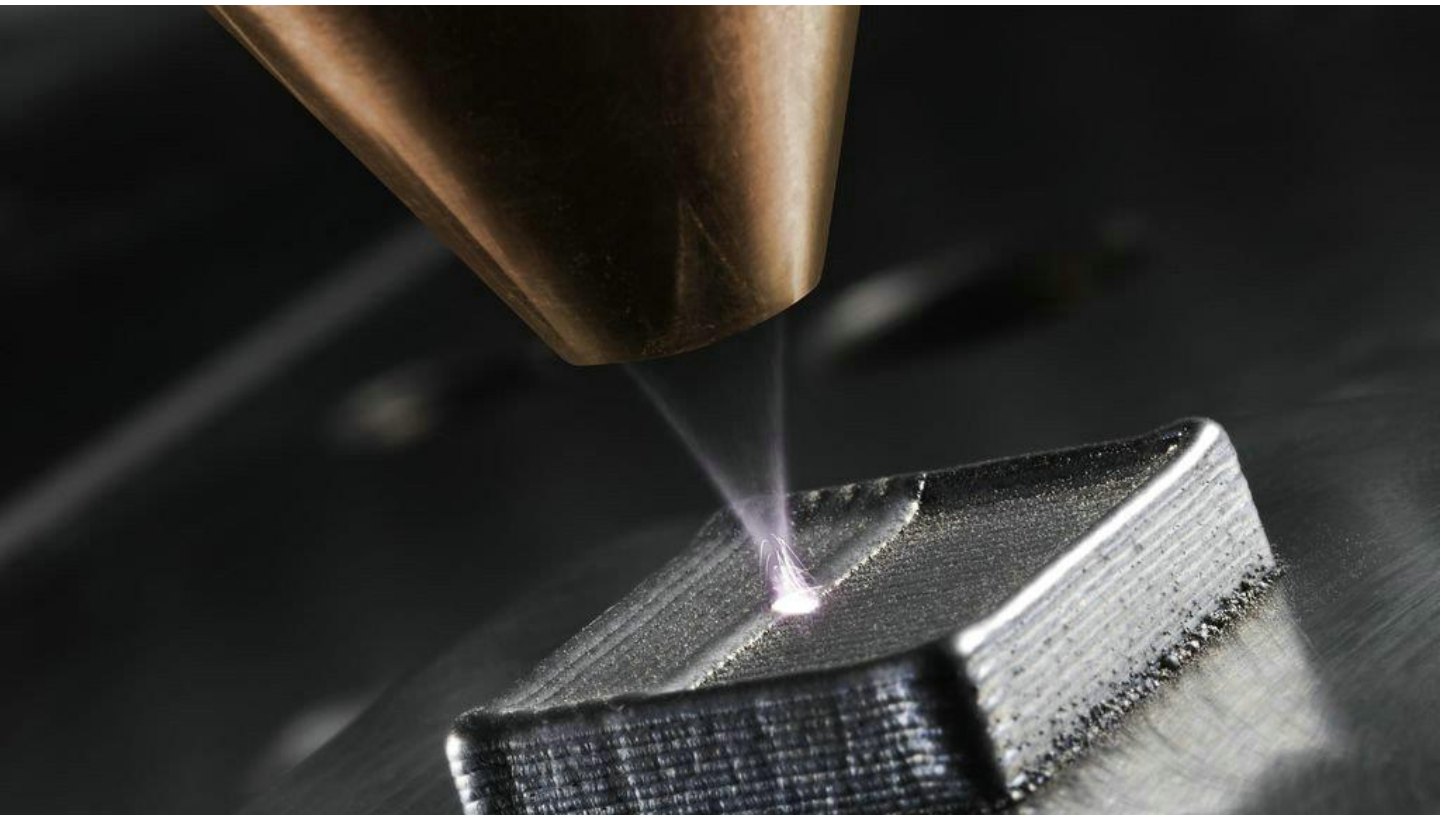
GREENSTONE®

Greenstone - Advanced Metal Surface Solutions Manufacturer and Supplier

PV Series Laser Cladding Metal Additive Manufacturing Equipment Brochure



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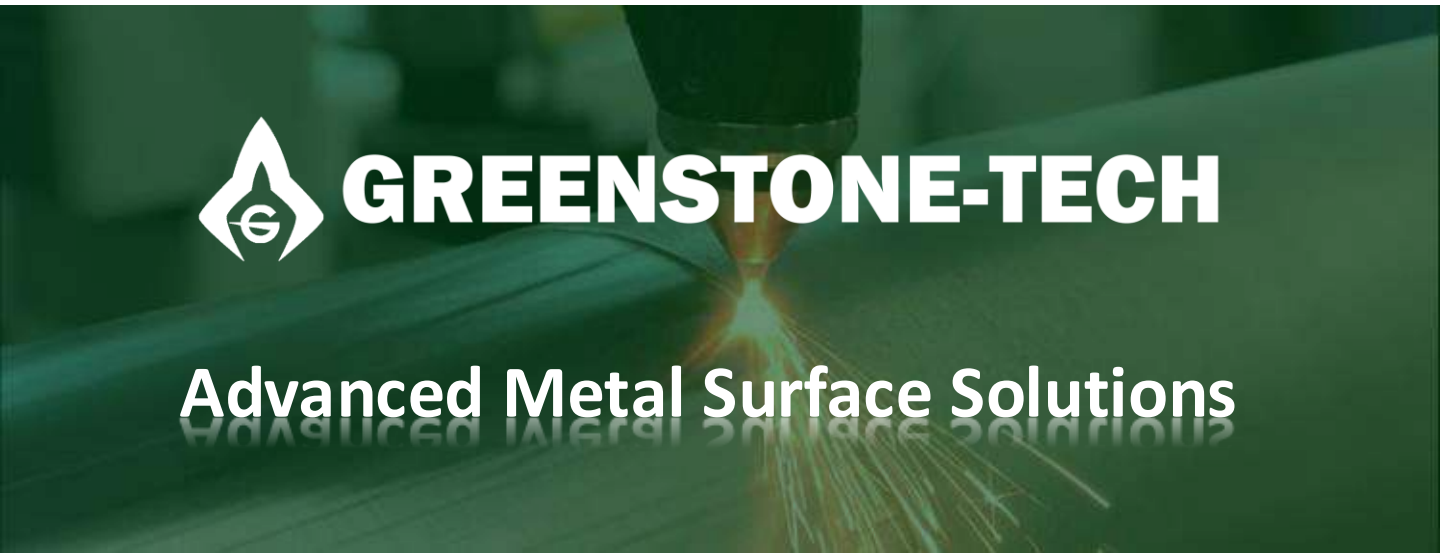
About Greenstone-Tech

Established in 2024, GREENSTONE is a global technology brand specializing in laser cladding, Directed Energy Deposition (DED) metal additive manufacturing, surface engineering, and industrial remanufacturing solutions. Built on the expertise of a core engineering team with laser industry experience since 1999, we provide high-performance equipment, proprietary laser technologies, intelligent manufacturing systems, and integrated engineering solutions for customers worldwide.

Our core technologies include laser cladding, DED metal additive manufacturing, laser hardening, and hybrid laser-arc welding. Through strategic collaboration with specialized engineering teams, we also provide advanced surface engineering, additive manufacturing, and industrial processing solutions for industries including aerospace, energy, oil & gas, mining, railway transportation, marine engineering, and heavy industry.

Driven by continuous innovation, engineering excellence, and long-term customer value, GREENSTONE is committed to advancing advanced manufacturing technologies and delivering one-stop engineering solutions that help manufacturers worldwide improve performance, extend equipment life, and increase production efficiency.



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External Cylindrical Laser Cladding Equipment | High-Precision Laser Surface Restoration System

This equipment is designed for laser cladding processing of various shaft-type components with a maximum weight of **≤10 tons** and a length of **≤20 meters**, making it suitable for multi-variety and large-volume production. The **open-structure design** enables fast and efficient loading and unloading of workpieces, significantly improving workflow flexibility.

Equipped with an **intelligent operation and control system**, the machine offers simple, user-friendly, and highly flexible operation for both automated and semi-automated scenarios.

Optional configurations include:

- **CCD molten pool monitoring**
- **Closed-loop molten pool temperature control**
- **Adaptive height-following system**
- **Oscillation system**
- **Online preheating system**
- **Wire feeding modules (cold wire / hot wire)**

These optional modules enhance processing stability, coating quality, and system versatility, enabling high-precision laser cladding for a wide range of industrial applications.

Performance Features

High Adaptability
Supports cladding and additive manufacturing for shaft-type components with a weight of up to 10 tons and a length of up to 20 meters, meeting the needs of multi-specification industrial applications.

