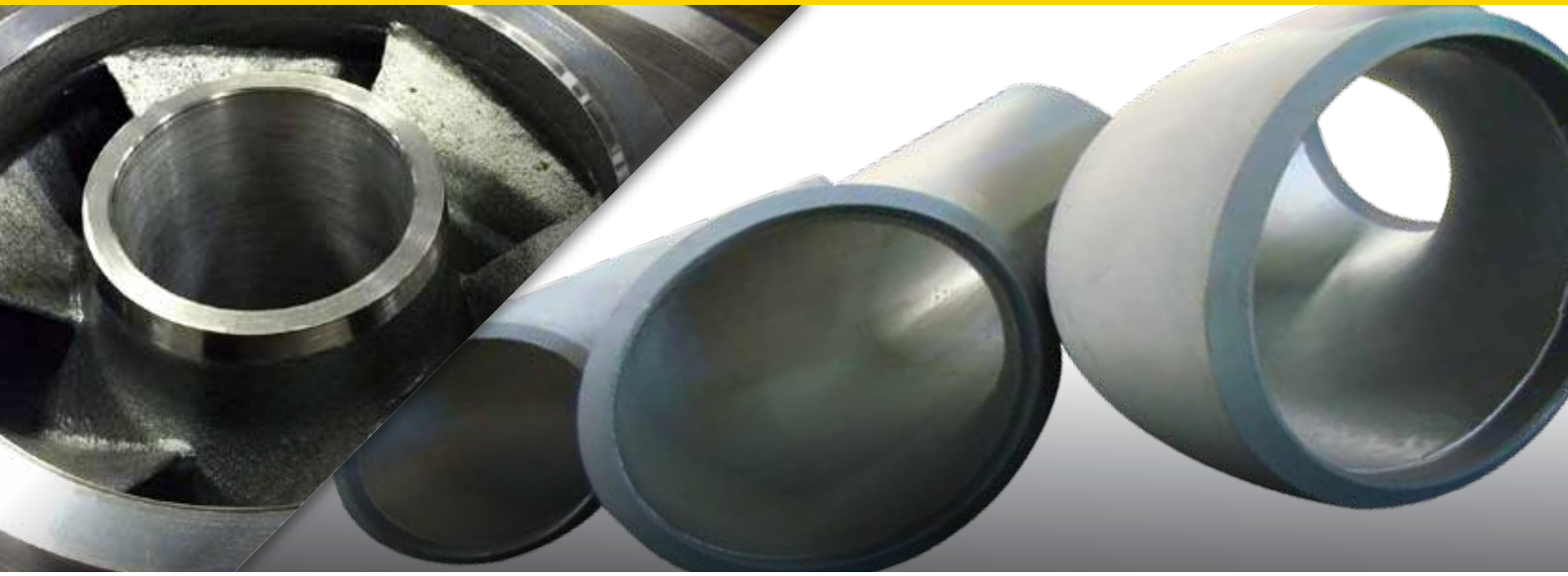
SURFACE

ULTRAFLEX™ CLADDING



KENNAMETAL™
CONFORMA CLAD

ULTRAFLEX™ CLADDING

Kennametal is a global provider of solutions for wear, heat, and corrosion problems, a world-class manufacturer of components, and a service provider to a wide range of industries. Kennametal is your trusted source for the most innovative solutions that deliver productivity, reliability, and extended service life in the most demanding environments.

Drawing on expertise from Kennametal with tungsten carbide-based materials, and incorporating super alloy-based technologies from the Kennametal Stellite™ organization, UltraFlex™ provides an extensive portfolio of surface treatments for your application. Designed to accommodate even the most complex geometries, including non-line-of-sight surfaces, UltraFlex covers a variety of industries and applications, including:

- **Oil & Gas Drilling & Production**
- **Chemical & Petrochemical Processing**
- **Power Generation**
- **General Conveyance**
- **Mechanical Equipment**

UltraFlex™ Cladding

UltraFlex, a wear-resistant surface treatment from Kennametal, brings industry-leading performance to components with complex geometries for power generation, oil and gas, and many other industries. UltraFlex is a proven product for extending component life and increasing productivity. The Kennametal UltraFlex treatment is available in a broad array of materials, ensuring the optimum solution for your application's wear environment.

Surface Wear Applications

- **Abrasion**
- **Erosion**
- **Corrosion**
- **Metal on metal wear**
- **Galling**
- **Fretting**
- **High-temperature environments**

Benefits

- **Increased component life**
- **Reduced downtime**
- **Reduction in failures**
- **Reduced maintenance costs**
- **Reliable performance between scheduled maintenance**
- **Consistent product quality**
- **Maintain system efficiency**

The UltraFlex Process

Using the Kennametal patented process, UltraFlex material is first applied in a slurry form to the substrate using proprietary flow-coating methods. This "green" coating is then fused to the substrate in a vacuum furnace, creating a dense, uniform, and metallurgically bonded coating.

