USA - Oklahoma City

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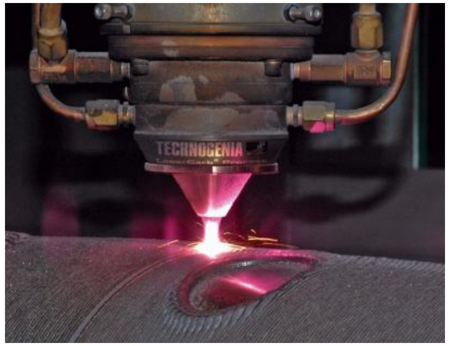


PRECISION HARDFACING THROUGH LASERCLADDING

TECHNOGENIA PRESENCE WORLDWIDE

USA - Oklahoma City

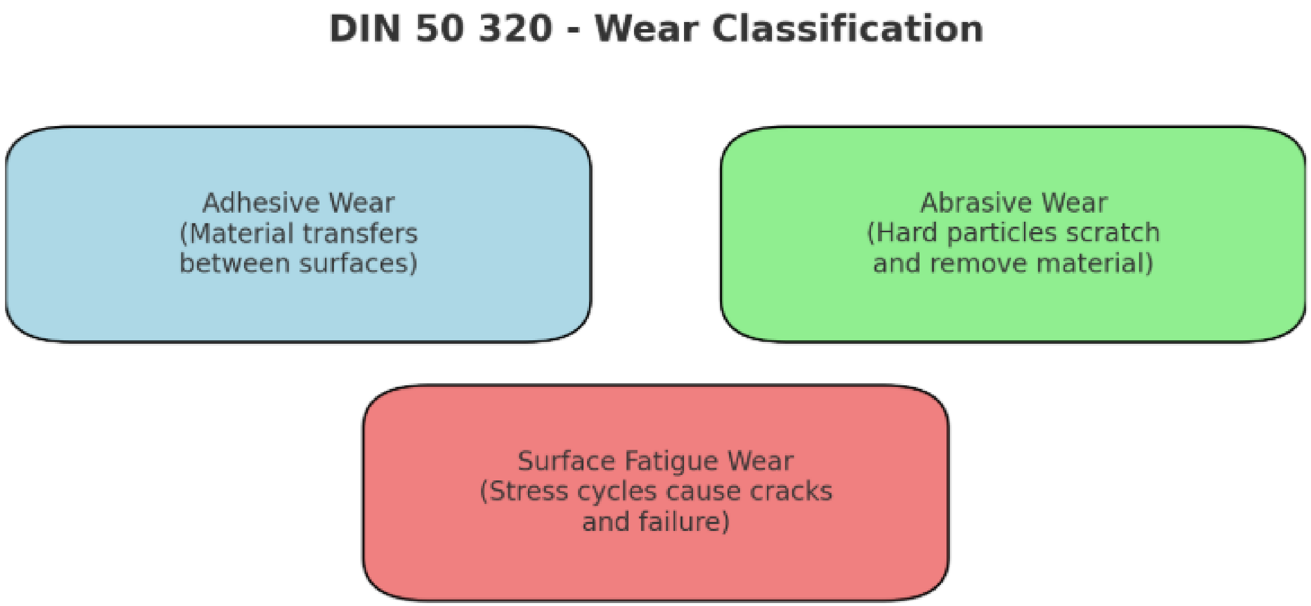
Technogenia is a specialist in the development and application of anti-wear and anti-corrosion welded coatings for new and used parts across the globe

Technogenia is the inventor of the LaserCarb® laser cladding process

AGENDA

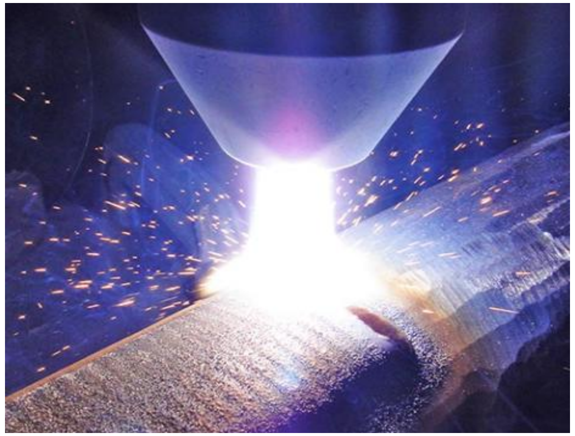
- INTRODUCTION. TYPES OF WEAR
- AVAILABLE HARDFACING TECHNOLOGIES
- LASER CLADDING PROCESS
- LASER CLADDING : TYPES OF COATINGS
- EXAMPLES

INTRODUCTION. TYPES OF WEAR: DIN 50 320



DIN 50 320 industrial concepts of reliability, failure, and maintenance classifies <u>wear as the progressive loss of material</u> from a solid surface due to mechanical causes from contact and relative motion with a counter-body, and identifies three main wear mechanisms: adhesive wear, abrasive wear, and surface fatigue wear

AVAILABLE TECHNOLOGIES TO RESTORE/ HARDFACE



PTA

✅ **Pros**

- Strong Metallurgical bond
- Thick build up possible

❌ Cons

- High dilution / Large HAZ
- Surface finish

MIG

✅ **Pros**

- Strong Metallurgical bond
- Thick build up possible
- Cost

❌ Cons

- High dilution / Large HAZ
- Surface finish

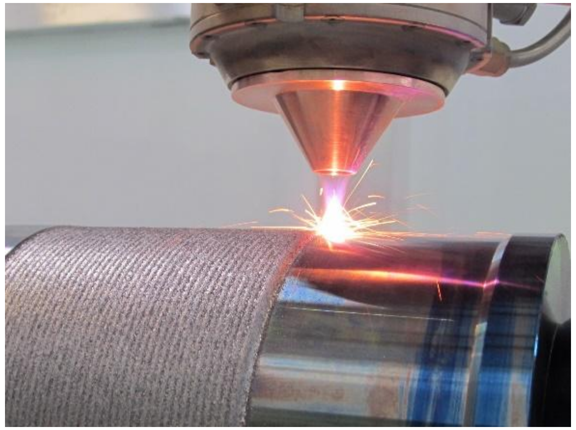
Thermal Spray (HVOF/ Arc Spray ...)

✅ **Pros**

- Surface finish
- Low dilution
- Dense coating

❌ Cons

- Weak bonding
- Thick build up are not possible



Laser Cladding

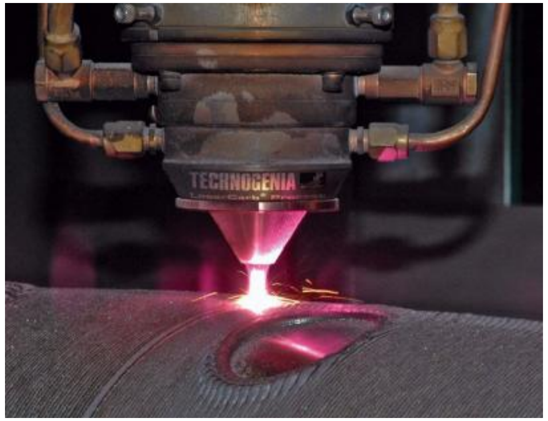
✅ **Pros**

- Strong Metallurgical bond
- Low dilution
- Thick build up possible
- Low heat input

❌ Cons

- Surface finish

LASER CLADDING PROCESS - ADVANTAGES



Thanks to low temperature combined with a small heat affected zone during the lasercladding process there is no delamination and almost no distortion while a true metallurgical weld is achieved.