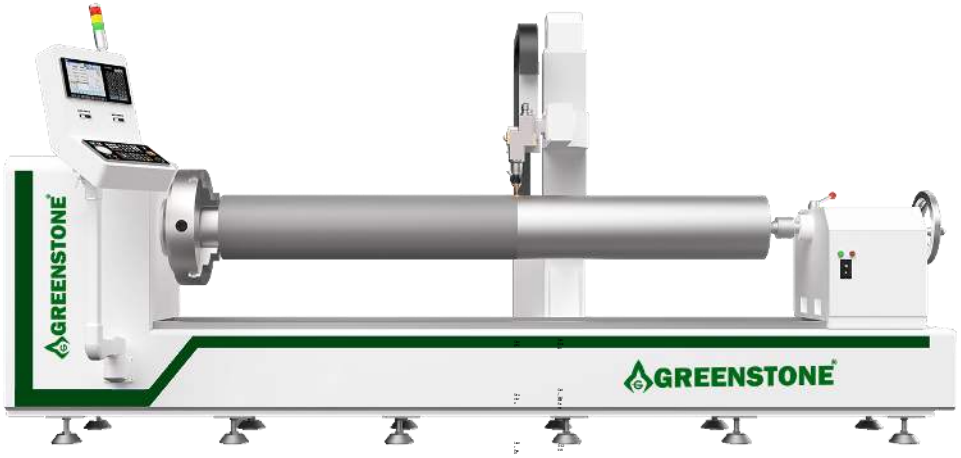
High-Efficiency Feeding
Utilizes high-power needle-type powder feeding and ring-shaped water-cooled powder nozzles to meet the demands of high-power laser processing with stable and uniform powder delivery.

Intelligent Control
Equipped with an integrated intelligent control system offering powerful functions and easy operation. Supports 2D/3D graphics import and no-programming workflow, improving processing efficiency and usability.

High Stability
Single-machine output can reach 10 m^2 per day, supporting 24/7 continuous and stable production for industrial-scale manufacturing.

Modular Design
Highly configurable system compatible with multiple brands of lasers and cladding heads, meeting various processing requirements for different types of workpieces.

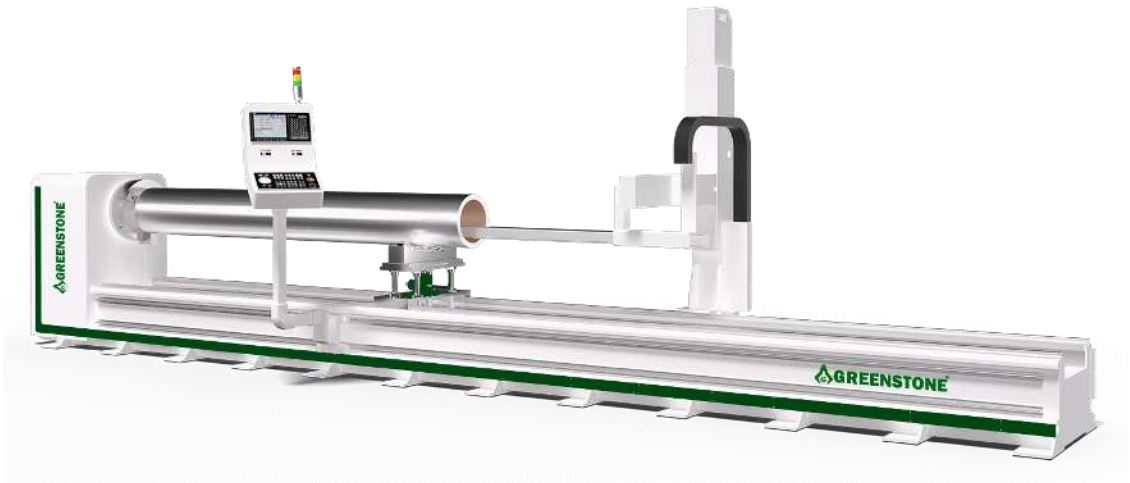
Excellent Forming Quality
Advanced beam homogenization technology ensures consistent molten pool performance, enabling high-quality cladding layers with surface roughness as low as Ra ≤ 6.3 μm.



Technical Specifications

Category	Specification
Structure	Cast / Welded Frame
Laser Power	3–12 kW
Max. Workpiece Diameter	≤1600 mm
Max. Workpiece Length	≤20,000 mm
Load Capacity	≤10 tons
Rotation Speed	0–100 r/min
Cladding Thickness	≤2.5 mm (single layer)
Cladding Efficiency	0.3–1.6 m²/h
Functions	Laser Cladding / Hardening
Cladding Heads	Coaxial Nozzle / Axis-Band Nozzle / Off-Axis Nozzle Options
Control System	PLC Control / Numerical Control / No-Programming Mode
Optional Features	CCD Molten Pool Monitoring, Molten Pool Closed-Loop Control, Adaptive Height Following, Oscillation System, Online Preheating, etc.

Internal Bore Laser Cladding Equipment | Precision Internal Surface Restoration System



This equipment is designed for internal laser cladding of components with an **inner diameter ≥ 45 mm**, a **maximum weight of ≤ 10 tons**, and a **length of up to 12 meters**. It has been widely applied in industries such as **hydraulic cylinders, petroleum casing, energy-storage pipelines, and screw barrels**, providing high-quality internal surface restoration and enhancement.

Featuring an **open-structure design**, the system enables fast and convenient loading and unloading of workpieces, significantly improving operational efficiency. The **intelligent operation and control system** ensures simple, flexible, and user-friendly operation suitable for a wide range of industrial environments.

Optional configurations include:

- **CCD molten pool monitoring**
- **Closed-loop molten pool temperature control**
- **Adaptive height-following system**
- **Online preheating system**
- **Wire feeding modules (cold wire / hot wire)**

These optional modules enhance process stability, coating consistency, and material adaptability, making the equipment a reliable solution for high-precision internal laser cladding applications.

Performance Features

High Adaptability
Supports cladding and additive manufacturing for internal bore components with a weight of up to 10 tons and a length of up to 12 meters, meeting diverse processing requirements across multiple industries.

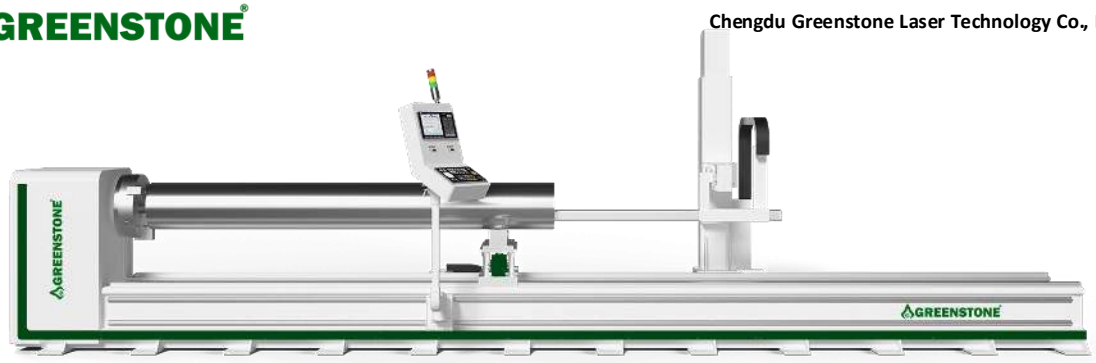
High-Efficiency Powder Feeding
Equipped with high-power needle-type powder feeding and ring-shaped water-cooled powder nozzles to meet the demands of high-power laser processing, ensuring stable and uniform powder delivery.

Intelligent Control
Integrated intelligent control system with powerful functions and a user-friendly interface. Supports 2D/3D graphic import and no-programming operation, greatly simplifying workflow and improving efficiency.

High Stability
Single-machine productivity can reach 10 m^2 per day, supporting 24/7 continuous and stable production, ideal for industrial-scale internal laser cladding operations.

Modular Design
Highly versatile configuration supporting multiple laser brands and various types of internal cladding heads to accommodate different workpiece specifications and application scenarios.

Excellent Forming Quality
Advanced beam homogenization technology ensures uniform molten pool performance, enabling high-quality cladding layers with a surface roughness as low as Ra ≤ 6.3 μm.



Technical Specifications

Category	Specification
Structure	Cast / Welded Frame
Laser Power	3–12 kW
Minimum Inner Diameter	≥ 45 mm
Maximum Workpiece Length	≤ 12,000 mm
Load Capacity	≤ 10 tons
Rotation Speed	0–100 r/min
Cladding Thickness	≤ 2.5 mm (single layer)
Cladding Efficiency	0.6–1.6 m²/h
Functions	Laser Cladding / Hardening
Cladding Heads	Coaxial Ring-Type / Multi-Point Needle-Type Nozzles
Control System	PLC Control / CNC / No-Programming Mode
Optional Features	CCD Molten Pool Monitoring, Adaptive Height-Following System, Wire Feeding Modules (Cold Wire / Hot Wire), etc.

Mobile Robotic Laser Cladding System | Portable High-Precision Surface Restoration Equipment

The mobile robotic laser cladding system offers unparalleled advantages when performing **on-site cladding and surface restoration** on components that cannot be disassembled or transported. By operating directly in the user's workshop or production environment, the system supports a wide range of large and complex workpieces. When combined with various motion systems—such as rotary tables and positioners—it can efficiently process multi-specification and large-size components.

