
LASER CLADDING
AND HARDFACING WIRES
LONGER-LASTING, HIGH-QUALITY SURFACES.
LESS DOWNTIME. MORE CONTROL.
www.lincolnelectric.eu
LINCOLN ELECTRIC

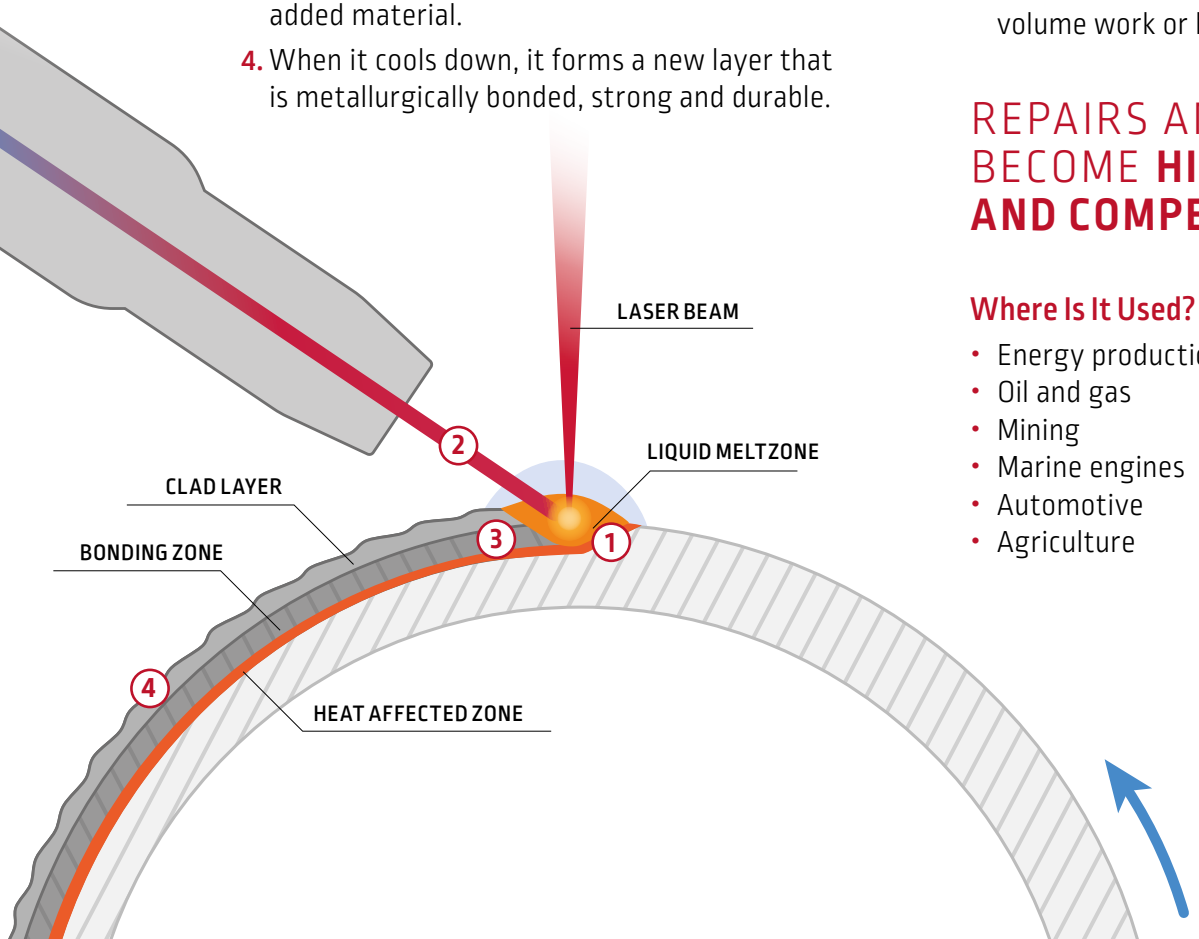
LASER CLADDING

What Is Laser Cladding?