	Laser Cladding	PTA Welding	TIG Welding	MIG Welding
Temperature	842–1112°F	30k–50k°F	11,000°F	3,000°F
Coating Thickness	0.01"–0.15"	0.05"–0.1"	0.002"–0.05"	0.002"–0.05"
Metallurgical Bond	Yes	Yes	Yes	Yes
Metal Dilution	Low	Moderate	Moderate-High	High
Heat Affected Zone	Low (~0.03")	Low-Medium	Large (~0.06")	Large (~0.06")
Cobalt-Based Alloys	✓	✓	✓	-
Nickel-Based Alloys	✓	✓	✓	-
Tungsten Carbide	✓	✓	✓	-
Stainless Steels	✓	✓	✓	✓

LASER CLADDING PROCESS - DEFINITION

Formal / Standards-Based Definitions

•**DIN EN ISO 4063 (Process no. 43 – Cladding by laser beam):**
"A process in which material is deposited onto a substrate by means of a laser beam to form a metallurgically bonded layer with properties different from the substrate."

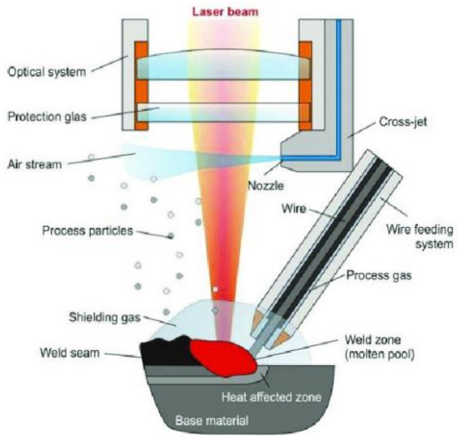
•**AWS (American Welding Society, C7.21):**
"Laser cladding is a thermal surface modification process where a laser beam is used to melt a thin layer of the substrate surface and simultaneously fuse an externally supplied material, creating a metallurgically bonded coating."

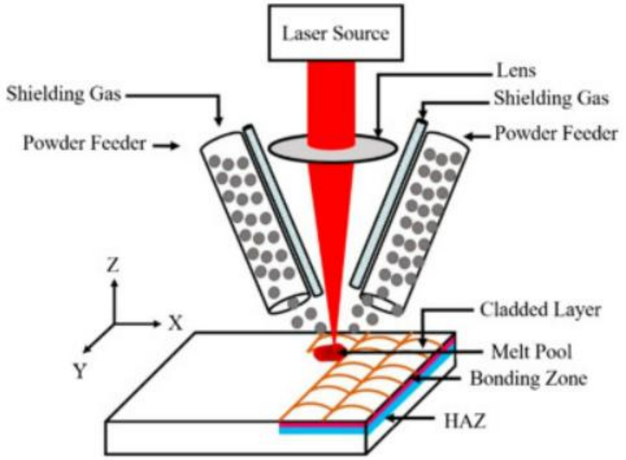
Technical Literature Definitions

•**Toyserkani, Khajepour, & Corbin (2005) – *Laser Cladding*:**
"Laser cladding is an additive manufacturing technique in which a laser beam creates a melt pool on a substrate while metallic powder or wire is delivered, producing coatings with minimal dilution and low heat input."

•**Steen & Mazumder – *Laser Material Processing* (4th ed., 2010):**
"Laser cladding is the deposition of a layer, often a corrosion- or wear-resistant alloy, on the surface of a component by melting a thin substrate layer together with injected material, ensuring strong metallurgical bonding."

LASER CLADDING PROCESS – WIRE FED VS POWDER FED





Wire Laser Cladding

✅ **Pros:**
High material efficiency — nearly 100% utilization.
Lower cost — wire is cheaper than powder.
Easy & safe handling — minimal contamination or health risks.
Cost-effective — ideal for small or custom parts.

❌ **Cons:**
Limited for complex shapes.
Less alloy flexibility.
Higher porosity / wider HAZ possible.
Process-sensitive — requires precise setup.

Powder Laser Cladding

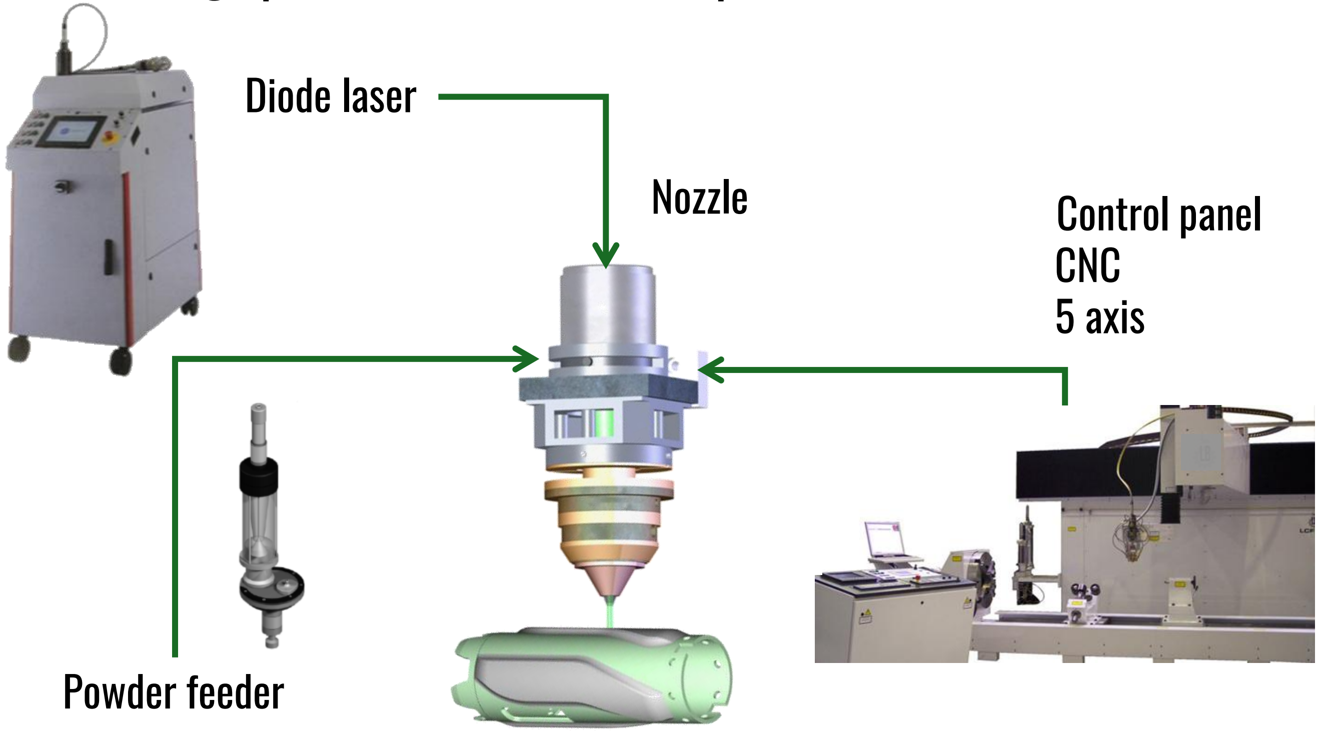
✅ **Pros:**
High deposition rates for thick coatings.
Allows complex alloy mixes and fine microstructures.
Wide material range — metals, alloys, ceramics, composites.
Excellent control of thickness, finish, and dilution.

❌ **Cons:**
Lower material efficiency — powder waste.
Higher powder cost.
Safety risks (dust, inhalation).
Possible machine contamination.