The mobile laser cladding solution consists of a **mobile platform, high-power laser source**, various types of **laser cladding heads**, a **six-axis industrial robot, positioner, water chiller, voltage stabilizer, powder feeder**, and all necessary integrated **control software and hardware**. Together, these modules enable high-quality laser cladding and additive manufacturing on diverse types of workpiece surfaces.

This versatile system is engineered for industrial environments requiring flexible deployment, efficient field repair, and high-precision metallurgical bonding, making it an ideal choice for heavy machinery, petrochemical facilities, energy production, marine engineering, and large-scale manufacturing industries.

Performance Features

High Integration
The system features a highly integrated mobile platform that allows convenient overall movement, lifting, transportation, and rapid deployment for on-site laser cladding operations. Ideal for scenarios requiring fast setup and flexible positioning.

High Adaptability
Compatible with various motion systems—such as rotary tables and positioners—enabling efficient laser cladding of multi-specification and large-size workpieces. Suitable for complex geometries and diverse processing requirements.

Intelligent Control
Equipped with a centralized intelligent control system offering powerful functions and user-friendly operation. Supports 2D/3D graphic import and no-programming workflows, significantly improving ease of use and processing efficiency.

High Stability
Single-machine production capacity can reach 10 m^2 per day, supporting 24/7 continuous and stable operation, making it well-suited for industrial-scale cladding applications.

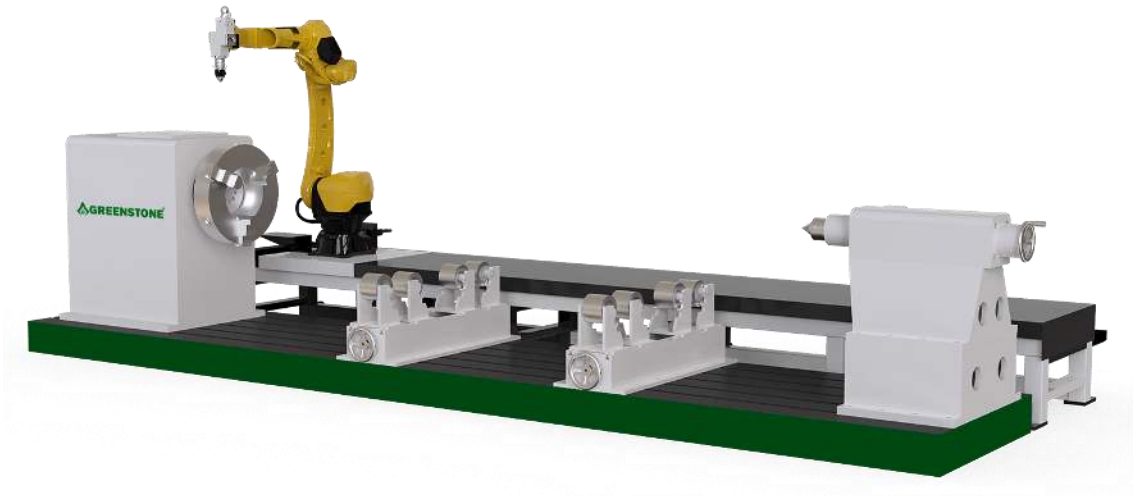
Modular Design
Rich configuration options allow integration of multiple laser brands and various cladding head structures, meeting processing needs for different workpiece types and application scenarios.

Excellent Forming Quality
Advanced laser beam homogenization technology ensures molten pool consistency, producing high-quality cladding layers with a surface roughness as low as Ra ≤ 6.3 μm.

Technical Specifications

Category	Specification
Structure	Welded Frame
Laser Power	3–6 kW
Motion System	Six-Axis Industrial Robot + Mobile Platform
Cladding Thickness	≤ 2.5 mm (single layer)
Cladding Efficiency	0.3–1.6 m²/h
Functions	Laser Cladding / Hardening
Cladding Heads	Coaxial Ring-Type / Multi-Point Needle-Type / Internal-Bore Nozzles
Control System	PLC Control / Online Teaching / No-Programming Mode
Optional Features	CCD Molten Pool Monitoring, Molten Pool Temperature Closed-Loop Control, Wire Feeding Modules (Cold Wire / Hot Wire), etc.

Rail-Mounted Robotic Laser Cladding System | Large-Scale Surface Restoration & Additive Manufacturing Equipment



This equipment is capable of performing laser cladding and additive manufacturing on large-scale workpieces weighing up to **30 tons** and measuring up to **30 meters in length**. By integrating various motion systems—such as planar rotary tables and positioners—it can also efficiently process **flat surfaces, curved surfaces, spherical components**, and other complex geometries.

Engineered for high versatility and industrial-level performance, the system provides precise control, stable deposition quality, and strong adaptability across a wide range of large and specialized components. It is ideal for heavy machinery, petrochemical equipment, marine engineering structures, long shafts, rollers, pipelines, and other oversized workpieces that require advanced surface restoration or enhancement.

Performance Features

High Adaptability
Supports laser cladding and additive manufacturing for a wide range of shaft-type, flat, and irregular-shaped components weighing up to 30 tons and measuring up to 30 meters in length. Suitable for large-scale industrial repair and surface enhancement.

High-Efficiency Powder Feeding
Equipped with high-power needle-type powder feeding and ring-shaped water-cooled powder nozzles that ensure efficient, stable, and uniform powder delivery, meeting the requirements of high-power laser processing.

Intelligent Control
Features a centralized intelligent control system with powerful functions and a user-friendly interface. Supports 2D/3D graphic import and no-programming operation, greatly simplifying workflow and improving automation.

High Stability
A single system can achieve production capacity of up to 10 m² per day, supporting 24-hour continuous and stable operation, ideal for long-term industrial manufacturing environments.

Modular Design
Rich configuration options allow compatibility with multiple laser brands and various laser cladding heads. Easily adapts to different types of workpieces and diverse application demands.

Excellent Forming Quality
Advanced laser beam homogenization technology ensures consistent molten pool behavior and stable deposition quality. Achieves high-quality coating with surface roughness as low as Ra ≤ 6.3 μm.

Technical Specifications

Category	Specification
Structure	Cast / Welded Frame
Laser Power	3–12 kW
Max. Workpiece Diameter	≤ 2000 mm
Max. Workpiece Length	≤ 30,000 mm
Load Capacity	≤ 30 tons
Rotation Speed	0–100 r/min
Cladding Thickness	≤ 2.5 mm (single layer)
Cladding Efficiency	0.3–1.6 m²/h
Functions	Laser Cladding / Hardening

Category	Specification
Cladding Heads	Coaxial Ring-Type / Coaxial Strip-Type / Off-Axis Strip-Type / Internal Cladding Heads
Control System	PLC Control / Online Teaching / No-Programming Mode
Optional Features	CCD Molten Pool Monitoring, Molten Pool Temperature Closed-Loop Control, Wire Feeding Modules (Cold Wire / Hot Wire), etc.

Gantry Robotic Laser Cladding System | Large-Format Surface Restoration & Additive Manufacturing Equipment

The gantry-type laser cladding system is primarily designed for the cladding and surface enhancement of **large and irregularly shaped workpieces**. Featuring a **gantry structure combined with a cantilever six-axis robotic arm**, the equipment provides a comprehensive solution for ultra-large and complex components that require high-precision laser cladding.

This advanced system has been successfully applied to the **laser cladding of boiler water-cooled wall tube panels**, demonstrating its reliability, stability, and suitability for heavy-duty industrial environments. Its large working envelope, high structural rigidity, and precise multi-axis control make it an ideal choice for high-performance cladding of oversized and non-standard parts.

Performance Features

High Adaptability
Supports laser cladding and additive manufacturing for flat panels, curved components, and irregular large workpieces with widths up to 4 meters and lengths up to 20 meters. Ideal for oversized and non-standard industrial parts.

High-Efficiency Powder Feeding
Equipped with high-power needle-type powder feeding and ring-shaped water-cooled powder nozzles that ensure efficient, stable, and uniform powder delivery—meeting the requirements of high-power laser processing.

Intelligent Control
Features a centralized intelligent control system with powerful functionality and an easy-to-operate interface. Supports 2D/3D graphic import and no-programming operation, significantly improving workflow flexibility and automation.

High Stability
Designed for 24/7 continuous and stable operation, meeting the long-duration production needs of industrial environments.

Modular Design
Offers rich configuration options, compatible with multiple laser brands and various cladding head structures to meet differe nt processing requirements for diverse workpieces.

Excellent Forming Quality
Advanced beam homogenization technology ensures consistent molten pool performance, producing high-quality cladding layers with a surface roughness as low as Ra ≤ 6.3 μm.

Technical Specifications

Category	Specification
Structure	Welded Frame
Laser Power	3–12 kW
Max. Workpiece Diameter	≤ 4 m
Max. Workpiece Length	≤ 20 m
Cladding Thickness	≤ 2.5 mm (single layer)
Cladding Efficiency	0.3–1.6 m²/h
Functions	Laser Cladding / Hardening
Cladding Heads	Coaxial Ring-Type / Coaxial Strip-Type / Multi-Point Needle-Type Nozzles
Control System	PLC Control / Online Teaching / No-Programming Mode
Optional Features	CCD Molten Pool Monitoring, Molten Pool Temperature Closed-Loop Control, Height-Following System, Oscillation System, Wire Feeding Modules (Cold Wire / Hot Wire), etc.