Laser cladding is a way to improve or repair metal surfaces by applying layers of specific protective materials.

How does it work ?

1. A laser beam heats up a small area on the surface of a metal part.
2. Metal powder or wire is added to that area.
3. The laser melts both the surface and the added material.
4. When it cools down, it forms a new layer that is metallurgically bonded, strong and durable.



Why Use Laser Cladding?

- It provides a high quality deposit with high deposition rate
- The low dilution obtained with the process preserves the chemistry of the clad layer and reduces the mixing with the base material
- There is a total control of the thickness applied
- It is low heat input
- It is robust and reliable, allowing high volume work or long duty cycles

REPAIRS AND PROTECTIONS BECOME **HIGHLY EFFICIENT AND COMPETITIVE**

Where Is It Used?

- Energy production
- Oil and gas
- Mining
- Marine engines
- Automotive
- Agriculture

LASER CLADDING & HARDFACING BENEFITS

Overcomes the limitations of other cladding processes and excells with a wide range of materials.

In addition to extending the life of new and worn components, hardfacing provides the following benefits:

- Fewer replacement parts needed to stock
- Operating efficiency is increased by reducing downtime
- The “right” quantity of material can be applied. Avoiding unnecessarily expensive deposits and material waste
- Less expensive base metal can be used
- Helps reduce overall costs

WHY CHOOSE WIRE:
BUT NOT ALL WIRE PROCESSES ARE EQUAL!

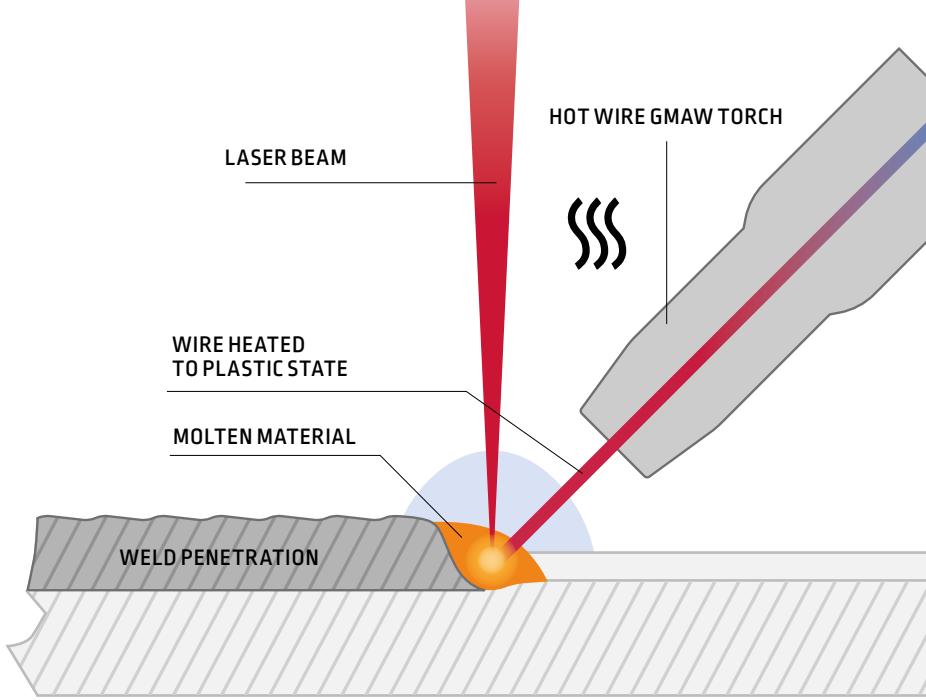
- Laser powder cladding has been around for decades and has for a long time never been matched in terms of low dilution and quality. Wire laser processes were historically unable to compete in these areas because wire requires more laser energy to melt properly. **But that was before Lincoln Precision Power Laser™ process!**
- Wires allow long runs without stopping, while powder tanks need frequent refills and handling
- Wires eliminate powder-related issues like particle oxidation or inconsistent flow, so porosity is typically lower.
- Powder can achieve finer finishes for thin coatings, but wire with optimized parameters can reach comparable results for most repair and overlay applications.