LASER CLADDING PROCESS - PRINCIPLE

High quality process for difficult and strategic parts

CNC Control: high precision, reliable and repeatable



Principle:

The process consists of using the energy of a Laser beam to melt the deposition powder (Ni-Cr or other material) on the part.

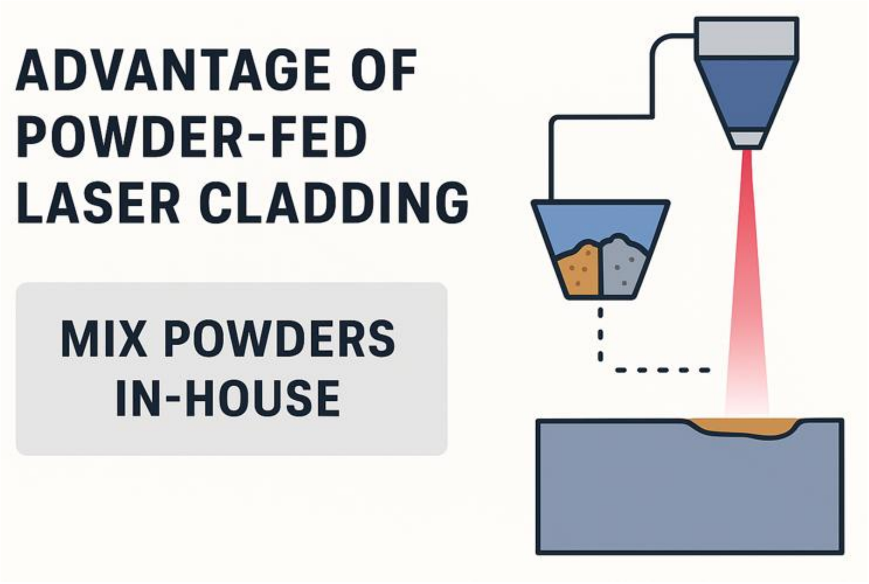
A weld occurs between the deposit and the base metal.

LASER CLADDING PROCESS - PRINCIPLE

LASER CLADDING PROCESS - PARAMETERS

Parameter	Unit / Typical Range	Function / Effect	Too Low	Too High
Laser Power (P)	Watts (300–6000 W typical)	Provides energy to melt the substrate surface and feed material; controls melt pool size, dilution, and bonding.	Incomplete melting, weak bonding, poor adhesion.	Excessive melting, high dilution, substrate distortion.
Laser Spot Size / Beam Diameter	mm (0.5–5 mm typical)	Determines power density (W/mm^2) — smaller spot = higher energy density. Affects melt pool depth, bead width, and dilution.	Narrow track, poor overlap, incomplete fusion.	Too wide pool, high dilution, carbide dissolution.
Scanning Speed (Traverse Speed)	mm/s	Governs exposure time of laser on surface; affects energy input per unit length and cooling rate.	High heat input, deep dilution, rough surface.	Poor fusion, lack of bonding, discontinuous track.
Powder Feed Rate	g/min or g/s	Controls amount of powder entering the melt pool; affects layer thickness and dilution.	Discontinuous coating, thin layer.	Excess powder, unmelted particles, surface roughness.
Shielding Gas Flow Rate	L/min	Protects melt pool from oxidation and assists powder flow; typically argon or helium.	Oxidation, porous coatings.	Turbulence in melt pool, powder deflection.
Standoff Distance (Nozzle–Substrate Distance)	mm (10–20 mm typical)	Influences powder focus and deposition efficiency; affects melt pool geometry and bonding quality.	Powder not well focused, low efficiency.	Powder scattered, poor adhesion.
Overlap Ratio / Track Spacing	% (30–50% typical)	Defines coverage and surface uniformity when building multiple tracks.	Gaps between tracks.	Overheating, high dilution, surface waviness.
Substrate Preheating Temperature	°C (often 100–300 °C)	Reduces thermal gradients, residual stress, and cracking, especially on hardenable steels.	Thermal stress, cracking risk.	Excessive dilution, slower solidification.

LASER CLADDING PROCESS: TYPES OF COATINGS



Types of coatings

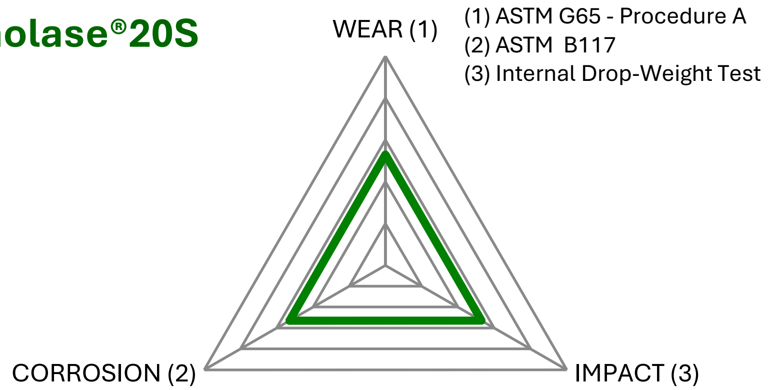
- Stainless steel
- Stellite 1 / 6 / 12 / 21
- Aluminum Bronze
- Technolase®
- Inconel
- Ultimet
- Ti-6Al-4V
- Hastelloy

LASER CLADDING PROCESS USING TECHNOLASE®

Technolase® is a composite powder containing spherical cast tungsten carbide (Spherotene®) + nickel/cobalt/iron base matrix.

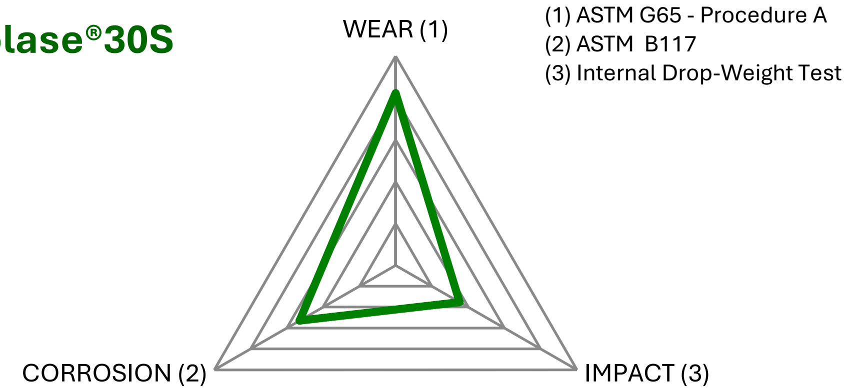
Technogenia uses in house mixed powder for laser cladding applications where wear, abrasion & corrosion resistance properties can be adjusted based on the nature of wear and customer requirements

Technolase®20S



Technolase® 20S is the top choice for crack-free overlays.
The hard phase provided by Spherotene® (spherical cast tungsten carbides) combined with a nickel-based matrix translates to high abrasion resistance with fair impact resistant properties.

Technolase®30S



Technolase® 30S is the most employed powder from the Technolase® family , showing a great balance between wear and impact resistance.