UltraFlex Material Options

Coating options tailored to meet specific needs.

Corrosion & Erosion	**Stellite™** Offers an extremely smooth coating. Ideal in corrosive and erosive environments.
Severe Erosion & Abrasion	**Tungsten Carbide** The best protection available for severe erosion and abrasive environments.
Application Examples: FCC bottoms pumps, catalyst withdrawal lines, delayed coker return bends, pellet conveyance elbows, abrasive slurry conveyance, coal ash screens, severe service valves, thermowells, and more.	

Substrate Compatibility

Our Stellite and tungsten carbide coatings are compatible with a broad range of substrate materials.

UltraFlex Coatings	Substrate Compatibility
Stellite 6, 12, 720 WC Composites	Carbon Steels (1026, 4130, 1018)
	Austenitic Stainless Steels (303, 304, 308, 316, 347)
	Precipitation Hardened Steels (17-4 PH)
	Martensitic Steels (410, 420, 440C, 9Cr1Mo, F9, F91)
	Ni-based Alloys (C276, 800H, 718)

When possible, Kennametal will consider additional coating formulations to meet our customers' requirements.

Non-Line-of-Sight & Complex Geometries

Parts with complex geometries, small inner diameters, and other non-line-of-sight features may be difficult to coat with traditional methods. By comparison, the UltraFlex™ treatment easily conforms to intricate shapes and reaches remote locations.

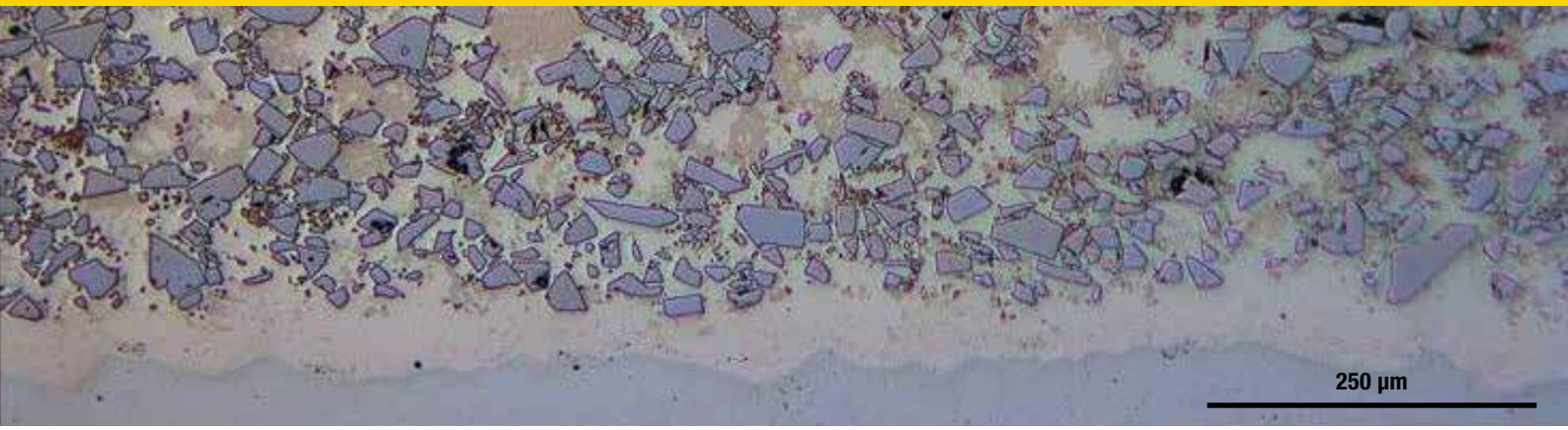
Unlike methods such as weld overlay, thermal sprays, and traditional cladding, the Kennametal UltraFlex treatment accommodates inside diameters and complex geometries.

	UltraFlex	Weld Overlay	HVOF	Boron Diffusion
Non-Line of Sight	Good ✓	Poor	Poor	Good
Complex Geometries	Good ✓	Poor	Fair	Good
Relative Thickness	Thick ✓	Very Thick	Thin	Very Thin
Bond Strength	Strong ✓	Strong	Weak	Strong

With the UltraFlex treatment, Kennametal is able to apply a high-quality super-alloy or tungsten carbide composite onto substrates with complex geometries without the problems commonly faced with welding.

The UltraFlex surface treatment can be applied in a range of thicknesses, depending on the application, coating material selected, and substrate geometry. The base thickness is approximately 0,25mm (0.010"), while typical applications range from 0,51–0,76mm (0.020–0.030") or more to accommodate your specific needs.