LINCOLN ELECTRIC PRECISION POWER LASER™ PROCESS. HIGH DEPOSITION RATE, LOW DILUTION

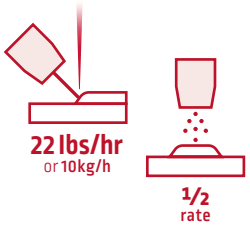
The Precision Power Laser™ process combines a super heated wire combined with a laser beam. The wire is heated by electrical resistance bringing the wire to a plastic state, very near the melting point, before it enters the melt pool. Lincoln Electric's Power Wave® R450, has improved the capability and performance of traditional Hot Wire Laser systems and has taken it to a whole new level: special controls in the power supply monitor the condition of the wire and maintain as much heat as possible into the wire without it going into an arc.

In traditional hot wire laser systems, the process operates much like a fuse and if too much current is applied to the wire, it will cause a loss of electrical conductivity, resulting in an arc. If arcing does occur, the process fails.

The Lincoln Electric Power Wave R450 with the Precision Power Laser™ waveform is capable of 450A of current without breaking into an arc and at a 100% duty cycle thus making the process much more efficient than traditional hot wire laser processes.

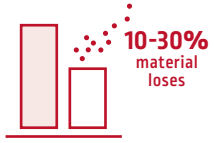


THE BENEFITS OF USING PRECISION POWER LASER™



Higher deposition rates

PPL™ uses a hot-wire laser process, preheating the wire before it enters the laser beam. This dramatically increases deposition rates- up to 22 lbs/hr or 10kg/h with an 8 kW laser, compared to typical powder cladding rates half that. In most cases, PPL™ achieves around 1 to 1.5kg/h per kW of laser power.

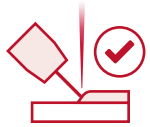


Improved Efficiency and Material Utilization

Wire-based feeding eliminates the inefficiencies of powder handling (overspray, recovery systems, and waste). **Nearly 100% material utilization versus powder cladding, which often loses 10-30% of material during spraying.**

Simplified Consumables and System Integration

PPL™ uses standard Lincoln Electric equipment and consumables, which are widely available and cost-effective.

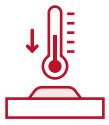


Better Dilution and Metallurgical Control

PPL™ provides independent control of heat input and wire preheat, reducing base metal dilution and improving clad quality. Conventional powder cladding can struggle with dilution control, especially at higher deposition rates.

Higher Travel Speeds

PPL™ enables arc-free, high-speed cladding, removing limitations imposed by arc dynamics in hybrid processes.



Lower Heat Input and Distortion

The process achieves precise control of weld size and penetration at minimal heat input, reducing distortion and residual stresses. Powder cladding also offers low heat input, but PPL's hot-wire approach further.

Safety and Environmental Benefits

Wire feeding avoids powder dust hazards and reduces environmental concerns without the need for special or additional containment controls.

TYPE OF WEAR

The primary consideration in selecting the final hardfacing layers is the type of wear to be encountered in service. These include:

Corrosion

Corrosion is often defined as the degradation of a metal by a chemical or electrochemical reaction with its environment. The effective wear is often a result of a combination of wear types. Corrosion is commonly addressed by cladding, often with austenitic stainless steels and nickel-based alloys.

Build-Up

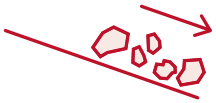
Severely worn areas can be rebuilt close to working size dimensions using tough, crack-resistant welding materials which can be deposited in an unlimited number of layers.

Metal-to-Metal Friction

Wear from steel parts rolling or sliding against each other with little or no lubrication.