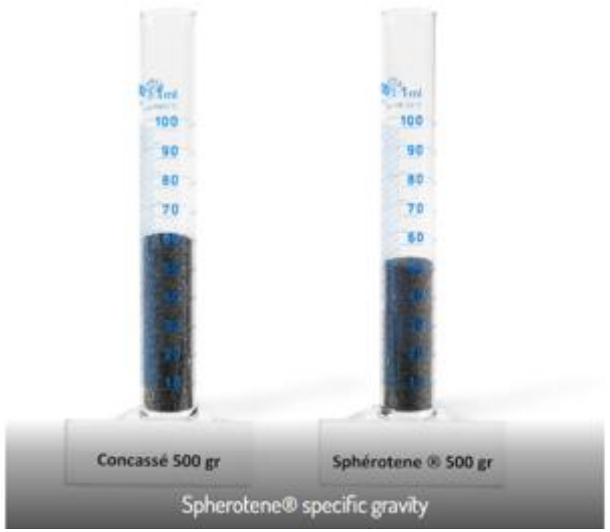
SPHEROTENE®

Spherotene® cast tungsten carbide spheres have hardness up to 3500 HV (Hardness Vickers) due to its very fine metallurgical structure known as “tangled needles”.

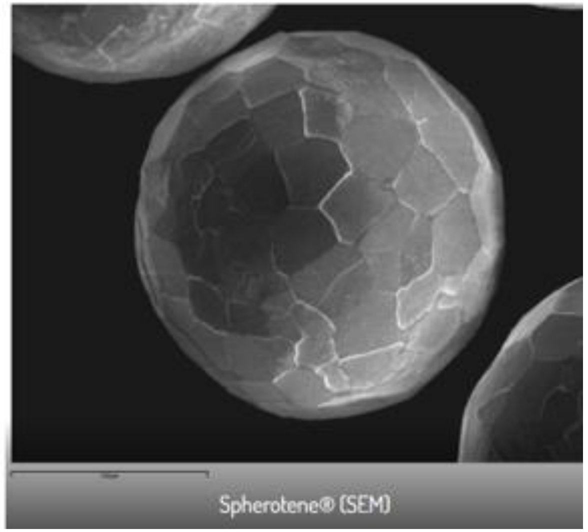
Due to the spherical shape of the tungsten carbide grains, the welding overlay has a much-improved impact resistance and wear resistance than crushed tungsten carbide.

Manufactured since 1986 by Technogenia, using a unique, innovative and patented process known as “cold crucible” Spherotene® is obtained by spraying a liquid phase of tungsten carbide.


Cold crucible

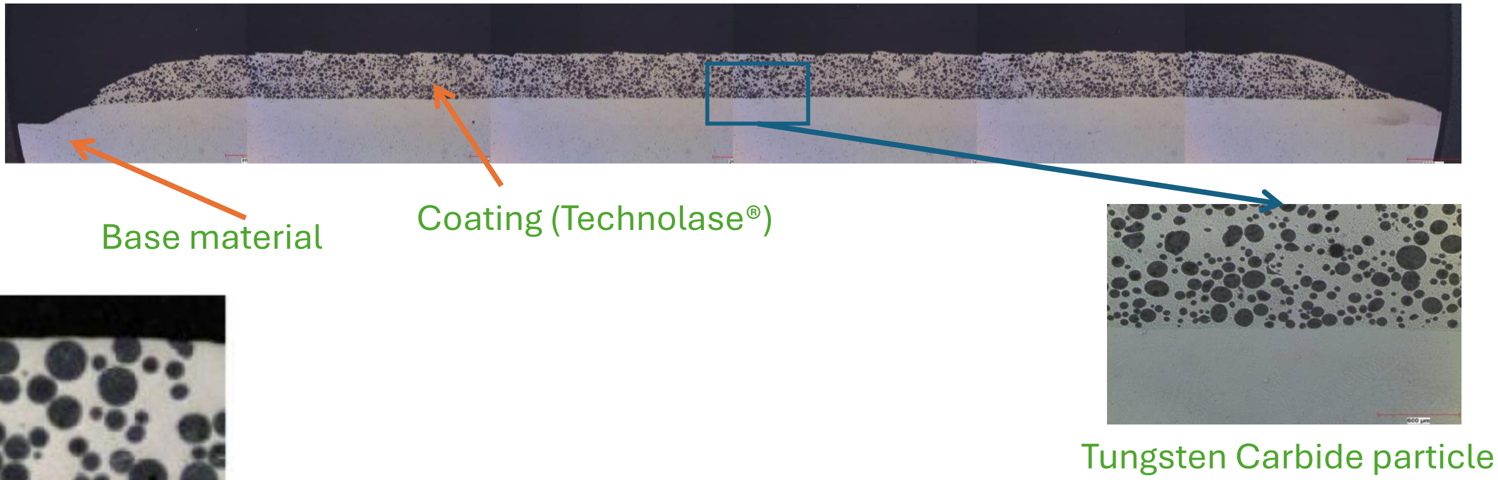


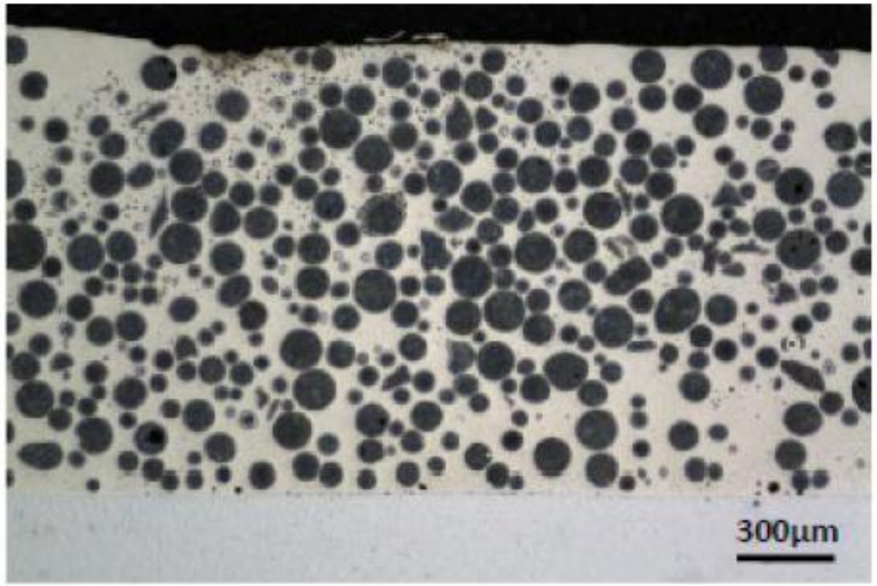
Spherotene® specific gravity


Spherotene® (SEM)

LASER CLADDING PROCESS: LASERCARB®: TECHNOLASE®

Cross section: 5mm thick deposit over stainless steel





Metallurgical aspect and advantages:

- Heat input control (through the accuracy of the laser)
- Low dilution with the base material (< 1%)
- True metallurgical bonding
- Fine metalurgical structure due to high solidification rate
- High density deposit .025-.065 (no porosity)
- Limited distorsion
- Precision and reliability of the process
- Possibility to apply several layers of material
- Possibility to remanufacture

