LASER ENGINEERED NET SHAPING (LENS)

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Laser engineered netshaping

LENS is a technology developed by **Sandia National Laboratories** in 1995 for fabricating metal parts directly from a computer-aided design (CAD) solid model by using a metal powder injected into a molten pool created by a focused, high-powered laser beam.

Since 1997, Optomec Inc. has focused on commercializing a direct fabrication process,

The system consists of

A Nd:YAG laser

Nd:YAG (neodymium-doped yttrium aluminum garnet; Nd:$Y_3Al_5O_{12}$) is a crystal that is used as a lasing medium for solid-state lasers.

A controlled atmosphere glove box,

A 3- 5axis computer controlled positioning system and

A powder feed unit.

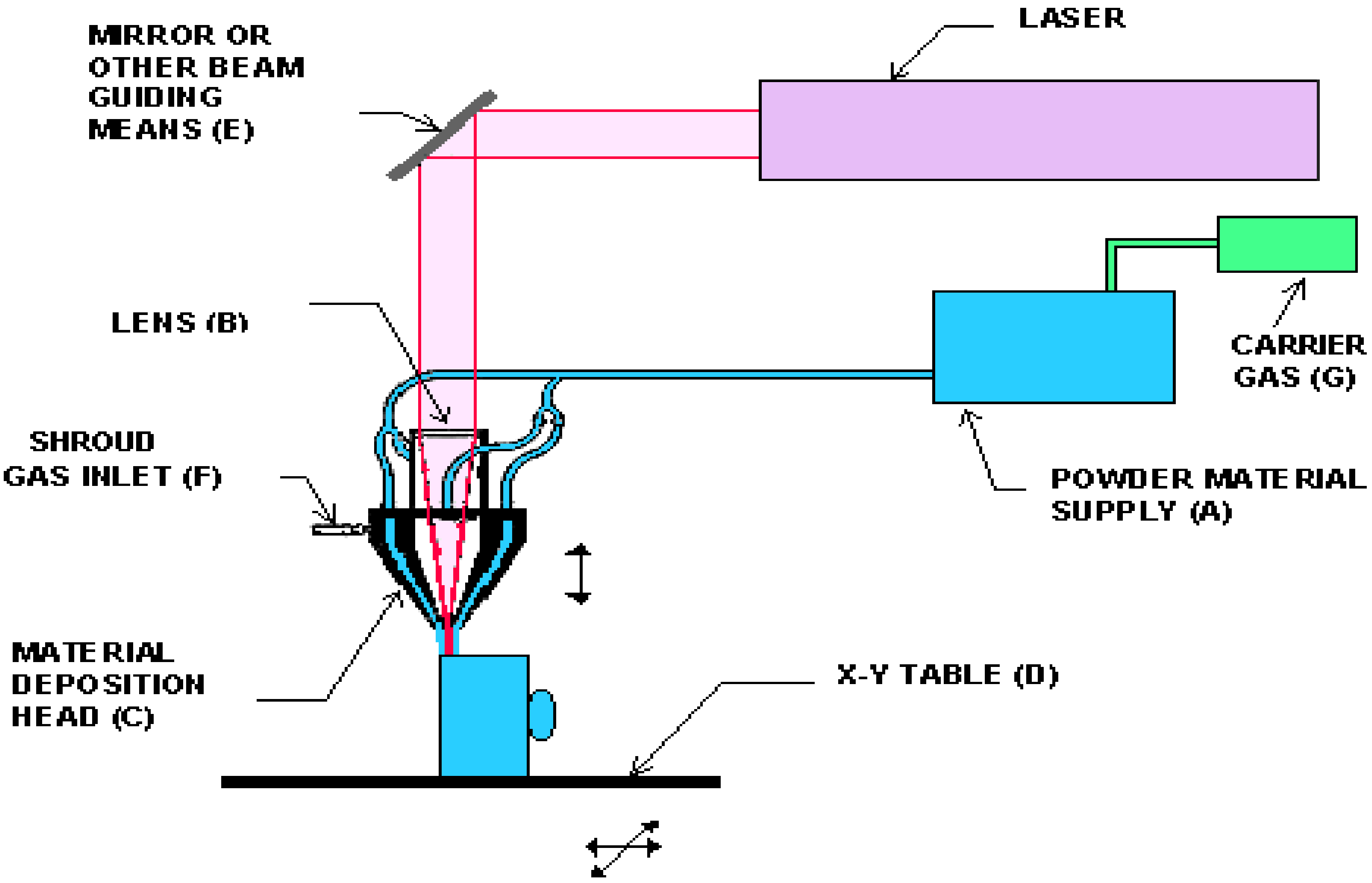


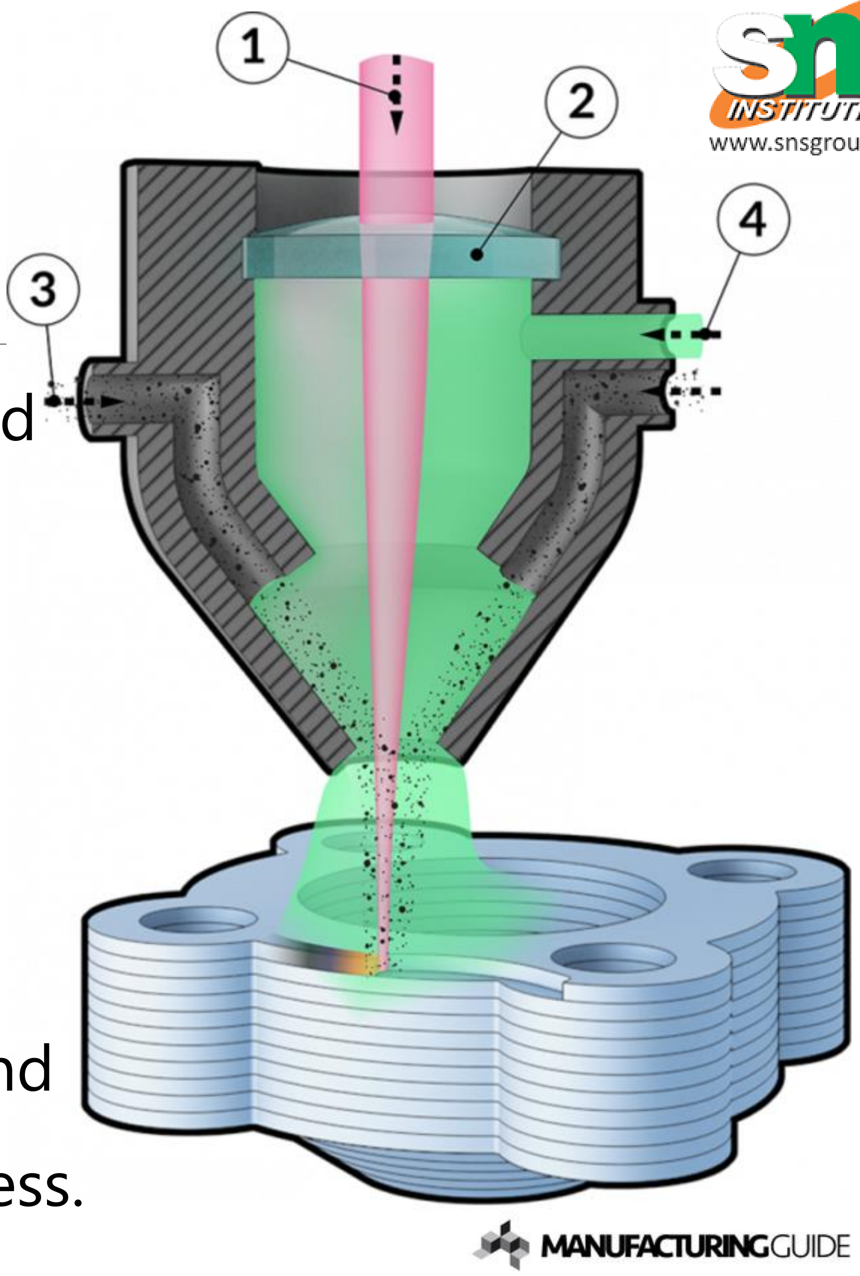
Fig. 8. Laser engineered net shaping.

LENS Process

A laser beam [1] created by a laser generator is focused through a lens [2] onto the workpiece.

Metal powder [3], or metal wire, is introduced at the focus of the laser beam, where the metal powder and workpiece melt and thus building on the surface.

An inert gas [4] is supplied to protect both the laser and the melt from contamination during the welding process.



Process