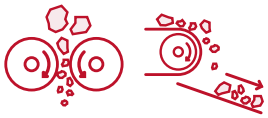
Severe Impact

Wear from severe pounding tends to damage, gouge and crack the surface. Manganese steel deposits, which work harden in service, provide the greatest impact wear resistance.



Abrasion Plus Impact

Wear from abrasive material accompanied by heavy pounding which tends to chip or crack, as well as grind away the surface.



Severe Abrasion

Wear from gritty materials which grind or erode the surface. Severe abrasion is often accompanied by heavy compression or moderate impact. Hard deposits are required to resist abrasion, but they may also need substantial impact resistance.

Metal-to-Earth Abrasion

Wear from soil or aggregate materials accompanied by moderate impact (pounding).

APPLICATIONS & REPAIRS

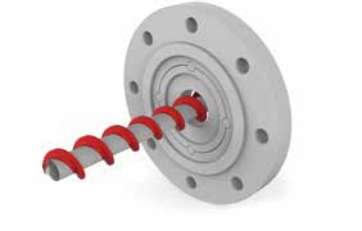
Typical repairs: restoration of shaft and journal diameters; valve seats; knife/rotor leading edges; screw conveyors and augers; guides/slideways; sealing rings.

SHORTER DOWNTIME
LONGER SERVICE LIFE
LOWER MATERIAL USAGE

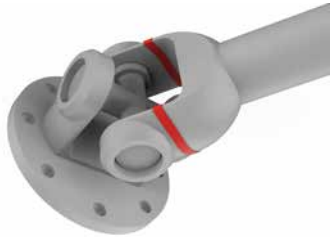
Pulverize

Pump Sleeves

Steam Valves



Shafts



Powertrains

Mixer Rotors

Ship propellers and brass cladding surfaces

Bucket Lips

Crusher rolls

Augers

CONSUMABLES

COBALT BASE WIRES

Cobalt-based cored wires are primarily alloyed with carbon, chromium, and tungsten. In some cases, they may also include nickel and molybdenum. These alloys are particularly well-suited for applications requiring resistance to wear caused by metal-to-metal contact and abrasion at elevated temperatures, as they maintain high hardness over time. Chromium contributes by forming a protective layer that helps prevent oxidation. When combined with carbon, chromium, tungsten, and molybdenum form hard carbides that enhance the mechanical strength and durability of the alloy.

METAL-TO-METAL

WEARTECH® WT-6

AWS/SFA A5.13-2000 ECoCr-A

- **Hardness HRc 38-48**
- **Available in Ø1.2mm and Ø1.6mm**

For resistance to many forms of chemical and mechanical degradation over a wide temperature range. It is the most versatile and widely used cobalt alloy, with a good balance of abrasion and impact resistance. Attributes of Weartech 6 are its outstanding anti-galling properties, high temperature hardness, and high resistance to cavitation erosion, which results in its wide use as a valve seat material. It bonds well to most weldable alloy steels and stainless.

Examples of applications: • Chemical and Steam Valve Trim • Bearing and Bushing Areas • Zinc Tanks • Diesel Engine Valves • Forging Dies • Guide Rolls • Trunnions • Pump Shafts & Sleeves • Extrusion Screws

EROSION

WEARTECH® WT-12

AWS/SFA A5.13-2000 ECoCr-E

- **Hardness HRc 51-59**
- **Available in Ø1.2mm and Ø1.6mm**

Develop high hardness and abrasion resistance and good corrosion resistance. These properties make Weartech 12 the choice for wood cutting saws and bars for industrial cutting applications for carpet, plastics, paper, and chemical industries.
It is non-forgeable and can be machined with difficulty using carbide tools. Weartech 12 bonds well to all weldable steels, including stainless steel.