ASTM G65 ABRASION TEST RESULTS COMPARISON

TECHNOGENIA®
USA - Oklahoma City

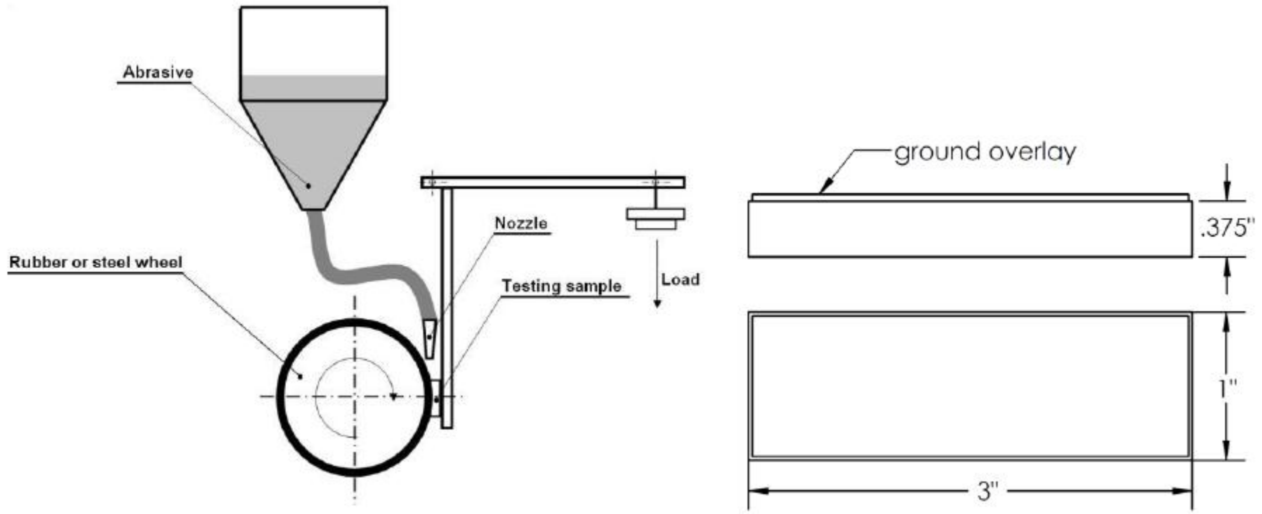


Figure 1 : Schematic diagram of ASTM G65 test apparatus (left) and standard test coupon dimensions (right)

WEAR RESISTANCE MATRIX (Abrasion Resistance)

Standard	
Designation	ASTM G65
Title	Standard Test Method for Measuring Abrasion Using the Dry Sand/Rubber Wheel Apparatus
Procedure	A

Coupons			
Base Material Designation			1018
Base Material	length width	mm(in)	76 x 25 (3 x 1)
Dimensions	thickness	mm(in)	10 (0.4)
Overlay Thickness Range[1]		mm(in)	0.75 - 1.4 (0.030 - 0.055)
Test surface	(flat within)	mm(in)	0.125 (0.005)

[1] After grinding (the general rule being to remove one third of the overlay thickness)

Test Parameters (Procedure A)		
Test load	N(lbf)	130 (30)
Sand Flow	g/min (lb/min)	342 (0.75)
Wheel Revolutions (Test time)		6000 (30 min)
Wheel Hardness		60 Shore A

Results

Products	Reports	Mass Loss (g)	Volume Loss[1] (mm^3)	Maximum Wear Scar Depth (in)	(mm)
20S	WTR.20S	0.2500	20.1	0.0010	0.0254
30S	WTR.30S	0.1205	10.6	0.0010	0.0254
40S	WTR.40S	0.1891	16.2	0.0050	0.1270
50S	WTR.50S	0.1027	10.0	0.0010	0.0254
80S	WTR.80S	0.1189	11.1	0.0010	0.0254
60S	WTR.60S	0.0877	7.8	0.0005	0.0127
TP245	WTR.TP245	1.8210	204.6	0.032	0.8128
TP255	WTR.TP255	2.1930	252.1	0.0424	1.0770
TP265	WTR.TP265	1.9191	210.9	0.0369	0.9373
TP275	WTR.TP275	2.9353	341.3	0.0455	1.1557
TP625	WTR.TP675	2.1499	247.1	0.0365	0.9271
TP276	WTR.TP276	2.6867	316.1	0.0450	1.1430
TP316	WTR.TP316	2.2850	282.1	0.0434	1.1024
TP420	WTR.TP420	1.8075	198.6	0.0335	0.8509
R706	WTR.R706	0.0839	12.2	0.0020	0.0508
R401	WTR.R401	1.8066	248.5	0.0362	0.9195
LV8	WTR.LV8	0.2167	19.1	0.0005	0.0127

[1] Densities used for the calculation of the volume loss come from internal data (see Density Matrix)

LASER CLADDING PROCESS: FLEXIBILITY

Types of coatings

- Stainless steel
- Stellite 1 / 6 / 12/ 21
- Aluminum Bronze
- Technolase®
- Inconel
- Ultimet
- Ti-6Al-4V
- Hastelloy

Base Material

- Carbon Steel
- Stainless Steel
- Non magnetic Stainless Steel
- Duplex, Super Duplex

Design

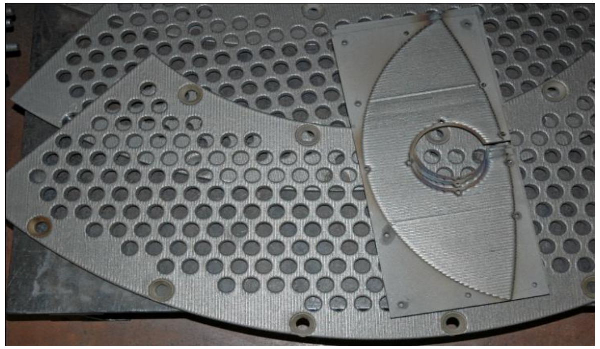
- External surfaces (OD)
- Complex geometry
- Internal areas (ID)

LASER CLADDING PROCESS: EXAMPLES









LASER CLADDING PROCESS: BOILER TUBES

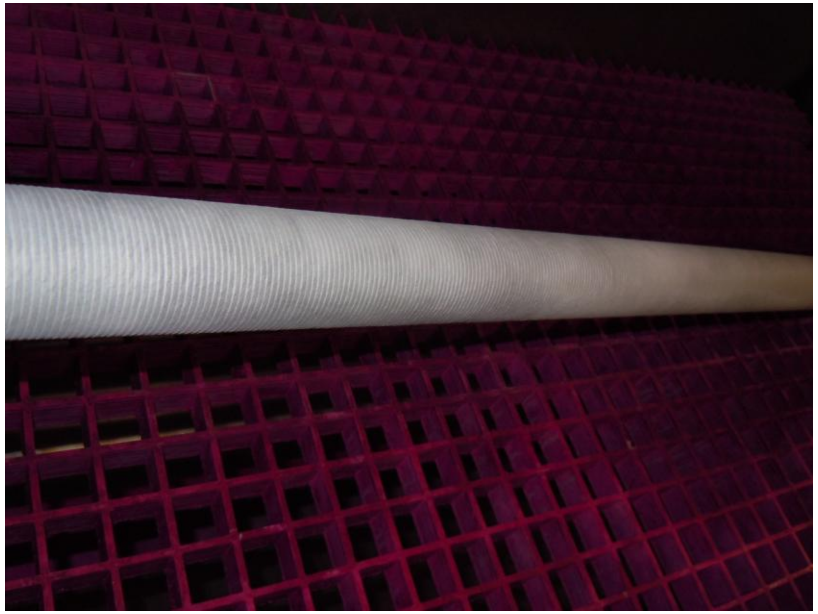
Study :
- Evaluation of Inconel 625 laser cladding on heat exchanger tube.