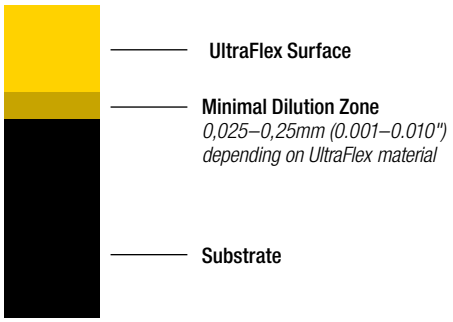
The “as applied” surface is extremely smooth — especially compared to weld overlay. Depending on the application, the coating can be used “as applied” or machined to the desired finish. For example, with the right substrate/coating combination, in some petrochemical applications, UltraFlex alloy formulations allow for “pigging” of conveyance lines due to the smooth, crack-free surface.



Metallurgical Bond

Surface treatments with mechanical bonding may not stand up to harsh environments due to cracking and spalling. UltraFlex™ features a metallurgical bond and unique benefits to extend component life.

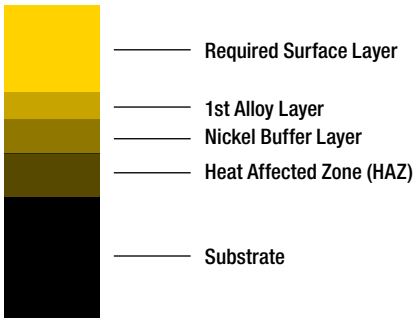
UltraFlex Surface Treatment



In comparison to traditional welding, the UltraFlex process metallurgically bonds the wear system directly to the substrate while minimizing the dilution zone. This includes several Stellite™ alloy surface chemistries that are not possible via casting or weld overlay.

In addition to the small diffusion zone, there is an inherent benefit of the direct bonding of the surface layer to the substrate — improving quality and reducing costs.

Example of Weld Overlay



Since buffer layers are not required between the substrate and the UltraFlex surface treatment, as is typical with some weld overlays, the result is a **pure coating** surface with minimal dilution.

The UltraFlex treatment does not result in a Heat Affected Zone (HAZ). Unlike a weld overlay process, hot hardness and wear resistance are not affected because there is no iron dilution.

Direct bonding. Minimal dilution. A "pure" coating.

Conveyance

UltraFlex™ coatings protect conveyance systems in the most critical applications when maximum life and reliability cannot be compromised.

Benefits

Protect Unreachable Areas

No other technology is capable of coating inside diameters like UltraFlex. Diameters smaller than 1" can be protected with UltraFlex.

Range of Coating Options

Maximize piping and elbow life by selecting the UltraFlex material most suited to deal with the fluid or media being conveyed. Available coating options are specifically designed to solve most wear problems — from corrosion to severe abrasion.

Hard-faced elbow **Smooth UltraFlex elbow**

High Surface Quality

Certain Stellite™/substrate combinations allow for crack-free coatings, prohibiting corrosive fluids from reaching the substrate, substantially increasing conveyance system life.

Smooth “as applied” surface minimizes efficiency losses inherent with other types of protection, like hard facing.

Coating Quality

UltraFlex coatings are pure, uniform, and dense, with consistent properties through the entire coating thickness to ensure ongoing reliable performance.

Metallurgical bond ensures the UltraFlex coating will not flake or chip off even under extreme conditions. No unexpected performance changes in operation due to loss of protection.

UltraSonic inspection of coatings possible to confirm coating thickness and monitor critical applications in situ.

Corrosion, Abrasion, & Erosion Solutions

Coupled with superior material technologies, UltraFlex™ surface treatments can result in dramatically extended component life, more predictable maintenance, higher productivity, and reduced operating costs.

For components such as severe service valves, while the corrosive wear rate is highly dependent on the chemical composition of the treatment, it is also affected by the surface finish of the cladding.

More predictable service life for critical components.

In this case, Kennametal would select the proper corrosion-resistant Stellite™ alloy-based grade of UltraFlex to ensure that there is no cracking or de-lamination of the surface to protect the substrate.

For components such as the bottoms pumps in fluid catalytic cracking units, harsh abrasion and erosion can destroy components within a matter of months. While there are several possible methods to treat steel substrates, none can match the effectiveness of the Kennametal tungsten-carbide based solutions to extend component life.

Using UltraFlex, Kennametal can deposit a highly dense layer of tungsten carbide throughout the surface layer of the component. This has been proven to improve life by to up to 4 times in such environments.

Highest Quality Surface Technologies

When partnering with Kennametal, customers can be assured that they will have access to the highest quality surface technologies. The UltraFlex product family has an extensive portfolio of material systems providing solutions for all of your abrasive, erosive, corrosive, and galling wear needs.

Wide range of material systems that offer flexibility and versatility.

The Kennametal UltraFlex portfolio utilizes a wide range of material systems that offer flexibility and versatility applicable to your specific wear type and operating conditions. With the ability to customize thickness and treat complex geometries and non-line-of-sight surfaces, we provide access to innovative technologies that produce longer component life, system efficiency improvements, and reduced operating costs.

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