Examples of applications: • Steam Valves • Hot Shears • Rings Chemical and Petrochemical Valves • Pump Impellers • Piercing Plugs • Hydro-Turbine • Cavitation Repair • Hot Trimming & Forging Dies

HIGH TEMPERATURE

WEARTECH® WT-1

AWS/SFA A5.13-2000 ECoCr-C

- **Hardness HRc 51-59**
- **Available in Ø1.2mm and Ø1.6mm**

WT-1 hardfacing wires have the highest hardness of the standard Weartech cobalt alloys and are used in elevated temperature wear applications. WT-1 has a large volume of chromium carbides in a cobalt matrix, giving the alloy excellent resistance to abrasion and solid particle erosion. It can be machined with difficulty using carbide tools or ground. It bonds well with stainless and other weldable alloy steels.

Examples of applications: • Mixer Seals and Rotors • Wear Pads • Oil Drilling Tools • Carbon Scrapers • Seaming Rolls • Pump Sleeves • Valve Balls and Seats • Hydro Pulper Disc Segments

ABRASION PLUS IMPACT

WEARTECH® WT-21

AWS/SFA A5.13-2000 ECoCr-B

- **Hardness HRc 38-48**
- **Available in Ø1.2mm and Ø1.6mm**

Provide a low carbon austenitic type deposit with excellent work hardenable high temperature strength and impact resistance. The deposits are quite stable, making them a favorite selection for hot die materials. Resistance to galling (self-mating), corrosion, and cavitation erosion make Weartech 21 a good choice for valve trim on steam and fluid control bodies and seats. It bonds well to all weldable steels, including stainless.

Examples of applications: • Steam Valves • Hot Shears • Rings • Pump Impellers • Piercing Plugs • Chemical and Petrochemical Valve • Hydro-Turbine Cavitation Repair • Hot Trimming & Forging Dies

IRON BASE WIRES

Cored wires can be tailored through the selection and addition of specific alloying elements. These elements enhance the wire's performance by improving resistance to various forms of wear, including abrasion, impact, metal-to-metal friction, corrosion, and high temperatures or even combinations of these factors.

BUILD-UP

LINCORE® BU-G

- **Hardness HRc 21-33 as welded**
- **Available in Ø1.2mm and Ø1.6mm**

Delivers deposits with moderate hardness for build-up or as final overlay. Provides some resistance to metal-to-metal wear and moderate impact. Unlimited layers with proper preheat and interpass temperatures and procedures.

Examples of applications: • Rolls • Shafts • Plows • Pump and shovel parts • Pulverizer

METAL-TO-METAL

LINCORE® 55-G

EN/ISO: T Fe_2

- **Hardness HRc 55-57**
- **Available in Ø1.2and Ø1.6mm**

Produces a deposit which resists metal-to-metal wear and mild abrasion. The deposit results in an even harder material when used with the Bulk Tungsten Carbide process. Unlimited layers with proper preheat and interpass temperatures and procedures.

Examples of applications: Crane wheels • Dredge parts • Blower blades • Tillage tools • Bucket lips

METAL TO METAL OR METAL TO EARTH

LINCORE® 57-G

- **Hardness HRc 59-61**
- **Available in Ø1.2 and Ø1.6mm**

Designed to meet the weldability and mechanical property needs of mining equipment suppliers and rebuilders. Maintain resistance to check cracking with proper preheat and interpass temperature. The hard martensitic matrix provides good metal-to-metal wear resistance and moderate impact resistance when tempered.

Examples of applications: • Dragline Bucket Lips • Augers • Sugar Cane Harvesters • Tire Shredders • Tire Shredders

LINCORE® 60-G

AWS/SFA A5.13-2000 ECoCr-E

- **Hardness HRc 59-61**
- **G65: 0.35g**
- **Available in Ø1.2mm and Ø1.6mm**

Delivers deposits with moderate hardness for build-up or as final overlay. Provides some resistance to metal-to-metal wear and moderate impact. Unlimited layers with proper preheat and interpass temperatures and procedures.