Atmospheric-Chamber 3-Axis / 5-Axis Laser DED Additive Manufacturing System | Metal 3D Printing Equipment

The equipment operates inside a fully sealed chamber filled with argon, capable of maintaining **ultra-low moisture and oxygen levels below 10 ppm**. This high-purity processing environment enables reliable additive manufacturing of highly reflective and reactive metals such as **copper, aluminum, magnesium, titanium, and zirconium**.

With its stable, contamination-free atmosphere control, the system is ideal for **advanced machining, scientific research, high-performance component fabrication, and new material development**. It provides optimal conditions for industries requiring precise metallurgical quality, oxidation-free processing, and high-integrity metal structures.

Performance Features

Powerful Functionality
The system integrates a three-axis motion platform with a dual-axis positioning mechanism, enabling five-axis coordinated motion. This configuration supports complex multi-angle deposition and high-precision additive manufacturing.

High-Efficiency Powder Feeding
Equipped with high-power needle-type powder feeding and ring-shaped water-cooled powder nozzles, the system ensures stable and precise powder delivery to meet the demands of fine-detail DED additive processing.

Intelligent Control
Features a centralized intelligent control system that supports 2D/3D model import, slice processing, and automatic toolpath planning. Designed for simplified operation and improved production efficiency.

High Reflectivity Resistance
Certain metal materials exhibit high reflectivity to laser beams, which reduces processing efficiency. The system is engineered to handle high-reflective metals effectively, ensuring stable energy absorption and consistent deposition quality.

Inert Gas Protection
The sealed chamber is filled with inert gas to create a controlled atmosphere, providing effective protection for the molten pool and preventing oxidation during the additive manufacturing process.

Optional Modules
Optional features include CCD molten pool monitoring, closed-loop temperature control, electromagnetic stirring, ultrasonic vibration, and other advanced process-enhancement modules that improve forming quality and material properties.

Technical Specifications

Category	Specification
Structure	Welded Frame
Laser Power	2–6 kW
Three-Axis Travel	X: 500 mm, Y: 500 mm, Z: 500 mm
Three-Axis Positioning Accuracy	≤ 0.03 mm
Positioner Rotary Table Diameter	200–300 mm
Positioner Load Capacity	100–200 kg
Moisture & Oxygen Content	≤ 10 ppm
Transfer Chamber Size	Ø 360 mm × 600 mm
Circulation Purification Control System	Circulation Purification System + Regeneration System + Dust Removal System + Vacuum System

Reflective Laser Cladding Head | High-Precision Beam-Redirecting Cladding Nozzle

The reflective laser cladding head adopts a **Z-type reflective optical path**, and its terminal end can be equipped with various nozzle configurations—including **coaxial ring, coaxial broadband**, and **off-axis broadband** nozzles. This design achieves exceptionally high **overall powder utilization efficiency**, enabling the system to meet the laser cladding and laser hardening requirements for the majority of industrial components.

With its optimized reflective beam delivery and multi-nozzle compatibility, the cladding head provides stable melt-pool control, uniform deposition, and high processing efficiency across a wide range of industrial applications.

Performance Features

High Stability
Equipped with high-quality beam homogenization technology, the system delivers exceptional process stability and outstanding resistance to high-reflective materials, ensuring reliable performance across demanding industrial applications.

High-Efficiency Powder Feeding
Supports high-power needle-type powder feeding, ring-shaped powder delivery, and coaxial broadband powder nozzles, meeting the requirements of high-power laser cladding and precision material processing.

Enhanced Safety
Integrated temperature-monitoring protection modules allow real-time tracking of the protective lens temperature during cladding operations, ensuring safe and stable long-term use of the optical components.

Wide Powder Particle Size Compatibility
The optimized powder delivery nozzles ensure smooth, stable feeding without clogging, supporting 100–400 mesh metal powders with high powder concentration and consistent flow.

Extended Service Life
The improved coaxial shielding gas injection module provides excellent molten-pool protection and reduces contamination, significantly extending the service life of protective lenses and key optical components.

Rich Functionality
By simply replacing the end-component module, the system can perform metal 3D printing, welding, hardening, coaxial cladding, off-axis cladding, and other advanced laser processing tasks, offering strong adaptability for diverse industrial needs.

Technical Specifications

Category	Reflective Coaxial Circular Laser Cladding Head	Reflective Coaxial Strip-Type Laser Cladding Head	Reflective Off-Axis Strip-Type Laser Cladding Head
Optical Interface	QBH, QD, LLK-D, LOE	QBH, QD, LLK-D, LOE	QBH, QD, LLK-D, LOE
Optical Path Design	Z-type reflective structure	Z-type reflective structure	Z-type reflective structure
Lens Configuration	Collimating lens + focusing lens	Collimating lens + focusing lens	Collimating lens + focusing lens
Protective Lens	3 layers	3 layers	3 layers
Cooling Method	Water cooling	Water cooling	Water cooling
Power Endurance	≤ 20,000 W	≤ 20,000 W	≤ 20,000 W
Focal Spot	Fixed spot: 2–5 mm; Rectangular spot: 3 × 3 mm, 4 × 4 mm	20 × 4 mm, 12 × 3 mm (customizable)	20 × 4 mm, 25 × 4 mm, 40 × 3 mm (customizable)
Applicable Wavelength	900–1080 nm	900–1080 nm	900–1080 nm
Laser Transmission Efficiency	> 99.25%	> 99.25%	> 99.25%
Optical Adjustment Module	Included	Included	X, Y, Z adjustment range: ±1.5 mm; Angular adjustment: ±40°
Temperature Sensor	Protective lens	Protective lens	Protective lens
Powder Feeding Structure	Distributed powder feeding	Coaxial strip powder feeding	Gravity powder feeding
Powder Utilization Rate	> 93%	> 85%	> 97%
Weight	7.5 kg	7.5 kg	11.5 kg
Optional Features	Temperature ring, CCD monitoring, height-following system, oscillation system	Temperature ring, CCD monitoring, height-following system, oscillation system	Temperature ring, CCD monitoring, height-following system, oscillation system

Internal Reflective Laser Cladding Head | Inner-Bore Laser Surface Restoration Nozzle

The internal reflective coaxial ring, off-axis broadband, and coaxial needle-type laser cladding heads all utilize a **reflective optical path**, offering a compact structure, homogenized laser spot, excellent high-temperature resistance, high powder utilization, and outstanding operational stability.

Their specialized structural design provides strong **anti-reflectivity performance** and effectively prevents spatter and fumes from contaminating the protective lens. The integrated **water-cooling**, **gas-cooling**, **and powder-feeding channels** ensure reliable **24-hour continuous processing**, making these cladding heads ideal for industrial inner-bore laser cladding and precision surface enhancement applications.

Performance Features

High Integration
The optical path, water-cooling channels, gas channels, and powder-feeding components adopt a highly integrated modular design, resulting in a compact structure and excellent overall stability.

Special Structural Design
The enhanced anti-reflection architecture effectively blocks back-reflected laser energy, spatter, and fumes, preventing contamination of the protective and reflective lenses.

Light–Powder Adjustment Module
The precise coaxial light–powder alignment module ensures uniform powder distribution and long, stable beam shaping, significantly improving cladding quality.

Wide Powder Particle Size Compatibility
The optimized powder-feeding nozzle ensures smooth, consistent delivery without clogging, supporting 100–400 mesh metal powder with high powder concentration and stable flow.

Extended Service Life
The improved coaxial shielding gas injection module enhances molten-pool protection, minimizes contamination, and significantly extends the service life of protective lenses and optical components.

Rich Functionality
By replacing the terminal nozzle module, the system can perform metal 3D printing, welding, quenching, coaxial cladding, off-axis cladding, and a variety of additional advanced laser-based manufacturing processes.