Conditions :
- Tests were done on OD 2” x ID 1.75” tube, P265GH steel due to availability.
- The tube was wire brushed before cladding
- Feeding material Inconel 625 powder

Visual examination :

- Smooth surface
- Cladding thickness :
  Min : .070”
  Max : .080”
- No cracks
- No deviation of the tube

Dye penetrant test



RESULTS

Liquid penetrant test :

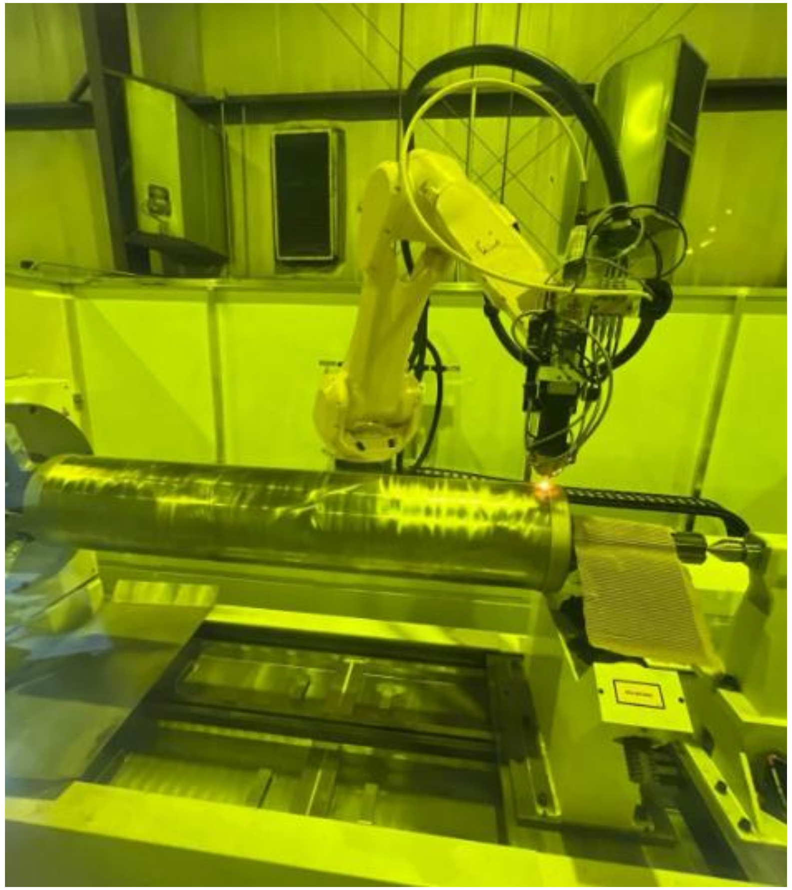
•No defects

LASER CLADDING PROCESS: BOILER TUBES

TECHNOGENIA®
USA - Oklahoma City

LASER CLADDING PROCESS: STEEL – TRANSPORTATION ROLLS

Pre Grinding



Laser Cladding with CNC Controlled Robot Laser

After Laser Cladding

LASER CLADDING PROCESS: STEEL – LOOPER ROLLS - REPAIR

TECHNOGENIA®
USA - Oklahoma City

Laser Cladded Rolls (as welded)

After Final Machining

LASER CLADDING PROCESS: STEEL – EXIT CASTER ROLL - REPAIR

Worn Roll

Removing Worn Material

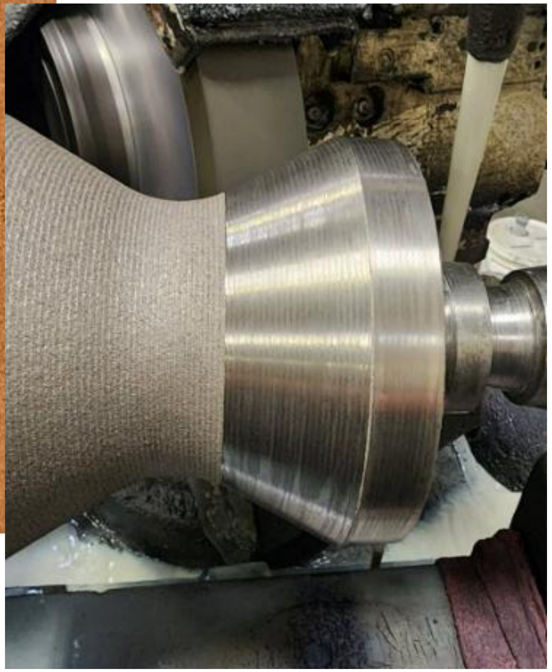
After Laser Cladding

Finished Part

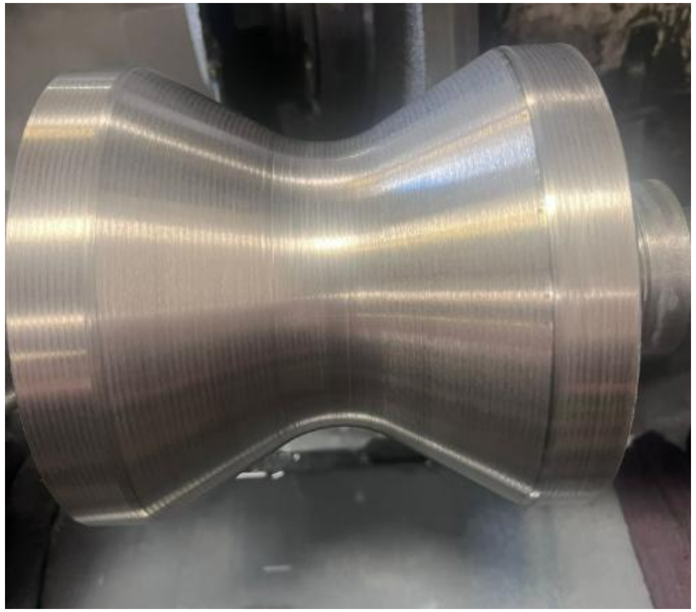
LASER CLADDING PROCESS: STEEL – GUIDE ROLLS – TURNKEY

Pre Machining

After Laser Cladding



Final Grind

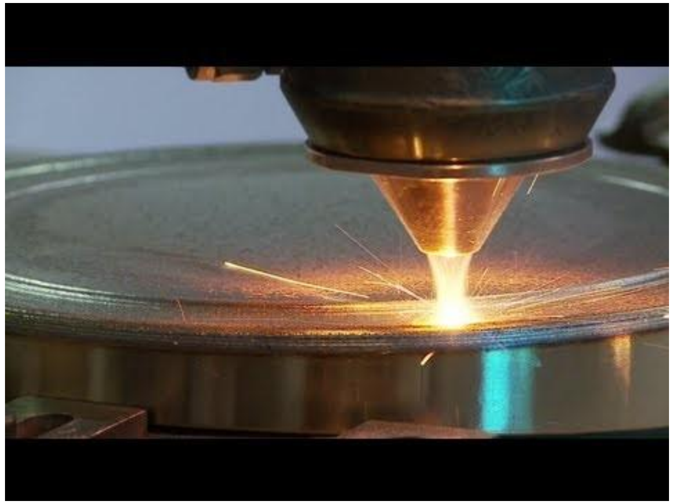


Finished Part

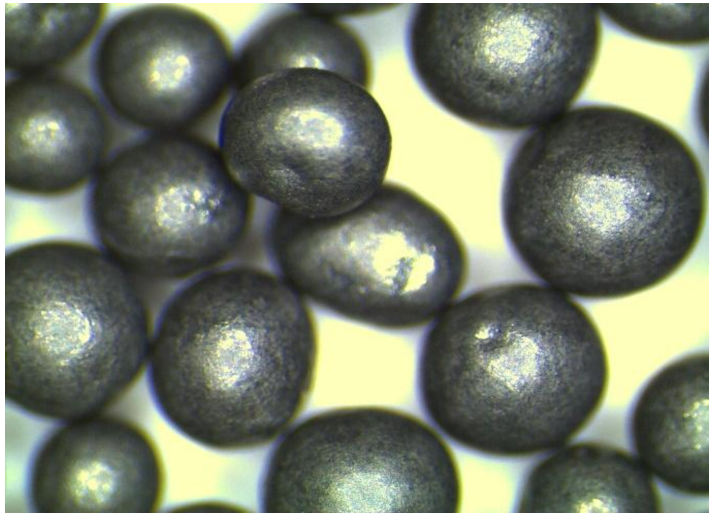
TECHNOGENIA'S DIFFERENTIATOR

Success in antiabrasion solutions is defined by hardfacing technology + hardfacing material