A CAD solid model is sliced into a sequence of layers, and translated into a series of tool path patterns to build each layer.

Each layer is fabricated by first generating an outline of the key component features and then filling the cross-section using a rastering technique.


OPTOMEC

Model	LENS™ 750	LENS™ 850
Process	LENS	LENS
Build volume, *XYZ* (mm × mm × mm)	300 × 300 × 300	460 × 460 × 1070
Laser type	Nd:YAG single head laser	Nd:YAG dual head laser
Laser power (W)	600	1000
Laser wavelength (mm)	1064	1064
XY resolution (mm)	0.5	0.5
Z resolution (mm)	5	5
Size of unit, *XYZ* (mm × mm × mm)	1830 × 1040 × 2080	1170 × 1245 × 2080
Machine size (kg)	2540−2858	2540−2858
Power supply	208 or 240 V_{AC}, 3-phase, 75 A	460 V_{AC}, 3-phase, 75 A
Workstation	Pentium III Windows NT	Pentium III Windows NT
Materials	Stainless steels, H13 tool steel, titanium, super alloys such as inconel, tungsten, copper and aluminium	

Layer Thickness is 20 µm to 100 µm

Cost of the machines, he estimates, will be in the $350,000 (2 crore INR) to $500,000 (3 crore INR) range.

Commonly Used Materials

Parts have been fabricated from

Stainless steel alloys,

Nickel-based alloys,

Tool steel alloys,

Titanium alloys, and

Other specialty materials; as well as composite and fully functional graded material deposition.