Technical Specifications

Category	Internal Reflective Coaxial Circular Laser Cladding Head	Internal Reflective Coaxial Strip Laser Cladding Head	Internal Reflective Needle-Type Off-Axis Laser Cladding Head
Optical Interface	QBH, QD, LLK-D, LOE	QBH, QD, LLK-D, LOE	QBH, QD, LLK-D, LOE
Optical Path Design	Reflective optical structure	Reflective optical structure	Reflective optical structure
Lens Configuration	Collimating lens + focusing lens	Collimating lens + focusing lens	Collimating lens + focusing lens
Protective Lens	Single layer	Single layer	Single layer
Cooling Method	Water cooling	Water cooling	Water cooling
Power Endurance	≤ 12,000 W	≤ 12,000 W	≤ 6000 W
Focal Spot	Rectangular spot: 3 × 3 mm, 4 × 4 mm Fixed spot: 2–5 mm	20 × 4 mm	Fixed spot: 2–5 mm (adjustable)
Applicable Wavelength	900–1080 nm	900–1080 nm	900–1080 nm
Laser Transmission Efficiency	> 99.25%	> 99.25%	> 99.25%
Optical Adjustment Module	Included	Included	Included
End Reflection Angle	110° / 120° / 130° (customizable)	110° / 120° / 130° (customizable)	130° (customizable)
Temperature Sensor	Protective lens temperature detection	Protective lens	Protective lens
Powder Feeding Structure	Coaxial powder feeding	Coaxial strip-type powder feeding	Needle-type powder feeding
Powder Utilization Rate	> 85%	> 97%	> 80%
Applicable Inner Diameter	≥ 180 mm	≥ 180 mm	≥ 45 mm
Applicable Bore Depth	3000 mm (extendable)	3000 mm (extendable)	2000 mm (extendable)
Weight	30 kg (increased after length extension)	35 kg (increased after length extension)	10 kg (increased after length extension)
Optional Features	CCD monitoring, height-following system, oscillation module	CCD monitoring, height-following system, oscillation module	CCD monitoring, height-following system, oscillation module

Transmission-Type Laser Cladding Head | High-Precision Direct-Transmission Laser Deposition Nozzle

The transmission-type coaxial ring and needle-type laser cladding heads both utilize a direct-transmission optical path and can be equipped with ring-shaped powder nozzles or needle-type powder nozzles. These cladding heads are designed for small-batch production, multi-specification components, and cladding operations in narrow or confined spaces, making them essential core modules for medium- and low-power laser cladding applications.

Performance Features

High Stability
The high-quality square or rectangular laser spot, combined with adjustable process parameters, enables precise control of melt-pool shape and heat-affected zones, ensuring excellent stability in cladding performance.

Multi-Channel Cooling Design
Equipped with an advanced multi-path water-cooling structure that supports 24-hour continuous and stable operation, even under medium- and low-power cladding conditions.

Modular Design
Supports modular expansion, including temperature-monitoring protection modules and light-powder alignment modules, enhancing processing flexibility and ease of maintenance.

Wide Powder Particle Size Compatibility
High-quality ring-type or needle-type powder feeding structures ensure stable, accurate powder delivery and support 100–400 mesh metal powders with consistent flow and high reliability.

Extended Service Life
Optimized powder feeding mechanisms and protective design reduce contamination and wear, significantly extending the lifespan of key optical components and powder-delivery structures.

Rich Functionality
By simply replacing the end nozzle module, the system can perform laser cladding, laser hardening, additive manufacturing, re pair processing, and material coating, covering a wide range of industrial applications.

Technical Specifications

Category	Transmission-Type Coaxial Ring Laser Cladding Head	Transmission-Type Needle Laser Cladding Head
Optical Interface	QBH, QD, LLK-D, LOE	QBH, QD, LLK-D, LOE
Optical Path Design	Transmission optical path	Transmission optical path
Protective Lens	3 layers	3 layers
Cooling Method	Water cooling	Water cooling
Power Endurance	≤ 6000 W	≤ 6000 W
Collimating Focal Length	150 mm	150 mm
Focusing Focal Length	300 mm	300 mm
Focal Spot	Fixed spot: 2–5 mm (adjustable)	Fixed spot: 2–5 mm (adjustable)
Applicable Wavelength	900–1080 nm	900–1080 nm
Laser Transmission Efficiency	> 99.25%	> 99.25%
Light–Powder Alignment Module	Included	Included
Temperature Sensor	Protective lens temperature detection	Protective lens
Powder Feeding Structure	Distributed powder feeding	Needle-type powder feeding
Powder Utilization Rate	> 93%	> 85%
Weight	4 kg	4 kg
Optional Features	CCD monitoring, laser height-following, oscillation system, extension modules	CCD monitoring, laser height-following, oscillation system, extension modules

Wire-Fed Laser Cladding Head | High-Precision Laser Metal Deposition (LMD) Nozzle

Wire-fed laser cladding technology uses **metal wire** as the cladding material and is primarily applied in the production of **protective surface coatings, laser remanufacturing of damaged or worn components**, and the cladding of **slender shafts, thin-walled structures, and other deformation-sensitive parts.**

This cladding head is compatible with a wide range of **cold-wire and hot-wire materials and specifications**, ensuring excellent adaptability for diverse industrial applications involving wear resistance, dimensional restoration, and precision surface en hancement.

Performance Features

High Material Utilization
The wire-fed process features excellent material utilization, minimal heat input, and low thermal distortion. It produces smoothand uniform cladding layers with refined microstructures, high bonding strength, low dilution rates, and reduced defect levels.

High Deposition Rate
Featuring an optimized hot-wire feeding system, the cladding head achieves significantly higher deposition rates—up to 2.5× faster—improving productivity for large-area and high-volume manufacturing.

Optimized Water-Cooling Structure
A highly efficient water-cooling design ensures stable thermal management and supports 24-hour continuous and reliable operation, even under long-duration industrial workloads.

Four-Dimensional Adjustment
The advanced multi-axis wire-feeding mechanism enables precise four-dimensional positional adjustment, ensuring accurate wire delivery into the melt pool for improved process stability and cladding quality.

Extended Service Life
Integrated coaxial shielding gas modules enhance melt pool protection and reduce oxidation, while superior thermal design pro longs the service life of critical optical components and protective lenses.

Rich Functionality
The cladding head supports a wide range of functions and can be quickly adapted to switch between metal wire cladding, powder cladding, and other hybrid processing modes, delivering high flexibility for diverse industrial applications.

Technical Specifications

Category	Wire-Fed Laser Cladding Head
Laser Interface	QBH, QD, LLK-D, LOE, etc.
Optical Path Structure	Reflective optical path
Protective Lens Group	3 layers
Cooling Method	Water cooling
Rated Power	≤12,000 W
Stand-off Distance	150 mm
Collimation Distance	300 mm
Focusing Optics	Rectangular Spot: 3 × 3 mm, 4 × 4 mm Circular Spot: 2–5 mm (adjustable)
Applicable Wavelength	900–1080 nm
Laser Transmission Efficiency	≥99.25%
Temperature Sensor	Protective lens temperature monitoring
Wire Feeding Structure	Four-axis wire feeding
Cladding Layer Thickness	0.1–3.0 mm
Wire Feeding Speed	0–100 mm/s (cold wire) 0–200 mm/s (hot wire)
Compatible Wire Materials	Stainless steels, structural steels, nickel-based alloys, cobalt-based alloys, copper alloys, etc.
Applicable Wire Diameter	Ø0.8 mm – Ø1.6 mm
Material Utilization Rate	100%
Weight	7.5 kg
Optional Features	CCD monitoring, laser rangefinder

Powder Feeder for Laser Cladding and Additive Manufacturing

To meet the high precision requirements of laser cladding, Greenstone offers two types of powder feeders: **a modular powder** feeder (with a separate powder hopper and control unit) and an **integrated powder feeder**.

The modular powder feeder features a compact hopper design that is easier to integrate with robotic or motion systems, enabling a fully integrated structure. This design eliminates issues caused by long powder-delivery hoses—such as unstable powder flow and excessive carrier-gas pressure—resulting in significantly more stable and consistent powder feeding.

Performance Features

Modular Structure
The modular single-tube powder feeder adopts a separated design, featuring a compact powder-hopper structure that is easy to integrate into various motion systems and laser processing equipment.

Motor-Driven System
Dual-tube or multi-tube powder feeders use dual servo-motor drive technology, enabling independent powder feeding for each tube or synchronized feeding for multiple tubes. This ensures stable powder delivery and consistent powder flow rates.

Integrated Control
Supports integrated control with external systems and processing equipment such as laser sources, machine tools, robots, and other automation platforms.

Powder Refill
Equipped with a transparent glass powder canister (compatible with powder-level monitoring modules), allowing real-time observation of powder levels for timely powder refilling and improved operational convenience.

Process Adaptability
Powder feeding volume, carrier-gas flow, and shielding-gas flow can be precisely and continuously adjusted to meet the requirements of different laser cladding and laser processing applications.

Gas-Pressure Alarm
When the gas pressure is too low or too high, the system automatically triggers alarms and instantly shuts off the laser to ensure process safety and equipment protection.