Examples of applications: • Rolls • Shafts • Pump and shovel parts • Pulverizer • Plows

SEVERE ABRASION/ LOW IMPACT

LINCORE® 70-G

- **Hardness HRc 67-70**
- **Available in Ø1.2mm; Ø1.6mm; Ø2.8mm**

Exceptional wear resistance with deposits that last approximately 2-3 times longer than most chrome carbide and complex carbide alloys, especially in wet abrasion applications. Maintains high hardness after exposure to elevated temperature. Great for high value applications where downtime is costly or replacement parts are expensive.

Examples of applications: • Wearplates • Crusher Rolls • Ore chutes • Screw Augers

CONSUMABLES

WEARPLATES

LINCOLN SHS® 9700

- **Hardness HRc 67-69**
- **G65: 0.13g**
- **Available in Ø1.1mm; Ø1.6mm; Ø2.4mm and Ø2.8mm**

Lower cost while maintaining near nanoscale (submicron) microstructure. Provides exceptional wear resistance lasting significantly longer than most chrome carbide and complex carbide alloys. Maintains high hardness after exposure to elevated temperature. Limited to 2 layers max.

Examples of applications: • Wearplates • Crusher Rolls • Ore chutes • Screw Augers

SEVERE SLIDING ABRASION

LINCOLN SHS® 9800

- **Hardness HRc 68-71**
- **G65: 0.12g**
- **Available in Ø1.1mm; Ø1.6mm; Ø2.4mm and Ø2.8mm**

Exceptional resistance to severe sliding abrasion. Provides longer lasting wear life than most chrome carbide and complex carbide alloys. Improved impact resistance results from complex borocarbide phases surrounded by ductile phases that form during welding. Limited to 2 layers max.

Examples of applications: • Wearplates • Crusher Rolls • Ore chutes • Screw Augers

SPALLING PROTECTION

Lincoln Guardian HB

- **Hardness HRc 55-59**
- **G65: 0.33g**
- **Available in Ø1.6mm**

LINCOLN® GUARDIAN HB Hardbanding Cored Wire designed for superior spalling resistance and high tool joint protection in Hardbanding casing wear applications.

Examples of applications: • Hardbanding

SEVERE ABRASION

LINCOLN GUARDIAN® CF

- **Hardness HRc 62-65**
- **Available in Ø1.6mm**

Crack free performance. Exceptional casing wear protection and tool joint life. With Precision Power Laser™, it provides high hardness with low or no preheating and a smooth deposit.

Examples of applications: • Drill Pipes • Wear pads • Tubulars • Stabilizers

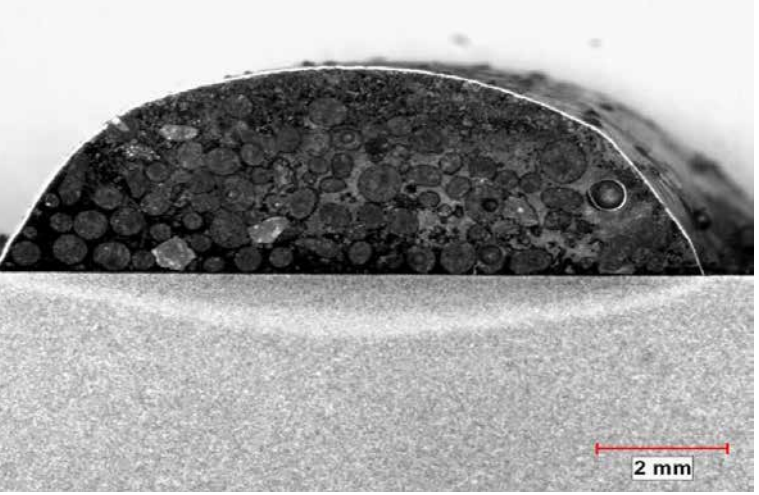
EXTREME ABRASION

LINCOLN SHS® 9192U

- **Hardness HRc 69-72**
- **Available in Ø1.6mm**
- **Limited to 2 layers**

SHS9192U is an iron-based steel alloy with a near nanoscale microstructure that features extreme abrasion resistance with high toughness, high volume of hard phases and superior high temperature hardness. Its unmatched wear performance allows it to be used as an alternative for some severe wear applications currently dominated by 60% tungsten carbides materials.