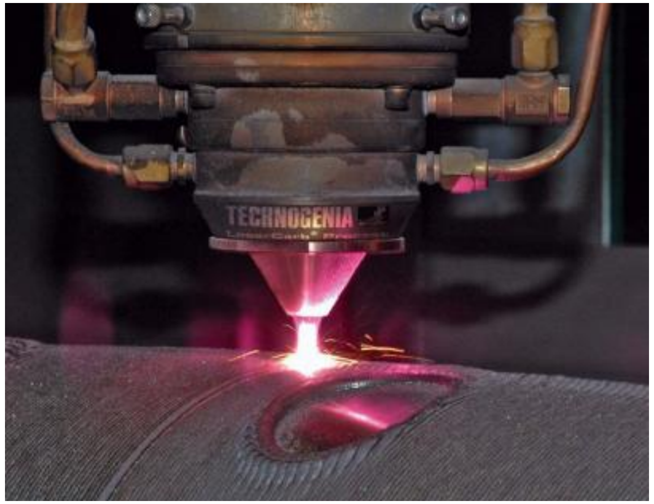
LASER CLADDING



CORRECTLY CHOSEN POWDER



LONG LASTING EQUIPMENT



LASERCLADDING CAPABILITIES : USA – OKLAHOMA CITY

USA - Oklahoma City

TECHNOGENIA LASERCARB OKLAHOMA INC.
41 S. Cooley Drive
OKC OK 73127

23 full time employees, 2 shifts -

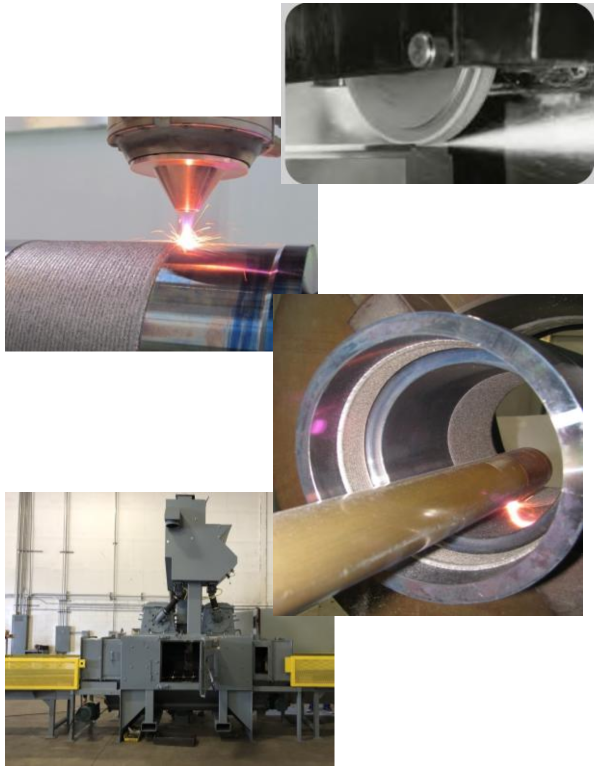
- 6 Laser cladding machines, **CNC programmable**, with a 30ft long parts capacity, up to **10 tons**.

- **External and internal laser cladding**
Maximum OD: 36”
Minimum ID 1 ½”, 20” deep maximum

- **Outside grinding, inside and surface grinding**
Maximum OD Grinding: 10”
Minimum ID Grinding 1 ½”
Maximum ID Grinding: 8”
Maximum surface grinding: about 30” long

- **Shot peening**
Using stainless cut wire 0.080” beads, OD only

- **Laser heat treatments**



LASERCLADDING CAPABILITIES : USA – HOUSTON TX

TECHNOGENIA USA - Oklahoma City

TECHNOGENIA INC.
708 old Montgomery Rd.
Conroe, TX 77301

25 full time employees, 2 shifts -

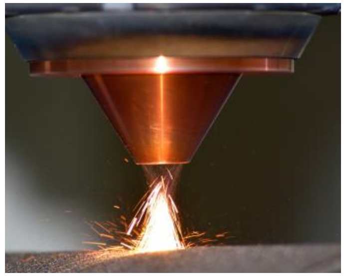
- 7 Laser cladding machines, **CNC programmable**, with a 30ft long parts capacity, up to **10 tons**.

- **External and internal laser cladding**
Maximum OD: 36”
Minimum ID 1 ½”, 20” deep maximum

- **Outside grinding, inside and surface grinding**
Maximum OD Grinding: 26”
Minimum ID Grinding 1 ½”
Maximum ID Grinding: 8”
Maximum surface grinding: about 36” long