Technical Specifications

Category	Modular Single-Tube Powder Feeder	Modular Dual/Multi-Tube Powder Feeder	Integrated Powder Feeder
Product Type	Single-Tube Modular Feeder	Dual/Multiple Modular Feeder	Integrated Cabinet-Type Feeder
Dimensions (W×D×H)	250 × 290 × 945 mm	525 × 300 × 945 mm	535 × 480 × 1400 mm
Working Unit	Modular Design	Modular Design	Cabinet-Type
Powder Hopper Volume	3 L / 9 L	Dual 3 L / Dual 9 L	3 L
Powder Tube Specification	8 mm (single tube)	8 mm (single tube)	8 mm (single tube)
Powder Disc Speed	0–10 r/min	0–10 r/min	0–10 r/min
Gas Type	Argon / Nitrogen	Argon / Nitrogen	Argon / Nitrogen
Carrier-Gas Flow Adjustment Range	0–25 L/min	0–25 L/min	0–25 L/min
Shielding-Gas Flow Adjustment Range	0–25 L/min	0–25 L/min	0–25 L/min
Pressure Display Range	0.3–0.9 MPa	0.3–0.9 MPa	0.3–0.9 MPa
Supported Powder Preheat Temperature	≤ 85°C	≤ 85°C	≤ 85°C
Supported Powder Size Range	200–400 mesh	200–400 mesh	200–400 mesh
Powder Feeding Accuracy	≤ 2%	≤ 2%	≤ 2%
Powder Delivery Repeatability	± 2%	± 2%	± 2%
Optional Functions	Heating, Vibration, Powder-Level Monitoring	Heating, Vibration, Powder-Level Monitoring	Heating, Vibration, Powder-Level Monitoring

Metal Powders

Greenstone supplies a full range of laser-cladding-grade metal powders compatible with various laser cladding systems and DED/laser additive manufacturing equipment. Our product portfolio includes **nickel-based, cobalt-based, and iron-based alloy powders**, as well as **carbides, metal-ceramic composites, and custom hybrid powders**.

Produced using **gas atomization and vacuum gas atomization technologies**, our powders offer precise chemical-composition control, extremely low oxygen levels, and strict regulation of harmful elements such as P and S.

Greenstone powders have been widely adopted across industries requiring **wear resistance, corrosion resistance, and high-temperature performance**, including:

- **Coal mining**
- **Metallurgy**
- **Power generation**
- **Mining equipment**
- **Wind energy**
- **Automotive**
- **Mould and tool manufacturing**

Our high-purity, high-sphericity powders ensure stable powder feeding, excellent coating quality, and reliable performance in demanding industrial applications.

Laser Cladding Powder for Hydraulic Support Components

Model	Main Composition (wt%)	Particle Size (μm)	Hardness	Application
Fe-1045	Cr:18; Si:0.8; Ni:4.0; Mo:1.5	100–270 / 200–450	43 HRC	Hydraulic support – external laser cladding
Fe-1055	Cr:18; Si:0.8; Ni:3.0; Mo:1.0	100–270 / 200–450	52 HRC	Hydraulic support – external laser cladding
Fe-1025	Cr:18; Si:0.5; Ni:12.0; Mo:1.5	100–270 / 200–450	27 HRC	Hydraulic support – internal laser cladding

Laser Cladding Powder for Laminar Flow Rolls / Conveyor Rolls

Model	Main Composition (wt%)	Particle Size (μm)	Hardness	Application
Fe-1060	Cr:18; Si:1.2; Ni:2.0; B:1.2	100–270 / 200–450	58 HRC	Laser cladding for laminar flow rolls and conveyor rolls

Laser Cladding Powder for Cast Iron and Bronze Components

Model	Main Composition (wt%)	Particle Size (μm)	Hardness	Application
Ni-2020	Si: 2.0; Fe: 0.5; Mo: 6.0; Mn: 0.5	100–270 / 200–450	20 HRC	Laser cladding for cast iron and bronze components

Laser Cladding Powder for Chemical Pipelines, Boiler Tubes, and Valves

Model	Main Composition (wt%)	Particle Size (μm)	Hardness	Application
Inconel 625	Cr: 21.5; Mo: 9.0; Fe: 1.0; Nb: 3.8	100–270 / 200–450	—	Laser cladding for chemical pipelines, boiler tubes, and valves
Inconel 600	Ni: 73; Cr: 15; Fe: 6; Mn: 0.8	100–270 / 200–450	—	Laser cladding for chemical pipelines and boiler tubes

Laser Cladding Powder for Wind Turbine Bearings

Model	Main Composition (wt%)	Particle Size (μm)	Hardness	Application
CuSn12Ni2	Sn: 12; Ni: 2; P: 0.03; O: 0.03	100–270 / 200–450	—	Laser cladding for wind turbine sliding bearings

Laser Cladding Ceramic Powder for Cutting Picks, Rotary Drilling Teeth, and Bucket Teeth

Model	Main Composition (wt%)	Particle Size (μm)	Hardness	Application
Ceramic-3065	Impact-resistant self-fluxing alloy + ceramic + high-temperature resistant components	100–325 mesh	65 HRC	Cutting picks, rotary drilling teeth, mining teeth

Laser Cladding Powder for Agricultural Shredding Blades, Harvesting Knives, and Woodworking Cutters

Model	Main Composition (wt%)	Particle Size (μm)	Hardness	Application
Ceramic-3060	Impact-resistant self-fluxing alloy + ceramic + high-temperature resistant components	Particle Size (Mesh)	60 HRC	Shredding blades / harvesting knives / woodworking cutters
NiWC	High-crack-resistance nickel-based self-fluxing alloy + WC (crushed or spherical WC optional, WC ratio up to 65%)	100–325 mesh	55 HRC	Shredding blades / harvesting knives / woodworking cutters

Greenstone Laser Cladding Core Technologies-Laser Cladding Optical Path Design

Laser cladding is a process driven by the interaction of four key elements: laser energy, powder flow, shielding gas flow, and the molten pool. The energy distribution of the laser spot plays a critical role in determining the stability and quality of this interaction.

Greenstone-Tech utilizes high-performance optical components to precisely shape the laser beam, enabling a controllable transition of energy distribution from Gaussian/quasi-Gaussian profiles to a uniform top-hat profile. This allows the generation of circular, square, or rectangular laser spots tailored to different cladding requirements, supporting ultra-high-speed, high-efficiency, and wide-band laser cladding applications.

Transmissive Optical Path

Laser Sources

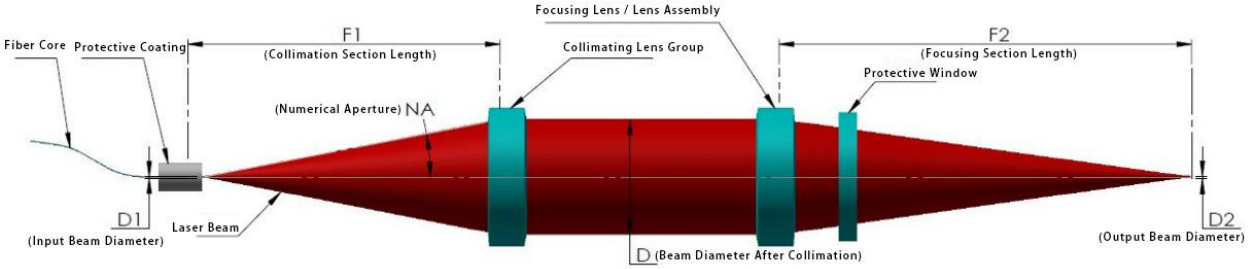
Fiber lasers, diode-pumped fiber-coupled lasers, and disk lasers.

Basic Optical Configuration

Dual-lens collimation combined with single-lens or dual-lens focusing modules, plus a protective window. Additional protective lenses can be added as needed depending on the application environment.

Typical Applications

- Transmissive coaxial ring-shape laser cladding
- Transmissive coaxial needle-type laser cladding
- Transmissive off-axis laser cladding



Reflective Optical Path

Laser Sources

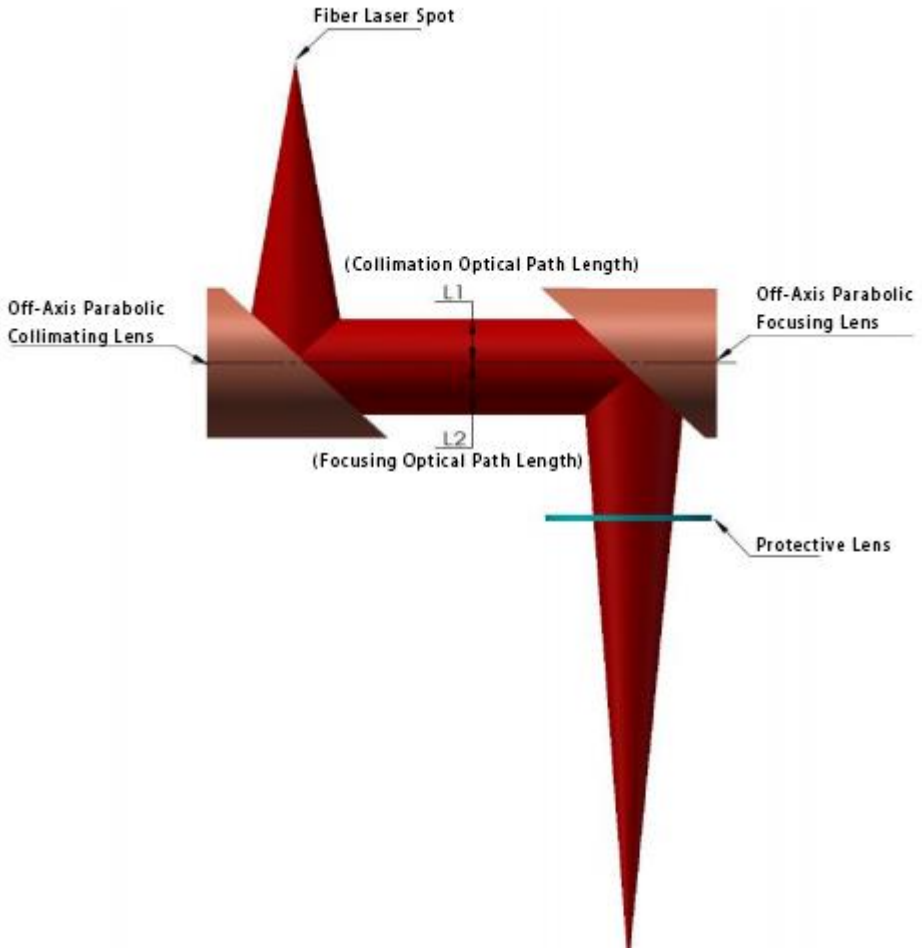
Fiber lasers, diode-pumped fiber-coupled lasers, and disk lasers.