Examples of applications: • Wearplates • Crusher Rolls • Ore chutes • Screw Augers



TUNGSTEN CARBIDES WIRES

Cored welding wires that contain special tungsten particles are extremely resistant to wear and scratching. These hard particles are added during manufacturing. Perfect for laser welding. When used with laser welding, the wire melts smoothly without damaging the tungsten particles. Because laser welding uses low heat and cools quickly, the particles stay trapped in the metal and spread out evenly, making the welded area stronger and more durable.

Precision Power Laser™ require the lowest laser energy level for cladding with DED-LB wire. Selecting it for working with tungsten carbide particles is highly efficient. It provides deposition rate up to 8kg/h and preserves the WC particles diffusion.

WC, WC2 IN NICKEL MATRIX

LINCOLN KESTRA® KST TUB TUNGDUR G

WC and Ni

- **As welded matrix: 30-40 HRC**
- **Microhardness of tungsten carbides (WC + W2C): 2200 to 2400 HV**
- **40% of WC**
- **Available in Ø1.6mm; Ø 2.4mm**

Metal Cored wire that provides a highly abrasion resistant coating layer by containing spherical tungsten carbides (WC + W2C) dispersed in a nickel matrix. Especially indicated for parts required severe abrasion resistance, such as mixing arms, drill bits, grinding and processing of limestone, clay, cement, sand, coal, food, among others.

Examples of applications: • Drill bits • Mining equipment • Mixers

WC IN STEEL MATRIX

LINCOLN KESTRA® KST TUB 60 WC OA

Fe BASE + WC

- **Weld metal hardness: 58-63 HRC (2 layers)**
- **WC micro hardness: 2000HV**
- **60% of WC**
- **Available in Ø1.6mm and Ø 2.8mm**

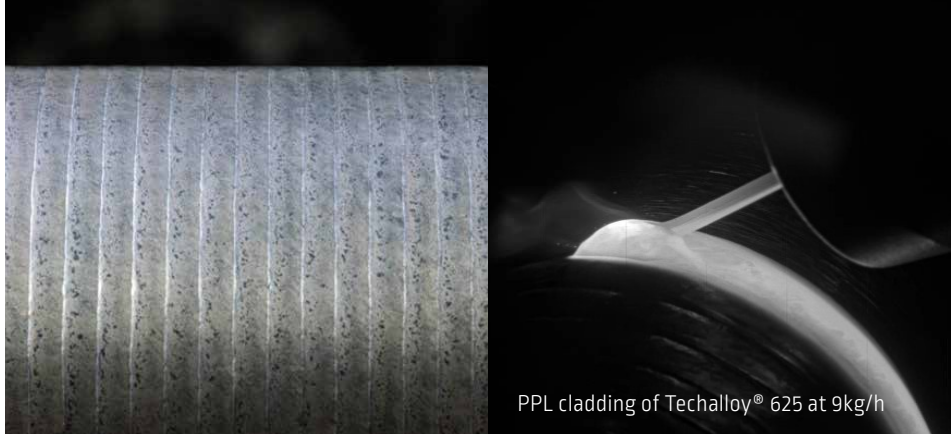
The TUB 60WC M is a metal cored for open arc welding, which produces a weld metal with Tungsten Carbide particles dispersed on iron base alloy. Indicated to mining equipment, tool clamps, well drilling bits, steel billets clamp, dust catcher fan blades at cement, steel and mining industries where high abrasion resistance is required.