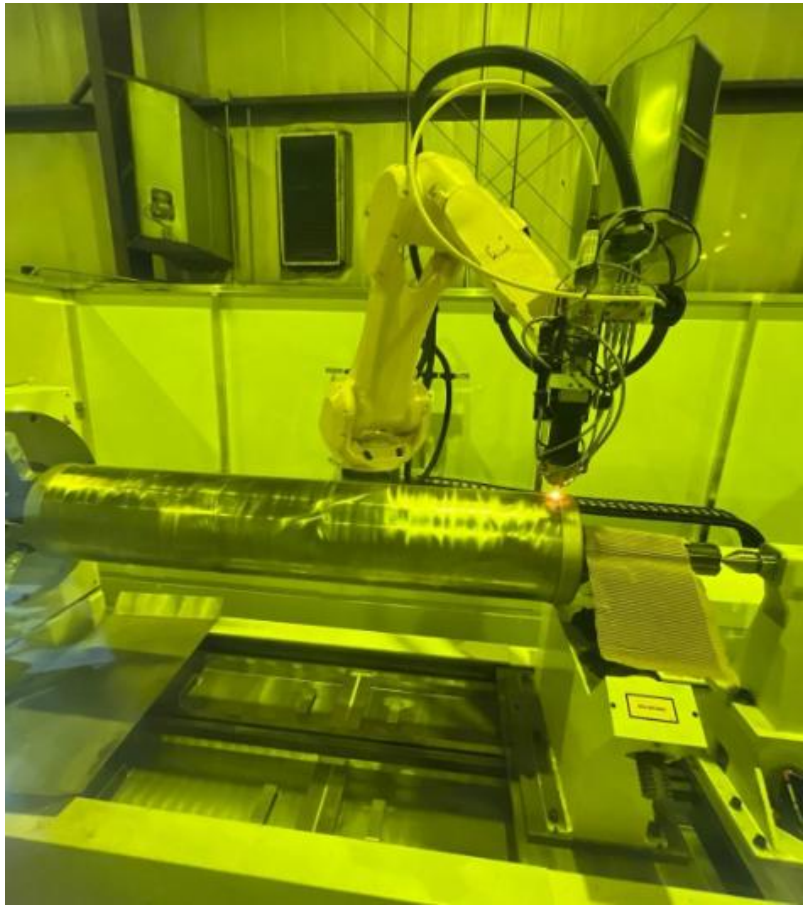
- **Laser heat treatments**

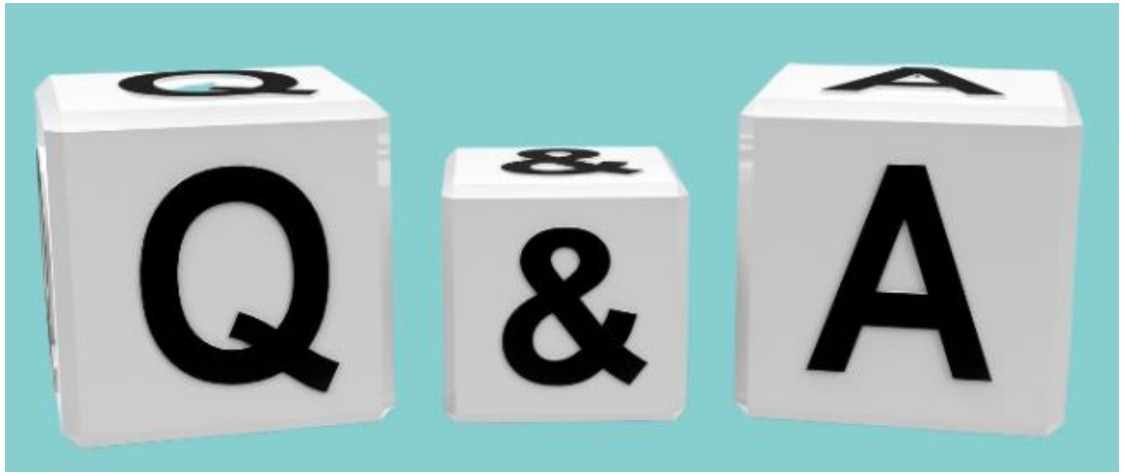
-**Machining equipment**
Lathe, 30ft long x 10” OD




LASER CLADDING PROCESS: ROBOTIC LASER

- Ultimate flexibility — coats complex shapes & hard-to-reach areas.
- Consistent quality — precise control ensures uniform, defect-free coatings.
- Minimal heat distortion — reduced heat-affected zone improves part integrity.
- Higher efficiency — faster, automated, and repeatable process.
- Versatile — handles small batches or large parts without retooling.





CONTACT INFO
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Email: natalia.fulton@technogenia.com
Address: 41 S. Cooley Dr Oklahoma City, OK 73127
https://www.technogeniausa.com/

LASER CLADDING PROCESS USING TECHNOLASE®- COMPARISON

TECHNOGENIA®
USA - Oklahoma City

Chromium Carbide case study for a classifier mill grinding blocks

Original hardfacing :

- EUTECTIC product EUTROLOY 16496 EN1274 (Alloy 60).
- Hardness 59-60HRC
- Layer thickness 6 mm
- Duration 1-2 weeks

Proposed hardfacing :

- Technolase® 30S – tungsten carbide with Nickel base matrix
- Hardness: Hard particles : 3500 Vickers, matrix 40 HRC
- Layer thickness 3 mm
- Duration 6 - 8 weeks

Conclusion: thinner layer of laser applied tungsten carbide hardfacing lasts at least two times longer than chrome carbide

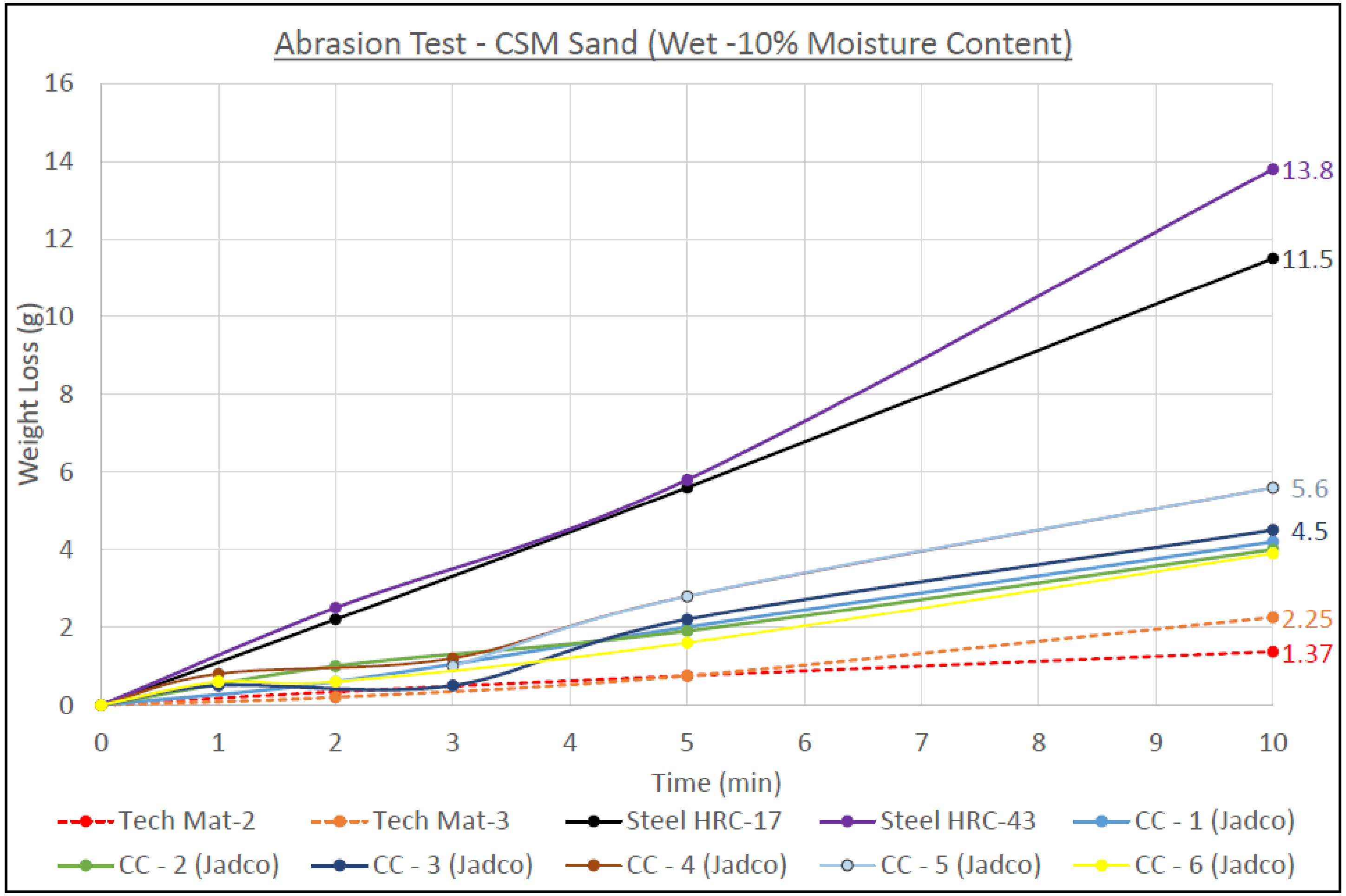
LASER CLADDING PROCESS USING DIFFERENT MATERIALS - COMPARISON

Chrome Carbide(CC) is commonly used in different industries as antiabrasion coating.

The graph represents comparison of weight loss of Technogenia hardfacing (Tech Mat - 2 & Tech Mat - 3) tested in wet sand next to uncoated (Steel HRC – 17 & Steel HRC – 43) and common CC coatings (CC -1, CC-2, CC – 3, CC – 4, CC - 5).

Technogenia's Material 2 (Technolase®) outperformed Chrome Carbide material by at least 3 times.

Excavation Engineering and Earth Mechanics Institute (EMI)



Note: Comparison is done with the published data of Kennametal products.