Basic Optical Configuration

Off-axis parabolic collimating mirror + off-axis parabolic focusing mirror + protective window.
Additional protective lenses can be added when required.
The off-axis parabolic focusing mirror can also be replaced with a homogenizing integrator to achieve a uniform (top-hat) laser spot.

Typical Applications

- Reflective coaxial ring-type laser cladding
- Reflective coaxial needle-type laser cladding
- Reflective coaxial broadband laser cladding
- Reflective off-axis broadband laser cladding



Internal Optical Path

Laser Sources

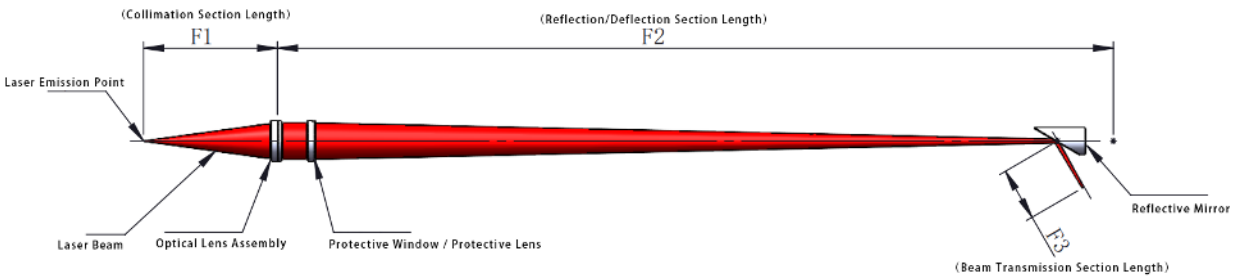
Fiber lasers, diode-pumped fiber-coupled lasers, and disk lasers.

Basic Optical Configuration

Collimating lens + off-axis parabolic focusing mirror + protective window.
Additional protective lenses can be added as needed.
The off-axis parabolic focusing mirror can be replaced with a homogenizing integrator to generate a uniform (top-hat) laser spot.

Typical Applications

- Internal-wall reflective coaxial ring-type laser cladding
- Internal-wall reflective coaxial needle-type laser cladding
- Internal-wall reflective off-axis broadband laser cladding



High-Quality Optical Components

Greenstone-Tech utilizes only the highest-quality optical components available worldwide across all of its laser cladding and laser processing equipment. These components include focusing mirrors, roof mirrors, homogenizing integrators, spherical mirrors, protective windows, and more. All reflective mirrors are manufactured using ultra-precision diamond machining on air-bearing spindle platforms, achieving nanometer-level dimensional accuracy.

To ensure superior optical performance, Greenstone-Tech uses oxygen-free high-conductivity copper (OFHC) as the base material for reflective mirrors and integrators. This enables exceptionally high reflectivity, low scattering, and excellent thermal stability. After heat treatment, the material maintains long-term surface stability, ensuring reliable performance over extended operation cycles.

The surfaces of the reflective mirrors and integrators are directly milled or turned using air-bearing ultra-precision machine tools, achieving sub-micron surface accuracy and nanometer-level surface roughness, resulting in outstanding optical efficiency. To further enhance optical properties (reflectivity and polarization performance) and mechanical durability (scratch resistance and corrosion resistance), all metal mirrors and integrators are coated with vacuum-deposited protective films.

High-power laser systems operating at multi-kilowatt levels inevitably generate thermal loads within the beam-delivery optics. Greenstone-Tech addresses this by integrating precisely engineered water-cooling structures, such as spiral water-cooling channels located beneath the mirrors. The top and bottom sections of each mirror module are hermetically welded using internal fusion-welding techniques to ensure mechanical robustness. Quick-disconnect cooling-water couplings allow operators to remove the mirror assembly easily for cleaning and maintenance.

Greenstone-Tech possesses core expertise in optical-path design and laser beam shaping, and combines this with premium optical components and high-precision mechanical parts to deliver industry-leading laser cladding equipment. Through continuous optimization and technological iteration, Greenstone-Tech drives innovation and advances the development of laser cladding technology across the industry.

Greenstone Laser Cladding Core Technologies-Laser Cladding Coating Development

The Greenstone-Tech Laser Cladding Coating Development Center is fully committed to supporting our clients in pursuing innovation and advancing their laser cladding coating business. With our expertise in powder technology, advanced laser cladding equipment, and experienced process engineers, you will find that our capabilities go far beyond those of typical coating technology development centers.

Services Provided by Greenstone-Tech Cladding Coating Development Center:

- **Laser Cladding Coatings**
- **Powder Selection, Evaluation, and Optimization**
- **Early-stage Product Development and Initial Batch Production**
- **Process Database Creation**
- **Training Programs**
- **Collaborative Process Development and Validation for Universities and Research Institutions (Horizontal/Vertical Projects)**

Laser Cladding Coatings

We leverage advanced equipment, specialized materials, and process knowledge, along with our clients' application expertise, to develop the most cost-effective laser cladding coatings. For specific materials and application fields, our process engineers possess the scientific expertise and efficient capabilities to optimize and determine the ideal process window.

Powder Selection, Evaluation, and Optimization

We combine our expertise in metal powders with your product's specific application conditions to provide the optimal powder selection solutions. Additionally, we offer powder composition adjustments and particle size distribution optimization tailored to your equipment requirements, ensuring that the metal powder used in your production process is the best match for your needs.

Early-Stage Product Development and Initial Batch Production

We provide efficient and reliable methods for monitoring the production process and automatically storing data. Additionally, we analyze this data to offer the optimal process parameters for various base materials and metal powder combinations.

Process Database

We provide efficient and reliable methods for monitoring the production process and automatically storing data. Additionally, we analyze this data to offer optimal process parameters for different base materials and metal powder combinations.

Training

We offer comprehensive, long-term training programs covering applications, processes, powder handling, and equipment maintenance to ensure that your production remains in optimal condition at all times.

EHorizontal/Vertical Research Project Process Development and Validation for Universities and Research Institutions

We possess specialized knowledge in powders, advanced laser cladding equipment, and experienced process engineers to offer professional process development and validation services for both horizontal and vertical research projects undertaken by universities and research institutions.

Greenstone Laser Cladding Core Technologies-Laser Cladding Mechanical Design

Laser cladding motion systems are the foundation for performing laser cladding and additive manufacturing on different materials and types of workpieces in industries, research, and other fields. Based on market diversification needs and years of industry experience, Greenstone-Tech, in collaboration with a professional mechanical design team, has developed a series of highly adaptable, feature-rich, cost-effective motion systems with high precision and stability for optimal operation.

Customization Requirements

- Structure Size
- Operational Precision
- Process Parameters
- Speed Range
- Load Capacity
- Control System

Types of Motion Systems

- **Machine-type Motion Systems:**

Small-scale three-axis precision, small-scale three-axis display, small-scale machines with six-axis or seven-axis configurations, suitable for laser cladding equipment used in glass molding processes.

- **Movement Mechanism Types:**

Single-axis horizontal, single-axis vertical, double-axis variable motion, double-axis motion with fixed axis, and fixed-axis variable mechanism.

- **Drive Methods:**

Large-scale servo motor, high-performance drive with a fixed-gear mechanism, and high-precision movements for the machine.

- **Custom Motion Systems:**

Large-scale three-axis precision, fixed gear systems, and fully customized designs for specific needs.