Examples of applications: • Steel industry • Mining equipment • Dust

Cladding sample with Precision Power Laser™
7.5kg/h deposition rate with 4000W of laser power

NICKEL BASE WIRES

Nickel-based wires are used in laser cladding to protect and enhance metal surfaces. Nickel-based wires offer excellent resistance to wear, corrosion, and high temperatures, making them ideal for tough environments. When deposited with **Precision Power Laser™** they create a smooth, high-quality layer. Their spatter less processing allows them to achieve extensive duty cycle at high productivity. Linked to the extremely low dilution of the PPL process, they provide close chemistry right at the first layer when other Arc based cladding technology would require several to reach the proper composition.


PPL cladding of Techalloy® 625 at 9kg/h

Ni/Fe

55NiFe / Techalloy® 55

AWS Similar to ENiFe-CI

- **Available in Ø1.1mm**

TECHALLOY® 55 is designed for welding cast irons to other cast irons as well as for joining cast irons to mild steels and readily used for the repair of castings application.

Examples of applications: • Cast iron repair • Cast iron rebuilt

Ni/Cr

20.70.Nb MIG / Techalloy 606

AWS ERNiCr-3

- **Available in Ø1mm, Ø1.2mm and Ø1.6mm**

TECHALLOY® 606 ideal for dissimilar welding applications between various nickel alloys and stainless or carbon steels as well as for overlay deposits, suitable for cryogenic to high temperatures operations.

Examples of applications: • Overlays • Dissimilar welding

Ni/Cr/Fe

Techalloy® 718

AWS ERNiFeCr-2

- **Available in Ø1mm, Ø1.2mm and Ø1.6mm**

TECHALLOY® 718 is ideal for welding high strength aircraft components and liquid rocket components involving cryogenic temperatures, as it can be age hardened to higher strengths operation.

Examples of applications: • High strength Aircraft components

Techalloy® 825

AWS A5.14M: 2011 ERNiFeCr-1
UNS N08065

- **Available in Ø1mm, Ø1.2mm and Ø1.6mm**

TECHALLOY® 825 is ideal for welding the nickel-chromium-molybdenum-copper alloys. This alloy can be used for overlay cladding where similar chemical composition is required.

Examples of applications: • Maintenance and repair • Overlay on similar chemical composition

Ni/Cr/Mo

Techalloy® 625

AWS ERNiCrMo-3

- **Available in Ø1mm, Ø1.2mm and Ø1.6mm**

TECHALLOY® 625 is the most popular alloy for cladding, designed to match the composition and properties of alloy 625. The Ni-Cr-Mo alloy system provides excellent resistance to oxidizing and reducing environments, with the high molybdenum content providing good stress, pitting and crevice corrosion resistance.

Examples of applications: • Overlay on steel and SS • Buffering layers • Cladding for heat and corrosion resistance

Techalloy® 276

AWS ERNiCrMo-4

- **Available in Ø1mm, Ø1.2mm and Ø1.6mm**

TECHALLOY® 276 is ideal for materials of similar composition due to high molybdenum content, this alloy offers excellent resistance to stress corrosion cracking, pitting and crevice corrosion. Used for dissimilar welding or cladding between nickel base alloys and stainless steels.

Examples of applications: • Overlays • LNG • Repair

CUSTOMER ASSISTANCE POLICY

The business of The Lincoln Electric Company® is manufacturing and selling high quality welding equipment, consumables, and cutting equipment. Our challenge is to meet the needs of our customers and to exceed their expectations. On occasion, purchasers may ask Lincoln Electric for information or advice about their use of our products. Our employees respond to inquiries to the best of their ability based on information provided to them by the customers and the knowledge they may have concerning the application. Our employees, however, are not in a position to verify the information provided or to evaluate the engineering requirements for the particular weldment. Accordingly, Lincoln Electric does not warrant or guarantee or assume any liability with respect to such information or advice. Moreover, the provision of such information or advice does not create, expand, or alter any warranty on our products. Any express or implied warranty that might arise from the information or advice, including any implied warranty of merchantability or any warranty of fitness for any customers' particular purpose is specifically disclaimed

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