser deposition welding and milling operation in only one clamping set-up

Complete generation of 3D-parts Application Examples.

Turbine casing
Material: Stainless steel
Laser Deposition Welding: 230 min.
Milling: 76 min.
Dimensions: Ø 180 mm × 150 mm

Laser Deposition Welding

Milling

1: Basic set-up of the cylinder

2: 90° swivel: Generation of the flange

3: 90° swivel: Milling of the plane surface and the outer contour

4: Continuation of the cylinder generation with conical funnel

5: Manufacturing of the 12 connectors

6: Finishing of the inner and outer contour

Fan Wheel
Material: Stainless steel
Laser Deposition Welding: 312 min.
Milling: 240 min.
Dimensions: Ø 160 mm × 160 mm

Laser Deposition Welding

Milling

1: Building a cylinder

2: Completions of the conical taper

3: Milling

4: Finish machining the cylinder

5: Building the vanes on the cylinder

6: Finish milling the vanes

Additive Manufacturing Buildup Strategies.

new!

“Internal Feature”

Feasibility of channels within a solid part structure e. g. cooling channels as well as similar complex, internal structures as cooling elements and other similar cooling components for injection moulds

new!

“Multi Material”

Combination of two different materials in one part. Two individually selectable powder feeders allow the combination of various materials, even the building of “Sandwich” workpieces

new!

“Build on Curve”

The basis for this operation is an existing part (build-up by additive manufacturing or with an alternative production process) “Flanging” of an additional 3D contour onto the existing part

new!

“3D-Coating”

Metal deposition of partial or complete coatings for corrosion protection and wear resistance. “3D-Coating” on 3D-parts as a material coating or a repair

Unique Technology Integration

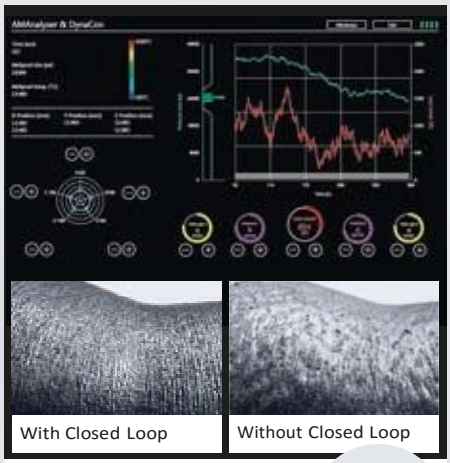
+ Intelligent combination of Laser Deposition Welding and Milling for highest surface quality and part precision

Laser Deposition Welding with a Powder Nozzle

+ 10 × faster compared to powder bed; 3D-parts up to Ø 500 mm also with undercuts and without supporting structure

Hybrid CAD/CAM Module for Laser and Milling Process

+ One universal programming solution for the laser and milling process incl. design, additive and subtractive programming, post processing and simulation in one software package



"Closed Loop" - In-Process Regulation, Analysis and Control

+ Continuous measuring and monitoring of the laser buildup process
+ Automatic regulation of the laser power guarantees a high quality "Closed Loop" build in real-time
+ Ensuring of a uniform laser welding process
+ Process monitoring for highest process safety and homogeneous part qualities

Flexible Integration of the Laser Head via the HSK Milling Taper

+ The laser head is handled by a fully automatic shuttle - without manual intervention
+ Coaxial nozzle for the uniform distribution of the metal powder
+ Independent of the laser buildup direction
+ Integrated safety glass monitoring
+ Optimal powder volume supply
+ During milling operations, the laser head is protected against dust, coolant and chips, outside the working area

Additive Manufacturing Material Data Base for Users

+ Basic parameter suggestions for users of the hybrid CAD / CAM in various materials
+ Customer development of process parameters for surfaces, ridges as well as 3D-parts in various materials
+ Influencing factors: Surface quality, process speed, powder efficiency
+ Customer specific material development in one of our 4 Additive Manufacturing Technology Centers Worldwide

Technical Data

Working area / drives		
Traverse X / Y / Z	mm	735 / 650 / 560
Work table / workpieces		
Dimensions (NC swivel rotary table)	mm	ø 650
Maximum workpiece dimensions (Additive Manufacturing)	mm	ø 500 x 400
Maximum workpiece weight (NC swivel rotary table)	kg	600
Rotary axis (C axis)	Degrees	360
Swivel range (A axis)	Degrees	–120 to +120
P_{max} under VDI / DGQ 3441 (C axis / A axis)	Ws	7 / 9
Milling spindle		
Maximum speed (standard / optional)	rpm	10,000 / 18,000
Output 40 % DC / 100 % DC (standard spindle)	kW	13 / 9
Torque 40 % DC / 100 % DC (standard spindle)	Nm	83 / 57
Tool holder	Type	HSK-A63
Laser source		
Nd: YAG Laser	Watt	7 000
Focal length (fixed)	mm	200
Laser spot diameter 1 (standard)	mm	3
Laser spot diameter 2 (optional)	mm	1.6
Linear axes (X / Y / Z)		
Rapid traverse speed	mm	40 / 40 / 40
Maximum acceleration on X / Y / Z	m/sec²	6 / 6 / 6
P_{max} under VDI / DGQ 3441	mm	0.008
Tool changesystem		
Standard / optional tools	Number	30 / 60 / 90