Motion System Advantages:

- **High Precision**
- **High Load Capacity**
- **High Quality**
- **Customization**

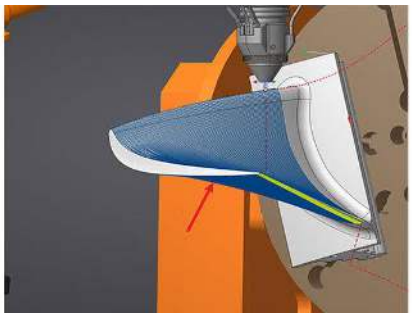
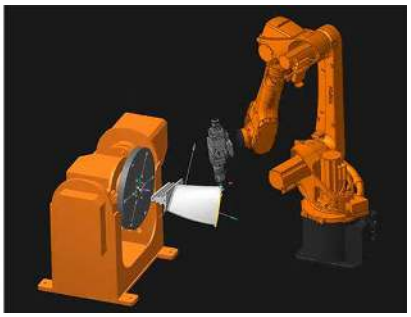
Greenstone Laser Cladding Core Technologies-Laser Cladding Intelligent Control

The Laser Cladding Intelligent Control System is an advanced software and hardware integrated control system, developed as an upgrade based on the commonly used CNC (Computer Numerical Control) systems and PLC (Programmable Logic Controller) control systems in the industry. This system primarily consists of a controller and control software, designed to optimize and automa te the laser cladding process.

Key Features:

- Integrated Control System: Combines both hardware and software for enhanced precision and efficiency.
- Advanced Automation: Streamlines control over various parameters in the laser cladding process, ensuring optimal results.
- Upgrade of Existing Systems: Built upon industry-standard CNC and PLC technologies, providing a modernized and more effective solution.

The intelligent control system enables real-time adjustments to key factors such as laser power, powder feeding, and gas flow, ensuring the highest quality and efficiency in laser cladding applications.

System Features

- **Human-Machine Interaction:** The system supports remote control and external equipment control.
- **Advanced Processing Capabilities:** The system can handle 2D and 3D graphics, providing sophisticated path planning capabilities.
- **Real-Time Process Control:** It enables precise control over the entire process flow, including adjustments for laser power, powder feeding, and other variables to maintain optimal working conditions.
- **Advanced Monitoring:** The system supports real-time monitoring of the laser processing, offering high precision and dynamic adjustment capabilities to adapt to changing operational conditions.

System Advantages

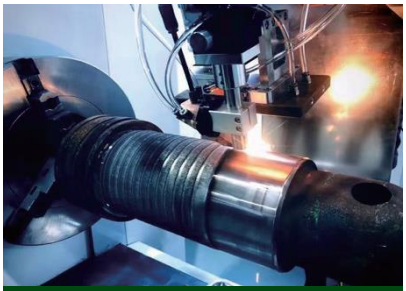
- **Enhanced Flexibility:** The system supports a wide range of configurations, capable of accommodating various process parameters and operational requirements.
- **High Precision:** With advanced system design, it allows for precise control of process parameters such as powder feeding and laser intensity. The system’ s ability to monitor real-time data improves operational consistency.
- **Easy Integration:** The system can easily integrate with existing equipment, providing the ability to adapt to a variety of processes and tools, thereby improving workflow efficiency.
- **Quality Assurance:** Equipped with multiple sensors and data acquisition systems, the system ensures high-quality output by performing real-time diagnostics, including error detection and monitoring of critical system components.

Industry Application Cases

Greenstone-Tech's cladding equipment and products are widely used across various industries, including **coal mining machinery, metallurgy machinery, road planers and excavator teeth, aerospace, high-speed rail and automotive, military defense, nuclear power, offshore equipment, chemicals, agricultural machinery, and oilfield machinery**.

Coal Mining Machinery

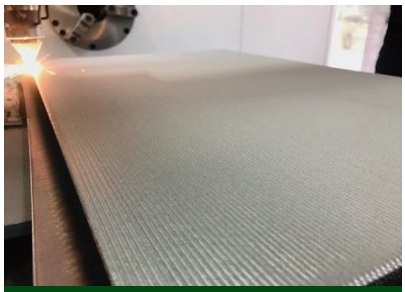
Laser Cladding on Cylinder Outer Surface



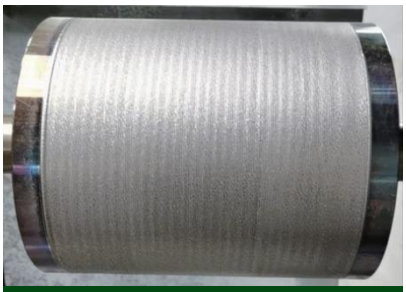
Wide Laser Spot Cladding on Cylinder Surface

Laser Cladding on Cylinder Inner Wall

Metallurgical Machinery



Laser Cladding on Continuous Casting Mold



Laser Cladding on Conveyor Roller Tracks

Laser Cladding on Guide Rolls

Road Planer Teeth and Excavator Teeth

Claw Tooth Cladding Equipment (Manual/Robot Loading and Unloading)

Laser Cladding on Claw Teeth

Laser Cladding on Excavator Teeth

Agricultural Machinery

Agricultural Tool Laser Cladding Equipment

Laser Cladding on Tools

Laser Cladding for Tool Surfaces

Oilfield Machinery

Laser Cladding on Centralizer Wear Bands

Laser Cladding on Oilfield Machinery

Laser Cladding on Oilfield Machinery

Automotive Industry

Laser Cladding on Valves

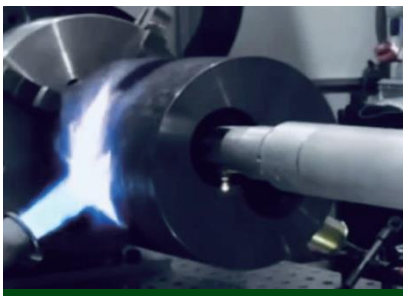
Laser Cladding on Valve Seats

Laser Cladding on Brake Discs

Injection Molding Machinery

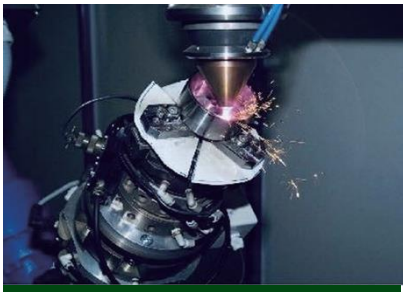
Laser Cladding on Screws

Laser Cladding on Barrels



Laser Cladding on Twin-Screw Extruder Cylinders

Valve Industry

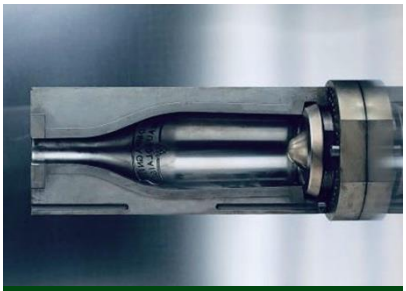


Laser Cladding on Valve Sealing Surfaces

Laser Cladding on Valve Sealing Surfaces

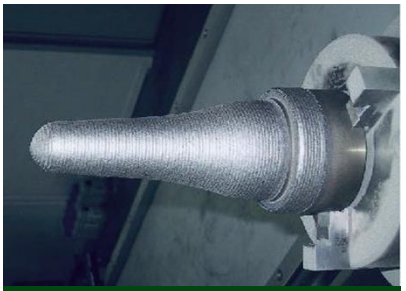
Laser Cladding on Ball Valves

Mold Industry



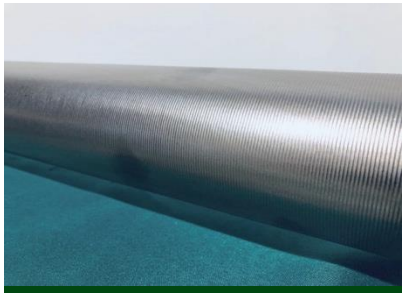
Laser Cladding on Glass Molds

Laser Cladding on Glass Molds



Laser Cladding on Punches

Power Industry



Laser Cladding on Boiler Tubes

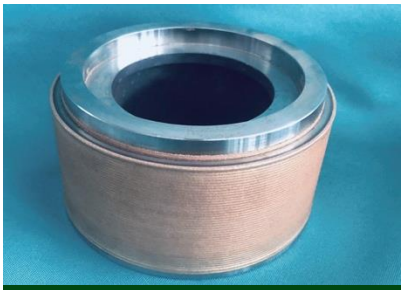
Laser Cladding on Waste Incinerator Tubes

Laser Cladding on Fan Blades

Bearings and Bearing Bushings

Laser Cladding on Bearing Bushings

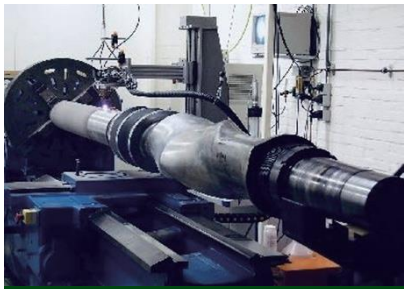
Laser Cladding on Wind Turbine Sliding Bearings/Sleeves



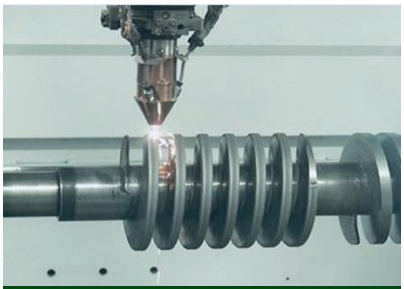
Laser Cladding on Bearings

Mold Industry

Laser Cladding on Glass Molds



Laser Cladding on Glass Molds



Laser Cladding on Punches