Material	Ultimate Tensile Strength (MPa)	Yield Strength (MPa)	Elongation (%)
LENS 316 Stainless Steel	799	500	50
316 SS Anneal bar	591	243	50
LENS Inconel® 625	938	584	38
IN 625 Annealed bar	841	403	30
LENS Ti-6Al-4V	1077	973	11
Ti-6Al-4V Annealed Bar	973	834	10

Post Processing Operations

The process can also make "near" net shape parts when it's not possible to make an item to exact specifications.

In these cases post production such as,

light machining,

surface finishing,

heat treatment may be applied to achieve end compliance

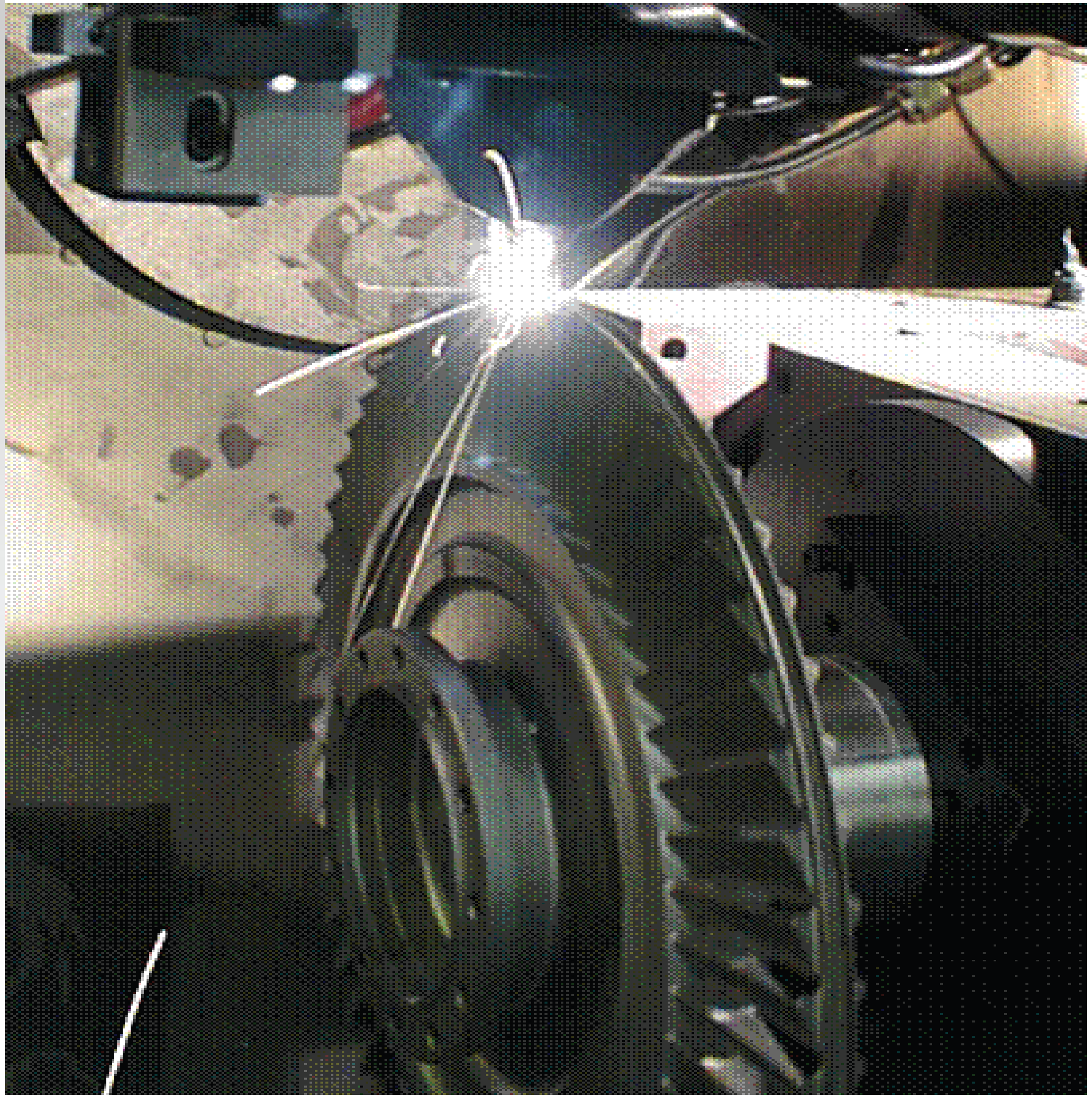
Applications

Build mould and die inserts

Producing titanium parts in racing industry

Fabricate titanium components for biological implants

Produce functionally gradient structures



Advantages

- Capable of depositing numerous materials
- Good accuracy in build plane; capable of producing thin walls and ribs
- Material properties are improved over casting
- 50% material usage (compared to 5-20% for standard forging and machining)
- Capable of producing functionally graded materials
- 100% dense parts

Disadvantages

- Poor accuracy in growth direction

Poor surface finish

- Cannot do very complex geometry
- In need of more specialized process control for reliable deposits

Video

https://www.youtube.com/watch?v=mkUVURLkxS4&feature=emb_rel_end

Thank you